

## Microwave Type RFID System **V690 Series**

### User's Manual

#### Read/Write Antenna, ID Tag, and Link Unit

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**Read/Write Antenna**

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**Model V690-HMG01**

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**ID Tag**

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**Model V690-D8KR01**

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**Link Unit**

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**Model V690-L01**

# Introduction

Thank you very much for choosing the microwave type RFID system V690 Series. The V690 Series has been developed by OMRON, based on the advanced technology and extensive experience. This user's manual describes the functions, performance and usage of V690 Series.

When you use the V690 Series, follow the instructions below:

- V690 series must be operated by a qualified electrical engineer who experts on knowledge about electricity.
- Read this user's manual with care, understand the V690 Series fully and use it appropriately.
- Keep this user's manual handy.

<b>Notes on use</b>
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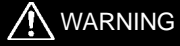
When you use the V690 Series in the following environments, we would like you to operate it within the rating and functions, take safety measures such as fail-safe system and consult our person in charge.

- (1) Use in an unsuitable condition or environment which is not described in the user's manual
- (2) Use for nuclear energy control, railroad, aeronautical system, car, combustion equipment, medical equipment, amusement facility, safety device, etc.
- (3) Use for application which may have a great influence on people's lives and property and must be executed safely in particular.

## Notes on safety

### • Warning symbols and meanings

For safety operation of V690 Series RFID system, the warning symbols below are used in this User's Manual. The notes mentioned below gives you an important message for safety operation. Be sure to follow the instruction. The warning symbols and meaning are as follows:



The hazard or unsafe practice could result in severe injury or death.

### • Description of symbol



- Explosive!  
It may burst under a particular condition.

 **WARNING**

Lithium battery is contained in an ID tag. Do not disassemble, heat above 212 °F (100°C) or incinerate the ID tag. Otherwise fire, explosion and/or burns may result..



## Remarks

For the safety, be sure to follow the instructions below:

1. Do not operate this device in any flammable, explosive or corrosive gas environment.
2. Do not disassemble, repair nor remodel this device.
3. Tighten the base lock screws and terminal block screws completely.
4. Be sure to use wiring crimp terminal of a specified size.
5. The 24 VDC power supply must meet the following items:
  - (1) Such 24 VDC power supply must be used for the V690 Series only and must not be connected to any other devices nor apparatuses.
  - (2) Voltage of such DC power supply must be within the specified rating (24 VDC +10%-15%).
6. Be sure to follow any other Warnings, Cautions and Correct Usage mentioned in this manual.

## Correct Usage

1. Do not install model V690-HMG01, model V690-D8KR01 and model V690-L01 in the following areas:
  - Place exposed to the direct sunlight.
  - Humid place where moisture condensation may occur.
  - Place affected by vibration or impact.
2. Preliminary check of installation site.

This device uses the frequency band 2450 MHz for the communication between an antenna and tag. Some of radio equipment, such as wireless LAN, cellular phone, personal handyphone system and transceiver, motor and switching power supply may generate a radio wave (noise) which affects the communication with a tag. If you must use this device near such heater, we would like to ask you to check the influence in advance.

To minimize general influence of noise, follow the instructions below:

  - Ground any metallic material located around this device according to Class D (Class III).
  - Wire this device keeping away from high voltage and heavy current.
3. Ambient environment and communication range
  - The communication range varies depending on the installation site environment. This is because a metal material and the ground reflect a radio wave, and water and human body absorb it. Locate an antenna and tag in the communication range and check the radio wave environment in advance.
  - The Read/Write antenna model V690-HMG01 has a communication test command to check the radio wave environment at a working site. (Refer to Section 3-5.)
4. Be sure to ground any ground terminal according to Class D (conventional Class III). Otherwise, performance may deteriorate.
5. Cleaning of model V690-HMG01, model V690-D8KR01 and model V690-L01
  - Do not use any thinner. Resin material and case paint are dissolved by thinner.

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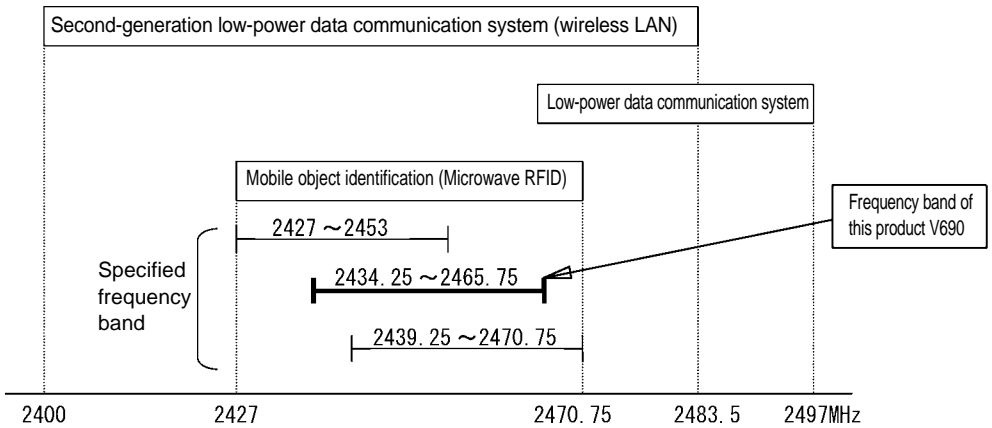
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**Notes on Interference to Second-Generation Low-Power Data Communication System (Wireless LAN), Cellular Phone, etc.**

1. Radio interference between radio stations

The frequency 2450 MHz band (2434.25 - 2465.75 MHz) used by the microwave RFID system V690 is designated for second-generation low-power data communication system (wireless LAN), local area radio station (a license required) for mobile object identification and specified low-power radio station (no license required) as well as industrial, scientific or medical equipment such as microwave oven. Therefore, the radio interference is expected in such frequency band. Moreover, the cellular phone and personal handyphone system (900 MHz - 1900 MHz) may generate the radio interference.



2. Possible trouble due to radio interference

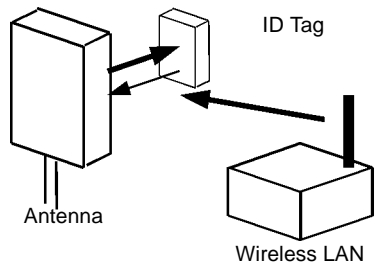
• Communication failure in RFID system

The radio wave from an ID tag to antenna is weak and, therefore, the communication between the antenna and ID tag may fail due to radio interference caused by any other devices. Keep sufficient space between the RFID system and any other devices. For the space, refer to Section 7-6.

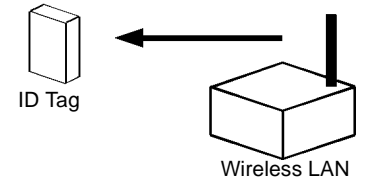
• ID tag battery power loss

An electronic circuit in the ID tag is started by a radio wave of other device and the battery power may be consumed considerably. V690 has a tag power-saving function (refer to Section 3-7) to control the battery power. Nevertheless, the battery power may be still consumed depending on a working environment. So, keep sufficient space between the ID tag and any other devices. For the space, refer to Section 7-6.

◆ Communication failure in RFID system



◆ ID tag battery power loss



3. Preparation at working site

(1) Check at working site

- 1) Before using V690, check that second-generation low-power data communication system (wireless LAN), local area radio station (microwave RFID system) for mobile object identification or specified low-power radio station (microwave RFID system) does not work near V690.
- 2) If V690 causes radio interference to the local area radio station for mobile object identification, change the channel immediately or stop the V690 emitting the radio wave. Then, we would like you to contact us to take necessary actions to avoid interference (e.g., partitioning).
- 3) If V690 causes radio interference to the second-generation low-power data communication system or specified low-power radio station for mobile object identification or if any other trouble happens, feel free to contact us.

(2) Product label and caution label

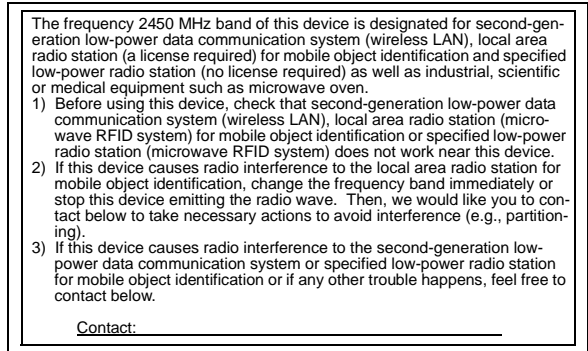
The product label and caution label come with the product.

- Affix the product label to a visible position on an antenna unit.
- Affix the caution label to a visible position near the antenna. The caution label must show the contact address or phone number of a person in charge of installation or any other related information.

◆ Product label



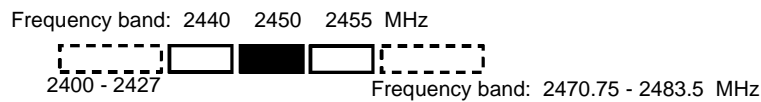
◆ Caution label



(3) Meaning of product label


- 2.4: Radio equipment which uses the frequency band 2.4 GHz.
- RFID: The application of Radio Frequency Identification.
- 10 mW: A value of antenna power.
- □□□: Frequency band as follows:

The V690 antenna uses the frequency band 2450 MHz and, therefore "2450" is marked.



# Manual Revision History

A manual revision history code is added to the end of catalog number shown at the left lower part of front cover and back cover

<b>Catalog No.</b>	<b>SCLB-Z149-E1-01</b> 
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Revision code

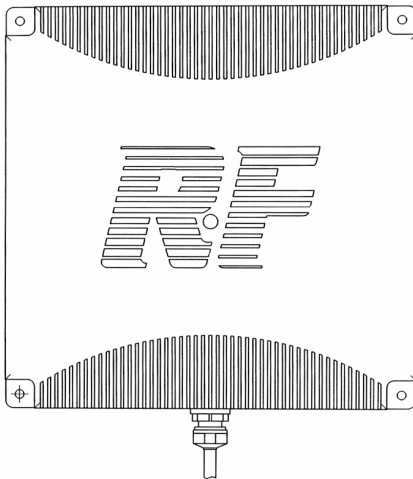
Revision Code	Date of Revision	Reason of Revision / Revised Page
--	October 2000	First Edition

# Chapter 1 Features and System Configuration

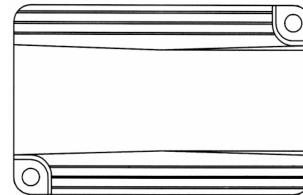
## 1-1 Features

The V690 Series is the microwave type RFID system which has achieved long-range and high-performance communication. This V690 system is the most suitable for an assembly line, physical distribution, and product control applications.

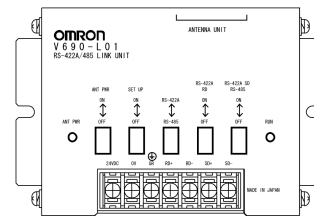
Read/Write Antenna  
Model V690-HMG01



ID Tag  
Model V690-D8KR01



RS-422A/485 Link Unit  
Model V690-L01



### (1) Read/Write Antenna Model V690-HMG01

- Consists of an antenna unit which communicates with the ID tag, and a controller unit which controls the communication.
- The antenna unit has achieved the transmission speed 600 kbps and maximum communication range 5 m.
- The antenna uses circularly polarized wave as radio wave. So, the ID tag facing the antenna can communicate at any rotating angle on the medial axis. The maximum communication range varies depending on the tag angle.
- This antenna is a specified low-power radio station and, therefore, any radio station license is not required.
- The Multi Access function which enables to access several tags in the antenna communication area and FIFO (First-In First-Out) function which enables to access the tags coming in the communication area sequentially one by one.
- By a command from a host device, the communication 2 m Mode and 5 m Mode can be switched to each other and a radio wave channel can be switched at a working site. You can select the most suitable communication range at a working site and prevent the mutual interference between antennas easily.
- The controller contains both of the RS-232C and RS-422A interfaces. So, it can connect to a general-purpose PC or programmable controller (PLC) which have RS-232C. Also, several antennas can be connected to one host device.
- A simplified communication test function, which can check the communication with a tag without a host device, and a communication test, which can check a radio wave environment at a working site, are available.

### (2) ID Tag Model V690-D8KR01

- This tag contains a battery and the memory capacity is 8 kbytes.
- Write Protect is available to disable writing by 256 bytes.
- Protective structure based on the IEC Standard IP67 (JEM Standard IP67g) has been achieved. So, this tag can be used even in a place splashed with water and oil.
- The battery life is 5 years at 25°C (a reference value). The battery is not replaceable, but a power-saving function and battery voltage alarm function are available.

### (3) RS-422A/485 Link Unit Model V690-L01

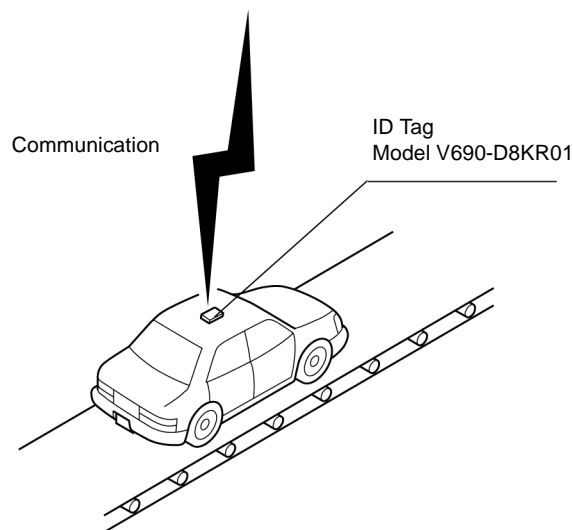
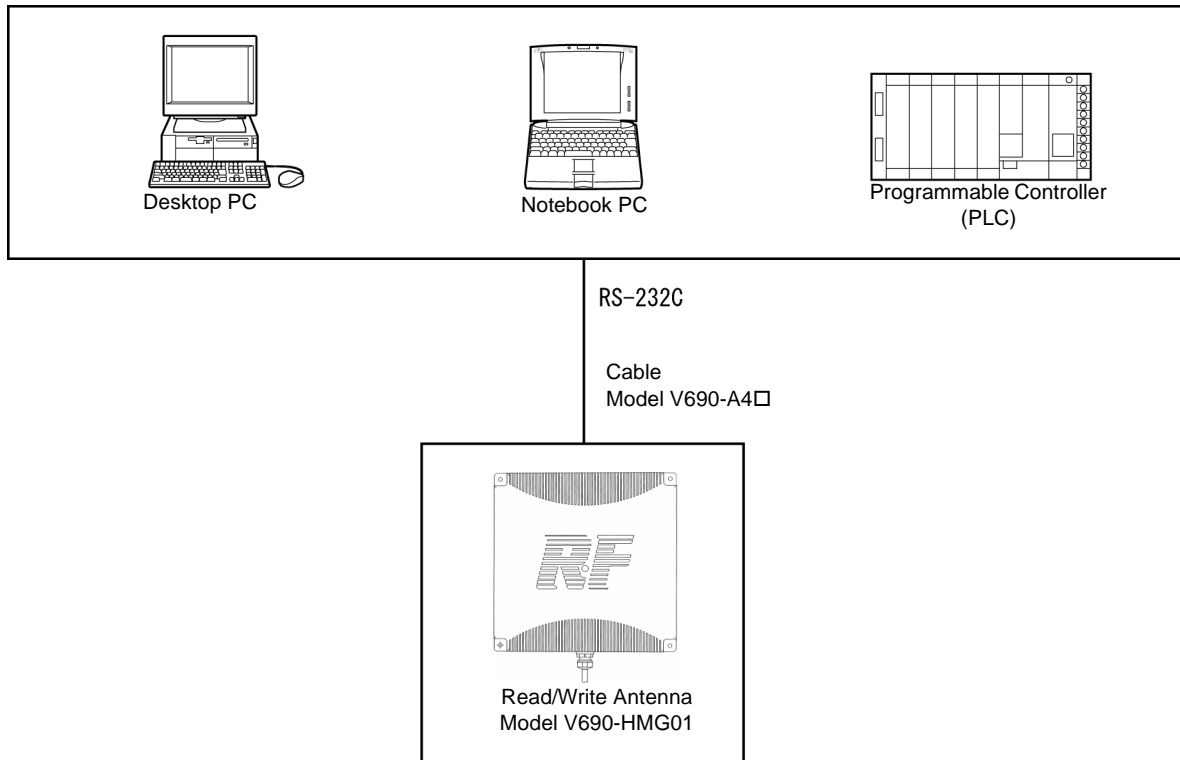
- Use when the communication with a host device is made through the RS-422A or RS-485.
- The power supply to the Read/Write antenna can be turned ON/OFF, the operation/setting mode can be switched, RS-422A/RS-485 can be switched and terminating resistance can be turned ON/OFF.

## 1-2 System Configuration

- **Example of system configuration of model V690-HMG01 (1:1 connection in a host communication through RS-232C)**

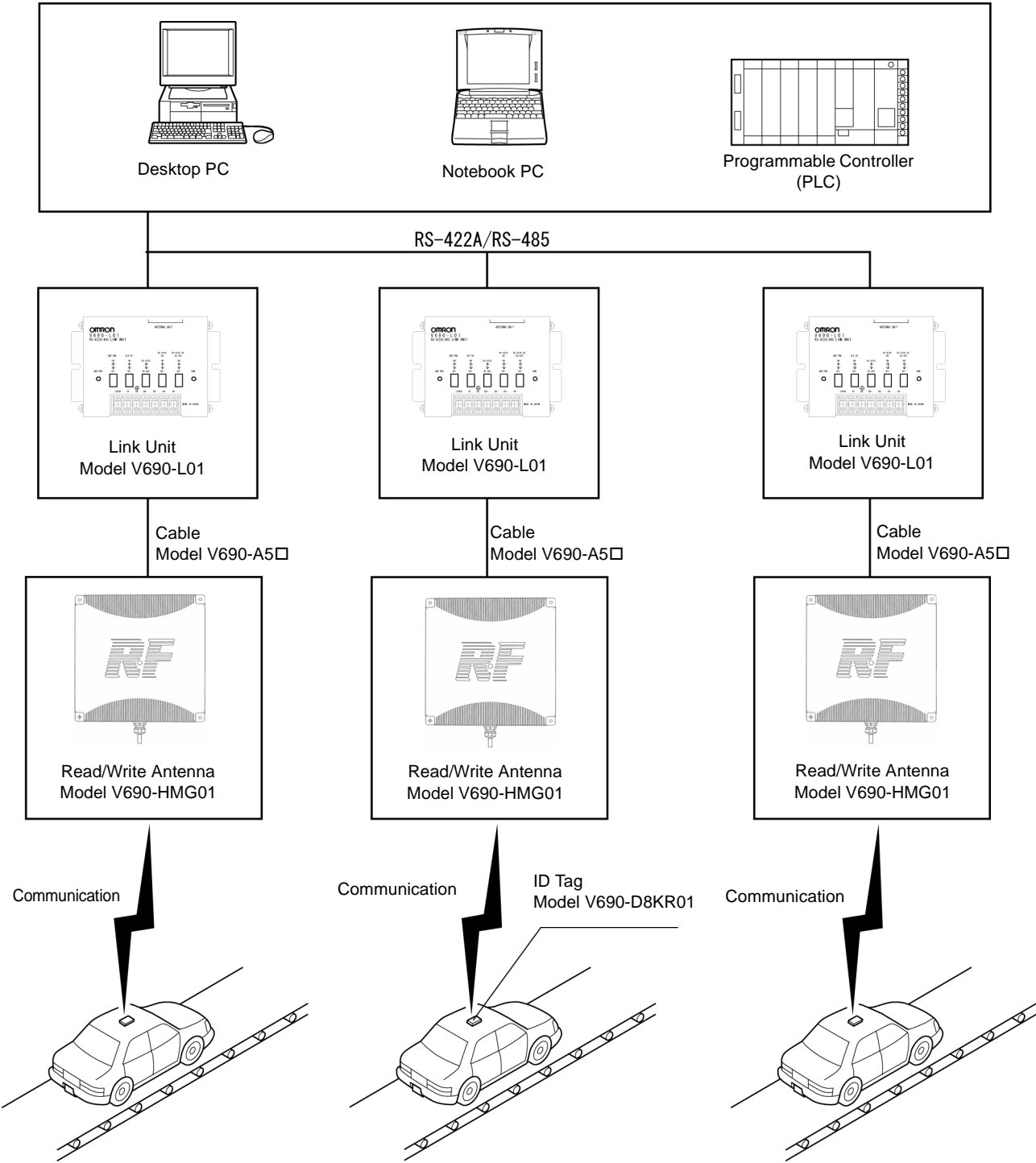
Model V690-HMG01 contains a serial interface based on RS-232C and can connect to a general-purpose PC or programmable controller (PLC) easily. All the communications with the tag are controlled according to the instructions (by commands) from a host device.

### <Host Devices>



- **Example of system configuration of Model V690-HMG01 (1:N connection in a host communication through RS-422A (4-wire)/RS-485 (2-wire))**  
Model V690-HMG01 contains the RS-422A/485 interface and can connect a maximum of 32 RS-422A/485 link units model V690-L01 to one general-purpose PC or programmable controller (PLC). A maximum length of RS-422A/485 is 300 m.

<Host Devices>

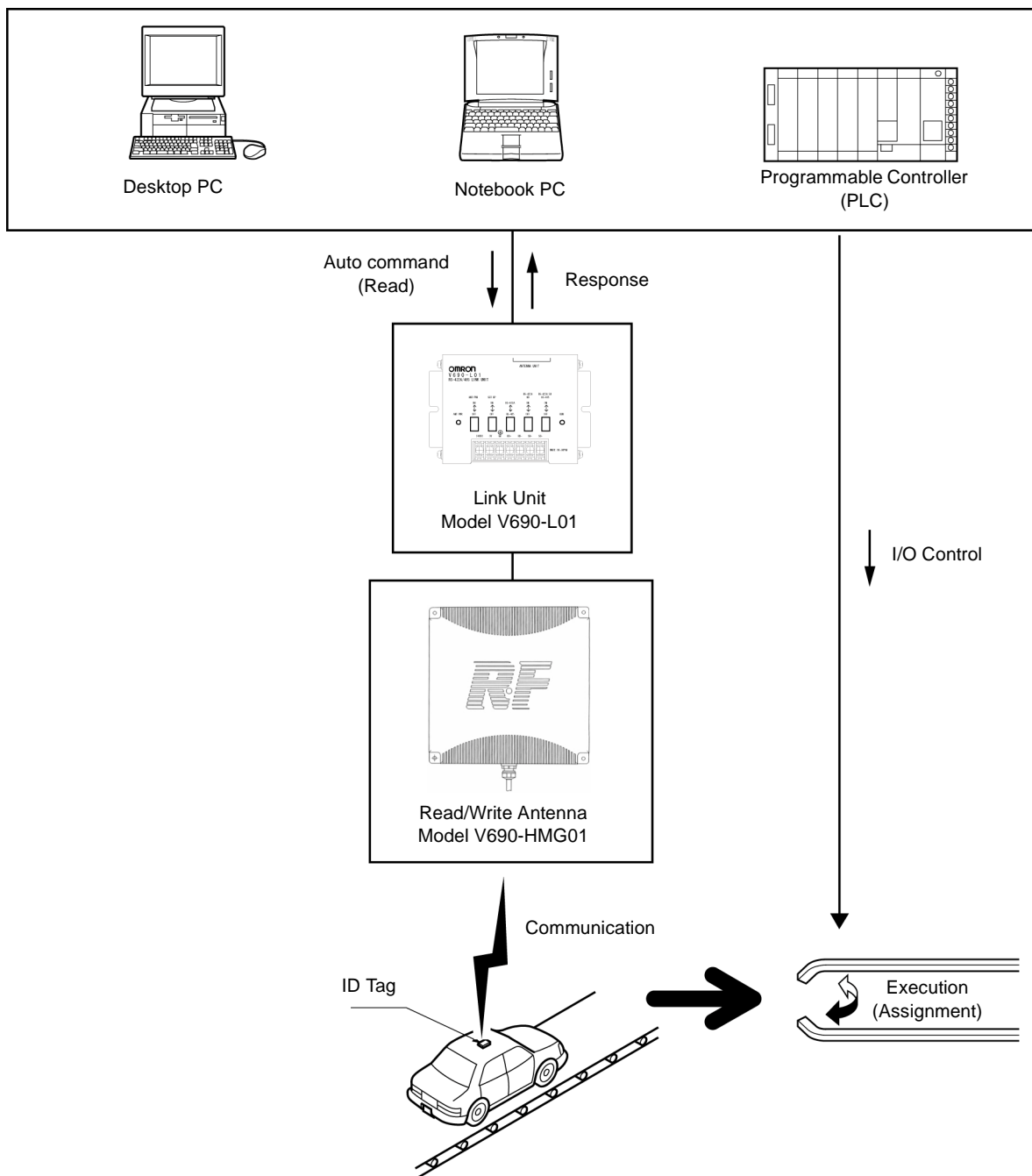


## 1-3 Operation Overview

Showing an example of assignment in car transportation, the V690 Series operation overview is described below.

The ID tag is mounted on a car body and the destination is assigned to the car according to the destination information stored in the ID tag.

### <Host Device>



- (1) When an auto command is sent from a host device to the Read/Write antenna, the antenna is ready to work and waits for an ID tag.
- (2) When any ID tag has come in the antenna's communication area, the antenna returns data of memory area specified by the auto command (Read) as a response.
- (3) Based on the data, the host device controls a transportation device and assigns the destination.

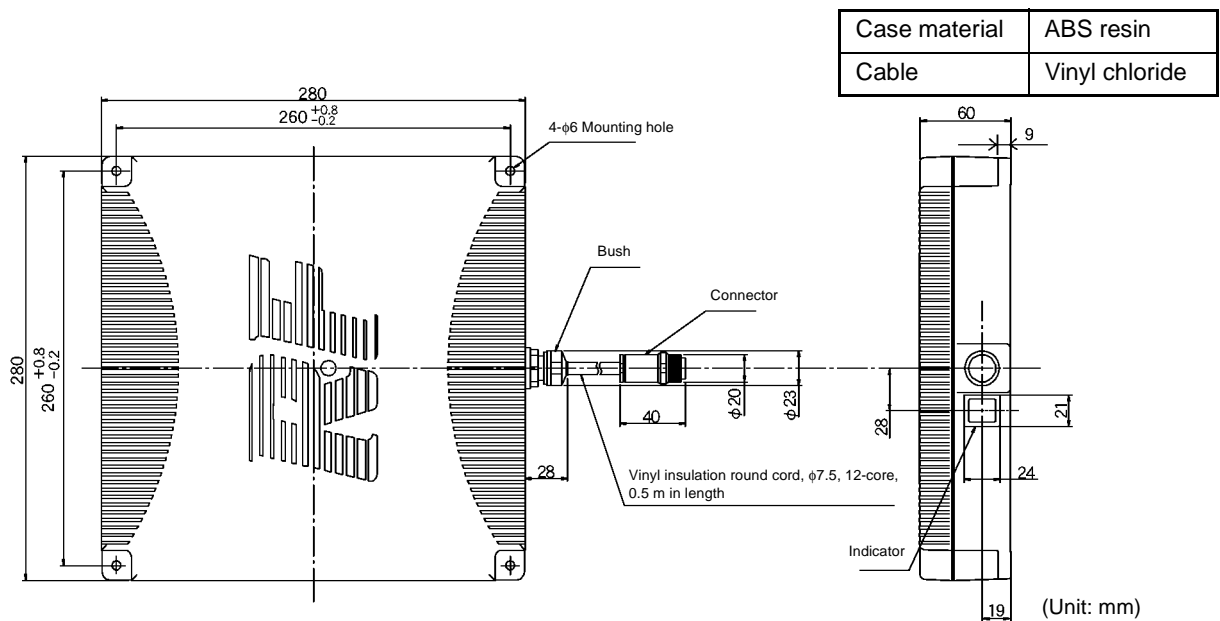
# Chapter 2 Specifications and Performance

## 2-1 Read/Write Antenna Model V690-HMG01

### 2-1-1 Specifications

Item	Specifications
Emitting frequency	2450 MHz band (2434.25 - 2465.75 MHz)
Power supplied to antenna	5 mW in the communication range 2 m mode. 10 mW in the communication range 5 m mode (specified low-power radio station - radio equipment for mobile object identification). * A user is not required to apply a license for radio station.
Power supply	24 VDC +10%/-15%
Consumption current	0.5 A or less.
Ambient operating temperature	-20 to +60°C (without icing)
Ambient operating humidity	35 to 85%RH (without moisture condensation)
Ambient storage temperature	-20 to +60°C (without icing)
Ambient storage humidity	35 to 85%RH (without moisture condensation)
Insulation resistance	20 MΩ or more (at 100 VDC mega). Between a group of cable terminals and a case.
Withstand voltage	1,000 VAC, 50/60 Hz for 1 minute, detected current 1 mA or less. Between a group of cable terminals and a case.
Protective structure	IP62 (IEC60529 Standard) * A cable outlet turns downward.
Vibration resistance	10 to 150 Hz, single amplitude 0.35 mm, maximum acceleration 50 m/s <sup>2</sup> . Performing sweep 10 times for 8 minutes in upward, downward, leftward, rightward, forward and backward directions.
Impact resistance	Giving impact of 150 m/s <sup>2</sup> 3 times each in upward, downward, leftward, rightward, forward and backward directions, i.e., 18 times in total.
Indicator	Power supply, radio wave emission, host transmission, tag transmission.
Cable length	0.5 m. A round connector (waterproof) comes with the cable.
Weight	2.6 kg or less (including a cable of 0.5 m in length and connector)

### 2-1-2 Outside Dimension



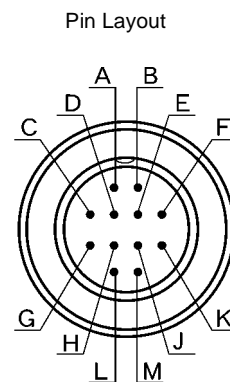
#### Correct Usage

Protective structure IP62 of the antenna is the protection against the drop of water. If the antenna is splashed with water spray or water jet flow, cover the antenna with a protection plate. (Refer to "Appendix 3 - Protective Structure".)



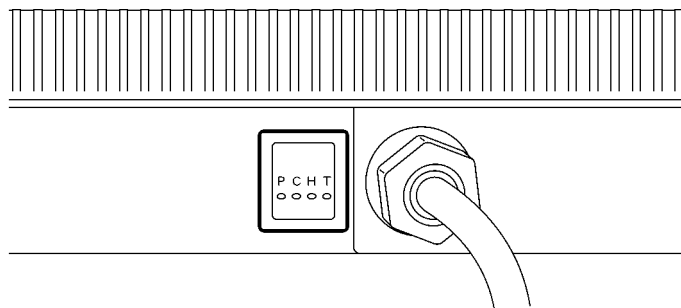
### 2-1-3 Signal of Supplied Connector

Item	Symbol	Pin Number	Usage
Power supply	+24V	A	Supply 24 VDC.
	0V	B	
Setting	+P	C	Short-circuit at the setting mode. Refer to Section 5-1. Do not connect at the operation mode
	-P	D	
RS-422A RD (Receiving)	RD+	E	Use for the communication in RS-422A. (Terminating resistance 220 Ω is connected to both of RD and SD in the antenna.) Do not connect when RS-232C is used.
	RD-	F	
RS-422A SD (Sending)	SD+	G	
	SD-	H	
RS-232C Receiving	Rx	J	Use for the communication in RS-232C. Do not connect when RS-422A/485 is used.
RS-232C Sending	Tx	K	
RS-232C Signal 0V	SG	L	
Frame ground	GR	M	Ground according to Class D.



### 2-1-4 Indicator

(1) The items below can be checked through the antenna indicator.



Indicator	P (Red)	C (Red)	H (Red)	T (Red)
Meaning	Power supply	Radio wave emission	Host transmission	Tag transmission

- P (Power): Turns on when 24 VDC power is being supplied to the antenna.
- C (Carrier): Turns on when the antenna is emitting a radio wave.
- H (Host): Turns on when the antenna is sending data to a host device.
- T (Tag): Turns on when the antenna is sending data to a tag.

(2) By enabling the setting mode, you can check the communication range to a tag without connecting to a host device. Refer to Section 3-4.

(3) If an operation fails, troubleshoot according to those indicators which turn on or blink. Refer to Section 6-2.

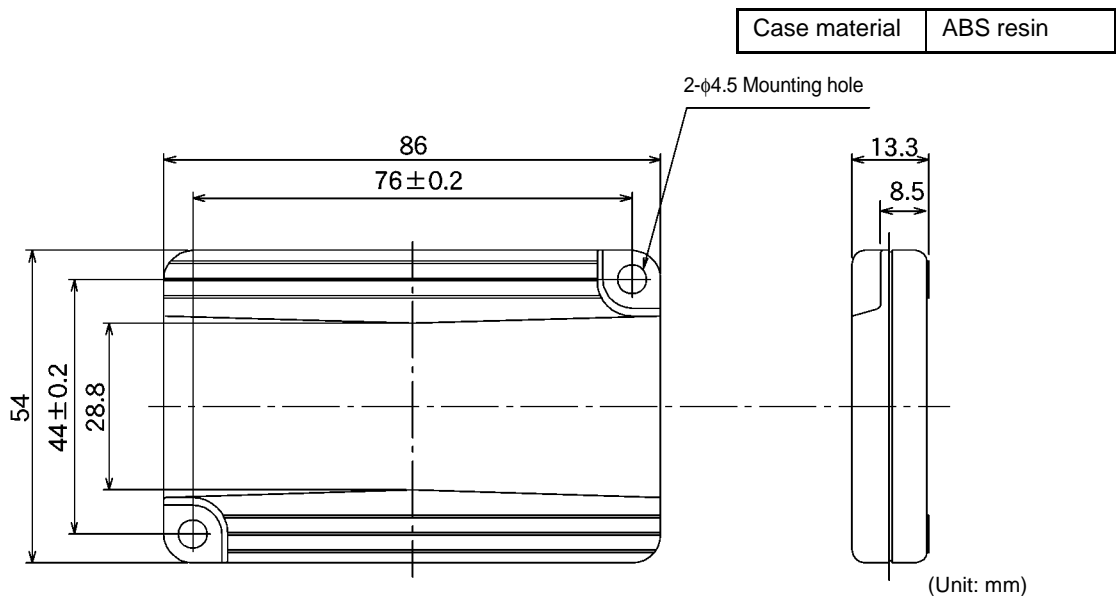
Correct Usage	
Do not disassemble it nor touch the inside when the power supply turns on. Otherwise, trouble may be caused.	

## 2-2 ID Tag Model V690-D8KR01

### 2-2-1 Specifications

Item	Specifications
Memory capacity	8 Kbytes
Type of memory	SRAM (volatile memory). Data is backed up by a battery.
Memory life (Reference value)	5 Years. * Ambient temperature 25°C. For details, refer to Section 2-2-4. Battery not replaceable. Battery voltage alarm function.
Ambient operating temperature	-20 to +60°C in the communication. -25 to +70°C not in the communication (without icing).
Ambient operating humidity	35 to 85%RH (without moisture condensation)
Ambient storage temperature	-25 to +70°C (without icing)
Ambient operating humidity	35 to 85%RH (without moisture condensation)
Protective structure	IP67 (IEC60529 Standard) / IP67g (JEM1030 Standard)
Vibration resistance	10 to 2,000 Hz, single amplitude 0.75 mm, maximum acceleration 150 m/s <sup>2</sup> . Performing sweep 10 times for 15 minutes in upward, downward, leftward, rightward, forward and backward directions.
Impact resistance	Giving impact of 500 m/s <sup>2</sup> 3 times each in upward, downward, leftward, rightward, forward and backward directions, i.e., 18 times in total.
Weight	60 g or less.

