OMRON

Electromagnetic Inductive RFID System

V670 Series

User's Manual

CF Reader/Writer

V670-CF01

ID Tag

V670-D13F03

V670-D13F01

V670-D13F01H

Cat. No. Z204-E1-02

Electromagnetic Inductive RFID System

V670-CF01	CF Reader/Writer
V670-D13F03	ID Tag
V670-D13F01	ID Tag
V670-D13F01H	ID Tag

User's Manual

Introduction

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual. Observe the following precautions when using a V670-series Electromagnetic Inductive RFID System.

- Read and understand this manual before attempting to use the product and use the product correctly.
- Keep this manual in a safe but accessible location so that it can be used as reference when required.

READ AND UNDERSTAND THIS DOCUMENT

Please read and understand this document before using the products. Please consult your OMRON representative if you have any questions or comments.

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

SUITABILITY FOR USE

THE PRODUCTS CONTAINED IN THIS DOCUMENT ARE NOT SAFETY RATED. THEY ARE NOT DESIGNED OR RATED FOR ENSURING SAFETY OF PERSONS, AND SHOULD NOT BE RELIED UPON AS A SAFETY COMPONENT OR PROTECTIVE DEVICE FOR SUCH PURPOSES. Please refer to separate catalogs for OMRON's safety rated products.

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PERFORMANCE DATA

Performance data given in this document is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the product may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

ERRORS AND OMISSIONS

The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

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Standard Conformity

1. FCC Rules (Federal Communications Commission)
   This product complies with Part 15 Subpart C of the FCC Rules.
   FCC ID: E4E 6CY CIDV6700104

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

   FCC WARNING
   Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

2. EC Declaration of Conformity
   Hereby, OMRON Corporation declares that this RFID System and all of its components are in compliance with essential requirements and other relevant provisions of the Radio and Telecommunications Terminal Equipment Directive 1995/5/EC, and satisfy tests for the appropriate requirements of the following relevant standards.

   Radio: EN 300 330-2V1.1.1 (06-2001)
   EN 300 330-1V1.3.1 (06-2001)
   EMC: EN 301 489-3V1.4.1 (08-2002)
   EN 301 489-1V1.4.1 (08-2002)
   Safety: EN 61010-1: 2001 (2nd Edition)

CE

English	Hereby, Omron, declares that the RFID System, Antenna V670-H11 Series, V670-H51 Series, V670-H51Q Series, and Controller V670-CD1D Series are in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.
Finnish	Omron vakuuttaa täten että RFID Säännös, Antenni V670-H11 Series, V670-H51 Series, V670-H51Q Series, jar Kontrollida V670-CD1D Series tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.
Dutch	Hierbij verklaart Omron dat het toestel de RFID Systeem, Antenne V670-H11 ´Serie, V670-H51 ´Serie, V670-H51Q ´Serie, en Controleur V670-CD1D ´Serie in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijh 1999/5/EG.
French	Par la présente Omron déclare que la RFID Système, Antenne V670-H11 Série, V670-H51 Série, V670-H51Q Série, et Contrôler V670-CD1D Série sont conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.
Swedish	Härmed intygar Omron att den RFID System, Antenn V670-H11 Serie, V670-H51 Serie, V670-H51Q Serie, och Kontrollant V670-CD1D Serie stär l överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.
Danish	Undertegnede Omron erklærer herved, at følgende den RFID System, Antenne V670-H11 Serie, V670-H51 Serie, V670-H51Q Serie, og Kontrollør V670-CD1D Serie overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.
German	Hiermit erklärt Omron, die RFID System, Antenne V670-H11 Serie, V670-H51 Serie, V670-H51Q Serie, und Kontrolleur V670-CD1D Serie in Übereinstimmung mit den grundlegenden Anforderungen und den anderen relevanten Vorschriften der Richtlinie 1999/5/EG befindet. (BMWi)
Greek	ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ Omron ΔΗΛΟΝΕΙ RFID ΟΥΟΓΉΜΑ, ΚΕΡΑΙΑ V670-H11 ΟΕΙΡΑ, V670-H51Q ΟΕΙΡΑ, ΚΑΙ ΚΟΥΡΟΛΗΡΨ V670-CD1D ΟΕΙΡΑ SYMMOPF ONETAI ΠΡΟΣ TIS OYSIOΔΕΙS ΑΠΑΙΤΗSEIS ΚΑΙ TIS ΛΟΙΠΕS SΧΕΤΙΚΕS ΔΙΑΤΑΞΕΙS THS OΔΗΓΙΑS 1999/5/ΕΚ.
Italian	Con la presente Omron dichiara che la RFID Sistema, Antena V670-H11Serie, V670-H51 Serie, V670-H51Q Serie, e Controlleur V670-CD1D Serie sono conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.
Spanish	Por medio de la presente Omron declara que el RFID Sistema, Antena V670-H11 Serie, V670-H51 Serie, V670-H51Q Serie, y Controlador V670-CD1D Serie esta conforme a los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.
Portuguese	Omron declara que a RFID Sistema, Antena V670-H11 Série, V670-H51 Série, V670-H51Q Série, e Controlador V670-CD1D Série ser conforme com os tequisitos essenciais e outras disposições da Directiva 1999/5/CE.
Romanian	Prin prezenta, Omron declară că acest V670-CF01 este conform cu cerinţele principale çi cu celelalte prevederi relevanate ale Directivei 1999/5/EC.

Precautions for Safe Use

For safety, be sure to observe the following precautions:

1. Do not operate this device in any flammable, explosive or corrosive gas environment.
2. Do not disassemble, repair, or modify this device.
3. Use only the recommended Handy Terminals. Proper operation many not be possible if any other Handy Terminal is used.

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4. Insert the CF Reader/Writer into the CF card slot with the indicator on the CF Reader/Writer facing upward.
5. Be sure to attach the Protective Covers to the Handy Terminal. Be sure to tighten the mounting screws securely. The Protective Covers are not designed to withstand dropping.
6. Do not apply excessive force to the surface of the antenna when communicating with an ID Tag.
7. If the system gives out a foul smell or if the CF Reader/Writer becomes abnormally hot, emits smoke, or exhibits any other abnormal condition, immediately stop using the system, turn OFF the power, and contact your OMRON representative.
8. Dispose of this product as industrial waste.

Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunctions, or undesirable effects on product performance.

1. Installation Environment

Do not install the product in the following locations

- Where it is exposed to direct sunlight
- Where it is exposed to corrosive gases, dust, metal chips, or salt
- Where the operating temperature exceeds the range given in the specifications
- Where there are sudden changes in temperature (including locations subject to condensation)
- Where the humidity exceeds the range given in the specifications
- Where vibration or shock exceeding the values given in the specifications is imposed directly on the product.
- Where the product is subject to splashing water, oil, or chemicals

2. ID Tag Installation

- This device uses the frequency band 13.56 MHz to communicate with Tags. This frequency band is also used as the ISM band (one of frequencies assigned to medical or industrial heaters). These heaters may affect