### 2-2-2 Outside Dimension



#### WARNING

Never disassemble, pressure, deform, heat to 100°C or more nor burn an ID tag. The ID tag contains lithium battery and it may ignite, burst or burn.



### 2-2-3 Memory Map

#### ◆ User data

Memory capacity of user data of ID tag is 8,192 bytes. Minimum unit of memory is 1 byte and the memory is specified by the address (0000h to 1FFFh). h: Hexadecimal number

Data address	Bit								Writing by user	Related commands
	7	6	5	4	3	2	1	0		
0000h to 1FFFh	User data (8 kbytes) Initial value: all 00h								○	Sections 5-7-1, 5-7-3 to 5-7-7

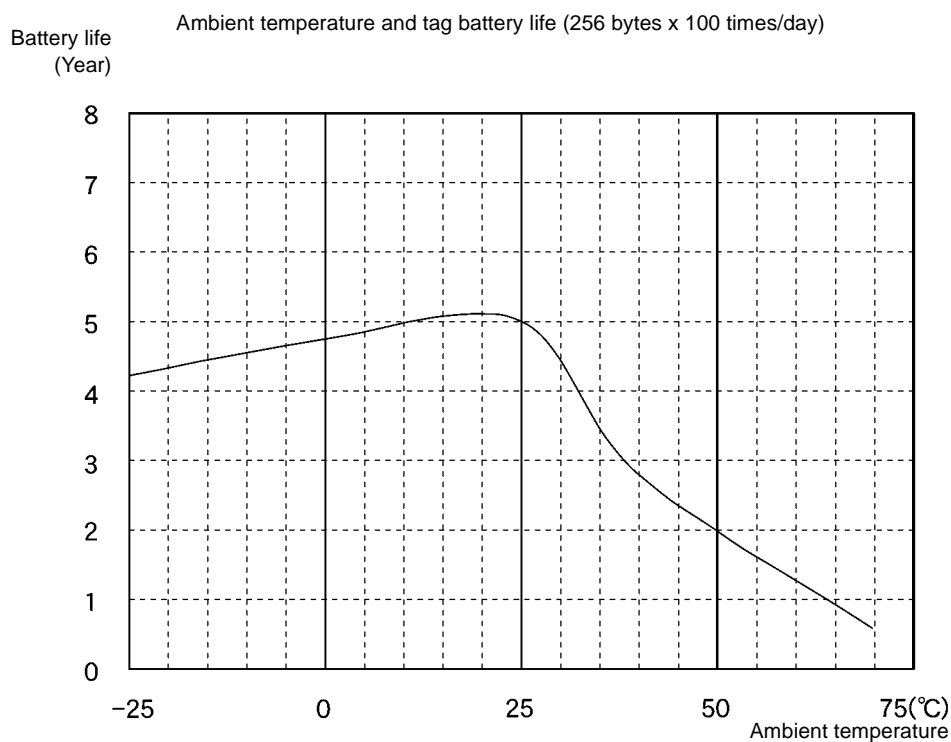
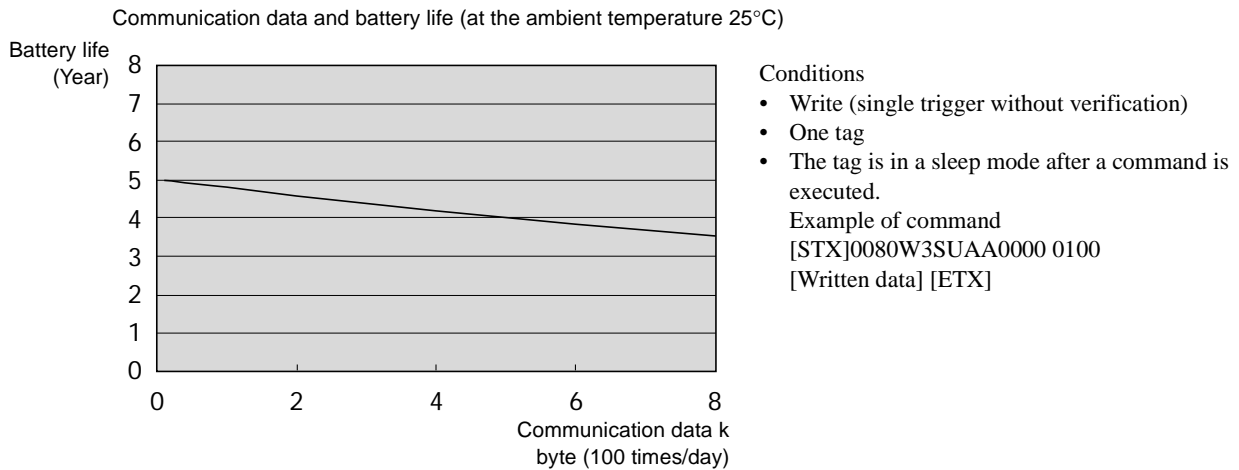
#### ◆ System data

In addition to user data, system data is included in the ID tag memory. Use an upper case such as "DATE" to specify the address. For the details of reading and writing, refer to Sections 5-7-1 to 5-7-5.

Content	Bit								Writing by user	Related commands
	7	6	5	4	3	2	1	0		
Date of manufacture	Thousand's place of Year				Hundred's place of Year				X	Sections 5-7-1 and 5-7-3
	Ten's place of Year				One's place of Year					
	Ten's place of Month				One's place of Month					
	Ten's place of Day				One's place of Day					
ID code	8 Bytes. * A value inherent in tag.								X	Section 5-7-2
Write Protect data	4 Bytes. * Refer to Section 3-6 Initial value: Write Protect disabled in all the areas.								○	Sections 5-7-1, 5-7-3 to 5-7-5
Sleep waiting time	2 Bytes * Refer to Section 3-7. Initial value: 4800 (8 minutes). Set by 100 msec.								○	

## 2-2-4 Battery Life Characteristic

The ID tag contains a battery. The charts below show the relation between the ID tag battery life, number of communication bytes and ambient temperature. The battery life means the time until the battery voltage alarm has been given.



## 2-2-5 Battery Voltage Alarm Function

When the voltage of ID tag battery becomes low, "7B" is returned to the termination code when a tag communication command (Read or Write) is executed.

### Correct Usage

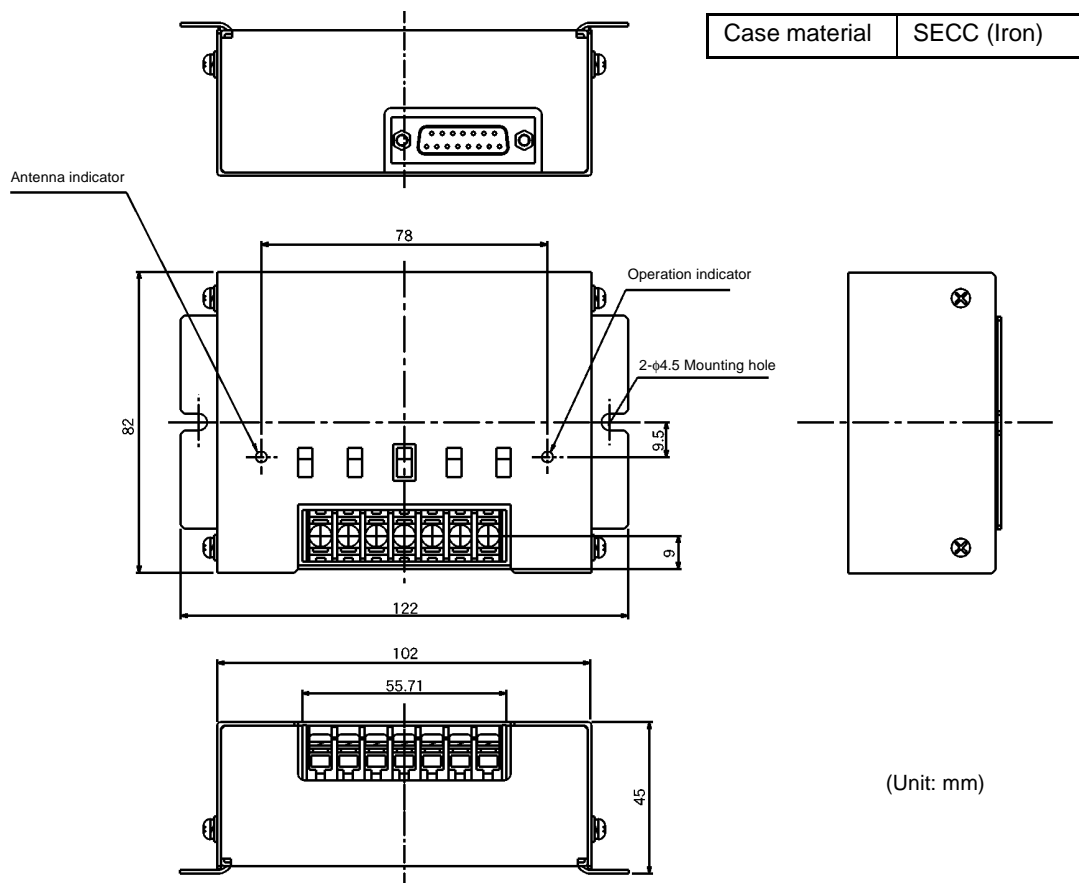
After the termination code 7B was generated, the ID tag can be used for approximately one month in a normal situation. However, we recommend you to replace the tag with a new one immediately.

## 2-3 RS-422A/485 Link Unit Model V690-L01

### 2-3-1 Specifications

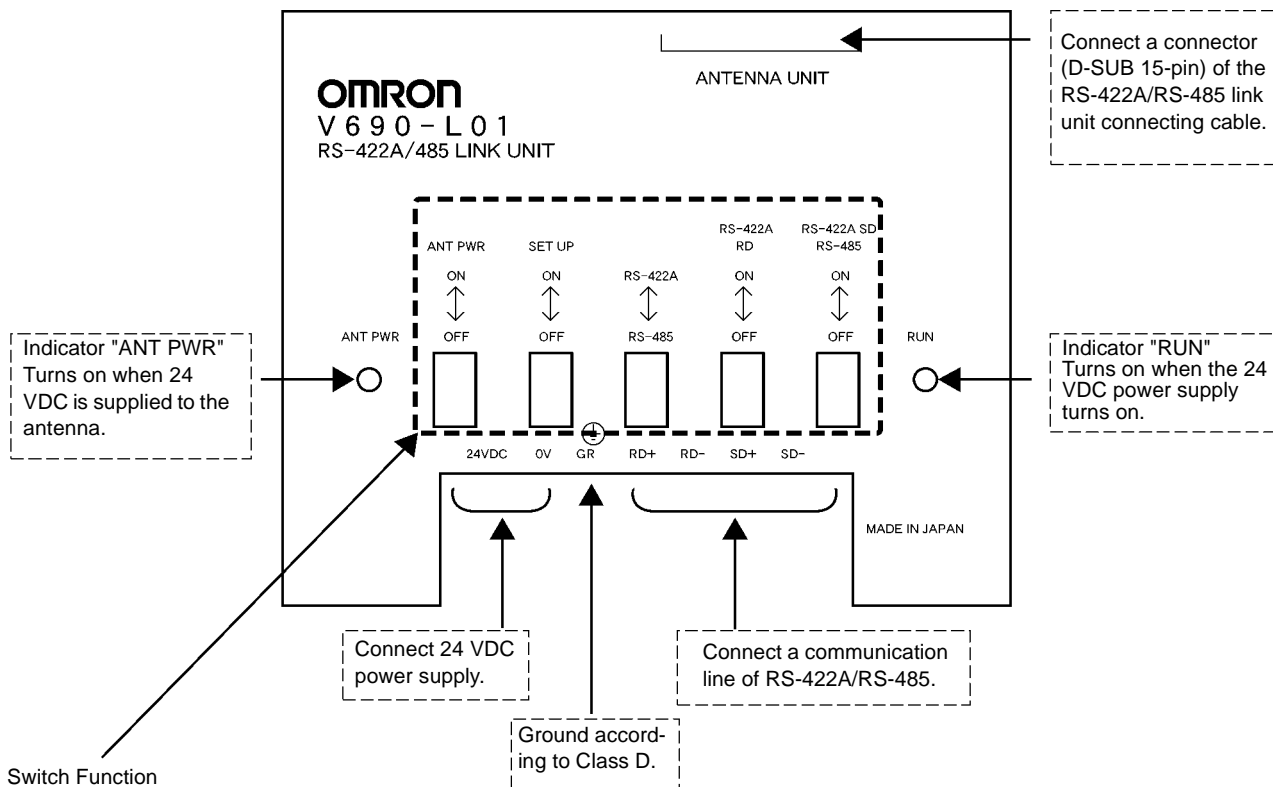
Item	Specifications
Interface specifications	RS-422A, RS-485
Power supply voltage	24 VDC
Allowable voltage	20.4 to 26.4 VDC
Power consumption	6 W or less
Operating temperature	0 to +55°C (without icing)
Operating humidity	35 to 85%RH (without moisture condensation)
Storage temperature	-10 to +65°C (without icing)
Storage humidity	35 to 85%RH (without moisture condensation)
Insulation resistance	20 MΩ or more (at 100 VDC mega). Between a group of cable terminals and a case, excluding GR.
Withstand voltage	1,000 VAC, 50/60 Hz for 1 minute, detected current 20 mA or less. Between a group of cable terminals and a case, excluding GR.
Protective structure	IP30 (IEC60529) * Connected to a connector of the dedicated cable model V690-A5□.
Vibration resistance	10 to 150 Hz, single amplitude 0.35 mm, maximum acceleration 50 m/s <sup>2</sup> . Performing sweep 10 times for 8 minutes in upward, downward, leftward, rightward, forward and backward directions.
Impact resistance	Giving impact of 150 m/s <sup>2</sup> 3 times each in upward, downward, leftward, rightward, forward and backward directions, i.e., 18 times in total.
Ground	According to Class D.
Weight	450 g or less

### 2-3-2 Outside Dimension



### 2-3-3 Function

This link unit functions as a relay to operate a host device and antenna through RS-422A/RS-485 communication. For an example of internal circuit, refer to Section 4-2-2.



Switch Function

ANT PWR	SET UP	RS-422A/RS-485	RS-422A RD (Receiving)	RS-422A SD (Sending) RS-485
By setting it to ON, the power is supplied to the antenna.  By setting it to OFF, the power is not supplied to the antenna.	By setting it to ON, the setting mode terminals "+P" and "-P" are short-circuited.  By setting it to OFF, "+P" and "-P" are disconnected from each other.	RS-422A and RS-485 are switched to each other.	For RS-422A, the terminating resistance (220 Ω) of RS-422A RD (Receiving) is turned ON/OFF.  For RS-485, the terminating resistance cannot be turned ON/OFF.	For RS-422A, the terminating resistance (220 Ω) of RS-422A SD (Sending) is turned ON/OFF.  For RS-485, the terminating resistance is turned ON/OFF.

Correct Usage	
Be sure to connect a grounding wire. Otherwise, an error may occur in an operation.	
Do not touch any terminal when the power supply turns on. Otherwise, an error may occur in an operation.	
Do not disassemble it nor touch the inside when the power supply turns on. Otherwise, trouble may be caused.	

## 2-4 Connecting Cable

### 2-4-1 Specifications

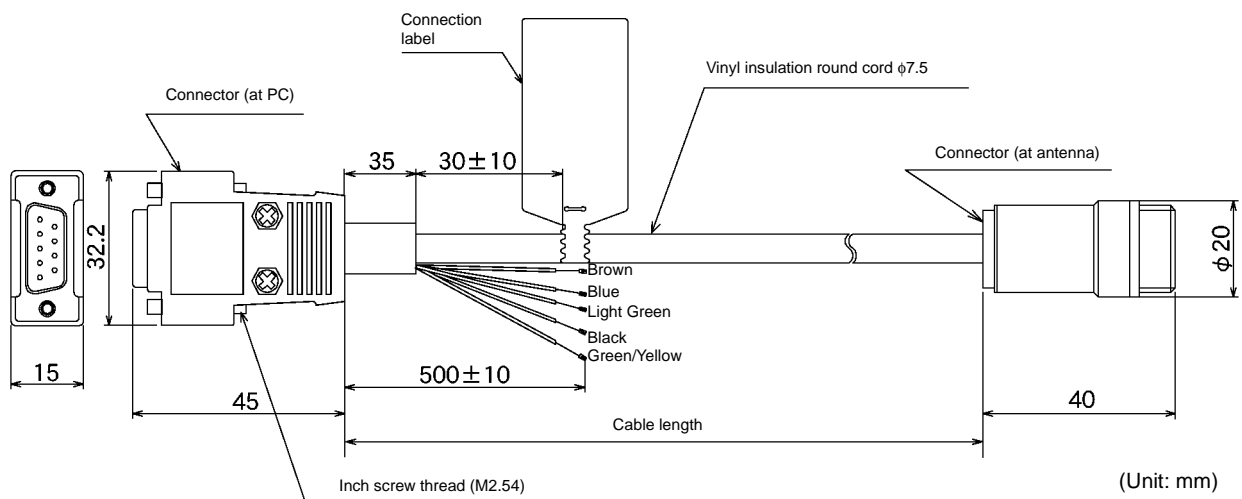
Item	Specifications
Cable outer diameter	7.5 mm
Cable color	Dark gray
Sheathing material	Vinyl chloride resin
Number of cores	12 (3 of AWG22 for power supply and GR and 9 of AWG26 for signals)
Insulation resistance	50 MΩ/km or more. Between a group of cables and cable sheath.
Withstand voltage	500 VAC for 1 minute. Between a group of cables and cable sheath.

### 2-4-2 Outside Dimension

#### (1) RS-232C connecting cable (for IBM PC compatible PC)

Item	Specifications
Connector at antenna	Round connector (waterproof)
Connector at host device	D-SUB 9-pin, female (not waterproof)

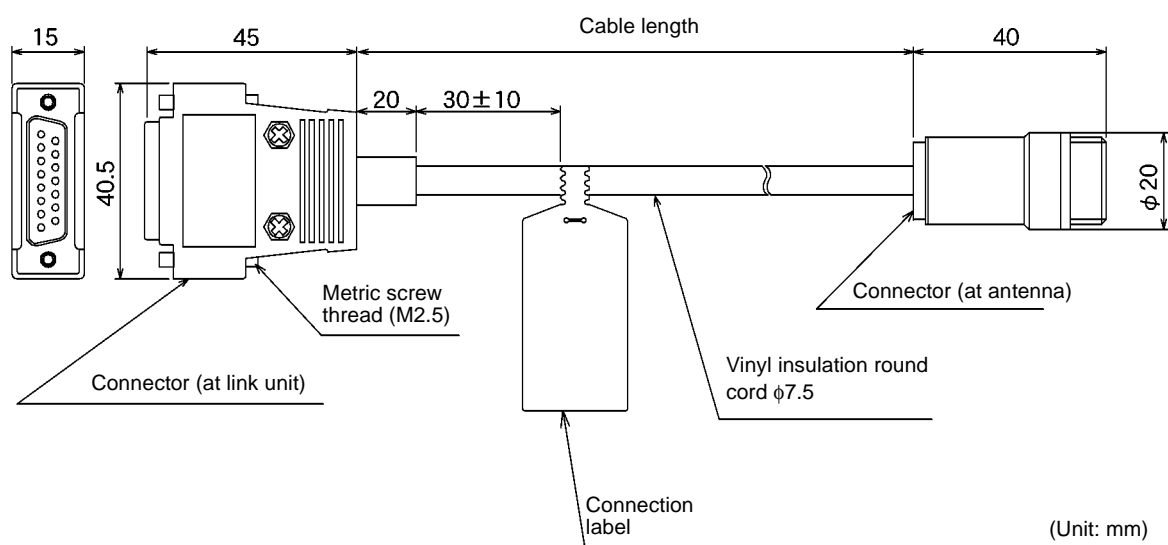
Model	Cable Length
Model V690-A40	2 m
Model V690-A41	3 m
Model V690-A42	5 m
Model V690-A43	10 m
Model V690-A44	15 m



**(2) RS-422A/485 link unit connecting cable**

Item	Specifications
Connector at antenna	Round connector (waterproof)
Connector at link unit	D-SUB 15-pin, male (not waterproof)

Model	Cable Length
Model V690-A50	2 m
Model V690-A51	3 m
Model V690-A52	5 m
Model V690-A53	10 m
Model V690-A54	20 m
Model V690-A55	30 m
Model V690-A56	50 m

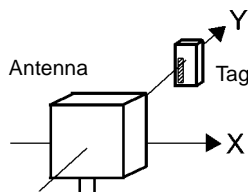





## 2-5 Communication Performance

Item	Specifications
Frequency	2450 MHz band (microwave, 2434.25 - 2465.75 MHz)
Type of radio station	Specified low-power radio station - radio equipment for mobile object identification (RCR STD-29 Version 3.0) * A user is not required to apply a license for radio station.
Transmission output at modulation	5 mW for 2 m mode and 10 mW for 5 m mode.
Polarized wave	Circularly polarized wave
Communication range	2 m mode/5 m mode switched by a host command. (Section 3-2) 2 m mode: 0.2 to 2.0 m (Reference value) 5 m mode: 0.2 to 5.0 m (Reference value) * Conditions for reference value <ul style="list-style-type: none"> <li>• Ambient temperature <math>20\pm 5^{\circ}\text{C}</math></li> <li>• Place the tag at a suitable rotating position so that the logo "omron" can become upright. (Refer to the figure below.)</li> <li>• On a medial axis of antenna placed at 1.5 m high in a large room where radio wave noise is minimized.</li> </ul>
Transmission speed	600 kbps
Communication error check	CRC 16 bits are used in two ways. (CRC: Cyclic Redundancy Check)

[Tag Rotating angle: 0 degrees]



\* A hatched area  on the tag shows a logo.

### Correct Usage

- The communication range varies depending on the installation site environment. This is because a metal material and the ground reflect a radio wave, and water and human body absorb it. Locate an antenna and tag in the communication range and check the radio wave environment in advance.
- The Read/Write antenna model V690-HMG01 has a communication test command to check the radio wave environment at a working site. (Refer to Section 3-5.)

---

## 2-6 Communication Specifications

---

Item	Specifications	Remarks
Reference standard	RS-232C RS-422A RS-485	Note 1
Communication method	Two-way half-duplex transmission	
Transmission speed	4,800 bps, 9,600 bps, 19,200 bps, 38,400 bps, 57,600 bps and 115,200 bps	Note 2
Synchronization method	Start-stop synchronization (Stop bit 1 or 2)	Note 2
Transmission code	ASCII 7 unit or JIS 8 unit	Note 2
Maximum number of connected antennas	32	
Error control	Vertical parity (even, odd, nil). Horizontal parity is used as BCC.	Note 2
Line length	RS-232C: A maximum of 15 m RS-422A: A maximum of 300 m RS-485: A maximum of 300 m	

Note 1. The antenna is equipped with RS-232C and RS-422A terminals. Refer to Section 2-1-3. RS-422A/485 is connected through the link unit.

Note 2. Switched by a command from a host device. (Refer to Section 5-9-7.)

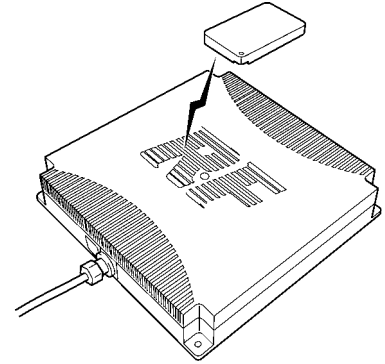
# Chapter 3 Functions

## 3-1 Single/FIFO/Multi Mode Access Function

You can use one of the three communication modes according to the number of tags in the communication area and the situation. The communication mode can be specified in the communication designation in a command.

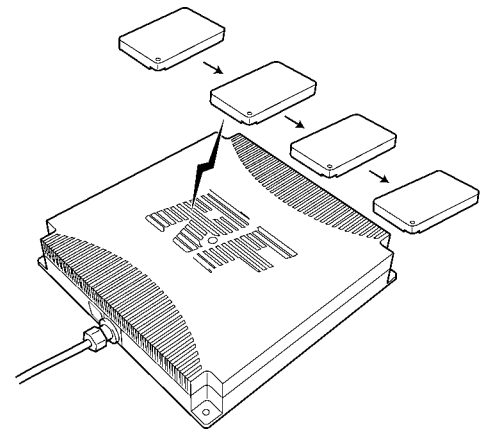
### (1) Single mode

In the Single mode, the communication is made to one tag in the antenna communication area. In the Single mode, only one tag must be placed in the antenna communication area. If two or more tags are in the antenna communication area, a communication error occurs.



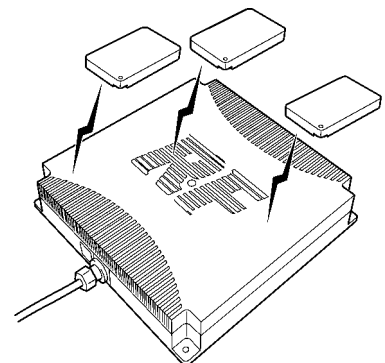
### (2) FIFO mode (First-In First-Out)

The FIFO mode enables to access the tags coming in the communication area sequentially one by one. When the communication to one tag has been completed, the tag is prohibited from communicating. So, even if there is any tag, which ended the communication, in the antenna communication area, the communication can be made to the next target tag. When the tag prohibited from communicating has gone out of the antenna communication area, such tag can communicate again.



### (3) Multi mode

When there are several tags in the antenna communication area, the Multi mode enables to access all those tags. By using the Selective Access function, the communication can be made to a specified tag of those in the antenna communication area.



#### Correct Usage

When you use the FIFO mode, only one tag must be placed in the antenna communication area. If two or more tags are in the antenna communication area, a communication error occurs. Then, the communication cannot be recovered from failure unless only one tag is in the antenna communication area.

---

## **3-2 Communication 2 m Mode/5 m Mode Switching**

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The communication 2 m mode and 5 m mode can be switched to each other by a command from a host device. Use either one depending on a working site.

For the command, refer to Sections 5-9-2 and 5-9-3. The default value is the 2 m mode.

For the communication area of 2 m mode and 5 m mode, refer to Section 7-1.

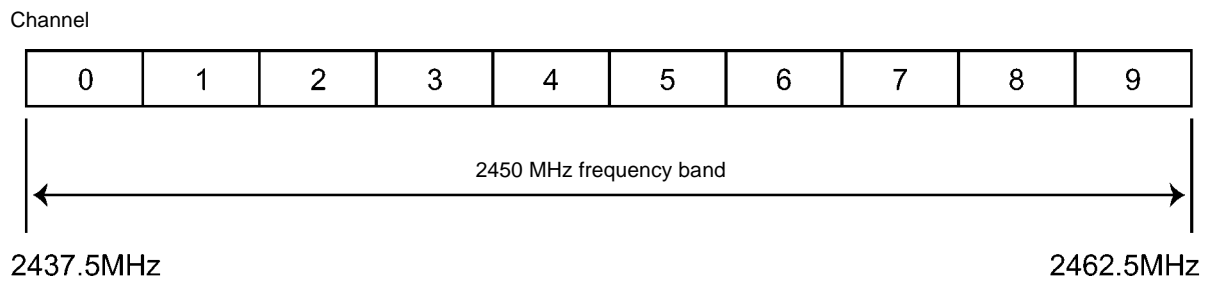
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### 3-3 Radio Wave Channel Switching

---

In this RFID system, a range from 2437.5 to 2462.5 MHz in the 2450 MHz frequency band can be divided into ten, and 10 channels (at 2.5-MHz intervals) are available. Those channels can be switched by a command from a host device. Use them to prevent the mutual interference between antennas or interference caused by any other devices.

For the command, refer to Sections 5-9-2 and 5-9-3. The default value is Channel 5 (2450 MHz).



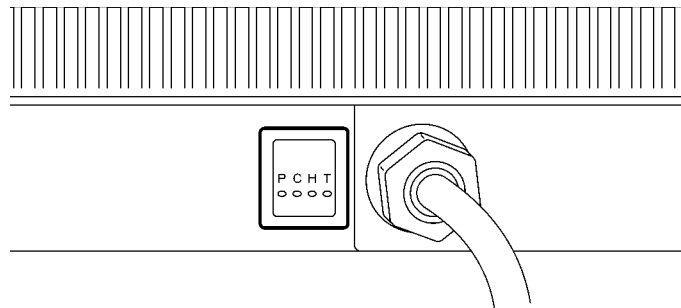
<b>Correct Usage</b>
----------------------

Due to dispersion of frequency, the frequencies of adjacent channels may overlap each other. Do not assign consecutive numbers to the channels of adjacent antennas.
--

### 3-4 Simplified Communication Test

You can check the communication between an antenna and tag using the antenna only without connecting to a host device. In the simplified communication test, the antenna detects the tag at approximately every 2 seconds and, if the tag responds, it turns on the indicator C.

- (1) Turn off the power supply.
- (2) Short-circuit the setting terminals "+P" and "-P".
- (3) Turn on the power supply. Then, the setting mode is enabled. (Refer to Section 5-1.)
- (4) The simplified communication test starts. As shown below, the indicator C (Radio wave emission) shows whether the communication to the tag is made successfully.
- (5) When any command has been sent from a host device to the antenna, the communication test stops.



Antenna Indicator (Red)				Indication
P	C	H	T	
Power supply	Radio wave emission	Host transmission	Tag transmission	
○	○	●	○	C and T blink at approximately every 2 seconds. This shows that there is no tag.
◎	◎	●	○	C turns on (◎). This shows that there is a tag in the antenna communication area.

◎: Turns on. ○: Blinks at approximately every 2 seconds. (This shows that data is being sent.) ●: Turns off.

## 3-5 Communication Test

Execute the communication test to check a radio wave environment at a working site.

Data (256 bytes) is communicated 256 times between the antenna and tag and the communication status is output. A total of 128 kbytes of data is communicated in two ways. So, it takes a few seconds to execute this test. The communication is not retried. Refer to Section 5-7-8.

- (1) Create a communication program at a host device.
- (2) Enable the operation mode. (Disconnect the terminals "+P" and "-P" from each other. Refer to Section 5-1.)
- (3) Turn on the power supply.
- (4) Put the tag in front of the antenna.
- (5) Send a communication test command (Section 5-7-8). If the antenna is 00, the command is [STX]0080T0SU[ETX].
- (6) If the antenna responds to the host device, the communication between the host device and antenna has been made successfully.
- (7) In the response [STX]8000T0000256□□[ETX], a radio wave environment value □□ is between 0000 and 0256. If the value is close to 0000, the communication to the tag is stable.

Example of response from antenna:

\* Radio wave environment is good.

[STX] 8 0 0 0 T 0 0 0 0 0 2 5 6 0 0 0 0 [ETX]

Number of      Radio wave  
communications      environment value

\* Radio wave environment is poor or no tag is in communication area.

[STX] 8 0 0 0 T 0 0 0 0 2 5 6 0 2 5 6 [ETX]

Number of      Radio wave  
communications      environment value

### Correct Usage

We recommend you to set the radio wave environment value to 50 or less.

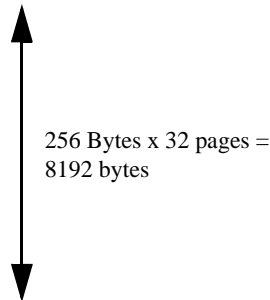
## 3-6 Write Protect Function

You can enable Write Protect for user data (8 kbytes) per page (256 bytes). Write Protect allows to prevent data being destroyed by authorized writing.

### ◆ Scope of Write Protect

The addresses of pages from P0 to P31 are described below.

Page	256 Bytes/page
P0	0000-00FF (h)
P1	0100-01FF (h)
P2	0200-02FF (h)
⋮	⋮
P30	1E00-1EFF (h)
P31	1F00-1FFF (h)

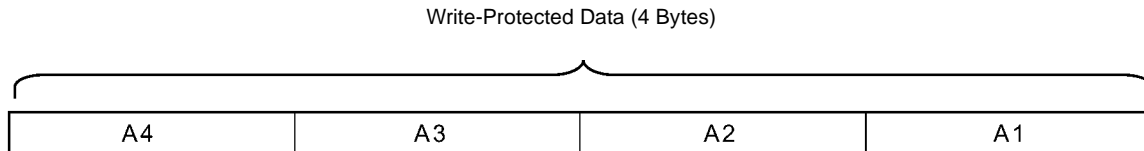


\* (h) means that the value is a hexadecimal number.

### ◆ How to enable Write Protect

32 Bits of Write Protect data (4 bytes) of system data (refer to Section 2-2-3) correspond to each page. By rewriting a bit corresponding to a write-protected page from 0 (disable) into 1 (enable), Write Protect to the page is enabled. To disable Write Protect, rewrite the bit from 1 into 0.

Relation between bit of write-protected data and page is described below.



Code	Bit								Description
	7	6	5	4	3	2	1	0	
A1	P7	P6	P5	P4	P3	P2	P1	P0	Status of Write Protect 0: Disabled (Default value) 1: Enabled
A2	P15	P14	P13	P12	P11	P10	P9	P8	
A3	P23	P22	P21	P20	P19	P18	P17	P16	
A4	P31	P30	P29	P28	P27	P26	P25	P24	

P\*\* : Status of Write Protect in page \*\* (between 0 and 31).



### ◆ Example of enabling/disabling Write Protect

(1) Enable Write Protect to P3 and P14 in the initial state of the ID tag.

Write-protected data is as follows:

	A 4	A 3	A 2	A 1
Decimal notation	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 1 0 0 0 0 0 0	0 0 0 0 1 0 0 0
Hexadecimal notation	0 0	0 0	4 0	0 8

An example of the Write command (Section 5-7-4) is as follows:

STX	D A	S A	Command code	Communication designation	Split flag	Data designation	Start address	Number of written bytes	Written data	ETX
	0 0	8 0	W 1	S U	A	H	W P R O	0 0 0 4	0 0 0 0 4 0 0 8	

Response from the antenna at the normal end is as follows:

STX	S A	D A	Command code	Termination code	Response number	ID code	ETX
	8 0	0 0	W 1	0 0	0 1	* * * * *	

(2) Disable Write Protect to P14, which was enabled in the step (1), and enable Write Protect to P17 and P28.

Write-protected data is as follows:

	A 4	A 3	A 2	A 1
Decimal notation	0 0 0 1 0 0 0 0	0 0 0 0 0 0 1 0	0 0 0 0 0 0 0 0	0 0 0 0 1 0 0 0
Hexadecimal notation	1 0	0 2	0 0	0 8

An example of the Write command (Section 5-7-4) is as follows:

STX	D A	S A	Command code	Communication designation	Split flag	Data designation	Start address	Number of written bytes	Written data	ETX
	0 0	8 0	W 1	S U	A	H	W P R O	0 0 0 4	1 0 0 2 0 0 0 8	

(3) Disable any Write Protect to any page.

Write-protected data is as follows:

	A 4	A 3	A 2	A 1
Decimal notation	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0
Hexadecimal notation	0 0	0 0	0 0	0 0

An example of the Write command (Section 5-7-4) is as follows:

STX	D A	S A	Command code	Communication designation	Split flag	Data designation	Start address	Number of written bytes	Written data	ETX
	0 0	8 0	W 1	S U	A	H	W P R O	0 0 0 4	0 0 0 0 0 0 0 0	

### 3-7 ID Tag Power-Saving Function

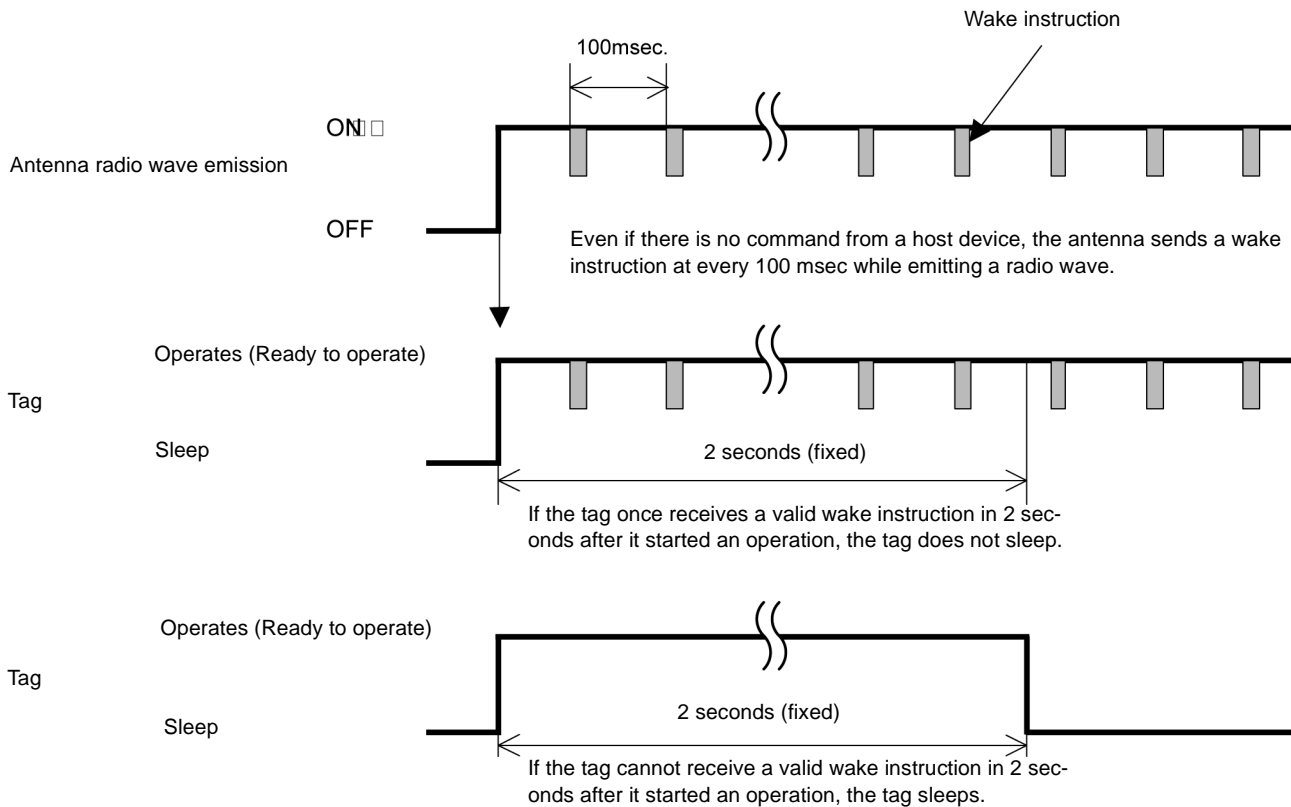
The tag has the two power-saving functions below.

#### ◆ Function to prevent battery power loss due to radio wave emitted from any other radio equipment (Enabled always)

If any radio equipment is located near a tag, the tag operates (ready to operate) because the tag's receiving band is wide. As a result, the tag battery may be consumed. (Refer to "Notes on Interference to Second-Generation Low-Power Data Communication System (Wireless LAN), Cellular Phone, etc." at the beginning of this manual.)

To prevent this power loss, the tag has a function to enter a sleep state (refer to "Appendix 1 - Glossary") against a radio wave emitted from any other radio equipment.

- The V690 antenna sends a wake instruction (refer to "Appendix 1 - Glossary") at every 100 msec after emitting a radio wave and the tag operates (ready to operate).
- When the tag receives a radio wave emitted from any other radio equipment, the tag may operate (ready to operate). However, unless receiving a valid wake instruction, the tag returns to a sleep state in 2 seconds.



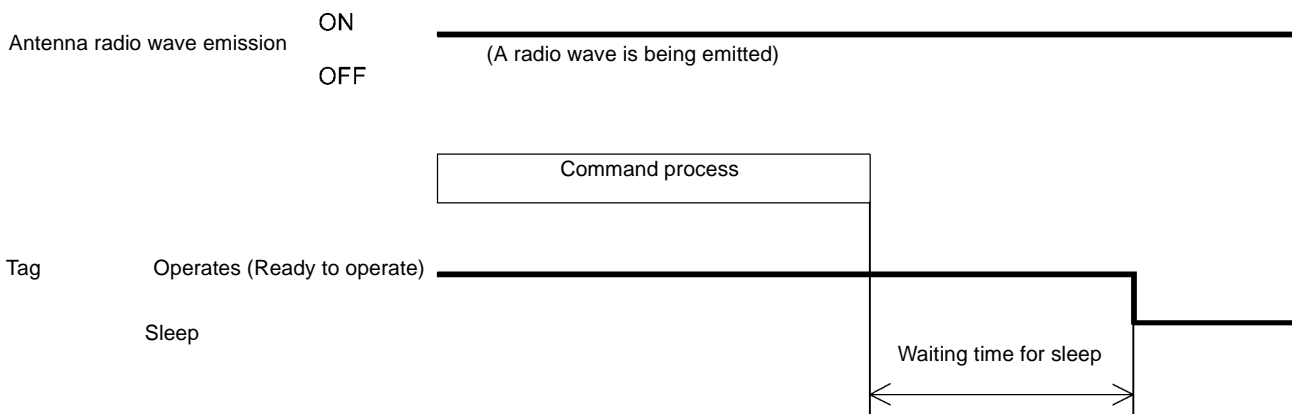
◆ **Function to prevent battery power loss due to neglect when tag works (Enabled always)**

When you use the antenna with a repeat command (refer to (3) in Section 5-2-1), due to a trouble in a working site, the tag may be left in front of the antenna which is emitting a radio wave, although the tag operates (ready to operate). Then, the tag battery is consumed. To prevent this power loss, the tag has a function to enter a sleep state when a waiting time for sleep (refer to a chart below) has passed.

If the tag cannot receive a valid command within a waiting time for sleep after receiving a valid command, the tag enters a sleep state. A default value of waiting time for sleep is 480 seconds (8 minutes). To change waiting time, specify "SLEP" as address in the Read/Write command. (Refer to Sections 5-7-1 and 5-7-3 to 5-7-5.)

To recover the tag from the sleep state:

- Turn OFF the power supply transmission of the antenna and turn ON it again.
- Take the tag out of the communication area and place it in the communication area again.



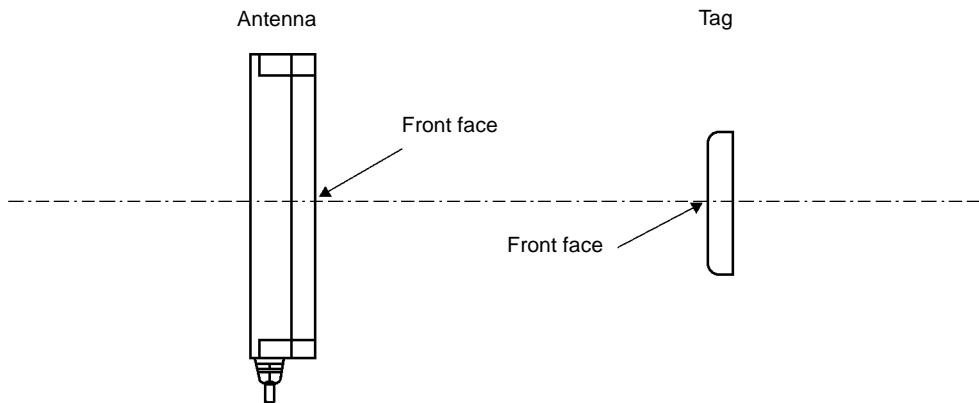
# Chapter 4 Installation and Connection

## 4-1 Read/Write Antenna and ID Tag

### 4-1-1 Installation Environment

#### (1) Antenna and tag

Install the antenna and tag so that those front faces can face each other. Confirm the front side and the reverse side of them. The front faces must face each other.



#### (2) Antennas

Keep sufficient space between the antennas according to Section 7-5. If sufficient space cannot be obtained:

- Assign the most different channel numbers to the radio channels of adjacent antennas. (Refer to Section 3-3.)
- Permit only one of antennas to transmit a radio wave so that those antennas do not transmit radio waves simultaneously.

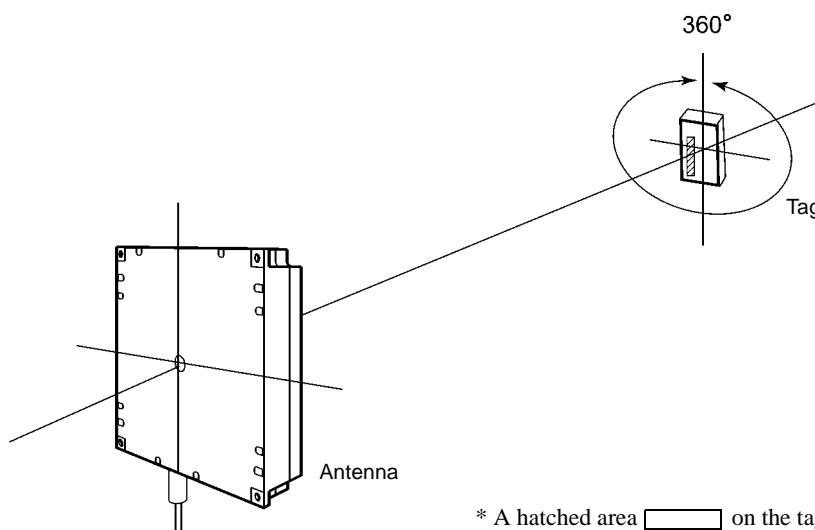
#### (3) Tag rotating position to antenna


The antenna and tag use "circularly polarized wave" as radio wave to communicate with each other. So, the tag can communicate with the antenna at any rotating angle.

The maximum communication range varies depending on the rotating angle of the tag. Refer to Section 7-3.

#### • Conceptual diagram of circularly polarized wave

The arrows show the directions of vibrating surface. The radio wave propagates while the vibrating surface is rotating.



\* A hatched area  on the tag shows the "omron" logo.

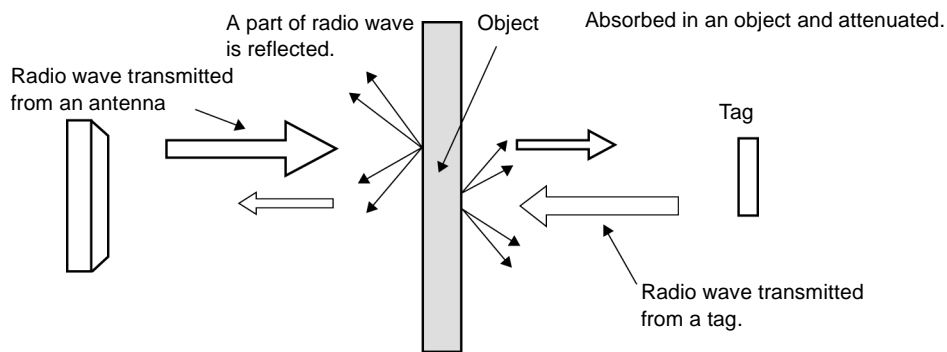
**(4) Influence of external objects**

**• Radio wave absorbers: water, human body, water screen, water-absorptive material, etc.**

A radio wave (microwave) penetrates anything (solid body and liquid) other than metal, but it is attenuated while penetrating. In particular, water absorbs a radio wave extremely. When a radio wave penetrates the water, the radio wave is absorbed considerably. Also, the radio wave is attenuated remarkably in a human body which contains much water. So, any solid body and liquid must not exist between the antenna and tag.

A general-purpose plastic plate with thickness of or glass plate a few millimeters does not absorb the radio wave, and the radio wave attenuation is not a serious problem in this case. However, the radio wave attenuation varies depending on a type of material and/or thickness of external objects which the radio wave penetrates. Execute the communication experiment in a working site in advance. When the communication is performed through the plastic plate or glass plate which absorbs the radio wave so much, such plastic plate or glass plate may be covered with water due to rain. The radio wave may be attenuated by this water screen and the communication may fail. Execute the communication experiment in a working site in advance and take great care not to get out of the communication range during an operation.

Dry wood and paper do not attenuate the radio wave so much. However, wood and paper absorb water easily. The wet wood and paper may attenuate the radio wave considerably. Execute the communication experiment in a working site in advance using both of dry materials and wet ones.

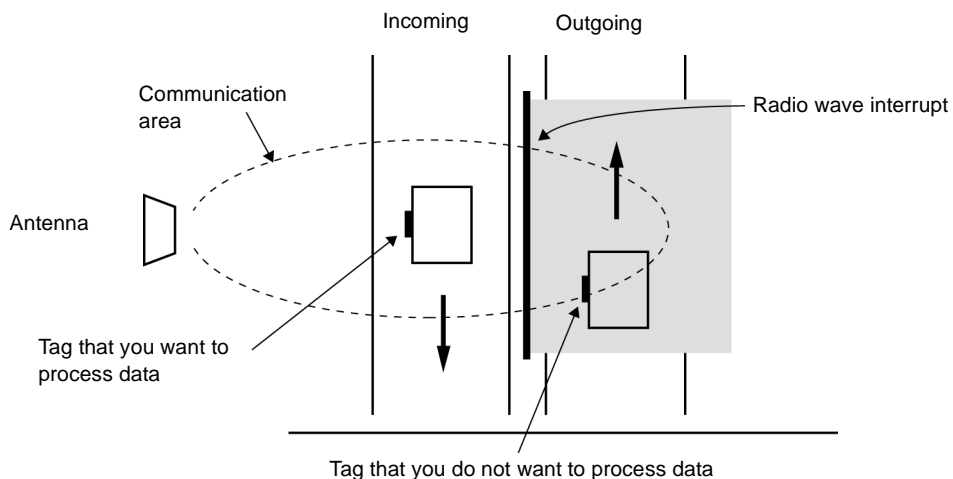


**• Radio wave reflectors: metal, ground, etc.**

Metal reflects a radio wave (microwave) like a mirror reflects light. If there is a metal near an antenna communication area, the communication area is affected by the metal. If a metal is put between an antenna and tag, the communication between the antenna and tag may fail. Metal, whether metal plate or wire netting, may affect the communication. Also, the ground affects the communication like metal.

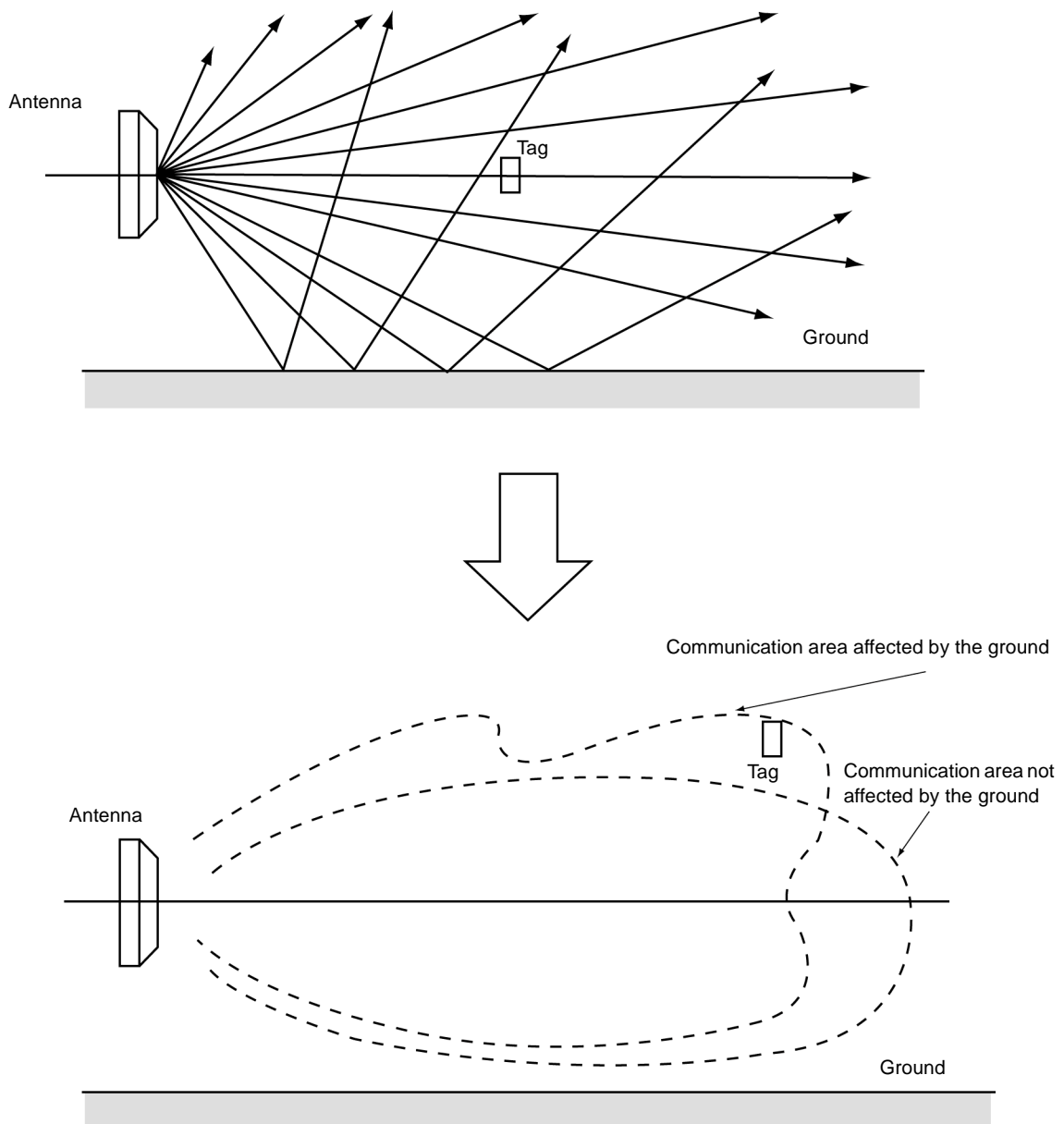
As shown below, a radio wave absorber or reflector can be used to interrupt a radio wave. When you interrupt the radio wave, execute the communication experiment in a working site in advance.

Example of radio wave absorber: ECCOSORB AN75 (61 x 61 cm, E&C Engineering)



- **Communication area affected by the ground**

If an antenna is installed near the ground, radio waves (microwave) emitted from the antenna and ones reflected by the ground overlap each other. Therefore, an outline of the communication area becomes ragged and complex. In this case, dead zones may be formed frequently, where no communication can be made to the tag.



#### Correct Usage

Depending on a working site, a special point may be generated in the communication area above and the communication to the tag cannot be made at the point. So, be sure to execute the communication check with a communication test (refer to Section 3-5), etc.

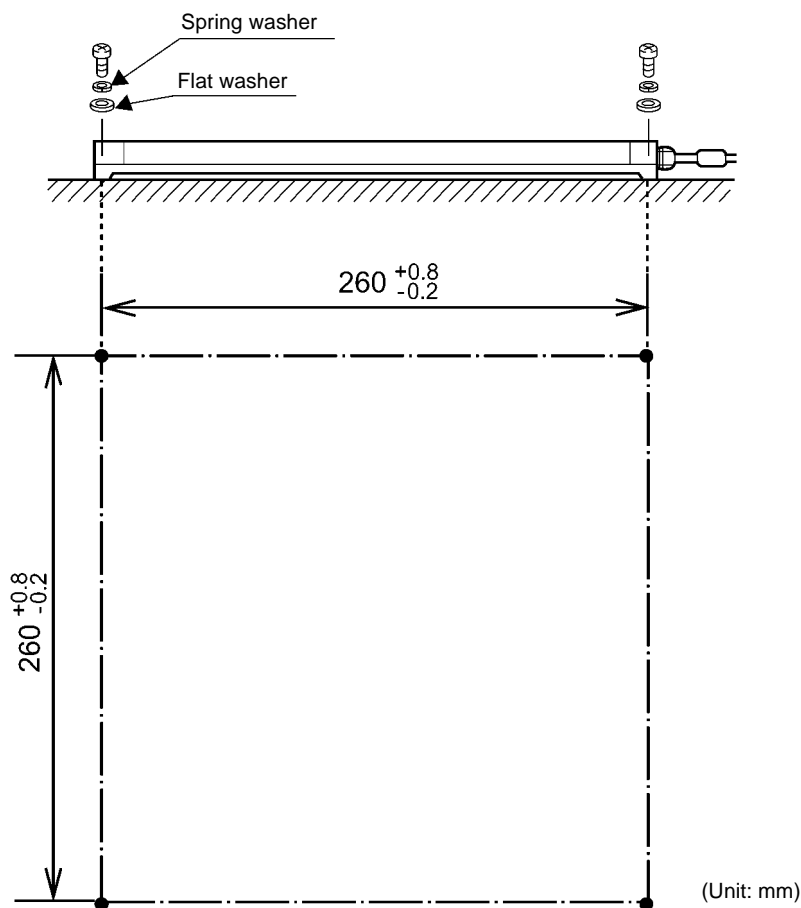
**(5) Installation environment**

Do not install the antenna and tag at any place below:

- Place where the ambient temperature is out of the range between -20 and +60°C for the antenna and -25 and +70°C for the tag, where the temperature fluctuates considerably and where moisture condensation occurs frequently.
- Place where the relative humidity is out of the range between 35 and 85% RH.
- Place where there is corrosive gas, flammable gas, dust, salt or iron powder.
- Place affected by vibration or impact.
- Place splashed with water, oil or chemicals

**4-1-2 How to Install Antenna**

Install an antenna on a flat plane taking care not to bend it by force. As shown below, mount the antenna with four M5 screws, spring washers and flat washers. Tightening torque is 2.0 N•m (approximately 20 kgf•cm). Do not use any lock paint to fix screws.



**Correct Usage**

Do not disassemble it nor touch the inside when the power supply turns on. Otherwise, trouble may be caused.

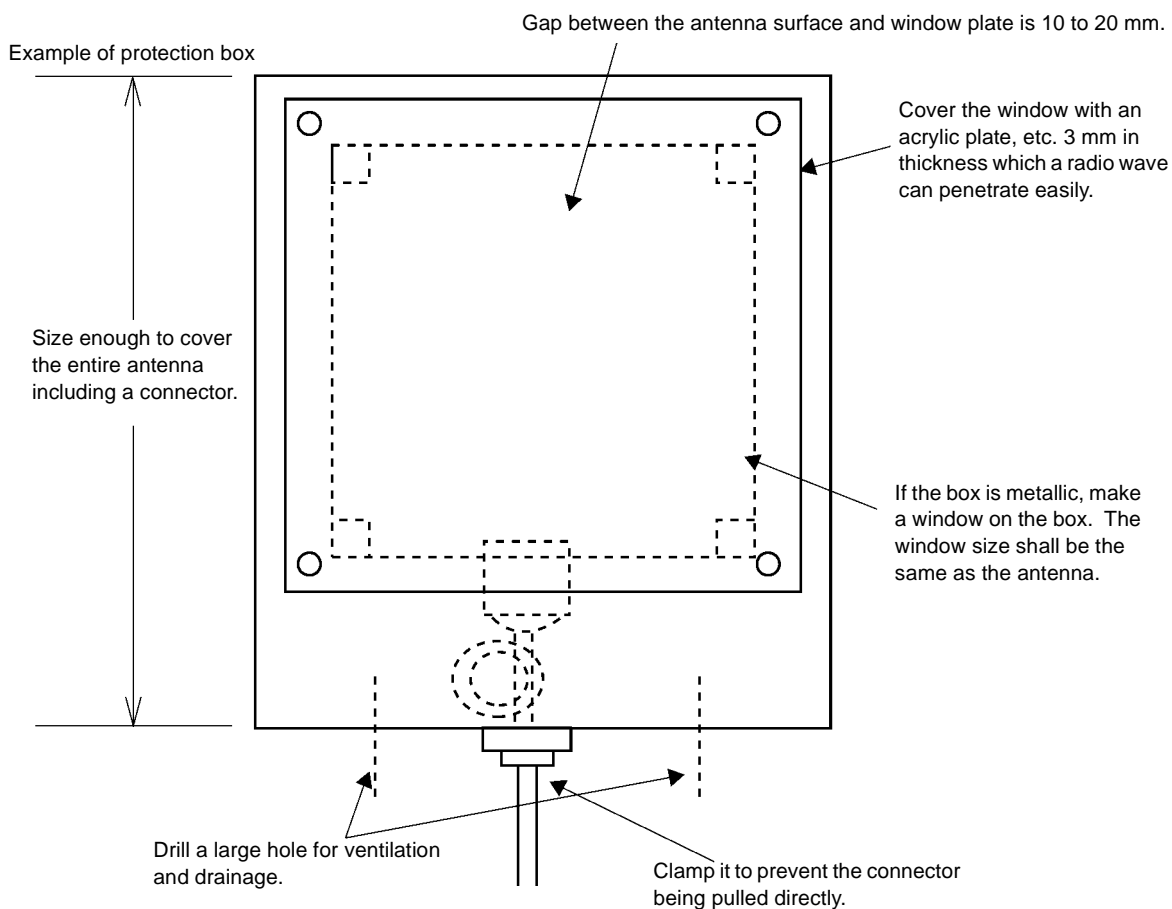


### 4-1-3 Rainproofing of Antenna

The antenna is not waterproof structure. So, do not install the antenna.

If you must install the antenna outdoors, protect the antenna against rain with a plastic rainproof box. To prevent the water droplet coming in the antenna through a cable, be sure to turn the antenna cable section downward.

Example of plastic rainproof box: Model WB-5AJ (Outside dimensions: 571 (H) x 412 (W) x 210 (D) mm, Mirai Industry)



#### Correct Usage

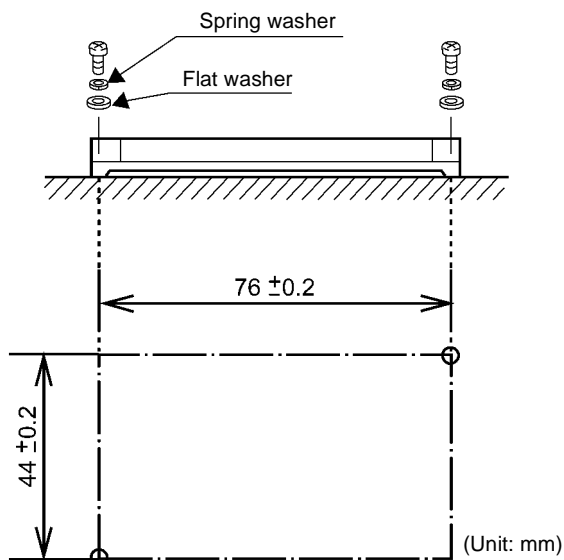
Protective structure IP62 of the antenna is the protection against the drop of water. If the antenna is splashed with water spray or water jet flow, cover the antenna with a protection plate. (Refer to "Appendix 3 - Protective Structure".)



### 4-1-4 How to Install Tag

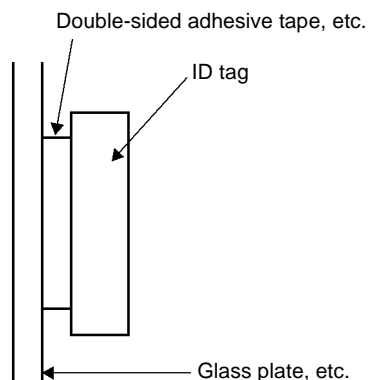
#### ◆ Installation

Install a tag on a flat plane taking care not to bend it by force. As shown below, mount the antenna with two M4 screws, spring washers and flat washers. Tightening torque is 1.2 N•m (approximately 12 kgf•cm). Do not use any lock paint to fix screws.



#### ◆ Influence on communication performance, adhesive, metal tape, water screen, etc.

- When you apply adhesive, etc. on the tag surface, a radio wave (microwave) is attenuated and the communication area may be affected. Execute the communication experiment with anything used actually in advance.
- If a metallic tape, etc. is put on the tag surface, a radio wave is interrupted and the communication to the antenna fails.
- If the tag is put on a glass plate with double-sided adhesive tape as shown below, a gap between the glass plate and tag sweats easily. Moreover, a water screen may be generated. In this case, please note that a radio wave is absorbed and the communication range may become small.

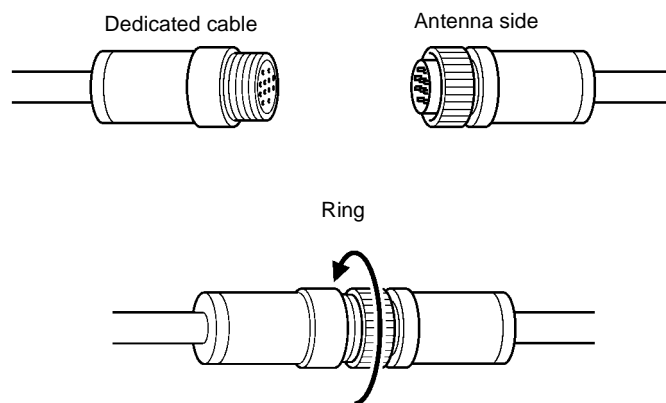


### 4-1-5 How to Connect Connecting Cable to Antenna

To connect an antenna and host device, use a connecting cable (unbundled).

RS-232C connecting cable                      V690-A4□ \* Refer to Section 2-4.  
RS-422A/485 link unit connecting cable    V690-A5□ \* Refer to Section 2-4.

- (1) When you connect a connector of dedicated cable and connector of antenna, be sure to hold those connectors and insert them into each other completely.
- (2) When you have connected the connectors, turn a ring completely as shown below.



#### Correct Usage

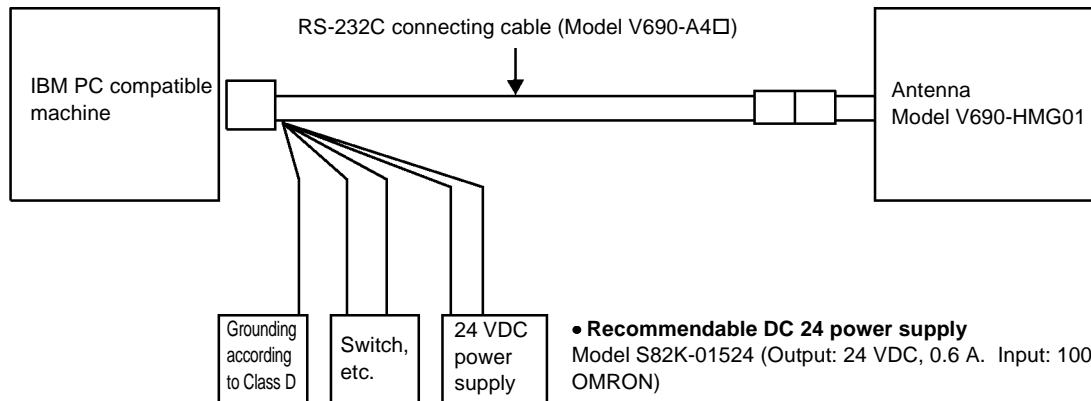
- Do not connect nor disconnect the connectors when the power supply turns on. Otherwise, a trouble is caused.
- Do not pull the cable by force.
- Do not touch a connecting terminal of the connector.
- Do not touch the connector during an operation.

## 4-2 How to Wire to Host Device

### 4-2-1 How to Wire RS-232C Interface

#### (1) Using RS-232C connecting cable

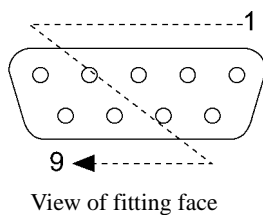
To connect an antenna and IBM PC compatible machine, use a dedicated RS-232C connecting cable model V690-A4□. Connect the five electric wires at a connector of host device as shown below.



#### Connection of leader line of RS-232C connecting cable

Leader line of connecting cable		Details of connection
Brown	Thick wire of AWG22	(+) of 24 VDC power supply
Blue		(-) of 24 VDC power supply
Light green	Thin wire of AWG26	" +P" and "-P" for the setting mode: Not connected for the operation mode. Short-circuited for the setting mode.
Black		
Green/Yellow	Thick wire of AWG22	Ground according to Class D.

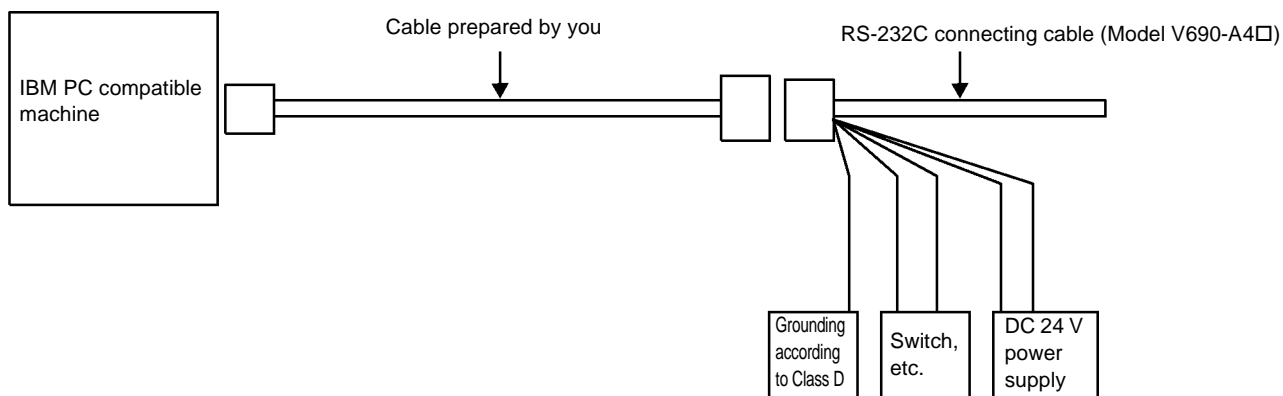
#### Connector pin layout



Pin No.	IBM PC Compatible Machine	RS-232C Connecting Cable Model V690-A4□
	Socket (Male)	Plug (Female)
1		
2	RD (Receiving)	TX (Sending)
3	SD (Sending)	RX (Receiving)
4		
5	SG (Grounding for signal)	SG (Grounding for signal)
6		
7	RS (Request to send)	] Loop back (Short-circuit)
8	CS (Clear to send)	
9		

**(2) Using RS-232C connecting cable to extend a cable and connecting to IBM PC compatible machine (typical)**

To connect an IBM PC compatible machine (typical) extending a dedicated RS-232C connecting cable, prepare the cables shown below. Thickness of wire in the cable must be AWG26 or more.



- **Recommendable 24 VDC power supply**

Model S82K-01524 (Output: 24 VDC, 0.6 A. Input: 100 to 240 VAC. OMRON)

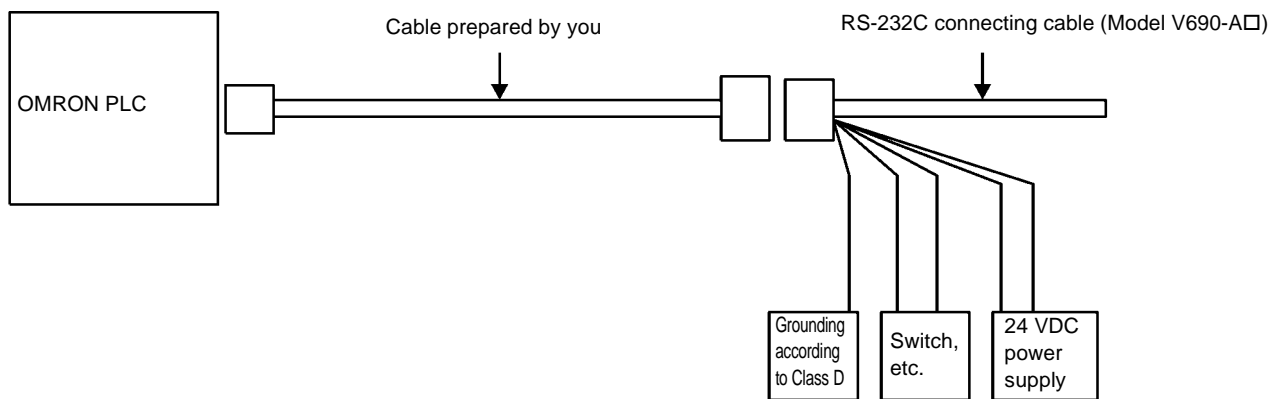
If you do not use the recommendable power supply or equivalent, connect to the 24 VDC power supply via a line filter type GT-205J (Tokin) or equivalent.

Pin No.	IBM PC Compatible Machine (Typical)	Cable prepared by you		RS-232C Connecting Cable Model V690-A4□
	Socket (Male)	Female	Male	
1				1
2	RD (Receiving)			2 TX (Sending)
3	SD (Sending)			3 RX (Receiving)
4				4
5	SG (Grounding for signal)			5 SG (Grounding for signal)
6				6
7	RS (Request to send)			7
8	CS (Clear to send)			8 ] Loop back
9				9

**(3) Connecting to OMRON PLC**

To connect an antenna and OMRON programmable controller (PLC), prepare a dedicated RS-232C connecting cable model V690-A4□ and connected cable.

Thickness of wire in the cable must be AWG26 or more.



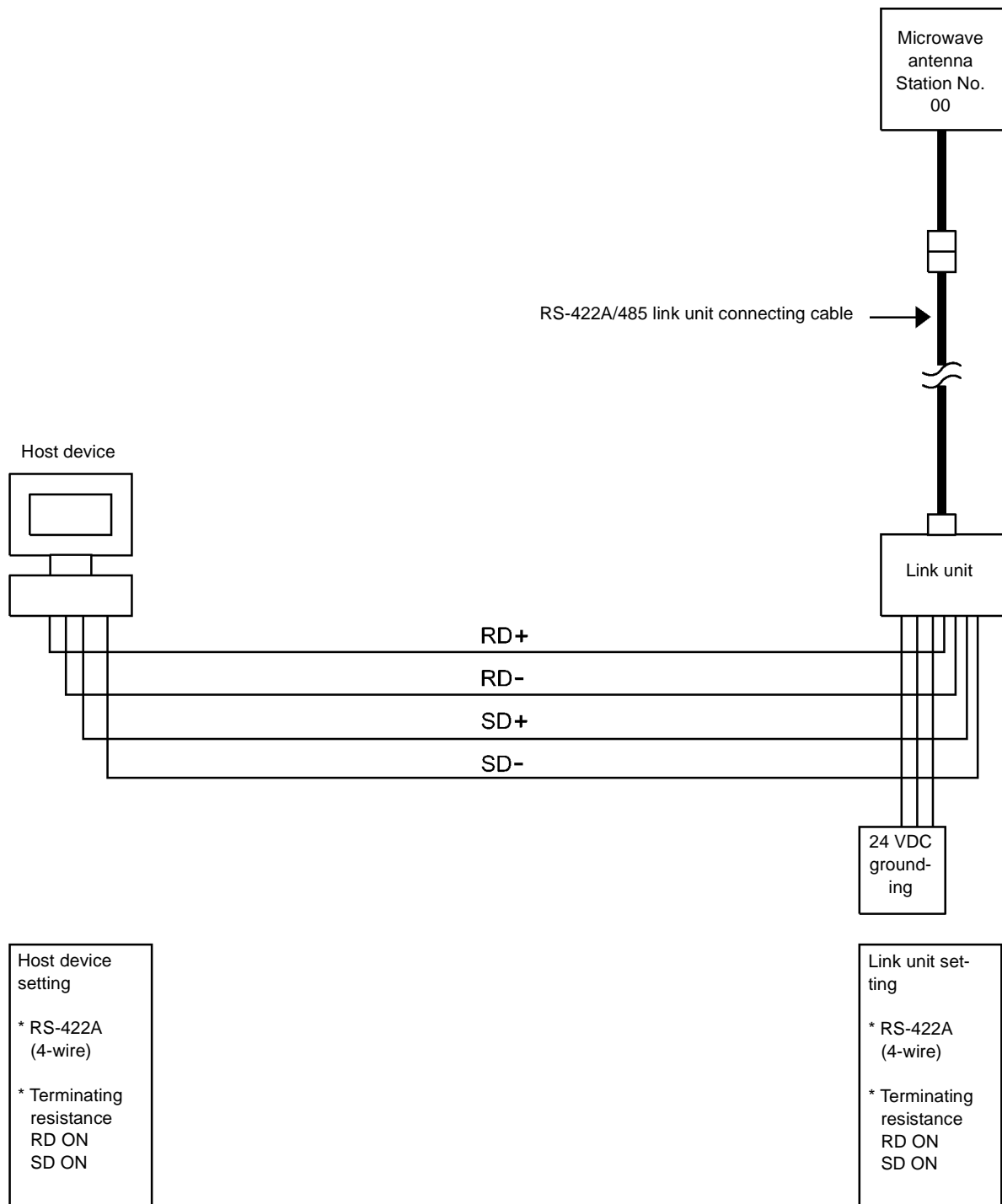
Pin No.	OMRON PLC	Cable prepared by you		RS-232C Connecting Cable
	Socket (Female)	Male	Female	
1				1
2	SD (Sending)			2 TX (Sending)
3	RD (Receiving)			3 RX (Receiving)
4	RS (Request to send)			4
5	CS (Clear to send)			5 SG (Grounding for signal)
6				6
7				7 } Loop back
8				8 }
9	SG (Grounding for signal)			9

Additional connections in the 'Cable prepared by you' section:  
 - A 'Loop back (Short-circuit)' is shown between pins 4 and 5.  
 - A 'Loop back' is shown between pins 7 and 8.

### 4-2-2 How to Wire When Connecting RS-422A/485

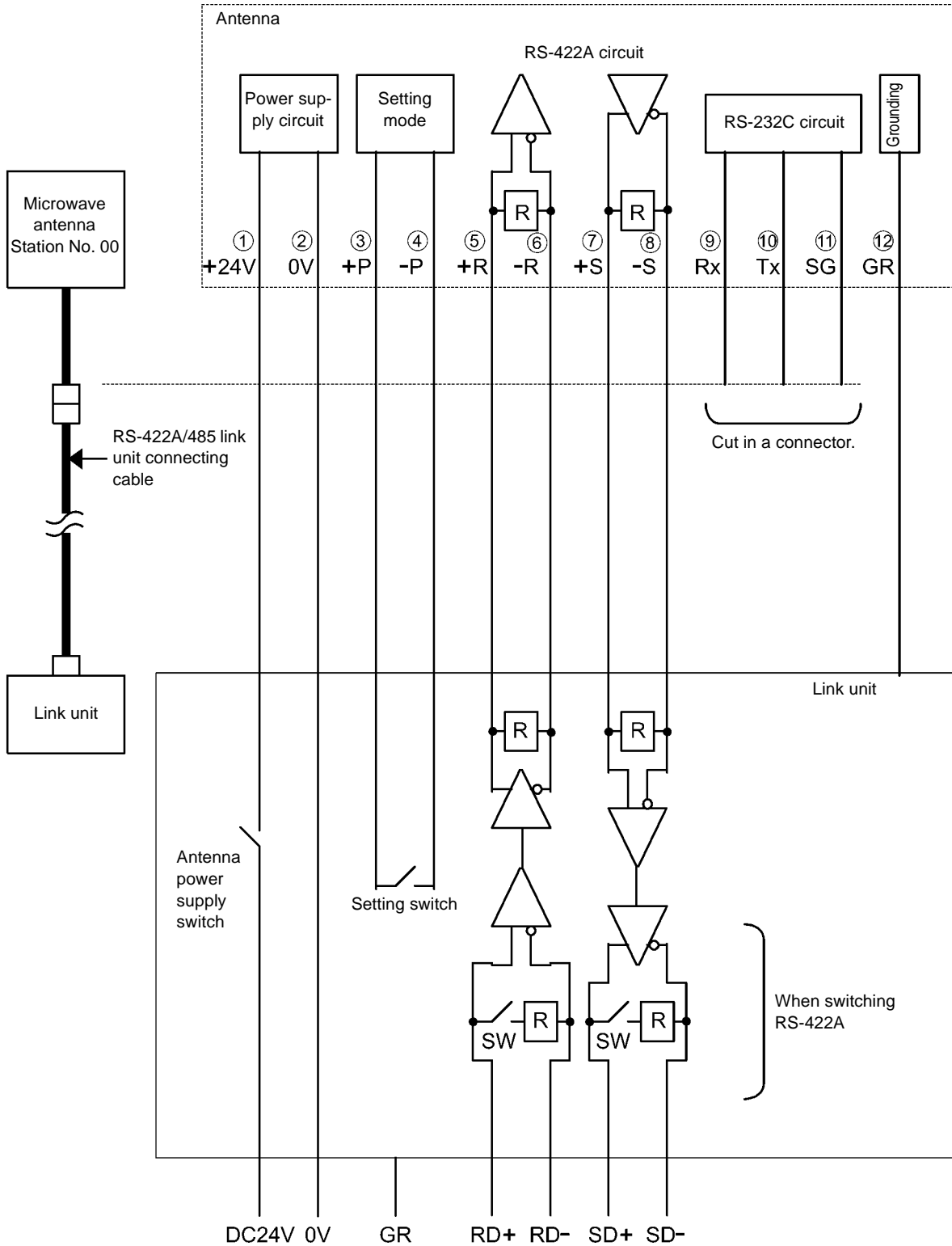
#### (1) 1:1 connection with link unit

To connect an antenna and host device through RS-422A/485, use the link unit. An example below shows the connection of one antenna and one host device through RS-422A (4-wire).



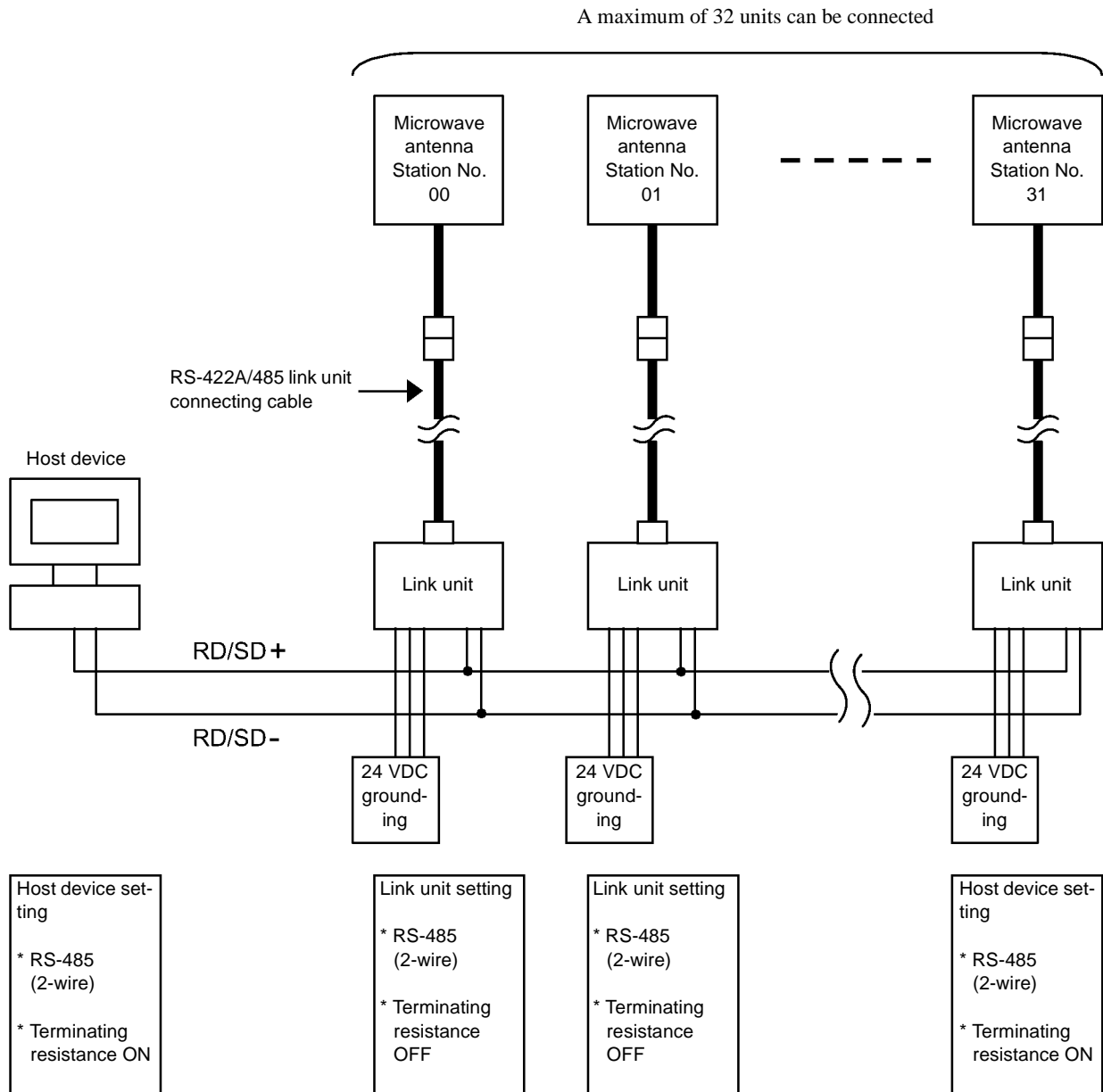
Internal configuration of the 1:1 connection of an antenna and host device through RS-422A (4-wire) is shown below.

- Signal lines (Rx, Tx and SG) of RS-232C are disconnected.
- If RS-422A is selected with the link unit, SD and RD of the terminating resistance (220 Ω) can be turned ON/OFF.



**(2) 1:N connection with link unit**

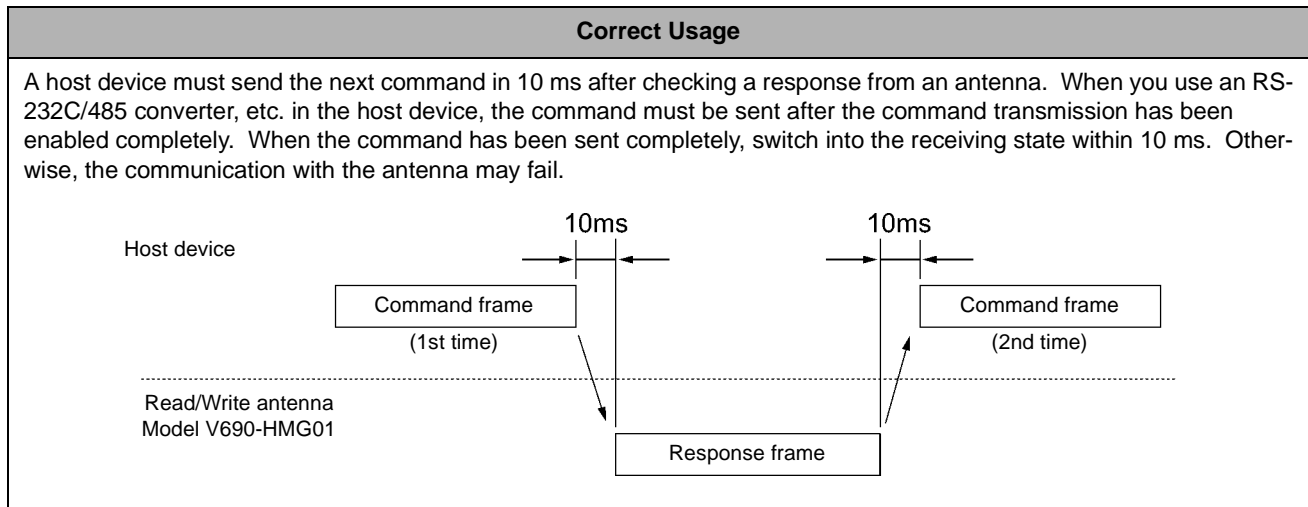
To connect an antenna and host device through RS-422A/485, use the link unit. An example below shows the connection of several antennas and one host device through RS-485 (2-wire).



**Correct Usage**

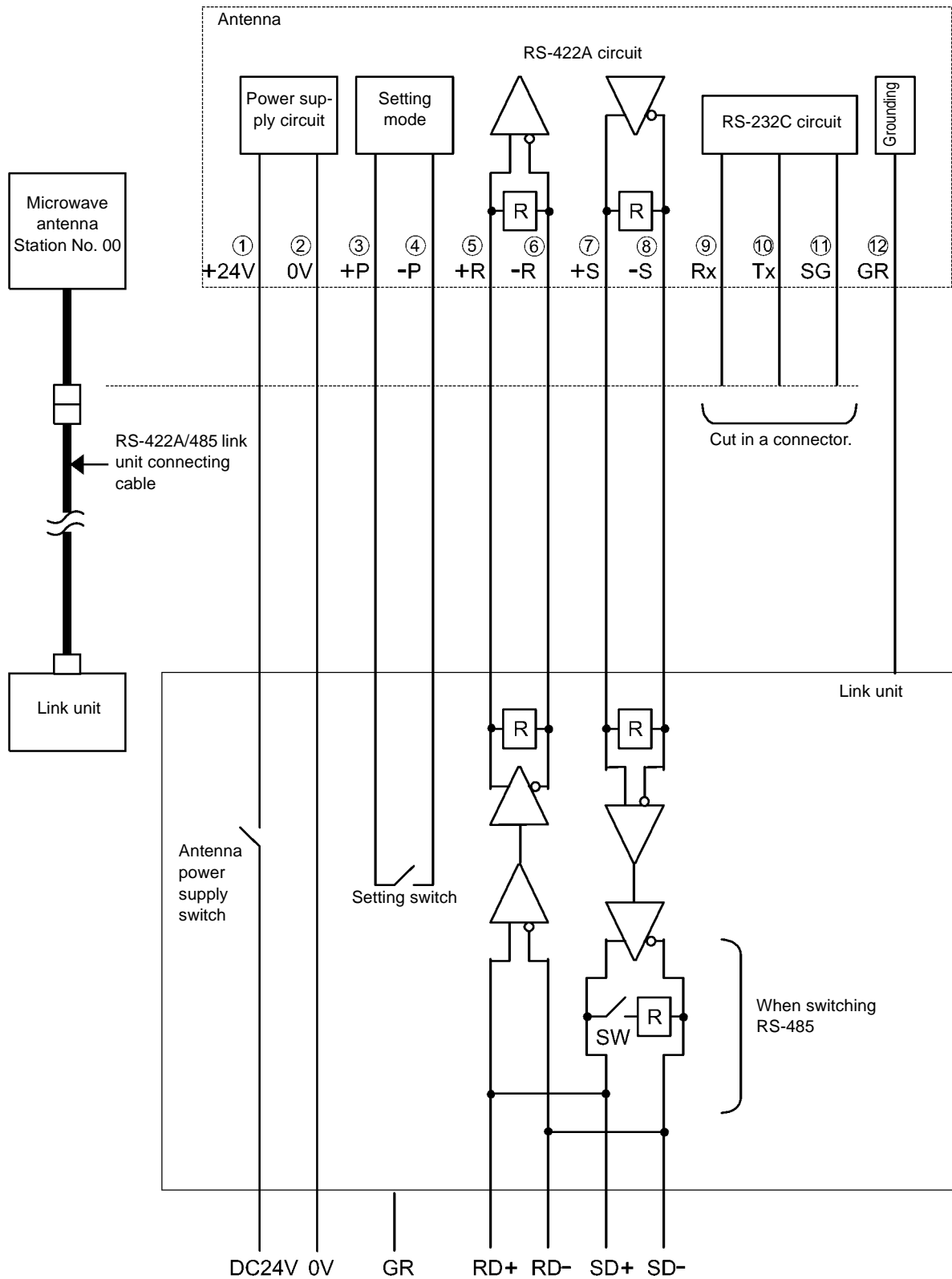
Turn ON (connected) the terminating resistances at both ends of the entire RS-422A/RS-485 communication wiring.





Internal configuration of the 1:N connection of an antenna and host device through RS-485 (2-wire) is shown below.

- Signal lines (Rx, Tx and SG) of RS-232C are disconnected.
- If RS-485 is selected with the link unit, the terminating resistance (220 Ω) can be turned ON/OFF.



---

## 4-3 Link Unit

---

### 4-3-1 Installation Environment

#### ◆ Installation site

Do not install the link unit at any place below:

- Place where the ambient temperature is out of the range between 0 and +55°C, where the temperature fluctuates considerably and where moisture condensation occurs frequently.
- Place where the relative humidity is out of the range between 35 and 85%RH.
- Place where there is corrosive gas, flammable gas, dust, salt or iron powder.
- Place affected by vibration or impact.
- Place splashed with water, oil or chemicals

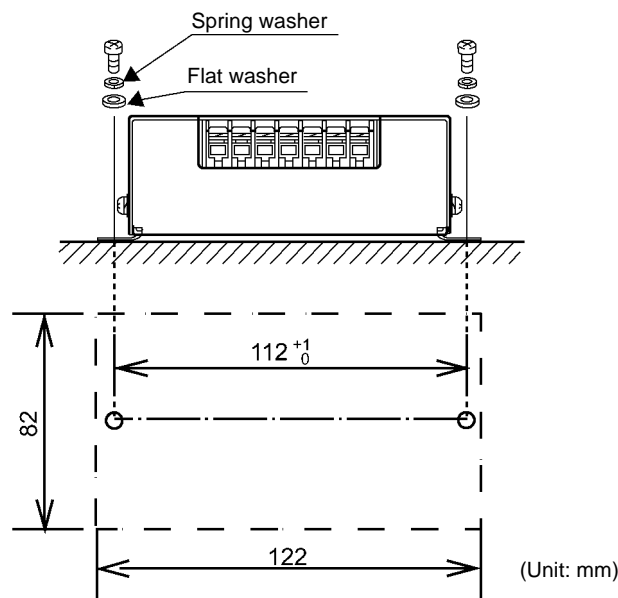
#### ◆ Assembly in panel

The ambient operating temperature of link unit is between 0 and +55°C. The following conditions must be met.

- Provide sufficient space for ventilation.
- Do not install the controller near by any heating sources (heater, transformer and large-sized resistance).
- If the ambient temperature rises to 55°C or more, install a ventilating fan or air conditioner to keep the temperature at 55°C or less.
- If you wire a power line (for high current to drive a motor) near the controller, execute the communication experiment fully to check the influence of noise and wire it with care.

### 4-3-2 How to Install

Install a link unit on a flat plane taking care not to bend it by force. As shown below, mount the antenna with two M4 screws, spring washers and flat washers. Tightening torque is 1.2 N•m (approximately 12 kgf•cm).

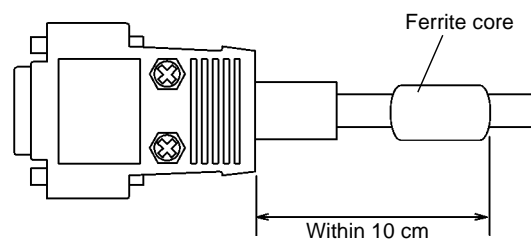


### 4-3-3 How to Wire

#### ◆ Connecting RS-422A/485 link unit connecting cable

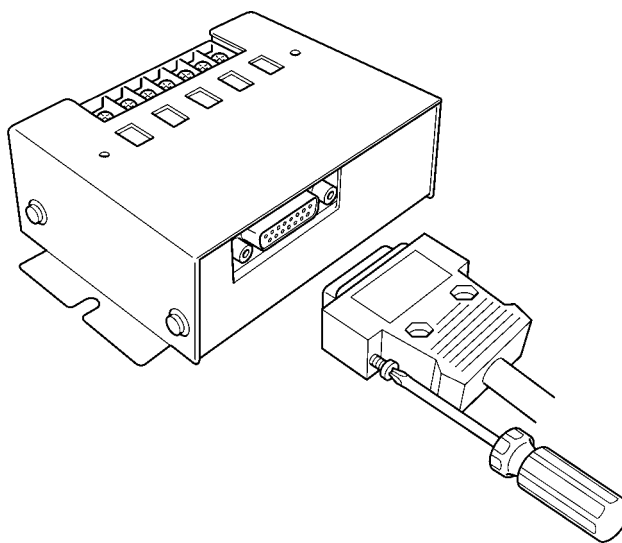
To connect:

- (1) When you connect a connector of dedicated cable to the link unit, be sure to hold the connector and insert it into the link unit completely.
- (2) When you have inserted the cable into the link unit, tighten the two lock screws with the Phillips type screwdriver to fix it.
- (3) Fit the connecting cable with a supplied ferrite core. Close the ferrite core and lock it completely.



To disconnect:

- (1) To disconnect the connector, loosen the two lock screws completely and pull out it straight holding the connector hood lug.
- (2) If it is hard to pull out, push the link unit pulling out the connector.



#### Correct Usage

Be sure to connect a grounding wire. Otherwise, an error may occur in an operation.



Do not touch any terminal when the power supply turns on. Otherwise, an error may occur in an operation.



Do not disassemble it nor touch the inside when the power supply turns on. Otherwise, trouble may be caused.

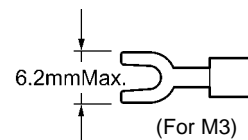


◆ **Connecting power supply wire, grounding wire and signal wire**

M3 screws are used for the power supply, grounding and signal terminals. For a crimp terminal, use any of terminals below. Tightening torque is 0.6 N•m (approximately 6 kgf•cm).

● **Applicable crimp terminal**

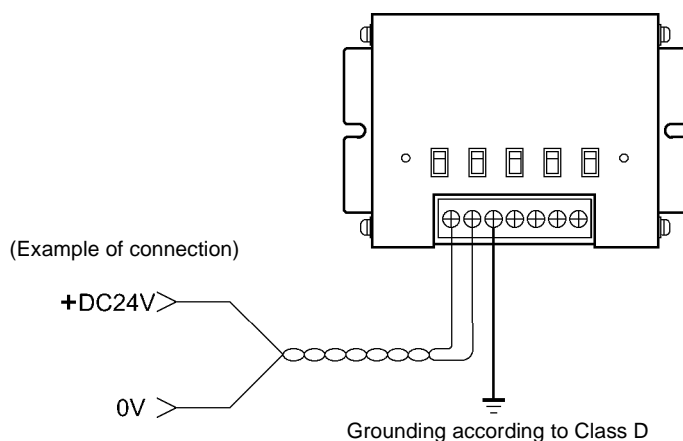
Manufacturer	Model	Applicable Wire	Type
Japan Solderless Terminal	1.25-B3A	AWG22 to AWG16	Fork
Japan Solderless Terminal	1.25-C3A		



● **Recommendable 24 VDC power supply**

Model S82K-01524 (Output: 24 VDC, 0.6 A. Input: 100 to 240 VAC. OMRON)

● **Be sure to ground GR according to the Class D.**

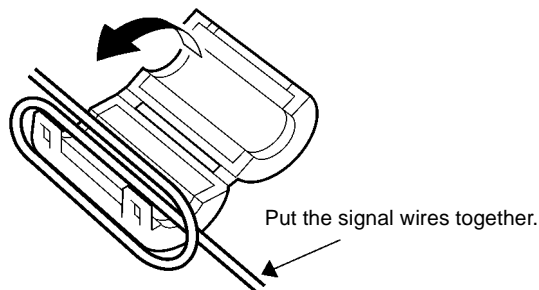


Correct Usage
If any noise superposed on the power supply line is large, supply the power through a line filter. Then, ground noise can be reduced considerably. Example of line filter: Model GT-205J (Tokin).

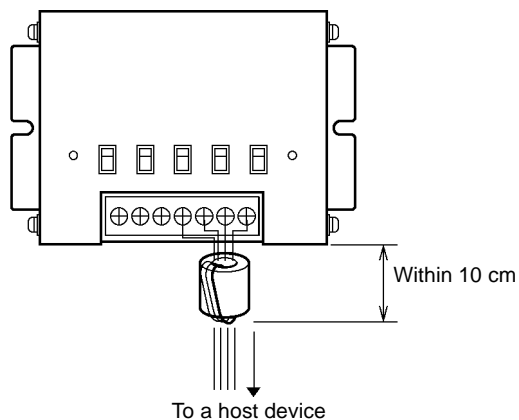
### ◆ Connecting signal wire

To suppress noise, fit a signal line with a supplied ferrite core as shown below.

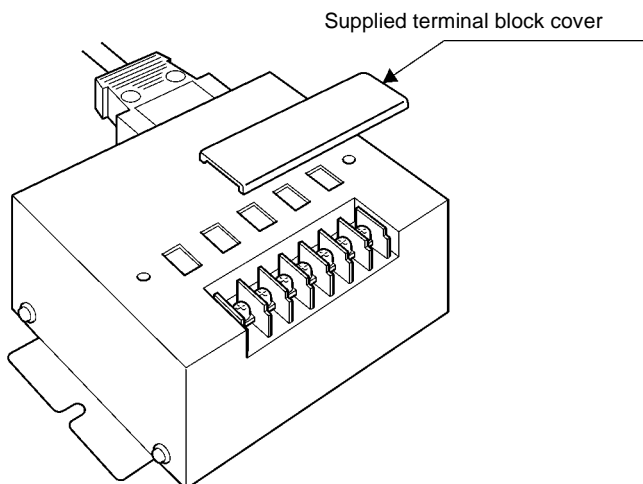
- (1) Wire the signal wires.
- (2) Put the signal wires together and wind the signal wire round the ferrite core. As shown below, wind the signal wire once to prevent the ferrite core moving. Position the ferrite core within 10 cm from the link unit.



- (3) Close the ferrite core and lock it completely.

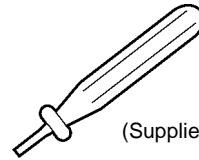


### ◆ When you have wired, attach a supplied terminal block cover.



### 4-3-4 Switch Setting

Turn on/off the switches with a supplied plastic screwdriver. By default, all the switches are set to a lower position (OFF or RS-485).



(Supplied plastic screwdriver)

#### ◆ Enabling the setting mode (Refer to Section 5-1)

- (1) Turn OFF the ANT PWR switch (A) referring to the next page.
- (2) Turn ON the SET UP switch (B).
- (3) Turn ON the ANT PWR switch (A). → The indicator ANT PWR turns on. → Then, the setting mode has been enabled.

#### ◆ Enabling the operation mode (Refer to Section 5-1)

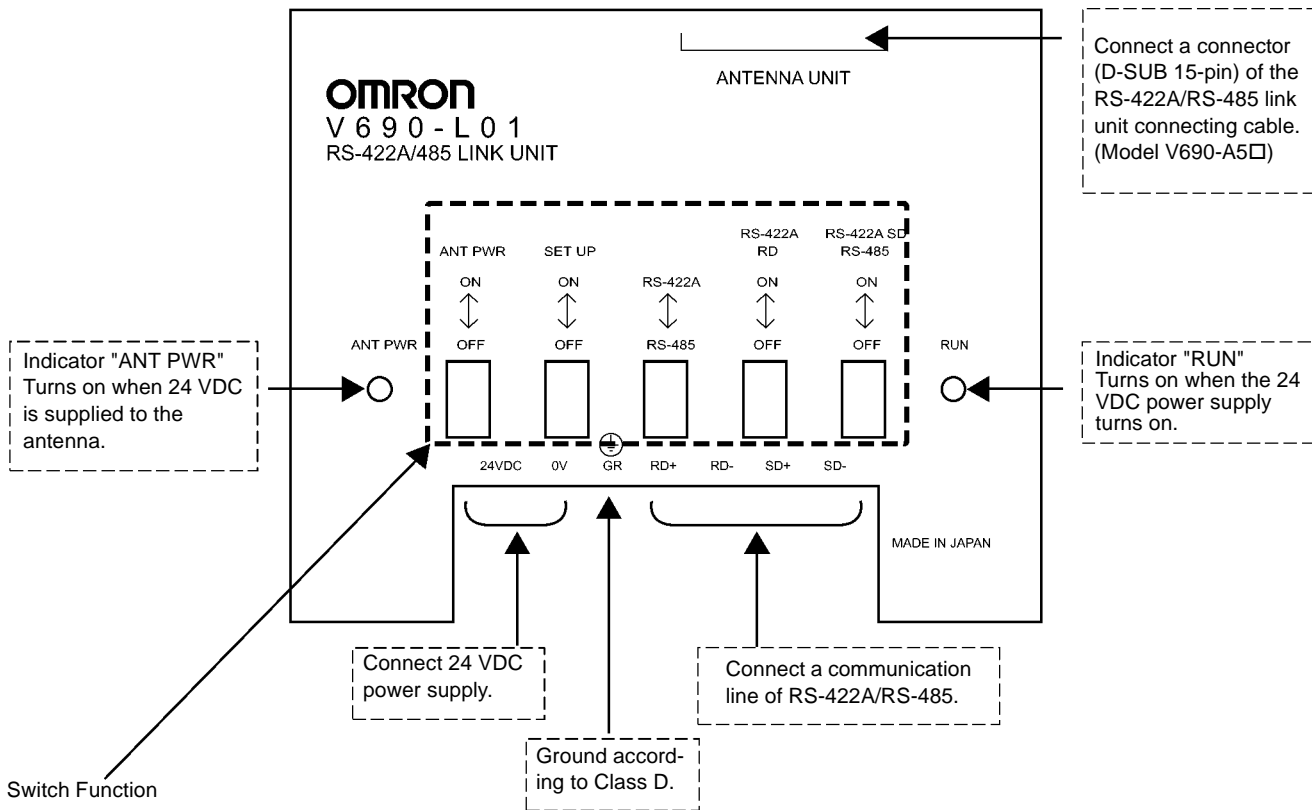
- (1) Turn OFF the ANT PWR switch (A) referring to the next page.
- (2) Turn ON the SET UP switch (B).
- (3) Turn ON the ANT PWR switch (A). → The indicator ANT PWR turns on. → Then, the operation mode has been enabled.

#### ◆ Enabling the RS-422A communication

- (1) Turn OFF the 24 VDC power supply of the link unit referring to the next page.
- (2) Set the RS-422A/RS-485 switch (C) to RS-422A.
- (3) Turn ON or OFF suitably the terminating resistance of RS-422A RD (D) and RS-422A SD (E).
- (4) Connect to the signal line terminal.
- (5) Turn on the 24 VDC power supply of the link unit.

#### ◆ Enabling the RS-485 communication

- (1) Turn OFF the 24 VDC power supply of the link unit referring to the next page.
- (2) Set the RS-422A/RS-485 switch (C) to RS-485. → RS-422A RD (D) is disabled.
- (3) Turn ON or OFF suitably the terminating resistance of RS-422A SD (E).
- (4) Connect to the signal line terminal.
- (5) Turn on the 24 VDC power supply of the link unit.



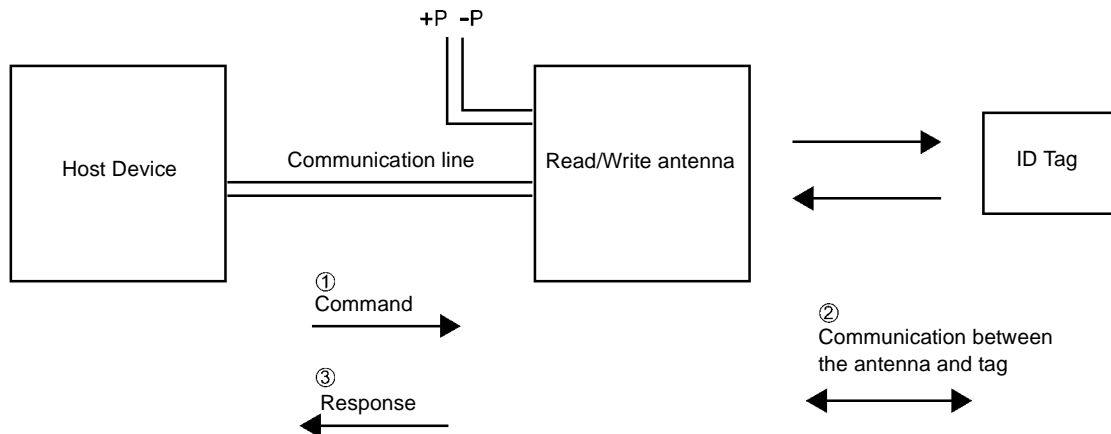
(A)	(B)	(C)	(D)	(E)
ANT PWR	SET UP	RS-422A/RS-485	RS-422A RD (Receiving)	RS-422A SD (Sending) RS-485



# Chapter 5 Control from Host Device

## 5-1 Operation Status of Read/Write Antenna and ID Tag

The V690 Series REID system communicates with a tag according to the instruction of a command (1) sent from a host device and returns the result to the host device as the response (3).



### ◆ Operation mode and setting mode of antenna

Two modes are available in the operation of antenna. Available commands vary depending on the mode. Refer to Section 5-4.

Mode	How to change mode	Description	Host communication condition	Antenna station number
Operation mode	Disconnect the two antenna terminals "+P" and "-P" and reset the power supply (turn off the power supply once and turn on it again).	Use for a normal operation.	Setting can be changed. (Refer to Section 5-9-7.)	00 to 31 (Initial value 00)
Setting mode	Short-circuit the two antenna terminals "+P" and "-P" and reset the power supply.	<ul style="list-style-type: none"> <li>A simplified communication function (without connection to a host device) is available. Refer to Section 3-4.</li> <li>A tag communication command and radio wave transmission ON/OFF command cannot be used.</li> </ul>	Fixed. (Refer to Section 5-9-7.) Use when the host communication condition is unknown.	99

### ◆ Tag status after a command has been executed

Two modes are available after a command has been executed.

Mode	How to change mode	Description
Sleep state	Specify S□ or R□ in communication designation with a command.	<ul style="list-style-type: none"> <li>Tag battery power can be saved.</li> <li>A tag cannot be started in 0.2 seconds immediately after sleep.</li> <li>Use for FIFO (First-In First-Out). Refer to (3) of Section 5-2-1.</li> </ul>
Standby state	Specify W□ or C□ in communication designation with a command.	<ul style="list-style-type: none"> <li>Use when several commands are executed consecutively to one tag.</li> </ul>

## 5-2 Communication Operation Sequence

Operation sequence, such as communication to a tag and response return timing, varies depending on the designation with a command. You need to use properly according to the tag status in an antenna communication area and a type of communication with a host device.

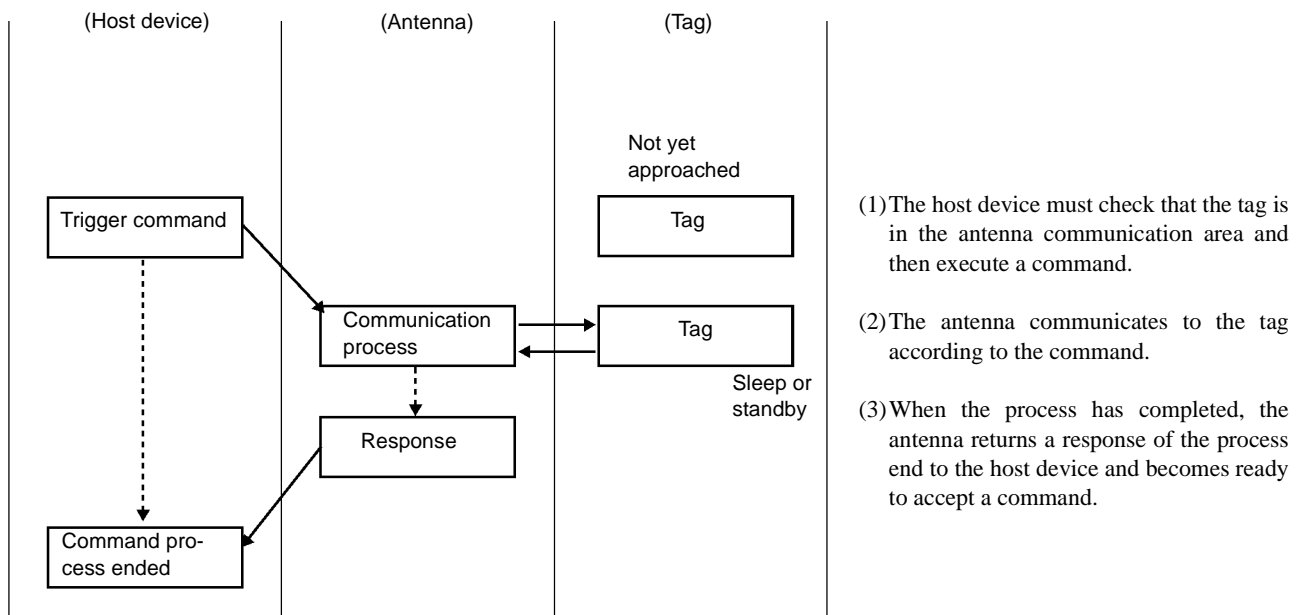
### 5-2-1 Communication Mode with Command

#### (1) Trigger

Communication is performed to a tag in an antenna communication area when a command has been received. Therefore, check that the tag is in the antenna communication area and then execute a command. If there is no tag in the antenna communication area when a command has been executed, the antenna returns an error response.

When a command is executed, the tag is in a sleep mode or standby mode.

- Sleep mode (Communication designation SU or SN)  
The tag battery power can be saved in the sleep mode. The tag cannot be started in 0.2 seconds immediately after sleep.
- Standby mode (Communication designation WU or WN)  
To execute several commands consecutively to one tag, enable the standby mode.



#### Correct Usage

Trigger, check that a tag is in the antenna communication area.

**(2) Single Auto**

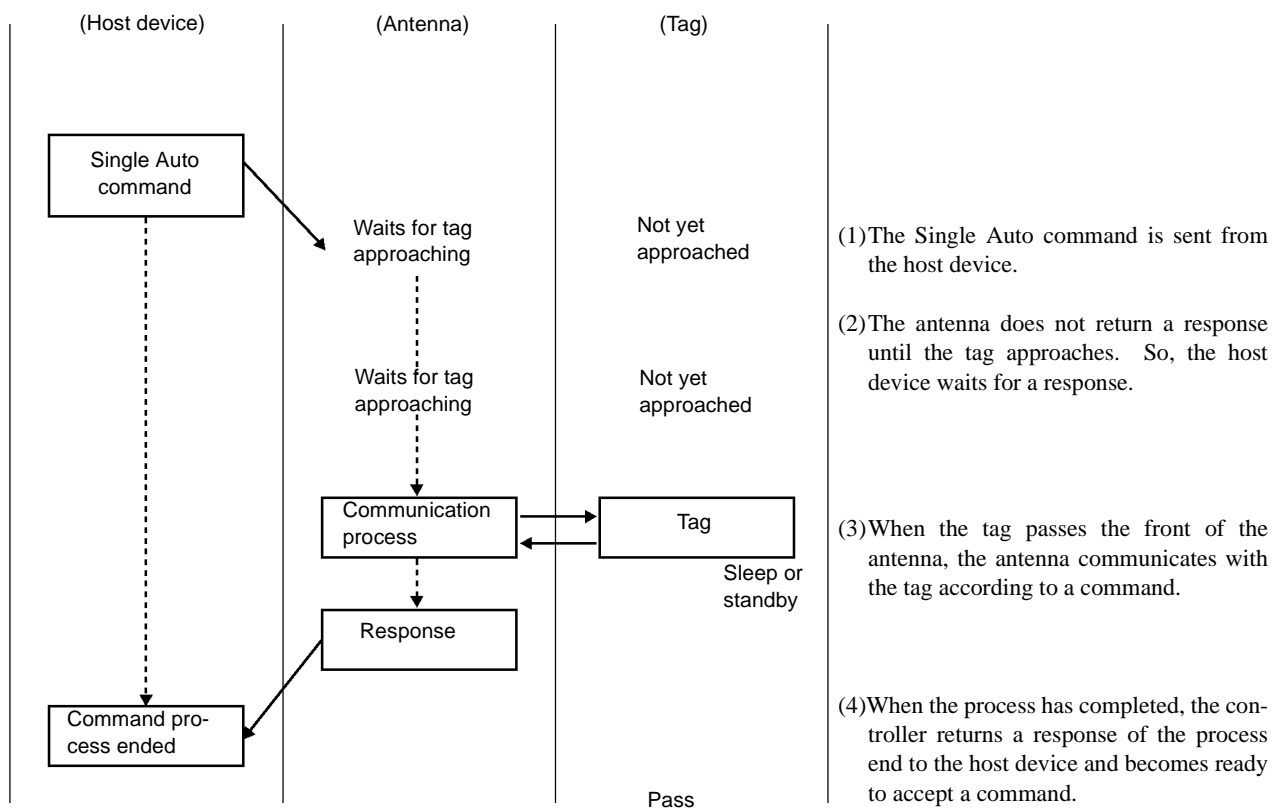
An antenna waits until a tag approaches the communication area and then communicates with the tag.

To terminate Single Auto:

- When an auto repeat cancel command (C2) is issued, the antenna discontinues Single Auto and becomes ready to accept a command.
- When any other command is issued, the antenna discontinues Single Auto and executes the new command. If the command format is wrong, the antenna returns the format error response 14 and discontinues Single Auto.
- If a waiting time for tag (refer to Section 5-9-4) is set, when the waiting time for tag has been passed, the antenna returns the no-tag error response 72 and discontinues Single Auto.

When a command is executed, the tag is in a sleep mode or standby mode.

- Sleep mode (Communication designation SU or SN)  
The tag battery power can be saved in the sleep mode. The tag cannot be started in 0.2 seconds immediately after sleep.
- Standby mode (Communication designation WU or WN)  
To execute several commands consecutively to one tag, enable the standby mode.



**(3) Repeat**

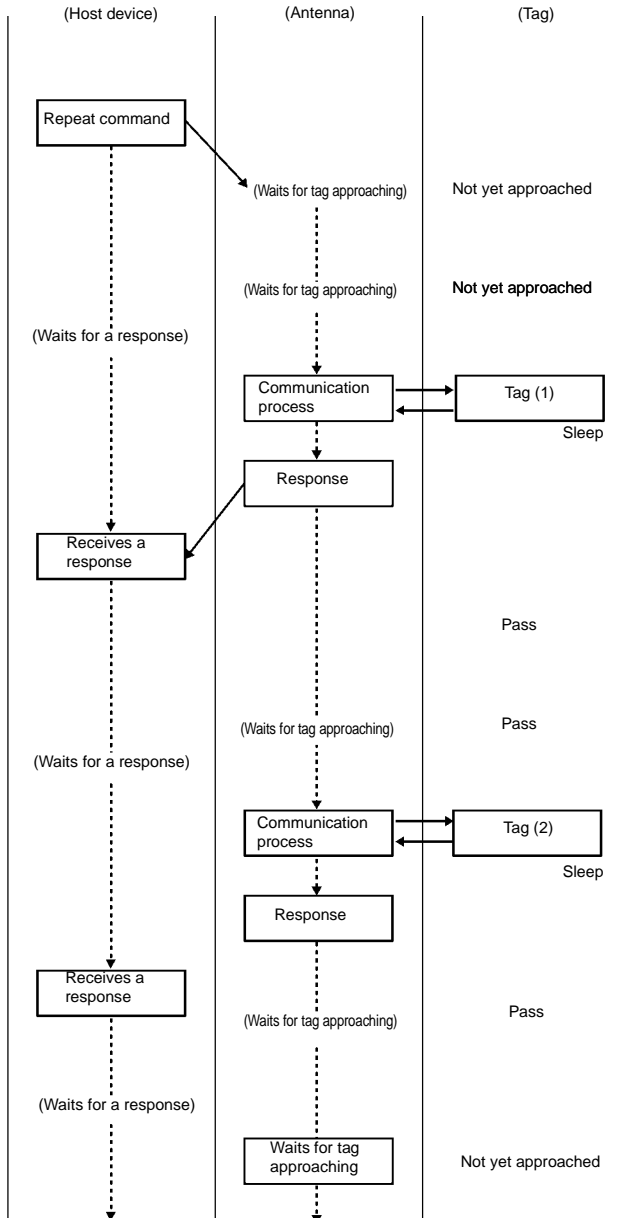
When an antenna receives a command from a host device, the antenna waits for tag approaching, communicates with the tag whenever the tag passes the antenna communication area, and returns a response to the host device.

After the command is executed, by specifying the sleep state (S□) as the communication designation, FIFO (First-In First-Out. Refer to Section 3-1) is enabled.

To terminate repeat state:

- When an auto repeat cancel command (C2) is issued, the antenna discontinues Repeat and becomes ready to accept a command.
- When any other command is issued, the antenna discontinues Repeat and executes the new command. If the command format is wrong, the antenna returns the format error response 14 and discontinues Repeat.

If a waiting time for tag (refer to Section 5-9-4) is set, when the waiting time for tag has been passed, the antenna returns the no-tag error response 72 and continues Repeat.



- (1) The Repeat command is sent from the host device.
- (2) The antenna does not return a response until the tag approaches.

- (3) When the tag passes the front of the antenna, the antenna communicates with the tag according to a command.
- (4) When the process has completed, the antenna returns a response of the communication end to the host device and waits for the next tag approaching.

- (5) When the tag passes the front of the antenna again, the antenna communicates with the tag.
- (6) When the process has completed, the antenna returns a response of the communication end to the host device.

---

## 5-2-2 Communication Mode with Communication Designation

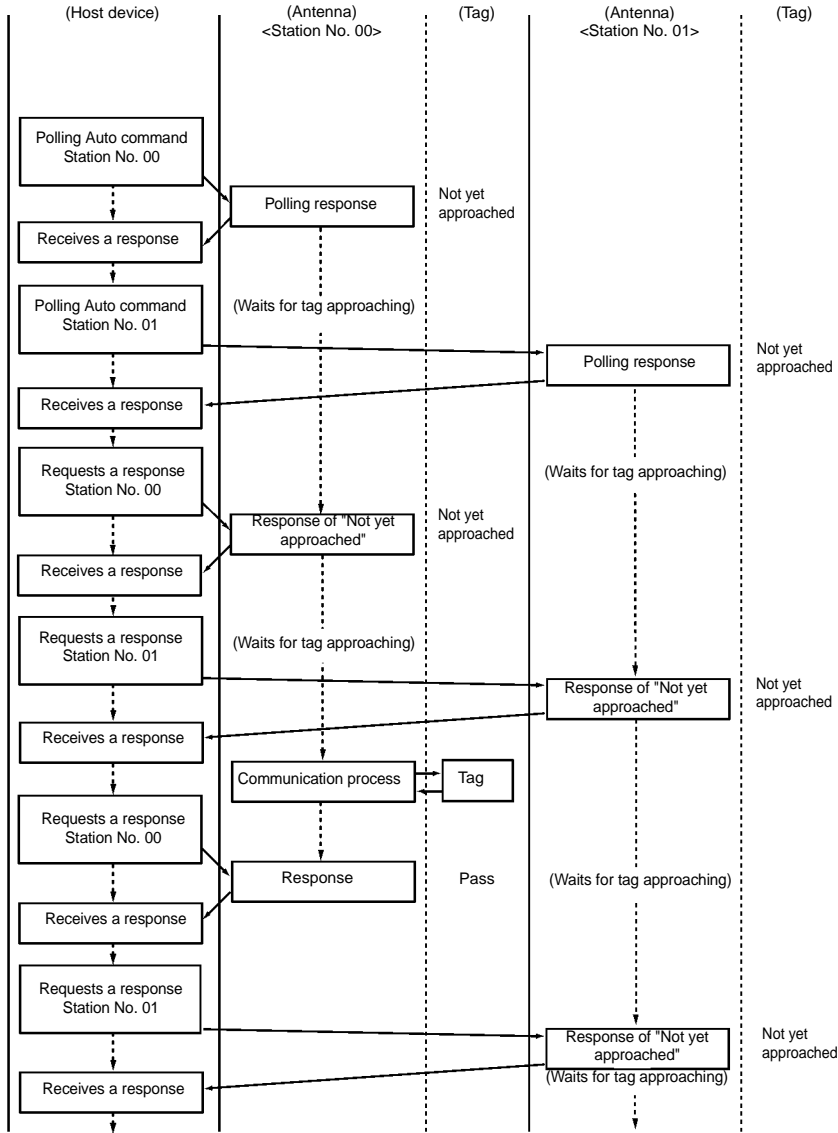
### (1) Polling

When one host device controls several antennas, if a normal auto command is used, a response is returned when the tag communication has completed. In this case, several antennas return a response. For polling, the antenna returns the response at the request of the host device. So, some responses are not returned simultaneously and several antennas can be controlled.

To terminate polling:

- When an auto repeat cancel command (C2) is issued, the antenna discontinues Polling Auto/Polling Repeat and becomes ready to accept a command.
- When any other command is issued, the antenna discontinues a polling mode and executes the new command. If the command format is wrong, the antenna returns the format error response 14 and discontinues Polling Auto/Polling Repeat.
- If a waiting time for tag (refer to Section 5-9-4) is set, when the waiting time for tag has been passed, the antenna returns the no-tag error response 72 and discontinues Polling Auto. For Polling Auto, the antenna returns an error response and continues Polling Repeat.

When a command is executed, the tag is in a sleep mode or standby mode according to the communication designation (C□, R□).



- (1) The Polling Auto command is sent from the host device to the antenna station No. 00.
- (2) Immediately after receiving the command, the antenna returns a response that the command has been accepted.
- (3) The Polling Auto command is sent from the host device to the antenna station No. 01.
- (4) Immediately after receiving the command, the antenna returns a response that the command has been accepted.
- (5) The host device can inquire the progress of process using a response request. If the tag has not yet approached, a response of "Not yet approached" is returned to the response request.
- (6) When the tag passes the front of the antenna station No. 00, the antenna station No. 00 communicates with the tag.
- (7) When the response request is sent to the antenna which ended the communication with the tag, the antenna returns a response of process result and becomes ready to accept a command.

**(2) Multi**

The communication to all the tags in the antenna communication area can be made. Multi Trigger and Multi Repeat commands are available:

In Multi Trigger, the antenna communicates with all the tags in the communication area when it receives a command. When the process has completed, the antenna returns the communication end response (termination code 72).

In Multi Repeat, the antenna waits for a tag when it receives a command. The antenna continues to communicate with all the tags coming in the communication area.

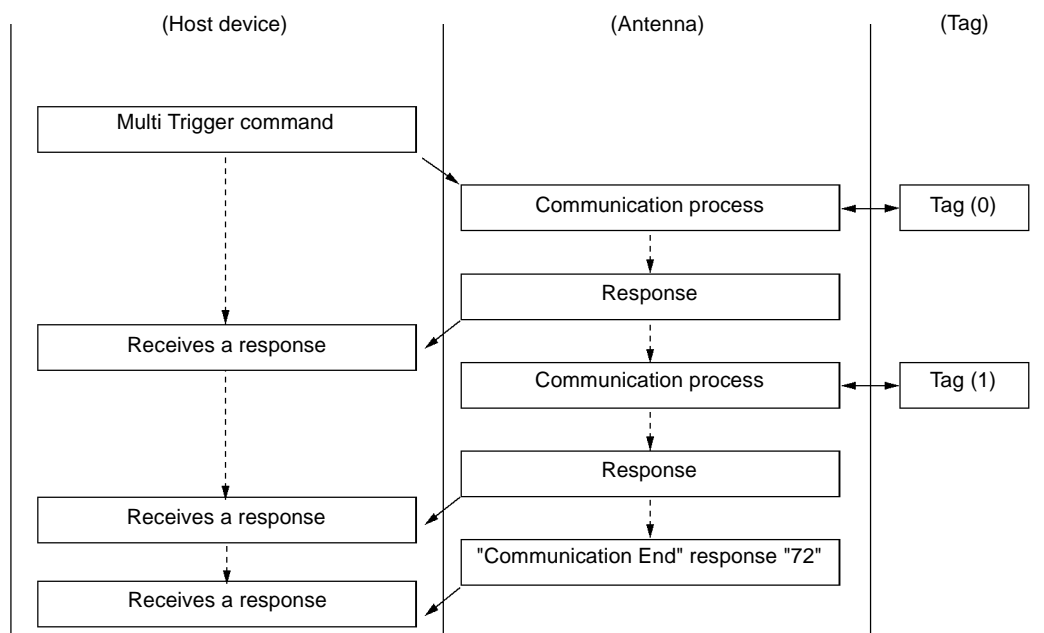
To terminate Multi Repeat:

- When an auto repeat cancel command (C2) is issued, the antenna discontinues Multi Repeat and becomes ready to accept a command.
- When any other command is issued, the antenna discontinues Multi Repeat and executes the new command. If the command format is wrong, the antenna returns the format error response 14 and discontinues Multi Repeat.

If a waiting time for tag (refer to Section 5-9-4) is set, when the waiting time for tag has been passed, the antenna returns the no-tag error response 72 and continues Multi Repeat.

When a command is executed, the tag is in a sleep mode according to the communication designation (S□).

An example of Multi Trigger is shown below.



**Multi S/M/L**

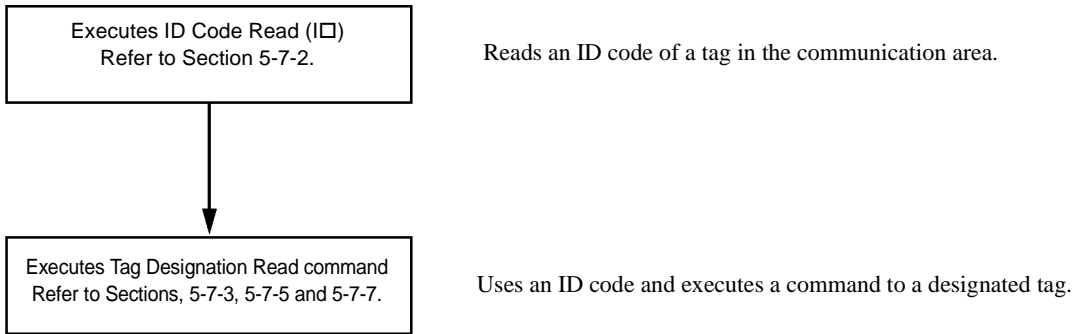
Time Slot method (refer to "Appendix 1 - Glossary") is used to detect several tags. Select S, M or L to optimize the Multi communication time.

Code	Number of communicated tags	Number of time slots
S	Approximately 4 tags	8
M	Approximately 8 tags	16
L	Approximately 16 tags	32

### 5-2-3 Other Communication Mode

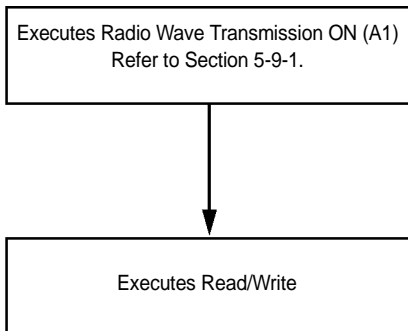
#### (1) Selective Access

Every tag has an inherent ID code which cannot be rewritten. By using this ID code, communication can be performed to a particular tag of those in an antenna communication area.



#### (2) Radio Wave Transmission ON mode

Usually, an antenna transmits a radio wave after receiving a command from a host device. When the Radio Wave Transmission ON mode of antenna is enabled, regardless of any command from a host device, the antenna transmits a radio wave always. In the Radio Wave Transmission ON mode, an application that the ID tag moves fast may be available.



Mode	Initial value	How to change mode	Radio wave transmission status
Radio Wave Transmission OFF mode	○	/	The antenna does not transmit a radio wave when it waits for a command. When the antenna accepts a communication command, the antenna transmits a radio wave and communicates with a tag. When the communication has ended, the antenna stops transmitting a radio wave.
Radio Wave Transmission ON mode		Radio Wave Transmission ON (A1) Refer to Section 5-9-1. How to switch to the Radio Wave Transmission OFF mode <ul style="list-style-type: none"> <li>• Radio Wave Transmission OFF command (A0) Refer to Section 5-9-1.</li> <li>• Reset command (C0) Refer to Section 5-9-2.</li> <li>• Reset the power supply.</li> </ul>	Regardless of any command from a host device, the antenna transmits a radio wave always.



## 5-3 Communication Response Format

### (1) Command

A text section of command consists of a command and option section which specifies information. The antenna receives a range from STX receiving to ETX correctly and, only when the antenna station No. and DA match, executes a command. After receiving STX, when the antenna receives STX again by the time the antenna receives ETX, the second STX shall be the beginning of the command. You can specify whether BCC is enabled or disabled. By default, BCC is disabled. How to specify whether BCC is enabled or disabled, refer to Section 5-9-7.

- Disabling BCC \*A value below shows the number of characters.

STX	DA	SA	Command code	Option	ETX
1	2	2	2		1

- Enabling BCC

STX	DA	SA	Command code	Option	ETX	BCC
1	2	2	2		1	1

Name	Description
STX	Shows the beginning of a command response frame. It corresponds to 02h (hexadecimal number) in the ASCII code table.
DA	Destination (antenna) station number. Operation mode "00" to "31" (initial value is "00"). Setting mode "99". A station number in the operation mode can be changed in "Station Number Setting".
SA	Source (host device) station number "80" to "89". Several host device can be used. If only one host device is used, specify "80".
Command Code	Specifies a command for antenna operation. For available command codes, refer to the command list in Section 5-4.
Option	Specifies the communication of command execution, reading data and writing data. For details, refer to the formats of commands after Section 5-7.
ETX	Shows the end of command response. It corresponds to 03h (hexadecimal number) in the ASCII code.
BCC	Block Check Character (referred to as "BCC"). Calculation result of horizontal parity immediately after STX to ETX. It is displayed in one character. For example of calculation of BCC, refer to the next page.

Note: "h" is a hexadecimal notation.

### (2) Response

A text section of response consists of a command, termination code and data section.

- Disabling BCC \*A value below shows the number of characters.

STX	DA	SA	Command code	Termination code	Data	ETX
1	2	2	2	2		1

- Enabling BCC

STX	DA	SA	Command code	Termination code	Data	ETX	BCC
1	2	2	2	2		1	1

Name	Description
DA	Destination (host device) station number "80" to "89".
SA	Source (antenna) station number. Operation mode "00" to "31" (initial value is "00"). Setting mode "99".
Command Code	Returns a command code of sent command.
Termination Code	Responds the result of command execution as a termination code. For the termination code, refer to the termination code list in Section 5-10.
Data	Responds a response number, ID code, read data, etc. For details, refer to the formats of commands after Section 5-7.

◆ Example of calculation of BCC

Use to detect data error due to noise in data communication between a host device and antenna. BCC is one-character data that XOR of every data was executed per character in a range from DA to ETX. For details, refer to "JIS5001 Character Configuration on Transmission Line and Horizontal Parity Usage".

An example of calculation is described below.

Example: ID Code Read, Single Trigger

Data Name	STX	DA	SA	Command Code	Communication Designation		ETX	BCC
Data	02h	"00"	"80"	"13"	"W"	"U"	03h	73h

Note: "h" is a hexadecimal notation.

DA	0	0011		0000
			XOR	0000
	0	0011		0000
			XOR	1000
SA	8	0011		1000
			XOR	0000
	0	0011		0000
			XOR	1001
Command Code	I	0100		1001
			XOR	0011
	3	0011		0011
			XOR	0111
Communication Designation	W	0101		0111
			XOR	0101
	U	0101		0101
			XOR	0011
ETX	03H	0000		0011
		0111		0011
		7h		3h

## 5-4 Communication and Communication Designation List

There are three types of commands as follows:

- (1) Tag communication command: A command to communicate with a tag
- (2) Antenna operation command: A command to operate an antenna when communicating with a tag.
- (3) Antenna setting command: A command to set an antenna before operating a system.

### (1) Tag communication command

Use this command when an antenna is in an operation mode. This command cannot be used in a setting mode. Refer to Section 5-1.

Command

Command	Communication Mode (Sections 5-2-1)	Command Code	Function
Read (Sections 5-7-1 and 5-7-3)	Trigger	R3	Reads data, Write Protect setting, date of production and waiting time for sleep.
	Single Auto	R6	
	Repeat	R9	
ID Code Read (Section 5-7-2)	Trigger	I3	Reads an ID code of tag. * The ID code is a value inherent to tag and cannot be rewritten.
	Single Auto	I6	
	Repeat	I9	
Write Without Verification (Sections 5-7-4 and 5-7-5)	Trigger	W3	Writes data, Write Protect setting and waiting time for sleep.
	Single Auto	W6	
	Repeat	W9	
Write With Verification (Sections 5-7-4 and 5-7-5)	Trigger	W1	Writes data, Write Protect setting and waiting time for sleep. Reads and checks written data after writing.
	Single Auto	W4	
	Repeat	W7	
Data Fill (Sections 5-7-6 and 5-7-7)	Trigger	F3	Writes a fixed data into a specified area in memory. For example, by writing "0" into all areas in memory, everything is cleared.
	Single Auto	F6	
	Repeat	F9	
Communication Test (Section 5-7-8)	Trigger	T0	Communication test between an antenna and tag.

Communication designation

Direct response / Polling (1) in Section 5-2-2)	One tag / Multi (several tags) / Tag designation (2) in Section 5-2-2 and (1) in Section 5-2-3)	Tag status after command execution (Section 5-1)	Communication designation	
			(1)	(2)
Direct response	One tag	Sleep	S	U
Direct response	One tag	Standby	W	U
Polling	One tag	Standby	C	U
Direct response	Multi (several tags)	Sleep	S	S/M/L
Polling	Multi (several tags)	Sleep	R	S/M/L
Direct response	Tag designation	Sleep	S	N
Direct response	Tag designation	Standby	W	N

\* Direct response: A communication mode that a command is received from a host device and a response is made immediately after the command execution.

Communication designation (1)	W: Direct response. A tag after execution is in a standby state. S: Direct response. A tag after execution is in a sleep state. C: Polling. A tag after execution is in a standby state. R: Polling. A tag after execution is in a sleep state.
Communication designation (2)	U: One tag access without ID code designation. N: One tag access with ID code designation. S/M/L: Several tag access.

Several tag access S/M/L

The time slot method is used to detect several tags. Select S/M/L to minimize the communication time of Multi. (Even if the number specified in S/M/L and the number of actual tags do not match, the Multi communication can be made. However, it may take a long time to communicate.)

Symbol	Number of estimated tags in communication area at a time	Number of time slots
S	Approximately 4 tags.	8
M	Approximately 8 tags.	16
L	Approximately 16 tags.	32

**(2) Antenna operation command**

Any command to operate an antenna is executed immediately.

Command Name (Referred item)	Command Code	Operation Mode	Setting Mode	Function
Auto Repeat Cancel (Section 5-8-1)	C2	Enabled		Cancels and disables Auto and Repeat commands.
Reset (Section 5-8-2)	C0		Enabled	<ul style="list-style-type: none"> <li>• Clears data read from a tag at polling. A response is not returned by the Request to Response (H0) command.</li> <li>• Clears the immediately preceding response. A response is not returned by the Request To Retransmit (H1) command.</li> <li>• Changes the Radio Wave Transmission ON mode into the OFF mode.</li> <li>• Enables the host communication condition setting and station number setting commands.</li> </ul>
Request to Respond (Section 5-8-3)	H0			Requests a response from a tag during polling.
Request to Retransmit (Section 5-8-4)	H1		Enabled	Requests to retransmit the immediately preceding response.

**(3) Antenna setting command**

Any command to set an antenna is executed immediately.

Command name (Referred item)		Operation mode	Setting mode	After resetting power supply or executing reset	Function	Initial value		
Radio Wave Transmission OFF (Section 5-9-1)	A0	Enabled	Disabled	No change in the radio wave OFF mode.	Selects the radio wave transmission OFF mode.	OFF mode		
Radio Wave Transmission ON (Section 5-9-1)	A1			Returns to the radio wave OFF mode.	Selects the radio wave ON mode.			
Communication Range Selection (Section 5-9-2)	A4		Enabled	Enabled	Setting before resetting does not change.	Selects the range selection mode (2 m/5 m).	2 m mode	
Radio Wave Channel Selection (Section 5-9-2)	A5					Selects a radio wave channel (0 - 9).	5 (2450 MHz)	
Radio Wave Output Status Read (Section 5-9-3)	A6					Reads a communication range mode and radio wave channel.		
Setting of Time to Wait Tag (Section 5-9-4)	T4					Sets a waiting time for communication with a tag after command execution when executing Auto or Repeat command.	Unlimited	
Command Data Response Time Setting (Section 5-9-5)	H4					Sets a command response time, data response time intervals.	10 ms 10 ms	
Read Data Length Setting (Section 5-9-6)	H3					Sets maximum data length which can be returned by one response of data read command.	256 bytes	
Host Communication Condition Setting (Section 5-9-7)	H5					Enabled (Note 1)	Sets conditions of communication with a host device.	27E200 (Note 2)
Station Number Setting (Section 5-9-8)	H6						Sets an antenna station number.	00
Setting Read (Section 5-9-9)	M2					Disabled	Reads an antenna setting value.	

Note 1. To enable "Host Communication Condition Setting" and "Station Number Setting", you must issue a reset command (Section 5-8-2) or reset the power supply after issuing a command.

Note 2. 9.6 kbps, data length 7 bits, even parity, stop bit 2, no BCC. (Refer to Section 5-9-7)

## 5-5 Data Code Designation

You can specify a type of code used to transmit data to be read or written between a host device and Read/Write antenna. ASCII code designation and hexadecimal code designation are available.

### ◆ ASCII code (JIS 8 unit code) designation "A"

1 byte of data of tag is transmitted directly as ASCII code or JIS 8 unit code. Transmitted one character is equal to a 1 byte of data in a tag. Character data can be read/written directly.

Do not use any control code, such as [SOH] and [CR], in transmission data. Otherwise, a command error occurs.

#### <Example 1 of writing>

When "OMRON" is specified in 5 bytes of memory beginning with 10h (hexadecimal number) as writing data, data is written into tag memory as shown below.

Command

STX	DA	SA	Command code	Communication designation	Split flag	Code designation	Start address	Number of written bytes	Written data	ETX
	00	80	W1	SU	A	A	0010	0005	OMRON	

ASCII code designation

Response

STX	DA	SA	Command code	Termination code	Response number	ID code	ETX
	80	00	W1	00	01	*****	

Address	Tag Memory		
10h	4	F	"O"
11h	4	D	"M"
12h	5	2	"R"
13h	4	F	"O"
14h	4	E	"N"

#### <Example 1 of reading>

In this data shown here, when 5 bytes of memory beginning with 10h (hexadecimal number) is read out, the read data is "OMRON".

Command

STX	DA	SA	Command code	Communication designation	Split flag	Code designation	Start address	Number of read bytes	ETX
	00	80	R3	SU	A	A	0010	0005	

Response

STX	DA	SA	Command code	Termination code	Response number	ID code	Split flag	Code designation	Start address	Number of read bytes	Number of read data	ETX
	80	00	R3	00	01	*****	A	A	0010	0005	OMRON	

#### <Example 2 of writing>

When "1234" is specified in 4 bytes of memory beginning with 10h (hexadecimal number) as writing data, data is written into tag memory as shown below.

Command

STX	DA	SA	Command code	Communication designation	Split flag	Code designation	Start address	Number of written bytes	Written data	ETX
	00	80	W1	SU	A	A	0010	0004	1234	

ASCII code designation

Response

STX	DA	SA	Command code	Termination code	Response number	ID code	ETX
	80	00	W1	00	01	*****	

Address	Tag Memory		
10h	3	1	"1"
11h	3	2	"2"
12h	3	3	"3"
13h	3	4	"4"

**<Example 2 of reading>**

In this data shown at the previous page, when 4 bytes of memory beginning with 10h (hexadecimal number) is read out, the read data is "1234".

Command

STX	DA	SA	Command code	Communication designation	Split flag	Code designation	Start address	Number of read bytes	ETX
	00	80	R3	SU	A	A	0010	0004	

Response

STX	DA	SA	Command code	Termination code	Response number	ID code	Split flag	Code designation	Start address	Number of read bytes	Read data	ETX
	80	00	R3	00	01	*****	A	A	0010	0004	1234	

**◆ Hexadecimal code designation "H"**

1 byte of data of tag is converted into two hexadecimal numbers ("00" to "FF") and those numbers are transmitted. Transmitted two characters are equal to 1 byte of data in a tag. Be sure to specify written data in two hexadecimal numbers from "00" to "FF" (even). If any odd number data is specified, a command error occurs.

**<Example of writing>**

When "1234" is specified in 2 bytes of memory beginning with 20h (hexadecimal number) as writing data, data is written into tag memory as shown below.

Command

Hexadecimal code designation

STX	DA	SA	Command code	Communication designation	Split flag	Code designation	Start address	Number of written bytes	Written data	ETX
	00	80	W1	SU	A	H	0020	0002	1234	

Response

STX	DA	SA	Command code	Termination code	Response number	ID code	ETX
	80	00	W1	00	01	*****	

Address Tag Memory

20h	1	2
21h	3	4

**<Example of reading>**

In this data shown here, when 2 bytes of memory beginning with 20h (hexadecimal number) is read out, the read data is "1234".

Command

STX	DA	SA	Command code	Communication designation	Split flag	Code designation	Start address	Number of read bytes	ETX
	00	80	R3	SU	A	H	0020	0002	

Response

STX	DA	SA	Command code	Termination code	Response number	ID code	Split flag	Code designation	Start address	Number of read bytes	Number of read data	ETX
	80	00	R3	00	01	*****	A	H	0020	0002	1234	

---

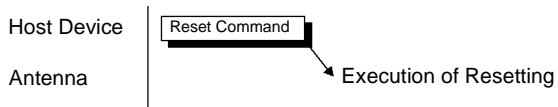
## 5-6 Communication Response Flow

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Depending on a type of command and the communication designation, the command transmission from a host device to an antenna and the response from the antenna to the host device vary.

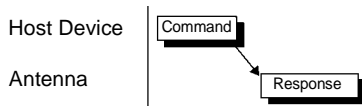
### (1) No response

When the host device issues a reset command to the antenna, the antenna does not send any response, performs resetting and waits for a command.



### (2) One to one

When the host device issues Single Trigger and Single Auto of a tag communication command, or when the host device issued an antenna operation command and antenna setting command, the antenna returns one response per command.



### (3) Several responses

When the host device issues Single Repeat, Multi Trigger and Multi Repeat, the antenna returns several responses per command.



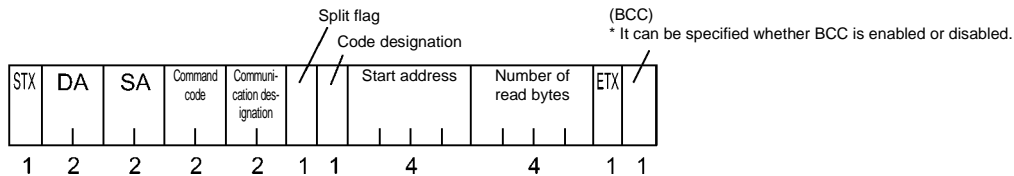


## 5-7 Tag Communication Command

### 5-7-1 Read

Reads data from a tag.

<Command Format> \* A figure below shows the number of characters.



DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	Specify according to the table below.	
Communication designation		
Split flag	Specify "A".	
Code designation	Specify whether data read out of a tag is ASCII code or hexadecimal code. A: ASCII code H: Hexadecimal code	
Start address	Specify according to the table below.	
Number of read bytes		

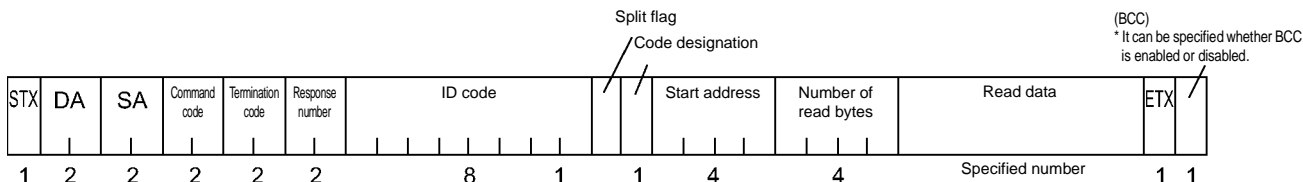
Command code and communication designation

Command	Tag status after execution	Command code	Communication designation	Remarks
Single Trigger	Sleep	R3	SU	
Single Trigger	Standby		WU	Any other command can be executed to the tag immediately after it.
Multi Trigger (approximately 4 tags)	Sleep		SS	
Multi Trigger (approximately 8 tags)			SM	
Multi Trigger (approximately 16 tags)			SL	
Single Auto	Sleep	R6	SU	
Single Auto	Standby		WU	Any other command can be executed to the tag immediately after it.
Polling Single Auto			CU	
Single Repeat	Sleep	R9	SU	FIFO
Multi Repeat (approximately 4 tags)			SS	
Multi Repeat (approximately 8 tags)			SM	
Multi Repeat (approximately 16 tags)			SL	
Polling Single Repeat			RU	For a query command of polling, refer to "5-8-3 Request To Respond".
Polling Multi Repeat (approximately 4 tags)			RS	
Polling Multi Repeat (approximately 8 tags)			RM	
Polling Multi Repeat (approximately 16 tags)			RL	

Start address, number of read bytes

Read content	Start address	Number of read bytes	
		ASCII code	Hexadecimal code
Data	Reading start address ("0000" to "1FFF") * Hexadecimal number	Specify the number of read bytes ("0001" to "2000") * Hexadecimal number	Specify the number of read bytes ("0001" to "2000") * Hexadecimal number
Write Protect setting	"WPRO"	Unavailable	"0004" * Refer to Section 3-6.
Date of production	"DATE"	"0008" * Refer to Section 2-2-3.	
Waiting time for sleep	"SLEP"	"0004" * Refer to Section 3-7.	

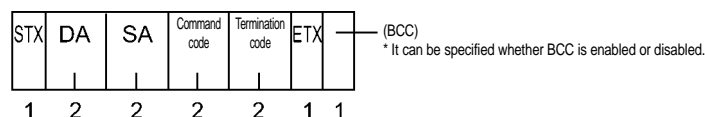
<Response Format> \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	"00": For a normal end. For any other termination codes, refer to "5-10 Termination Code List".
Response number	Consecutive number of response of tag. For one response, only "01". For several responses, "02" or more.
ID code	ID code of tag. This is inherent to tag and cannot be rewritten.
Split flag	"Data read length" can be set in an antenna (Refer to Section 5-9-6). An initial value is 256 bytes. <ul style="list-style-type: none"> <li>If number of read bytes ≤ data read length, the flag is "A".</li> <li>If number of read bytes &gt; data read length, the flag is divided and sent to a host and several responses are made.</li> </ul> "T" for data start. "C" for data continuation. "E" for final data.
Read data	Data read out of a tag. Number of characters of data is as follows: ASCII code is specified: Number of read bytes. Hexadecimal code is specified: Number of read bytes x 2.

<Polling Response Format> \* A figure below shows the number of characters.

Response immediately after a polling command is issued.



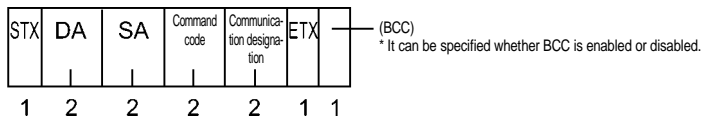
Termination code	Fixed to "00".
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<b>Correct Usage</b>
For an available range of number of read bytes, check the ID tag memory capacity.

## 5-7-2 ID Code Read

Reads an ID code from a tag. The ID code is inherent to a tag and cannot be rewritten.

<Command Format> \* A figure below shows the number of characters.

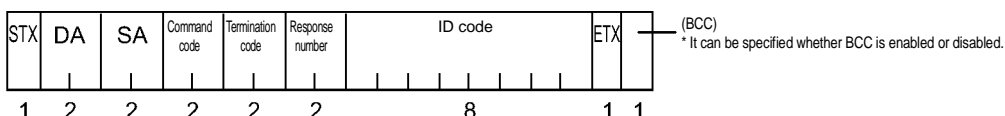


DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	Specify according to the table below.	
Communication designation		

Command code and communication designation

Command	Tag status after execution	Command code	Communication designation	Remarks
Single Trigger	Sleep	13	SU	
Single Trigger	Standby		WU	Any other command can be executed to the tag immediately after it.
Multi Trigger (approximately 4 tags)	Sleep		SS	
Multi Trigger (approximately 8 tags)			SM	
Multi Trigger (approximately 16 tags)			SL	
Single Auto	Sleep	16	SU	
Single Auto	Standby		WU	Any other command can be executed to the tag immediately after it.
Polling Single Auto			CU	
Single Repeat	Sleep	19	SU	FIFO
Multi Repeat (approximately 4 tags)			SS	
Multi Repeat (approximately 8 tags)			SM	
Multi Repeat (approximately 16 tags)			SL	
Polling Single Repeat			RU	For a query command of polling, refer to "5-8-3 Request to Respond".
Polling Multi Repeat (approximately 4 tags)			RS	
Polling Multi Repeat (approximately 8 tags)			RM	
Polling Multi Repeat (approximately 16 tags)			RL	

<Response Format> \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	"00": For a normal end. For any other termination codes, refer to "5-10 Termination Code List".
Response number	Consecutive number of response of tag. For one response, only "01". For several responses, "02" or more.
ID code	ID code of tag. This is inherent to tag and cannot be rewritten.

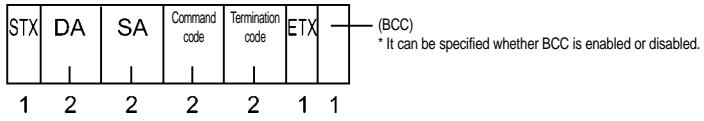
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## 5-7 Tag Communication Command

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### <Polling Response Format> \* A figure below shows the number of characters.

Response immediately after a polling command is issued.

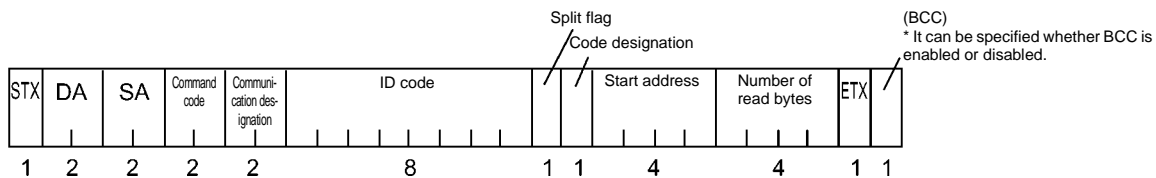


Termination code	Fixed to "00".
------------------	----------------

### 5-7-3 Tag Designation Read

Reads data from a particular ID tag.

<Command Format> \* A figure below shows the number of characters.

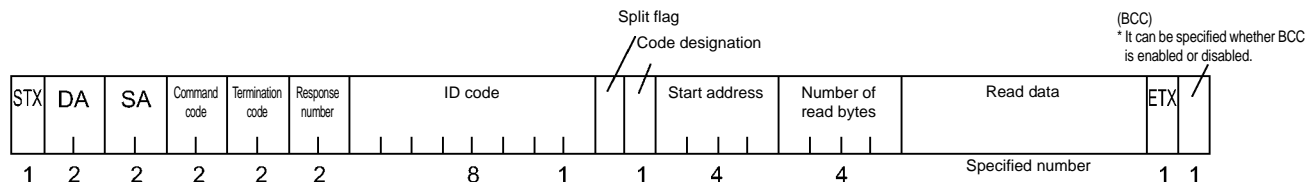


DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	R3: Single Trigger	
Communication designation	Gives communication designation to a tag. SN: A tag will be in a sleep state after execution. WN: A tag will be in a standby state after execution.	
ID code	Specify an ID code of a particular tag.	
Split flag	Specify "A".	
Code designation	Specify whether data read out of a tag is ASCII code or hexadecimal code. A: ASCII code H: Hexadecimal code	
Start address	Specify according to the table below.	
Number of read bytes		

Start address, number of read bytes

Read content	Start address	Number of read bytes	
		ASCII code	Hexadecimal code
Data	Reading start address ("0000" to "1FFF") * Hexadecimal number	Specify the number of read bytes ("0001" to "2000") * Hexadecimal number	Specify the number of read bytes ("0001" to "2000") * Hexadecimal number
Write Protect setting	"WPRO"	Unavailable	"0004" * Refer to Section 3-6.
Date of production	"DATE"	"0008" * Refer to Section 2-2-3.	
Waiting time for sleep	"SLEP"	"0004" * Refer to Section 3-7.	

<Response Format> \* A figure below shows the number of characters.



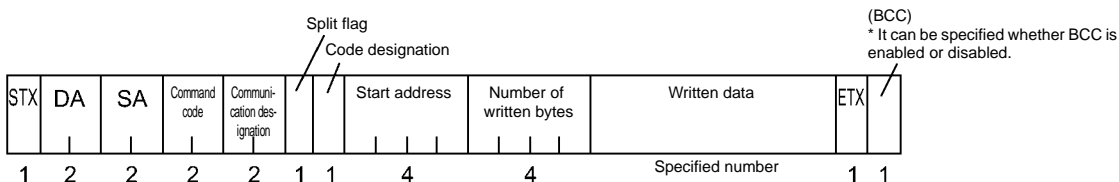
DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	"00": For a normal end. For any other termination codes, refer to "5-10 Termination Code List".
Response number	Fixed to "01".
Split flag	"Data read length" can be set in an antenna (Refer to Section 5-9-6). An initial value is 256 bytes. If number of read bytes ≤ data read length, the flag is "A". If number of read bytes > data read length, the flag is divided and sent to a host and several responses are made. "T" for data start. "C" for data continuation. "E" for final data.
Read data	Data read out of a tag. Number of characters of data is as follows: ASCII code is specified: Number of read bytes. Hexadecimal code is specified: Number of read bytes x 2.

Correct Usage
<ul style="list-style-type: none"> <li>• Before executing this command, you need to use an ID code read command (I□) to check the ID code of the tag.</li> <li>• For an available range of number of read bytes, check the ID tag memory capacity.</li> </ul>

### 5-7-4 Write

Writes data into a tag.

<Command Format> \* A figure below shows the number of characters.



DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	Specify according to the table below.	
Communication designation		
Split flag	Specify "A".	
Code designation	Specify whether a data read out of a tag is ASCII code or hexadecimal code. A: ASCII code H: Hexadecimal code	
Start address	Specify according to the table below.	
Number of written bytes		

Command code and communication designation

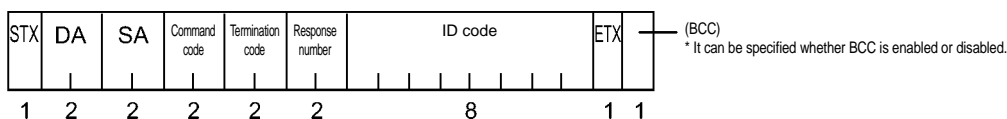
Command	Tag status after execution	Command code	Communication designation	Remarks
Single Trigger	Sleep	W1 W3	SU	
Single Trigger	Standby		WU	Any other command can be executed to the tag immediately after it.
Multi Trigger (approximately 4 tags)	Sleep		SS	
Multi Trigger (approximately 8 tags)		SM		
Multi Trigger (approximately 16 tags)		SL		
Single Auto	Sleep	W4 W6	SU	
Single Auto	Standby		WU	Any other command can be executed to the tag immediately after it.
Polling Single Auto			CU	
Single Repeat	Sleep	W7 W9	SU	FIFO
Multi Repeat (approximately 4 tags)			SS	
Multi Repeat (approximately 8 tags)			SM	
Multi Repeat (approximately 16 tags)			SL	
Polling Single Repeat			RU	For a query command of polling, refer to "5-8-3 Request to Respond".
Polling Multi Repeat (approximately 4 tags)			RS	
Polling Multi Repeat (approximately 8 tags)			RM	
Polling Multi Repeat (approximately 16 tags)			RL	

With verification read	W1, W4, W7	After an antenna writes data into a tag, the antenna reads the data from the tag and check whether the data is correct. If the data is not correct, the termination code becomes 71. Writing is reliable, but the communication time with verification read is twice the length of that without verification read.
Without verification read	W3, W6, W9	After an antenna writes data into a tag, the antenna does not read the data.

Start address, number of read bytes

Written content	Start address	Number of written bytes	
		ASCII code	Hexadecimal code
Data	Reading start address ("0000" to "1FFF") * Hexadecimal number	Specify the number of written bytes ("0001" to "2000") * Hexadecimal number	Specify the number of written bytes ("0001" to "1000") * Hexadecimal number
Write Protect setting	"WPRO"	Unavailable	"0004" * Refer to Section 3-6.
Waiting time for sleep	"SLEP"	"0004" * Refer to Section 3-7.	

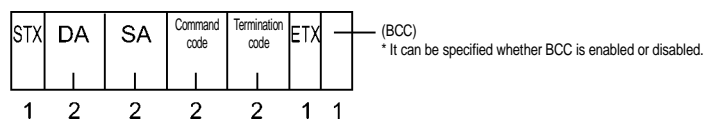
<Response Format> \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	"00": For a normal end. For any other termination codes, refer to "5-10 Termination Code List".
Response number	Consecutive number of response of tag. For one response, only "01". For several responses, "02" or more.
ID code	ID code of tag. This is inherent to tag and cannot be rewritten.

<Polling Response Format> \* A figure below shows the number of characters.

Response immediately after a polling command is issued.



Termination code	Fixed to "00".
------------------	----------------

**Correct Usage**

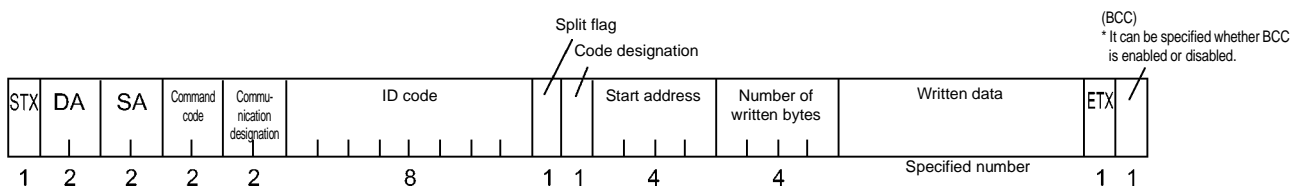
For an available range of number of written bytes, check the ID tag memory capacity.



### 5-7-5 Tag Designation Write

Writes a data into a particular ID tag.

<Command Format> \* A figure below shows the number of characters.

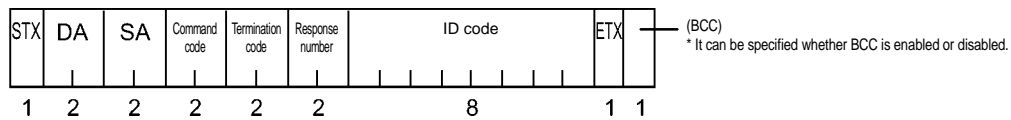


DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	W1: Single Trigger, with verification read. * For the verification, refer to Section 5-7-4. W3: Single Trigger, without verification read.	
Communication designation	Gives communication designation to a tag. SN: A tag will be in a sleep state after execution. WN: A tag will be in a standby state after execution.	
ID code	Specify an ID code of a particular tag.	
Split flag	Specify "A".	
Code designation	Specify whether data read out of a tag is ASCII code or hexadecimal code. A: ASCII code H: Hexadecimal code	
Start address	Specify according to the table below.	
Number of written bytes		

Start address, number of read bytes

Written content	Start address	Number of written bytes	
		ASCII code	Hexadecimal code
Data	Reading start address ("0000" to "1FFF") * Hexadecimal number	Specify the number of written bytes ("0001" to "2000") * Hexadecimal number	Specify the number of written bytes ("0001" to "1000") * Hexadecimal number
Write Protect setting	"WPRO"	Unavailable	"0004" * Refer to Section 3-6.
Waiting time for sleep	"SLEP"	"0004" * Refer to Section 3-7.	

<Response Format> \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	"00": For a normal end. For any other termination codes, refer to "5-10 Termination Code List".
Response number	Fixed to "01".
ID code	ID code of tag. This is inherent to tag and cannot be rewritten.

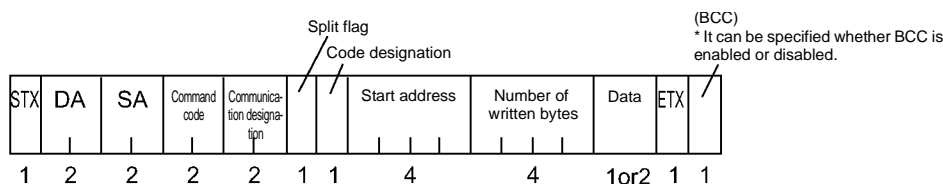
**Correct Usage**

For an available range of number of written bytes, check the ID tag memory capacity.

### 5-7-6 Data Fill

Writes the same data into a specified area of a tag.

<Command Format> \* A figure below shows the number of characters.



DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	Specify according to the table below.	
Communication designation		
Split flag	Specify "A".	
Code designation	Specify whether data read out of a tag is ASCII code or hexadecimal code. A: ASCII code H: Hexadecimal code	
Start address	Specify according to the table below.	
Number of read bytes		
Data	If the data designation is ASCII code, one character. If the data designation is hexadecimal code, two characters.	

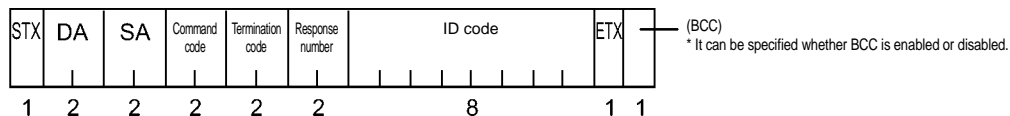
Command code and communication designation

Command	Tag status after execution	Command code	Communication designation	Remarks
Single Trigger	Sleep	F3	SU	
Single Trigger	Standby		WU	Any other command can be executed to the tag immediately after it.
Single Auto	Sleep	F6	SU	
Single Auto	Standby		WU	Any other command can be executed to the tag immediately after it.
Polling Single Auto			CU	
Single Repeat	Sleep	F9	SU	FIFO
Polling Single Repeat			RU	For a query command of polling, refer to "5-8-3 Request To Respond".

Start address, number of read bytes

Read content	Start address	Number of written bytes	
		ASCII code	Hexadecimal code
Data	Reading start address ("0000" to "1FFF") * Hexadecimal number	Specify the number of written bytes ("0001" to "2000") * Hexadecimal number	

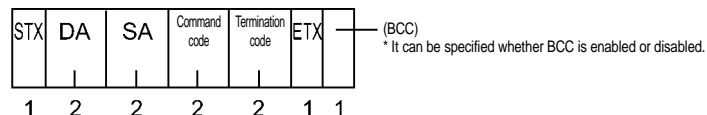
<Response Format> \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	"00": For a normal end. For any other termination codes, refer to "5-10 Termination Code List".
Response number	Fixed to "01".
ID code	ID code of tag. This is inherent to tag and cannot be rewritten.

<Poling Response Format> \* A figure below shows the number of characters.

Response immediately after a polling command is issued.



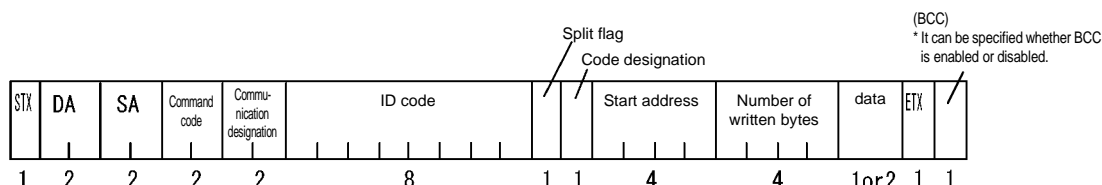
Termination code	Fixed to "00".
------------------	----------------

<b>Correct Usage</b>
For an available range of number of written bytes, check the ID tag memory capacity.

### 5-7-7 Tag Designation Data Fill

Writes fixed data into a particular ID tag.

<Command Format> \* A figure below shows the number of characters.

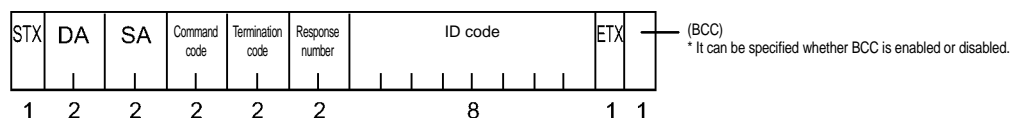


DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	F3: Single Trigger	
Communication designation	Gives communication designation to a tag. SN: A tag will be in a sleep state after execution. WN: A tag will be in a standby state after execution.	
ID code	Specify an ID code of a particular tag.	
Split flag	Specify "A".	
Code designation	Specify whether data read out of a tag is ASCII code or hexadecimal code. A: ASCII code H: Hexadecimal code	
Start address	Specify according to the table below.	
Number of read bytes		
Data	If the data designation is ASCII code, one character. If the data designation is hexadecimal code, two characters.	

Start address, number of read bytes

Read content	Start address	Number of written bytes	
		ASCII code	Hexadecimal code
Data	Reading start address ("0000" to "1FFF")	Specify the number of written bytes ("0001" to "2000")	

<Response Format> \* A figure below shows the number of characters.



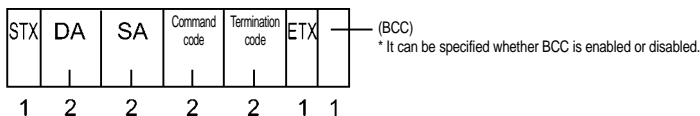
DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	"00": For a normal end. For any other termination codes, refer to "5-10 Termination Code List".
Response number	Fixed to "01".
ID code	ID code of tag. This is inherent to tag and cannot be rewritten.

Correct Usage
For an available range of number of written bytes, check the ID tag memory capacity.

### 5-7-8 Communication Test

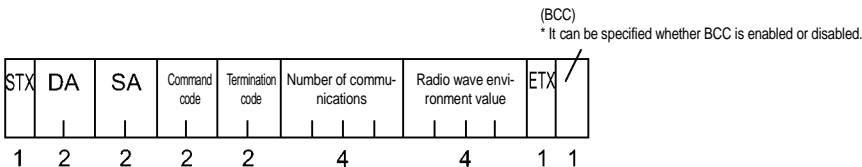
To check a radio wave environment, data (256 bytes) is communicated 256 times between the antenna and tag and the communication status is output. A total of 128 kbytes of data is communicated in two ways. So, it takes a few seconds to execute this text. The communication is retried in active use. However, the communication is not retried in a communication test.

**<Command Format>** \* A figure below shows the number of characters.



DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	T0: Single Trigger	
Communication designation	SU: A tag will be in a sleep state after execution.	

**<Response Format>** \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".
Number of communications	Fixed to "0256".
Radio wave environment value	"0000" to "0256" (decimal number). A smaller radio wave environment value shows a better radio wave environment. (The radio wave environment value is the number of failed communication of total 256 communications. In the communication test, communication is not retried. However, the communication is retried when the communication fails in an actual operation. If the radio wave environment value is 50 or less, a communication error does not occur in an actual operation.)

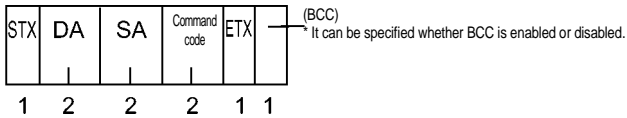
Correct Usage
Check your radio wave environment with this command before operating your system. We recommend you to set the radio wave environment value to 50 or less.

## 5-8 Antenna Operation Command

### 5-8-1 Auto Repeat Cancel

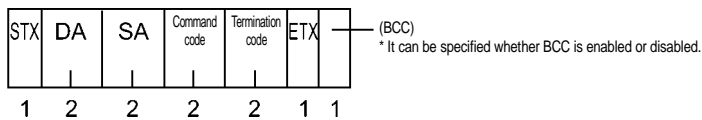
Cancels the Auto or Repeat command during the execution of the command. Then, an antenna waits for a command.

**<Command Format>** \* A figure below shows the number of characters.



DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	C2	

**<Response Format>** \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.	
SA	Source (antenna) station number.	
Termination code	Fixed to "00".	

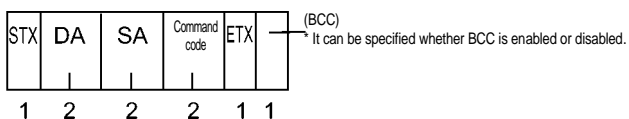
### 5-8-2 Reset

Resets an antenna. It takes approximately 2 seconds to reset.

Resetting:

- Clears data read out of a tag at polling. A response is not returned by the Request to Response (H0) command.
- Clears the immediately preceding response. A response is not returned by the Request to Retransmit (H1) command.
- Changes the Radio Wave Transmission ON mode into the OFF mode.
- Enables the host communication condition setting (Section 5-9-7) and station number setting (Section 5-9-8) commands.

**<Command Format> \* A figure below shows the number of characters.**



DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	C0		

**<Response Format>**

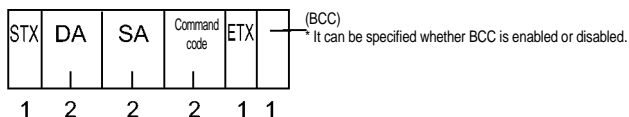
There is no response format.



### 5-8-3 Request to Respond

Requests a tag to respond during the execution of a polling command.

**<Command Format>** \* A figure below shows the number of characters.

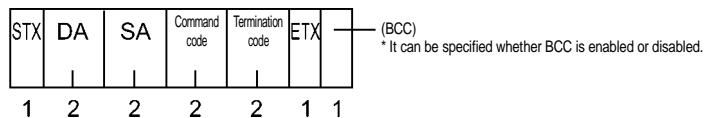


DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	H0	

**<Response Format>** \* A figure below shows the number of characters.

- If a tag responds:  
Returns a response from the tag, which received at polling.

- If a tag does not respond:

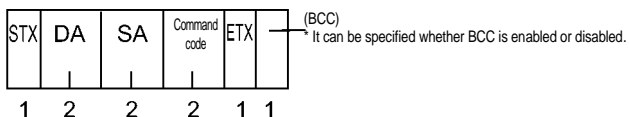


DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "74".

### 5-8-4 Request to Retransmit

Request to retransmit the immediately preceding response.

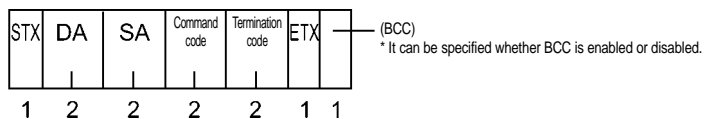
**<Command Format>** \* A figure below shows the number of characters.



DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	H1	

**<Response Format>** \* A figure below shows the number of characters.

- If there is an immediately preceding response, such response is returned.
- If there is no immediately preceding response (it is not stored in an antenna), the following response is returned.



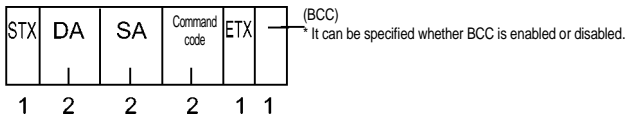
DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "15".

## 5-9 Antenna Setting Command

### 5-9-1 Radio Wave Transmission ON/OFF

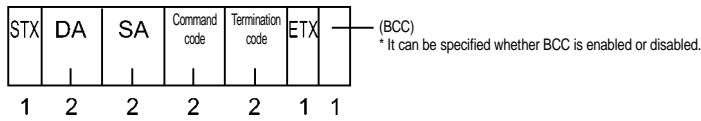
Specifies the radio wave transmission OFF mode and radio wave transmission ON mode of an antenna. (Refer to (2) in Section 5-2-3.) This command can be used in the operation mode, not in the setting mode. (Refer to Section 5-1 and (3) in Section 5-4.) When the power supply is reset or a reset command is executed, the radio wave transmission OFF mode which is initial value is enabled.

**<Command Format>** \* A figure below shows the number of characters.



DA	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".	
Command code	A0: Specifies the radio wave transmission OFF mode. A1: Specifies the radio wave transmission ON mode.	Initial value is the radio wave transmission OFF mode.

**<Response Format>** \* A figure below shows the number of characters.

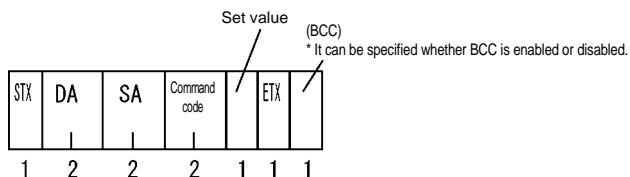


DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".

### 5-9-2 Communication Range Mode and Radio Wave Channel Selection

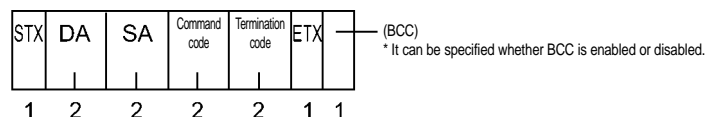
Selects a communication range mode and radio wave channel of an antenna. A communication range mode can be changed by selecting the communication range mode. Frequency is changed by selecting the radio wave channel and interference between antennas and interference caused by any other radio equipment are prevented.

**<Command Format>** \* A figure below shows the number of characters.



DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	A4: Selects a communication range mode. A5: Selects a radio wave channel.		
Set value	For the command A4 L: Communication range 2 m mode H: Communication range 5 m mode		Initial value of communication range L (2 m mode)
	For the command A5 "0" to "9": Divides the frequency range 2437.5 to 2462.5 MHz into ten.		Initial value of radio wave channel Channel 5 (A value of center)

**<Response Format>** \* A figure below shows the number of characters.

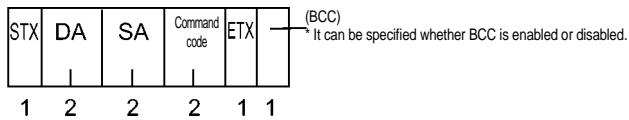


DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".

### 5-9-3 Radio Wave Output Status Read

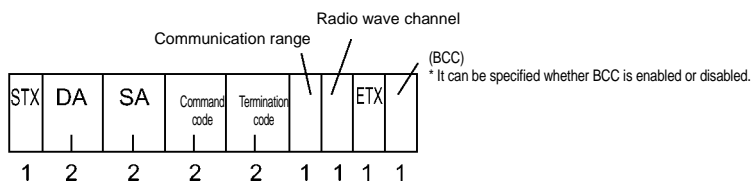
Selects a communication range mode and radio wave channel of an antenna.

**<Command Format>** \* A figure below shows the number of characters.



DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	A6		

**<Response Format>** \* A figure below shows the number of characters.



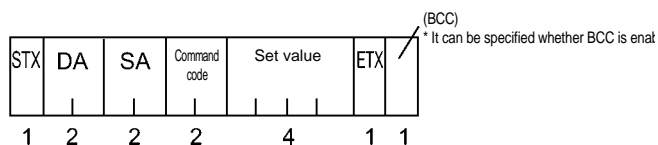
DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".
Communication range	L: Communication range 2 m mode H: Communication range 5 m mode
Radio wave channel	Divides the frequency range 2437.5 to 2462.5 MHz into ten.

### 5-9-4 Setting of Time to Wait Tag

Specifies time to wait for communication with a tag after issue of command when executing Auto or Repeat command. Initial value is infinity (0000).

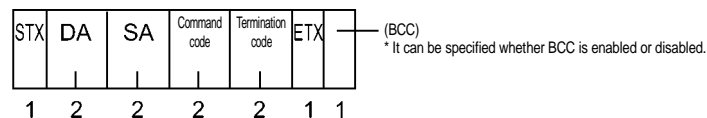
For the Auto command, when the waiting time for tag has been passed, the antenna returns the no-tag error response 72 and discontinues the Auto command. For the Repeat command, when the waiting time for tag has been passed, the antenna returns the no-tag error response 72 and continues the Repeat command.

**<Command Format>** \* A figure below shows the number of characters.



DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	T4		
Set value	"0000": Infinity. "0001" to "9999": A left value x 100 msec.		Initial value "0000": Infinity

**<Response Format>** \* A figure below shows the number of characters.

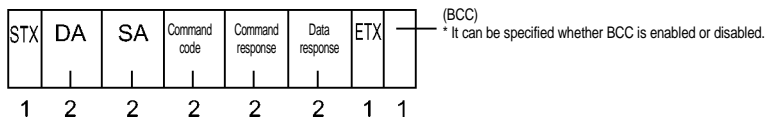


DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".

### 5-9-5 Command Data Response Time Setting

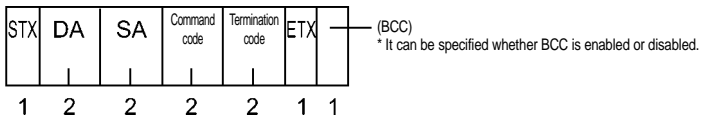
Specifies a minimum time until an antenna returns a response after receiving a command and a minimum time until the antenna returns the next response after returning the last response. Initial value is 10 msec. (Refer to "Correct Usage" of (2) in Section 4-2-2.)

**<Command Format>** \* A figure below shows the number of characters.



DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	H4		
Command response	Specifies a minimum time until an antenna returns a response after receiving a command. "00" to "99": A left value x 1 msec.		Initial value "10": 10 msec
Data response	Specifies a minimum time until the antenna returns the next response after returning the last response, if the antenna returns several responses. "00" to "99": A left value x 1 msec.		Initial value "10": 10 msec

**<Response Format>** \* A figure below shows the number of characters.



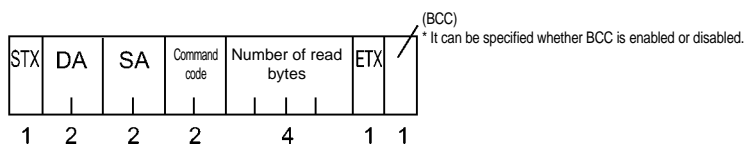
DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".

### 5-9-6 Read Data Length Setting

Specifies the maximum number of read bytes which can be returned as one response by the Read command. If the conditions of communication with a host device is good, specify a large number. If not, specify a small number.

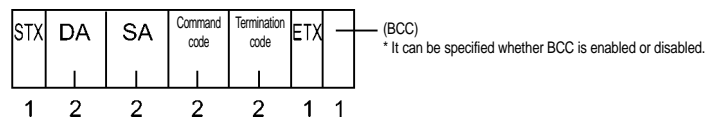
For example, if you try to read 2048 bytes of data, of which read data length is 256 bytes, by the Read command, the antenna returns a response 8 times.

**<Command Format>** \* A figure below shows the number of characters.



DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	H3		
Number of read bytes	"0020" to "4000": Hexadecimal notation. The unit is byte.		Initial value "0100" 256 bytes

**<Response Format>** \* A figure below shows the number of characters.



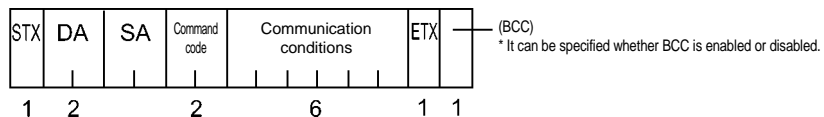
DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".



### 5-9-7 Host Communication Condition Setting

Specifies the conditions of communication between a host device and antenna. To enable this setting, you must issue a command and then issue the reset command (Section 5-8-2) or reset the power supply.

**<Command Format>** \* A figure below shows the number of characters.

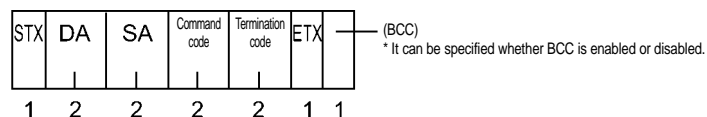


DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	H5		
Communication condition data	As described below.		

**<Set Character String>** Specify all together as shown below.

Parameter Name	Byte Length	Set Value	Meaning	Initial value Communication condition in the setting mode
Transmission speed	1	1	4.8 kbps	"2" = 9.6 kbps
		2	9.6 kbps	
		3	19.2 kbps	
		4	38.4 kbps	
		5	57.6 kbps	
		6	115.2 kbps	
Data length	1	7	7 bits	"7" = 7 bits
		8	8 bits	
Parity	1	E	Even	"E" = Even
		O	Odd	
		N	Nil	
Stop bit	1	1	1 bit	"2" = 2 bits
		2	2 bits	
Communication mode	1	0	Fixed	"0"
BCC enabled/disabled	1	0	BCC disabled	"0" = BCC disabled
		1	BCC enabled	

**<Response Format>** \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".

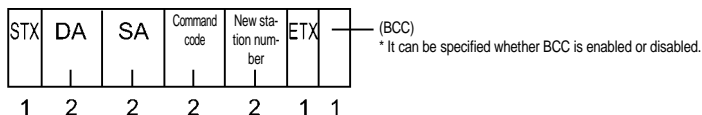
#### Correct Usage

If the data length is set to 7 bites, alphanumerical character only can be used.

### 5-9-8 Station Number Setting

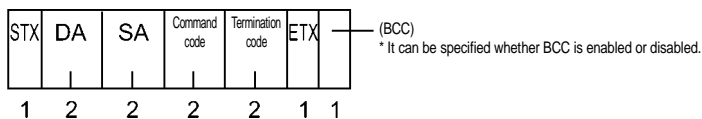
Specifies a station number as a radio station for an antenna. To enable this setting, you must issue a command and then issue the reset command (Section 5-8-2) or reset the power supply.

**<Command Format>** \* A figure below shows the number of characters.



DA	Operation mode	Destination (antenna) station number. "00" to "31".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	H6		
New station number	"00" to "31"		

**<Response Format>** \* A figure below shows the number of characters.



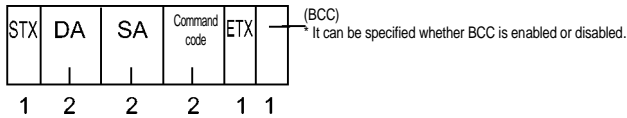
DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".

## 5-10 Termination Code List

### 5-9-9 Setting Read

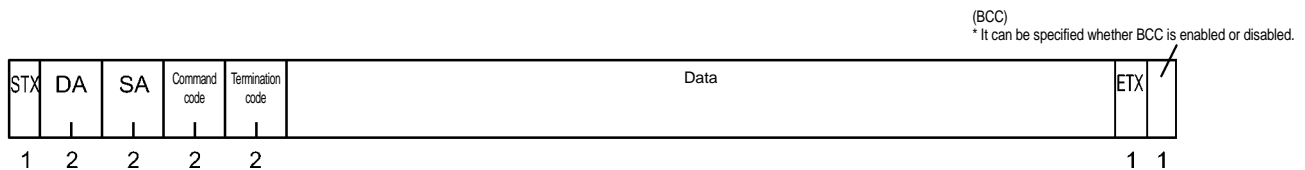
Reads antenna attribute, setting type, date of production, etc.

<Command Format> \* A figure below shows the number of characters.



DA	Operation mode	Destination (antenna) station number. "00" to "31". This can be modified in "5-9-8 Station Number Setting".	Initial value "00"
	Setting mode	"99"	
SA	Source (host device) station number. "80" to "89". If only one host device is used, specify "80".		
Command code	M2		

<Response Format> \* A figure below shows the number of characters.



DA	Destination (host device) station number. * In the command format, the destination is an antenna.
SA	Source (antenna) station number.
Termination code	Fixed to "00".
Data	As described below.

Data about Setting Read (M2)

Data Name	Radio Wave Transmission OFF Time	Communication Range Mode	Radio Wave Channel	Waiting Time for Tag	Command Response Time	Data Response Time	Read Data Length	Communication Condition	Station Number	Number of Retries	
Data	"0000"	"H/L"	*	"eeee"	"nn"	"ii"	"kkkk"	"abcdef"	"ff"	"m"	
Number of characters	4	1	1	4	2	2	4	6	2	1	Total 27

Note) The radio wave transmission OFF time and the number of retries are fixed.

The meanings of termination code of response are described below.

Type	Termination Code	Name	Description
Normal end	"00"	Normal end	Command execution has ended correctly.
	"15"	Non-executable	There is no immediately preceding response at Request to Retransmit (Section 5-8-4).
	"72"	Multi Trigger ended	Multi Trigger ended.
	"74"	No polling tag communication	Communication with a tag has not yet been ended by a polling command.
Host communication error	"10"	Parity error	A parity error has occurred in any character of command.
	"11"	Framing error	A framing error has occurred in any character of command.
	"12"	Overrun error	An overrun error has occurred in any character of command.
	"13"	BCC error	BCC of received command is invalid.
	"14"	Format error	A format of a command received properly is incorrect.
	"15"	Non-executable	A received command cannot be executed in a current mode.
	"18"	Frame length error	ETX more than 8220 characters is not received after STX is received.
Communication error	"70"	Communication error	An error has occurred during the communication with a tag and the communication cannot be completed correctly.
	"71"	Verification error	Writing was not performed correctly. An data error was detected at writing verification.
	"72"	No-tag error	There is no tag in front of a tag when the Trigger command is executed. Waiting time for a tag has passed in the Auto Repeat command.
	"7A"	Address error	Memory address of inexistent ID tag was designated.
	"7B"	Battery voltage low	Voltage of battery built in an ID tag dropped.
	"7D"	Write Protect error	Something was written into a write-protected page.
System error	"92"	Antenna failure	Failure of radio wave transmitter, etc. or an error in a program in an antenna.
	"93"	Tag memory error	An ID tag data error was detected at data reading.

Correct Usage
When a communication error or verification error has occurred at the execution of Write command, data of address designated by the command may be rewritten partially or completely.

# Chapter 6 From Startup to Run

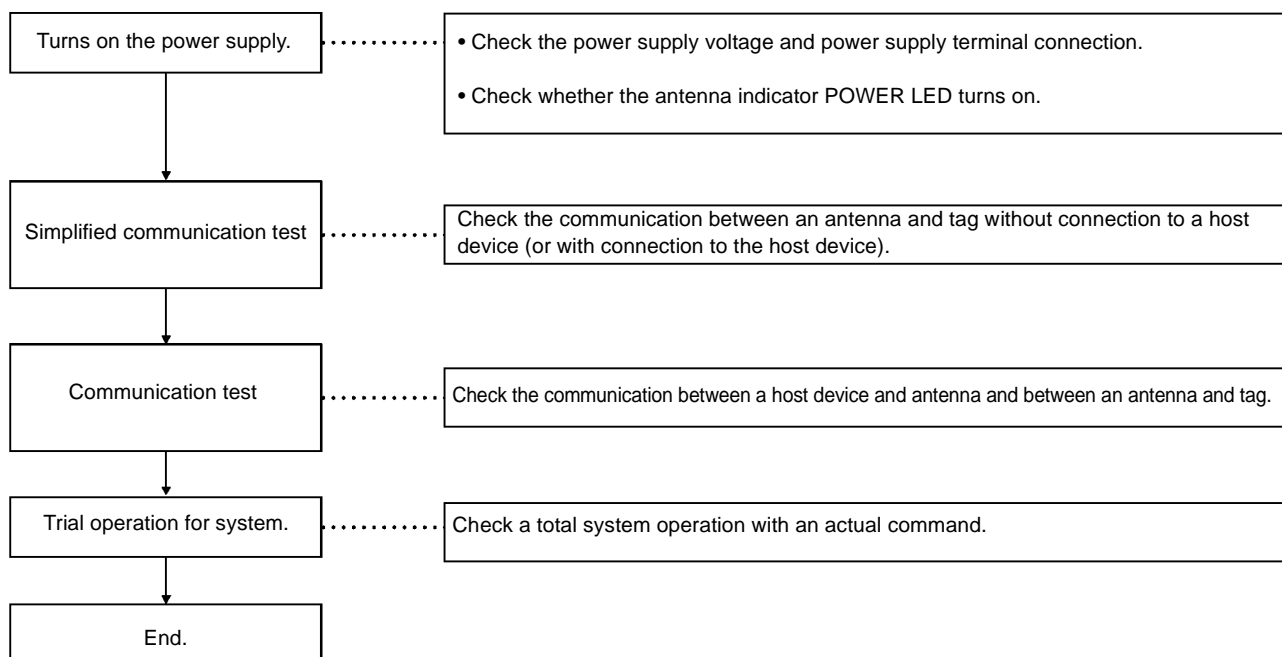
## 6-1 Trial Operation

### ◆ Items to be checked

Before performing a trial operation, check the following items:

No.	Items to be checked	Checking	Page
1	Installation environment of antenna and tag	Whether the installation environment is suitable.	Section 4-1-1
2	Installation of antenna and tag	Whether the antenna and tag are installed correctly.	Sections 4-1-2 and 4-1-3
3	Connection of antenna and dedicated cable	Whether the connector is connected properly.	Section 4-1-4
4	Connection to host device	<ul style="list-style-type: none"> <li>• Whether RS-232C, RS-422A and RS-485 are connected properly.</li> <li>• Whether connected to 24 VDC power supply.</li> <li>• Whether installed.</li> <li>• Whether "+P" and "-P" are connected.</li> </ul>	Section 4-2
5	Installation of link unit for RS-422A and RS-485	Whether the link unit is installed correctly.	Section 4-3

### ◆ Trial operation procedure



### ◆ Simplified communication test

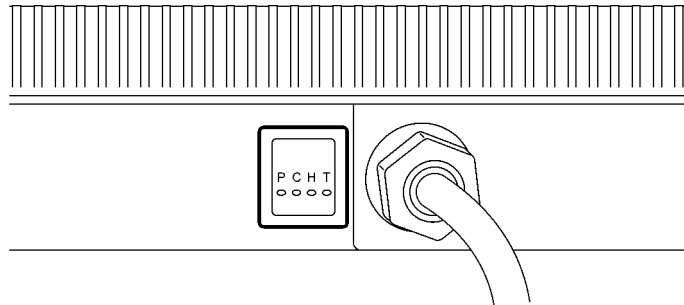
The communication between an antenna and tag can be tested without connection to a host device. Use this test to check the location of antenna and tag. For how to operate, refer to Section 3-4.

### ◆ Communication test

The connection to a host device is made and the "Communication Test" command is sent from the host device to an antenna. Communication cable connection, communication processing, communication status between the antenna and tag can be checked. For how to operate, refer to Section 3-5.

## 6-2 Diagnosis Function

To shorten the system down time when an error has occurred in an antenna, you can diagnose through an indicator.



### ◆ At a normal operation

Antenna Indicator				Indication
P	C	H	T	
Power supply	Radio wave transmission	Host transmission	Tag transmission	
○	●	●	●	Power is supplied to an antenna, but no communication is made to a tag.
○	○	●	○	Simplified communication function of the setting mode works. Indicator C: ○ means waiting for a tag and ◎ means communication with a tag.
◎	◎	●	○	
◎	○	○	○	Executes a command of Trigger and communicates with a tag.
◎	◎	●	◎	Executes a command of Auto or Repeat and waits for a tag.
◎	◎	○	◎	Executes a command of Auto or Repeat and communicates with a tag.

◎: Turns on. ○: Turns on only at radio wave transmission or communication. ●: Turns off.

### ◆ When an error has occurred

Trouble	Antenna Indicator				Estimated Cause	Countermeasures
	P	C	H	T		
Antenna does not respond	●	●	●	●	• An error in power supply to an antenna • Antenna failure.	• Check the power supply voltage. • Replace the antenna with a new one.
	△	△	●	●	• Antenna failure.	• Replace the antenna with a new one.
	◎	●	●	●	• An error communication with a host device.	• Check the communication line to the host device.
	◎	—	△	—		
Tag does not respond	◎	○	—	△	• A tag is in a sleep state. • Tag failure. • Antenna failure.	• Take the tag out of the communication area and return to the area again. • Replace the tag with a new one. • Replace the antenna with a new one.

◎: Turns on. ○: Turns on at communication. △: Blinks. ●: Turns off.

## 6-3 Error List

Refer to "5-10 Termination Code List" also.

### ◆ Host communication error

Error Code	Name	Check Points
"10"	Parity error	<ul style="list-style-type: none"> <li>• Checking the setting about conditions of communication with a host device. → Refer to Sections 5-9-7 and 5-9-9.</li> <li>• Wiring of RS-232C, RS-422A and RS-485 (Example: Terminating resistance and influence of ambient noise) → Refer to Sections 4-2, 4-3 and 6-3.</li> </ul>
"11"	Framing error	
"12"	Overrun error	
"13"	BCC error	<ul style="list-style-type: none"> <li>• How to calculate BCC → Refer to Section 5-3.</li> <li>• Wiring of RS-232C, RS-422A and RS-485 (Example: Terminating resistance and influence of ambient noise) → Refer to Sections 4-2, 4-3 and 6-3.</li> </ul>
"14"	Format error	<ul style="list-style-type: none"> <li>• Format of command (Example: Applicable characters and position of STX/ETX) → Refer to Sections 5-7 to 5-9.</li> </ul>
"18"	Frame length error	

### ◆ Communication error

Error Code	Name	Check Points
"70"	Communication error	<ul style="list-style-type: none"> <li>• Distance between an antenna and tag, and tag movement speed.</li> <li>• Wiring of FG, power cable, etc. (Influence of ambient noise)</li> <li>• Noise environment around antenna. (FG ground of devices, shield and location change) → Refer to Sections 4-2, 4-3 and 6-3.</li> </ul>
"71"	Verification error	<ul style="list-style-type: none"> <li>• Noise environment around antenna. (FG ground of devices, shield and location change) → Refer to Sections 4-2, 4-3 and 6-3.</li> </ul>
"72"	No existence error	<ul style="list-style-type: none"> <li>• Distance between an antenna and tag, and tag movement speed.</li> </ul>
"7A"	Address error	<ul style="list-style-type: none"> <li>• Designation of address/number of bytes of executed command.</li> <li>• Tag memory capacity and applicable address range. → Refer to Section 5-7.</li> </ul>
"7B"	Battery voltage low	<ul style="list-style-type: none"> <li>• Traffic, ambient temperature and battery life. → Section 2-2-6.</li> </ul>
"7D"	Write Protect error	<ul style="list-style-type: none"> <li>• Setting of Write Protect information. → Section 3-6.</li> <li>• Designation of address/number of bytes of executed command. → Refer to Section 5-7.</li> </ul>

### ◆ System error

Error Code	Name	Description
"92"	Antenna failure	<ul style="list-style-type: none"> <li>• Antenna indicator. → Section 6-2.</li> </ul>
"93"	Tag memory error	<ul style="list-style-type: none"> <li>• Take out of the communication area, return to the area again and check the termination code. If the same error occurs, replace a tag with a new one.</li> </ul>

## 6-4 Errors and Countermeasures

The six main causes of troubles in V690 Series are as follows:

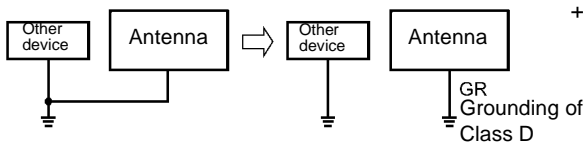
- Influence of installation environment . . . . . Refer to Section 4-1-1.
  - Influence of noise. . . . . Take countermeasures against noise.
  - External device failure
  - Antenna failure
  - Link unit failure
  - Cable failure
  - Tag failure
  - Others
- } . . . . . Must be repaired.

### ◆ Influence of noise

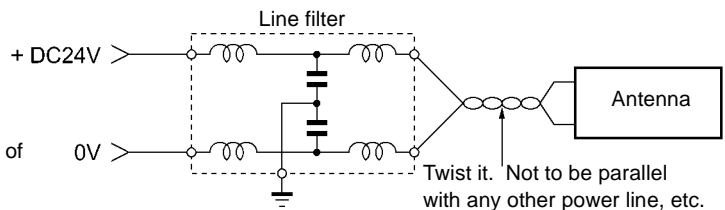
If an error occurs in an operation of your system, take suitable countermeasures against noise referring to the table below.

No.	Trouble	Estimated Cause	Countermeasures
1	Trouble caused in large-capacity motor, transformer, capacitor, etc. when the power supply turns on.	Instantaneous voltage drop in power supply system due to inrush current of large-capacity load.	<ul style="list-style-type: none"> <li>• Increase the capacity of power supply equipment and of power cable.</li> </ul>
		Common mode noise due to cause above.	<ul style="list-style-type: none"> <li>• Supply the power through 1:1 non-contact insulation transformer.</li> <li>• Do not use together with ground to any other large-capacity load. Perform ground of Class D (conventional Class III) only.</li> </ul>
2	Trouble caused at irregular intervals.	Noise superposed on the power supply.	<ul style="list-style-type: none"> <li>• Supply the power through 1:1 non-contact insulation transformer or noise filter.</li> <li>• Do not use together with ground to any other large-capacity load. Perform grounding of Class D (conventional Class III) only.</li> </ul>
		Influence of space noise.	<ul style="list-style-type: none"> <li>• Keep 1 meter or more away from an antenna if there are PC, AD adapter for PC, switching power supply, programmable terminal, motor, proximity switch, etc.</li> </ul>

### • Improvement of grounding



### • Countermeasure against power supply noise



### Correct Usage

One meter away from a space noise generating source is a reference value. Depending on a noise generating source, more than one meter must be away from it. Execute the communication test to check.



## 6-5 Maintenance and Inspection

To maintain V690 Series in the best condition, you need to inspect it daily or periodically. V690 Series mainly consists of semiconductor components which have a long life. However, the following malfunctions are expected depending on the service environment or operating condition.

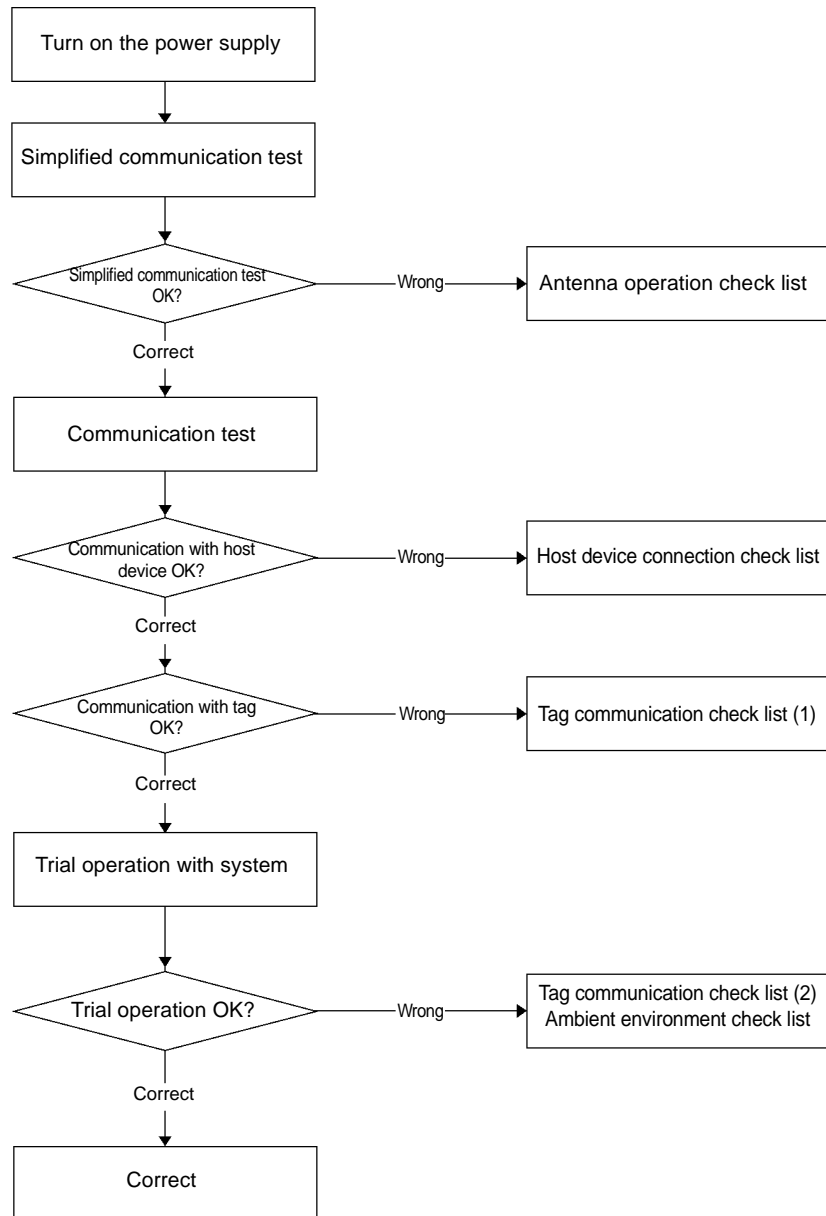
- (1) Deterioration of element due to over-voltage or over-current.
- (2) Deterioration of element due to long-term stress arisen from use in a high-temperature site.
- (3) Deterioration of insulation or imperfect contact of connector due to unsuitable temperature or dust.
- (4) Imperfect contact of connector or corrosion of element due to corrosive gas.

### ◆ Inspection item

No.	Inspection Item	Inspection	Criterion	Remarks
1	Fluctuation of power supply voltage	(1) Check at a terminal block of power supply whether the criterion is satisfied.	Within the specifications for power supply voltage.	Tester.
		(2) Check whether instantaneous power failure occurs frequently and whether voltage fluctuates considerably	Within a allowable voltage fluctuation range.	Power supply analyzer.
2	Ambient environment (1) Temperature (2) Humidity (3) Vibration or impact (4) Dust (5) Corrosive gas	(1) Within the specifications. (2) Within the specifications. (3) Influence of vibration or impact of machines. (4) Dust or foreign material. (5) Discoloration or corrosion in a metal part.	(1) Within the specifications. (2) Within the specifications. (3) Within the specifications. (4) Neither dust nor foreign material is acceptable. (5) Neither discoloration nor corrosion is acceptable.	Lowest temperature thermometer. Hygrometer.
3	Panel conditions (1) Whether the panel is ventilated. (2) Whether packing material of sealed structure is deteriorated.	(1) Check whether natural ventilation, forced ventilation and cooling are performed. (2) Check whether packing material in the panel is removed or damaged.	(1) Ventilation must be made properly. Temperature must be within -10 and +55°C. (2) Any damage is unacceptable.	—
4	Power supply for I/O (1) Voltage fluctuation (2) Ripple	Check at a terminal block of every I/O section whether criterion is satisfied.	Within the specifications.	Tester. Oscilloscope.
5	Mounting state	(1) Whether every device is fixed tightly.	Every device must be fixed tightly.	—
		(2) Whether every connector is inserted completely.	Every connector must be locked properly and fixed by screws.	—
		(3) Whether terminal block screws are tightened completely.	The terminal block screws must be tightened completely.	—
		(4) Whether wire is not damaged.	The wire must not be damaged.	—
		(5) Whether condition between a tag and antenna is within the specifications.	The condition must be within the specifications.	—
		(6) Whether grounding complies with the Class D (conventional Class III).		—

## 6-6 Troubleshooting

When an error has occurred, grasp the situation fully and check according to the flow below ("Trial operation procedure" in Section 6-1).



### ◆ Antenna operation check list

Check Point	Countermeasures
<input type="checkbox"/> Whether the antenna indicator P (power supply) turns on.	<ul style="list-style-type: none"> <li>• Check 24 VDC power supply line.</li> <li>• Turn ON the antenna power supply switch of link unit.</li> <li>• Check the power supply voltage.</li> <li>• Replace the antenna with a new one.</li> </ul>
<input type="checkbox"/> Whether the antenna indicator C (radio wave transmission) turns on.	<ul style="list-style-type: none"> <li>• Enable the setting mode. → Refer to Section 3-4.</li> <li>• Replace the antenna with a new one.</li> </ul>

### ◆ Host device connection check list

Check Point	Countermeasures
<input type="checkbox"/> Connection of a host communication cable, connector and link unit.	<ul style="list-style-type: none"> <li>• Connect appropriately.</li> </ul>
<input type="checkbox"/> Host communication conditions of antenna.	<ul style="list-style-type: none"> <li>• Modify the communication conditions. → Refer to Sections 5-9-7 and 5-9-9.</li> </ul>
<input type="checkbox"/> Host device operation (communication port).	<ul style="list-style-type: none"> <li>• Replace the host device with a new one.</li> </ul>
<input type="checkbox"/> Host communication conditions of host device.	<ul style="list-style-type: none"> <li>• Modify the communication conditions.</li> </ul>
<input type="checkbox"/> Program of host device.	<ul style="list-style-type: none"> <li>• Modify the program.</li> </ul>
<input type="checkbox"/> Antenna station number.	<ul style="list-style-type: none"> <li>• Change the antenna station number.</li> </ul>
<input type="checkbox"/> When an antenna sends data to a host device, the antenna indicator H (host communication) must be turned on a moment.	<ul style="list-style-type: none"> <li>• Replace the antenna with a new one.</li> </ul>

### ◆ Tag communication check list (1)

Check Point	Countermeasures
<input type="checkbox"/> Operation of tag and antenna.	<ul style="list-style-type: none"> <li>• Replace the tag with a new one.</li> <li>• Replace the antenna with a new one.</li> </ul>

### ◆ Tag communication check list (2)

Check Point	Countermeasures
<input type="checkbox"/> Check with Section 6-3 "Error List"	
<input type="checkbox"/> Space between an antenna and tag.	<ul style="list-style-type: none"> <li>• Change the communication range mode (2 m/5 m).</li> </ul>
<input type="checkbox"/> Tag face (front/reverse).	<ul style="list-style-type: none"> <li>• Turn the front face of tag to the antenna.</li> </ul>
<input type="checkbox"/> Tag movement speed.	<ul style="list-style-type: none"> <li>• Movement speed. Change the movement speed.</li> </ul>

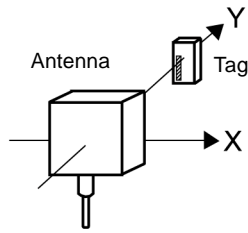
◆ **Ambient environment check list**


Check Point	Countermeasures
<input type="checkbox"/> Radio wave interrupted by an object (e.g., human body) which contains much metal or water.	<ul style="list-style-type: none"> <li>• Remove the object.</li> <li>• Change the antenna position.</li> </ul>
<input type="checkbox"/> Dead zone generated by reflection at ambient metal face.	<ul style="list-style-type: none"> <li>• Change the metal object position.</li> <li>• Change the antenna position.</li> <li>• Change the communication range mode (5 m to 2 m).</li> </ul>
<input type="checkbox"/> Interference caused by a adjacent antenna.	<ul style="list-style-type: none"> <li>• Change the radio wave channel.</li> <li>• Move the installation place.</li> </ul>
<input type="checkbox"/> Interference caused by a radio equipment.	<ul style="list-style-type: none"> <li>• Change the radio wave channel.</li> <li>• Move the installation place.</li> </ul>
<input type="checkbox"/> Check with Section 6-4 "Errors and Countermeasures"	
<input type="checkbox"/> Check with Section 6-5 "Maintenance and Inspection"	

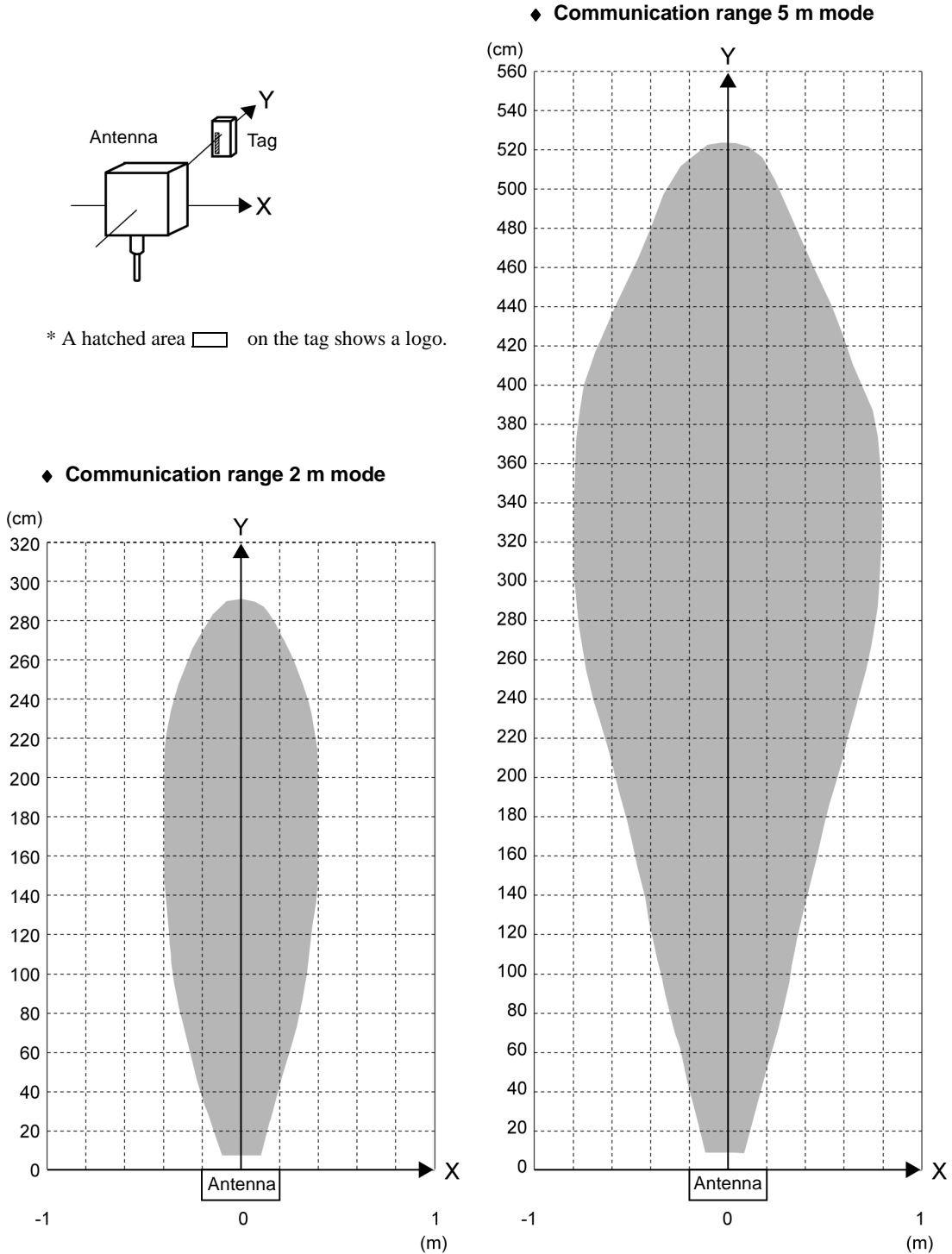
# Chapter 7 Communication Performance and Characteristic Data (Reference)

## 7-1 Communication Area (Reference)

- Ambient temperature  $20\pm 5^{\circ}\text{C}$ . Antenna and tag rotation are shown below.
- Communication area at 1.5 m high in a large room where radio wave noise is minimized.



\* A hatched area  on the tag shows a logo.



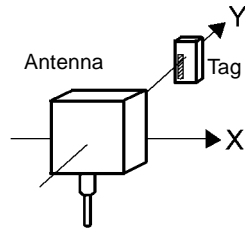
### Correct Usage

Before operating the system, execute the communication test (Section 3-5) between an antenna and tag and check that the communication can be made to the tag without fail.

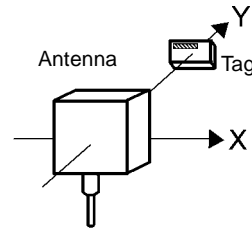
## 7-2 Influence of Ambient Temperature (Reference)


Influence of ambient temperature at tag rotating angle 0 degrees and 90 degrees is shown below.

Tag rotating angle 0 degrees

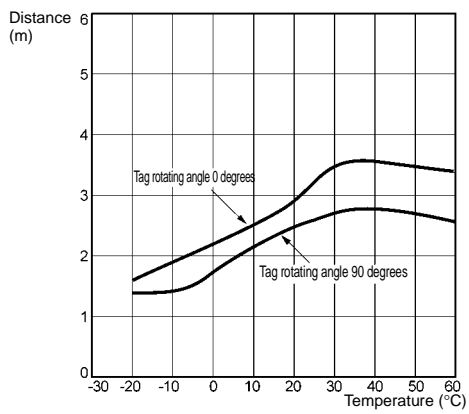


Tag rotating angle 90 degrees

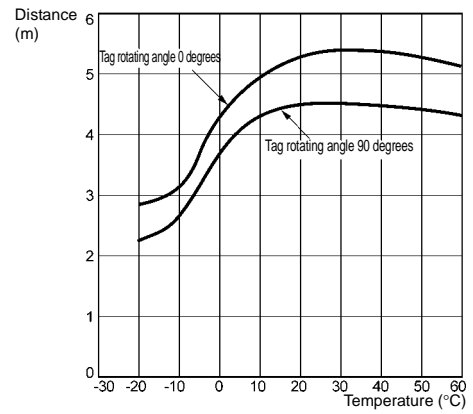


\* A hatched area  on the tag shows a logo.

2 m mode

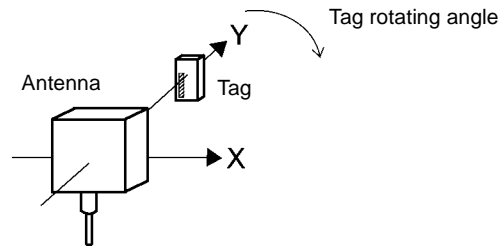



5 m mode

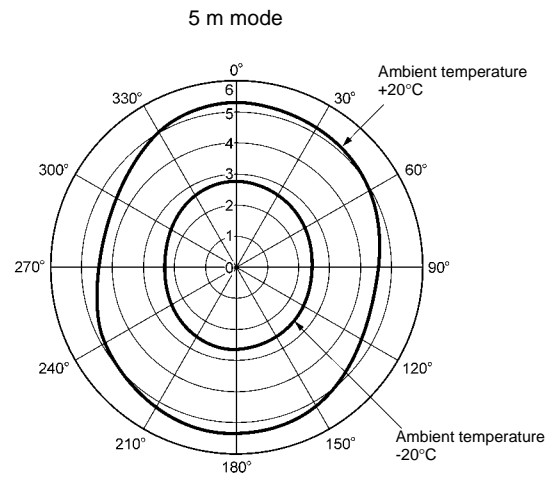
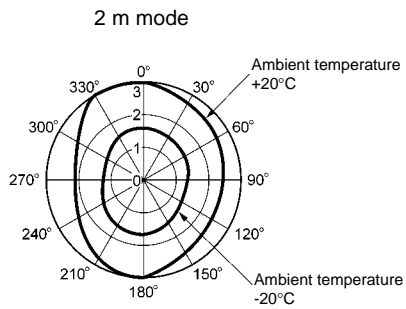


## 7-3 Influence of Tag Rotation Angle (Reference)

- Communication range fluctuating according to the variation of a tag angle to an antenna is shown below.
- Location of antenna and tag below shows the tag rotating angle 0 degrees.

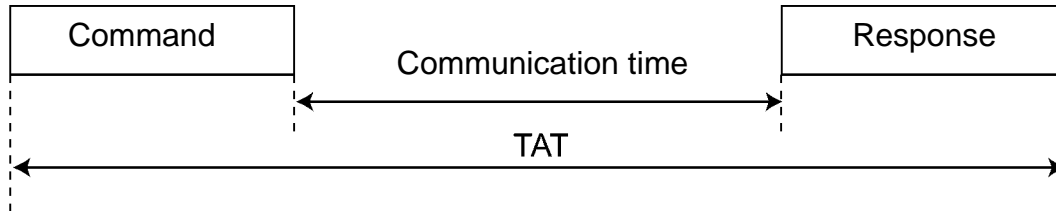


\* A hatched area  on the tag shows a logo.



## 7-4 Communication Time (Reference)

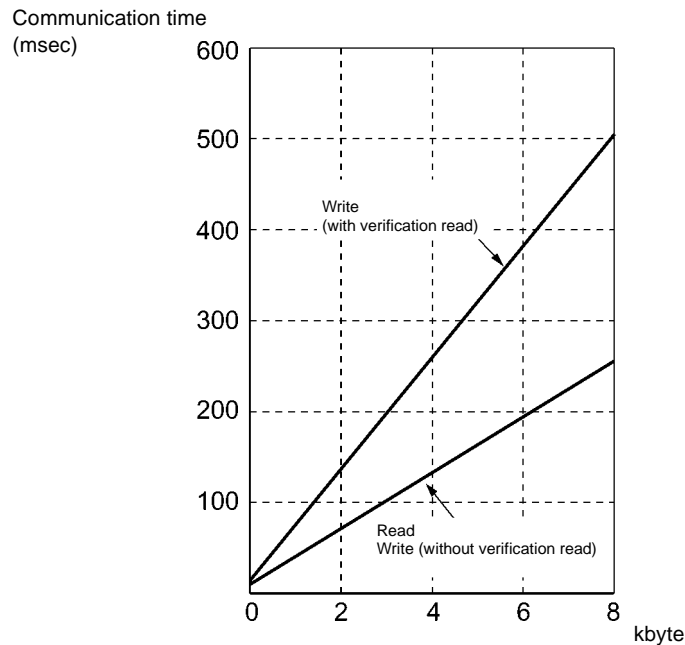
In the operation time, there are TAT (Turn Around Time) and communication time between the Read/Write antenna and ID tag.



### (1) One tag

The communication designation is SU. N is the number of bytes. In case of Trigger, Auto and Repeat command.

Command	Communication time (ms)
Read	
Write (without verification read)	$t = 11 + 0.03 * N$
Write (with verification read)	$t = 13 + 0.06 * N$
ID code read	$t = 10$
Communication test	$t = 1,100$



### Correct Usage

Communication speed (a maximum of 115.2 kbps) between a host device and antenna is faster than that between an antenna and tag. So, if the tags move to the front of the antenna one after another, use the polling command.



**(2) Multi (several tags)**

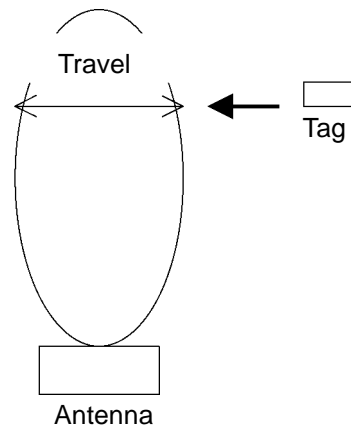
The communication time of Multi command varies depending on the number of processed bytes, the number of tags and designation of communication designation S/M/L. Average values are shown below.

Communication designation	Number of tags	Average communication time (ms)
U	1	17
S	Approximately 4	65
M	Approximately 8	128
L	Approximately 16	256

**(3) How to calculate maximum movement speed of tag**

The maximum movement speed of tag moving at the front of antenna is calculated as follows:

$$\text{Maximum movement speed} = \frac{\text{Travel in communication area}}{\text{Communication time}}$$

**Example of calculation (1)**

Calculate the movable speed of tag, based on the distance 1 m between the antenna and tag and 32-byte read. If the distance is 2 m in the communication range 2m mode, the area width is 0.8 m. The communication time of 32-byte read is 12 ms.

$$\text{Maximum movement speed} = \frac{0.8 \text{ m}}{12 \text{ ms}} = \frac{0.8 \text{ m}}{0.012 \times 1 / 60 \text{ (minutes)}} = 4 \text{ km per minute (= 240 km per hour)}$$

**Example of calculation (2)**

Calculate the movable speed of tag, based on the distance 4 m between the antenna and tag and 256-byte read. If the distance is 4 m in the communication range 5 m mode, the area width is 1.5 m. The communication time of 256-byte read is 19 ms.

$$\text{Maximum movement speed} = \frac{1.5 \text{ m}}{19 \text{ ms}} = \frac{1.5 \text{ m}}{0.019 \times 1 / 60 \text{ (minutes)}} = 4.7 \text{ km per minute (= 280 km per hour)}$$

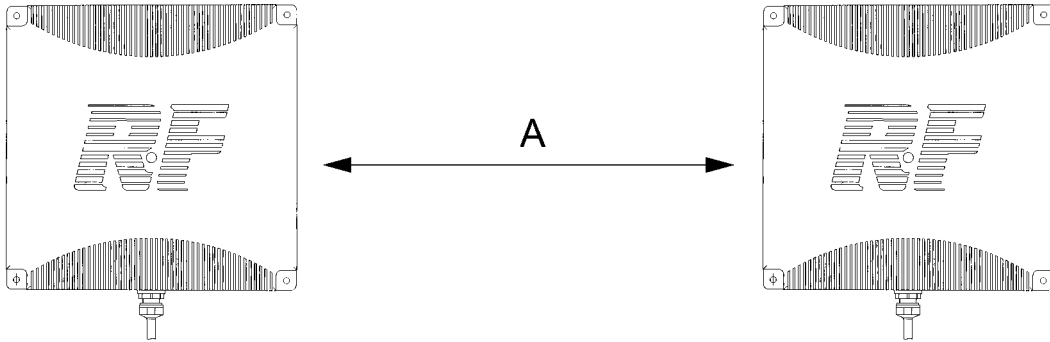
**Correct Usage**

The tag movement time above is a value of the best example. In an actual operation, taking into consideration peripheral objects and radio wave environment at the working site, design a system that a margin was removed from the calculated value and execute a test in the working site.

## 7-5 Mutual Interference Between Antennas (Reference)

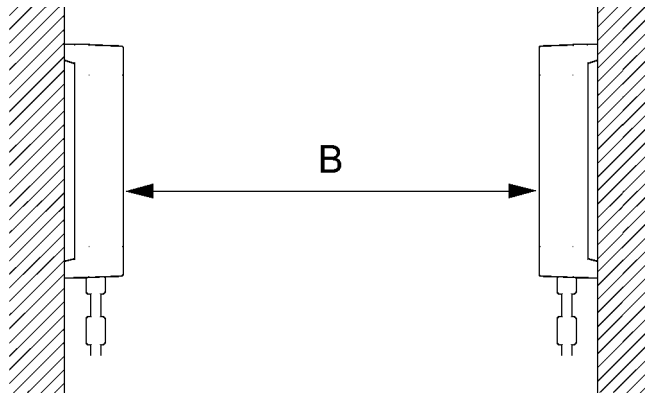
- If several antennas are used, the communication may fail due to mutual interference. Keep specified installation space shown below. Both radio wave channels are "5" (2450 MHz).
- Even if such installation space shown below cannot be kept, the space may be reduced by switching the radio wave channel. Refer to Section 3-3.

- **Installing antennas in parallel with each other**



Communication range	Space A
2 m mode	4.5 m or more
5 m mode	6 m or more

- **Installing antennas facing each other**



Communication range	Space B
2 m mode	9 m or more
5 m mode	17 m or more

## 7-6 Space to Wireless LAN Cellular Phone (Reference)

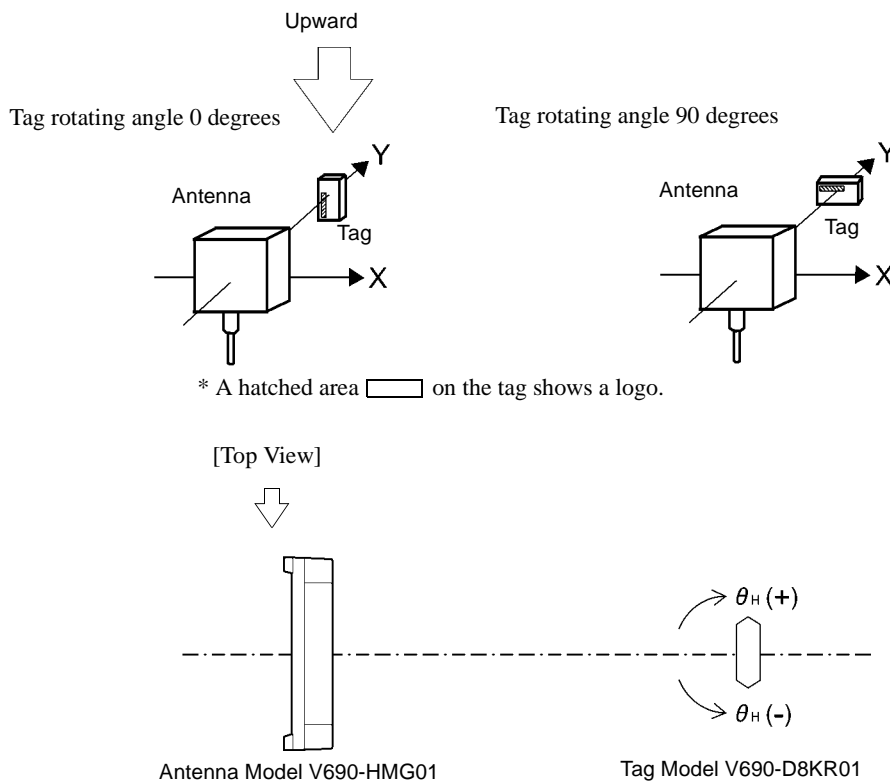
- Due to radio wave interference caused by wireless LAN and cellular phone, the RFID system communication fails and the ID tag battery power is consumed. (Refer to "Notes on Interference to Second-Generation Low-Power Data Communication System (Wireless LAN), Cellular Phone, etc." at the beginning of this manual.)
- Be sure to keep specified space from wireless LAN and cellular phone as shown below.
- If any trouble occurs, increase the space.

	Prevention of RFID communication failure	Prevention of ID tag battery power loss
Wireless LAN Our WD30M (Note)	3 m or more	2 m or more
Cellular phone (800M, 1500 MHz)	1 m or more	50 cm or more
Personal handyphone system (1900 MHz)	1 m or more	20 cm or more

Note: Set the channel of wireless LAN to 1 (2400 MHz).

## 7-7 Influence of Tag Installation Angle (Reference)

- The maximum communication range can be achieved when the antenna face and tag face are in parallel with each other. If the antenna and/or tag are inclined, the communication range becomes small. Install the tag paying attention to the tag angle.
  - For the tag rotating angle 0 degrees and 90 degrees, deterioration characteristic of communication range depending on the tag angle is shown below.
  - Because of antenna position in the tag, communication range deterioration varies depending on the installation angle (whether "+" or "-").
- **Horizontal installation angle of tag**



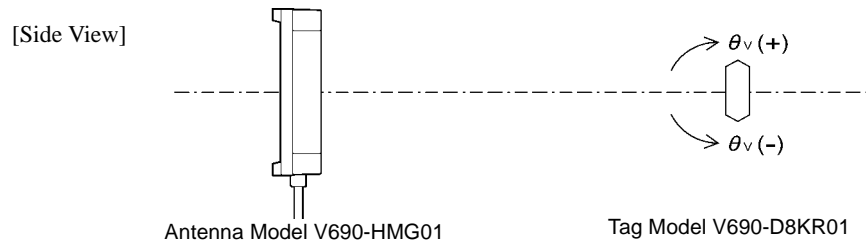
### (1) Tag rotating angle 0 degrees

$\theta_H$ (°)	Deterioration of communication range	
	2 m mode	5 m mode
+60	-54%	-55%
+45	-38%	-40%
+30	-23%	-17%
+15	-12%	-8%
0	0%	0%
-15	0%	-1%
-30	-4%	-7%
-45	-11%	-13%
-60	-26%	-25%

**(2) Tag rotating angle 90 degrees**

$\theta_H$ (°)	Deterioration of communication range	
	2 m mode	5 m mode
+60	-40%	-40%
+45	-23%	-24%
+30	-14%	-11%
+15	-6%	-3%
0	0%	0%
-15	-11%	-10%
-30	-26%	-23%
-45	-31%	-35%
-60	-34%	-37%

- Vertical installation angle of tag

**(1) Tag rotating angle 0 degrees**

$\theta_V$ (°)	Deterioration of communication range	
	2 m mode	5 m mode
+60	-41%	-36%
+45	-26%	-18%
+30	-10%	-2%
+15	0%	0%
0	0%	0%
-15	-16%	-13%
-30	-23%	-21%
-45	-30%	-28%
-60	-42%	-39%

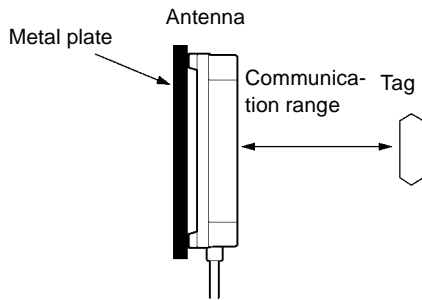
**(2) Tag rotating angle 90 degrees**

$\theta_H$ (°)	Deterioration of communication range	
	2 m mode	5 m mode
+60	-60%	-67%
+45	-43%	-50%
+30	-26%	-27%
+15	-12%	-14%
0	0%	0%
-15	0%	-3%
-30	-2%	-6%
-45	-13%	-14%
-60	-24%	-27%

## 7-8 Influence of Back Metal (Reference)

Deterioration characteristic of communication range depending on the distance between an antenna and tag back metal is shown below.

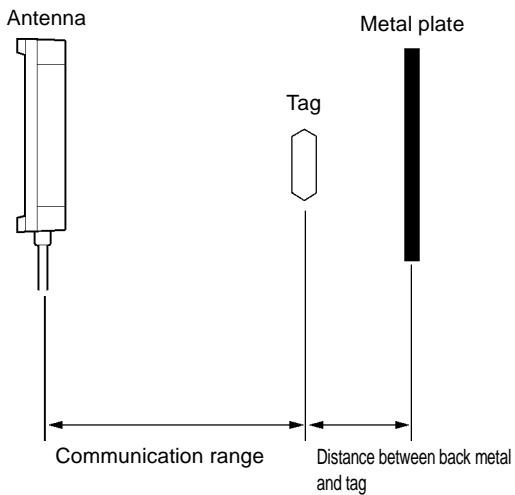
### • Antenna



Influence of metal plate at the back of antenna on the communication range is 1% or less.

\*Metal plate 350 x 350 x 1 (thickness) mm, aluminum, stainless steel.

### • Tag



Distance between back metal and tag	Communication	
	2 m mode	5 m mode
0 mm	-10%	-10%
5 mm	-5%	-5%
10 mm or more	0%	0%

\* Metal plate 120 x 120 x 1 (thickness) mm, aluminum, stainless steel.

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# Appendix

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## Appendix 1 Glossary

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### Antenna

In this manual, this refers to the Read/Write antenna, a reader/writer which accesses an ID tag of the RFID system.

### ARIB

Association of Radio Industries and Businesses, which issues the standards for radio equipment based on the Radio Law of Japan. The first edition of Specified Low-Power Radio Station - Radio Equipment for Mobile Object Identification RCR STD-29 was issued in 1992 and revised in July 2000 into Version 3.0

### ASCII

American Standard Code for the Information Interchange. American standard character code. This is almost the same as JIS 7 unit code for alphanumerical character, except that "¥" in JIS code is "\" in ASCII code.

### AWG

Shows a wire size. As the AWG number becomes small, the wire size becomes large. For the cable of this product, cross-sectional area of AWG22 is approximately 0.45 mm<sup>2</sup> and that of AWG26 is approximately 0.18 mm<sup>2</sup>.

### Circularly polarized wave

A wave that direction of electrical field (or magnetic field) is one way and not affected by time and place is referred to as "Linearly polarized wave". On the other hand, a wave that direction of electrical field varies depending on time and place, i.e., the electrical field rotates in the radio wave transmitting direction, is referred to as "Elliptically polarized wave". Among the elliptically polarized waves, a wave that amplitude is constant is the circularly polarized wave.

### Command

In this manual, this refers to an instruction from a host device to the Read/Write antenna.

### Communication

In this manual, this refers to data communication between a host device and Read/Write antenna. Data communication between an ID tag and Read/Write antenna is referred to as data exchange.

### Data exchange

In this manual, this refers to data communication between an ID tag and Read/Write antenna.

### Grounding Class D

Grounding method that grounding resistance is 100 Ω or less. This was formerly referred to "Grounding Class III".

### Half-duplex communication

Although this is two-way data transmission, transmission can be performed only in one way at a time. In the full-duplex communication, the data transmission can be done in two ways simultaneously.

### HEX

Hexadecimal number. A method to express a numerical value. The hexadecimal numbering system has a base of 16. The numbers 0 to 9 and characters A to F are used. The characters A to F correspond to the decimal numbers 10 to 15.

### Host device

A device, such as PC, programmable controller (PLC), etc., to issue a command to the Read/Write antenna.

### JIS8

Character code of JIS. There are 8 unit code (8 bits) and 7 unit code (7 bits). JIS8 unit code is for both of alphanumerical character and Japanese Kana character.

### m/s<sup>2</sup>

Unit of acceleration based on SI (International System of Units). The old unit is "G". 1G = 9.807 m/s<sup>2</sup>.

### Microwave

This product uses 2450 MHz which is recognized as IMS band (for industrial, medical and scientific purpose) in the world.

### N•m

Unit of torque based on SI (International System of Units). N is Newton. The old unit is "kgf•m". 1 kgf•m = 9.807 N•m.

**Response**

In this manual, this refers to a response returned by the Read/Write antenna after a host device issued an instruction to the Read/Write antenna.

**RFID**

Radio Frequency Identification, i.e., automatic identification with radio system. Data about object is stored in the ID tag memory and the data is read/written by a reader/writer without contacting.

**RS-232C**

Common physical interface standard of EIA (Electronics Industries Association). Communication speed 9600 bps can be achieved in communication range 15 m.

**RS-422A**

Common physical interface standard of EIA (Electronics Industries Association). RS-422A is more excellent in noise resistance than RS-232C and a maximum of 3000 m of communication range is available. Communication is performed through four wires. Two wires are for sending and the others are for receiving.

**RS-485**

Common physical interface standard of EIA (Electronics Industries Association). The same line is used for both of sending and receiving. So, communications can be made through two wires.

**Second-generation low-power data communication system**

Remarkably applicable wireless LAN which was legislated in 1999. A wide range of frequency band 2400 to 2483.5 MHz can be used by the SS (Spread Spectrum) system and multiple channels are available. ARIB RCR STD-33 (1999) is the Standard.

**Sleep, sleep state**

The state that any communication to the Read/Write antenna is not performed. In this state, battery power is used only to back up data in SRAM and the power consumption is 1/100 or less of the state that the ID tag operates or communicates. Therefore, to extend the life of the battery of ID tag, we recommend you to put the ID tag in the sleep state whenever the ID tag does not work. When the ID tag receives a radio wave from the Read/Write antenna, the ID tag quits the sleep state and works.

**Specified low-power radio station**

A radio station that the antenna power is 10 mW or less. A user is not required to apply a license for radio station. This product is verified by Technical Regulation Conformity Certification of an official organization before shipment.

**SRAM**

Static RAM (Random Access Memory). Volatile memory. Data is backed up by battery.

**Standby, standby state**

The state that all the circuits in a tag are ready to operate after a command is executed. The battery power consumption is the same as that at an operation such as communication. As a period of the standby state becomes short, the life of the battery can be extended.

**Start-stop synchronization**

Asynchronous data communication system which does not use synchronizing clock. Communication line is only one. Use it when synchronizing clock cannot be sent.

**Tag**

In this manual, this refers to ID tag which is memory media accessed by the Read/Write antenna of the RFID system. As accurate technical term, this is referred to as "Transponder". We call it "Tag" because "Transponder" is hard to say.

**Terminating resistance**

Put at both ends of communication line to prevent reflection in the communication line in RS-422A/RS-485.

**Time slot**

One of the systems that the Read/Write antenna accesses several ID tags. This system adopts the time slot. For example, if "M" (the number of time slots = 16) is specified in the data exchange designation of a command, the antenna informs the ID tag that there are 16 time slots and every ID tag returns a response according to timing of any of 16 time slots. If responses of several ID tags collide with each other, the time slots for those tags are rearranged. For "M", if the number of tags are approximately 8, probability of rearrangement is reduced and the total data exchange time is not prolonged so much.



**Wake instruction**

A command for identification transmitted at every 100 msec when the Read/Write antenna transmitted a radio wave. The ID tag only can identify it. When the ID tag receives the wake instruction, the ID tag continues an operation. If the ID tag cannot receive the wake command, the ID tag enters the sleep state. The ID tag power-saving function described in Section 3-7 is achieved by utilizing this function.

## Appendix 2 JIS8 Unit Code List (ASCII Code List)

High order digit Low order digit	b8~b5	0000	1001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
	b4~b1	Column 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0000	0	NUL	TC <sub>7</sub> (DLE)	(SP)	0	@	P	`	p	▲	▲	Undefined	—	タ	ミ	▲	▲
0001	1	TC <sub>1</sub> (SOH)	DC <sub>1</sub>	!	1	A	Q	a	q			。	ア	チ	ム		
0010	2	TC <sub>2</sub> (STX)	DC <sub>2</sub>	"	2	B	R	b	r			「	イ	ツ	メ		
0011	3	TC <sub>3</sub> (ETX)	DC <sub>3</sub>	#	3	C	S	c	s			」	ウ	テ	モ		
0100	4	TC <sub>4</sub> (EOT)	DC <sub>4</sub>	\$	4	D	T	d	t			,	エ	ト	ヤ		
0101	5	TC <sub>5</sub> (NEQ)	TC <sub>8</sub> (NAK)	%	5	E	U	e	u			.	オ	ナ	ユ		
0110	6	TC <sub>6</sub> (ACK)	TC <sub>9</sub> (SYN)	&	6	F	V	f	v			ヲ	カ	ニ	ヨ		
0111	7	BEL	TC <sub>10</sub> (ETB)	'	7	G	W	g	w	Undefined	Undefined	ア	キ	ヌ	ラ	Undefined	Undefined
1000	8	FE <sub>0</sub> (BS)	CAN	(	8	H	X	h	x			イ	ク	ネ	リ	Undefined	Undefined
1001	9	FE <sub>1</sub> (HT)	EM	)	9	I	Y	i	y			ウ	ケ	ノ	ル	Undefined	Undefined
1010	10	FE <sub>2</sub> (LF)	SUB	*	:	J	Z	j	z			エ	コ	ハ	レ		
1011	11	FE <sub>3</sub> (VT)	ESC	+	;	K	[	k	{			オ	サ	ヒ	ロ		
1100	12	FE <sub>4</sub> (FF)	IS <sub>4</sub> (FS)	,	<	L	¥	l				ヤ	シ	フ	ワ		
1101	13	FE <sub>5</sub> (CR)	IS <sub>3</sub> (GS)	-	=	M	]	m	}			ユ	ス	ヘ	ン		
1110	14	S0	IS <sub>2</sub> (RS)	.	>	N	^	n	-			ヨ	セ	ホ	°		▼
1111	15	S1	IS <sub>1</sub> (US)	/	?	O	_	o	DEL	▼	▼	ッ	ソ	マ	°	▼	Undefined

Note 1: The code 01011100 (column 5, row 12) is " \ " in the ASCII character.

# Appendix 3 Protective Structure

- **Protective Structure** Note: IP-□□□ is classified by a test method below. Check sealing in working environment and operating conditions in advance
- ◆ **IEC** (International Electrotechnical Commission) Standards (IEC60529: 1989-11) ◆ **JEM** (Japan Electrical Manufacturers' Association) Standards (JEM1030: 1991)

IP-□□□  
Protective property code (International Protection)  
Protective classification for "1st Symbol" solid foreign material

Class	Protection Level	
0		No protection.
1		Solid foreign material 50 mm or more in diameter (hand etc.) cannot come in.
2		Solid foreign material 12.5 mm or more in diameter (finger etc.) cannot come in.
3		Solid foreign material 2.5 mm or more in diameter (wire etc.) cannot come in.
4		Solid foreign material 1 mm or more in diameter (wire etc.) cannot come in.
5		Dust, which interferes a normal operation of device or spoils the safety, cannot come in.
6		Any dust cannot come in.

IP-□□□  
Complies with the 1st and 2nd symbols of IEC60529.  
Protective classification for oil penetration.

Class	Protection Level	
f	Oil retaining type	Not affected considerably by oil drops or oil spray in any direction.
g	Oil resistance type	Any oil drop or oil spray in any direction cannot come in.

Note) There are four other classes: "h", "c", "d", and "e".

## NEMA (National Electrical Manufactures Association)

Table for conversion from NEMA enclosure into IEC60529. (Conversion from IEC60529 into NEMA enclosure is unavailable.)

NEMA250	IEC60529	NEMA250	IEC60529
1	IP10	4, 4X	IP56
2	IP11	5	IP52
3	IP54	6, 6P	IP67
3R	IP14	12, 12K	IP52
3S	IP54	13	IP54

Note: Based on the NEMA Standards. The difference between NEMA enclosure classification and IEC60529 is anticorrosion, rust prevention, moisture condensation on surface, etc.

Our test method

\*1. In addition to the tests below, confirm that the proximity sensor IP67 repeats a heat shock cycle 5 times in cool water (0°C) for 1 hour and hot water (70°C) for 1 hour and that detected distance and insulation resistance satisfy the performance.

\*2. Working conditions of proximity sensor type E2F: Natural condition at 10 cm deep in water.

- (1) Even if it is immersed in water of 2 atm for 1 hour, any water penetration must not be observed.
- (2) Repeat the heat shock cycle above 20 times and confirm that detected distance and insulation resistance satisfy the performance.

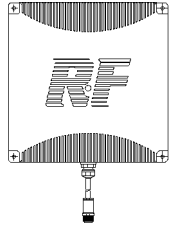
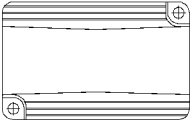
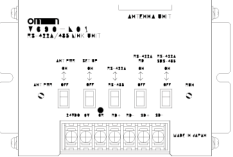
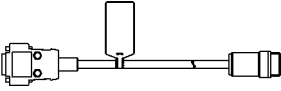
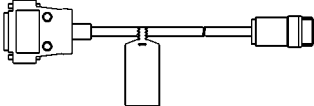
## Protective classification for "2nd Symbol" water penetration

Class	Protection Level		Test Method Overview (Test with fresh water)
0	No particular protection	Any particular protection is not taken to water penetration.	No Test.
1	Protection against drop of water	Not to be affected by water dropped vertically.	Drop water for 10 minutes using a water drop tester.
2	Protection against drop of water	Not to be affected by water dropped deviating 15° from a vertical line.	Drop water to an object set inclined 15° for 10 minutes (2.5 minutes per direction) using a water drop tester.
3	Protection against water spray	Not to be affected by water spray deviating within 60° from a vertical line.	Spray water in an area within 60° to the right and left from a vertical line for 10 minutes using a tester shown in this figure.
4	Protection against water splash	Not to be affected by water splash from all the directions.	Spray water from all the directions for 10 minutes using a tester shown in this figure.
5	Protection against water jet flow	Not to be affected by direct water jet flow from all the directions.	Spray water from all the directions for 1 minute per surface area 1 m², total 3 minutes or more using a tester shown in this figure.
6	Protection against extreme water jet flow	Not to be affected by extreme direct water jet flow from all the directions.	Spray water from all the directions for 1 minute per surface area 1 m², total 3 minutes or more using a tester shown in this figure.
7	Protection against water soaking *1	Even if an object is immersed in water of specified pressure for a specified time, any water penetration must not be observed.	Immerse an object at 1 m deep in water for 30 minutes (assuming that device height is lower than 850 mm).
8	Protection against water immersion *2	An object must work always in water.	According to an agreement between a manufacturer and device user.

(January 1998)

## Appendix 4 Order Format List

### ◆ Main unit and system components

Name/Shape	Specifications	Model
Antenna 	RS-232C/RS-422A interface 24 VDC power supply	Model V690-HMG01
ID tag 	Memory capacity: 8 kbytes Battery life: 5 years (25°C)	Model V690-D8KR01
RS-422A/485 link unit 	RS-422A/485 interface 24 VDC power supply	Model V690-L01
RS-232C connecting cable (for IBM PC compatible machine) 	2 m	Model V690-A40
	3 m	Model V690-A41
	5 m	Model V690-A42
	10 m	Model V690-A43
	15 m	Model V690-A44
RS-422A/485 link unit connecting cable 	2 m	Model V690-A50
	3 m	Model V690-A51
	5 m	Model V690-A52
	10 m	Model V690-A53
	20 m	Model V690-A54
	30 m	Model V690-A55
	50 m	Model V690-A56

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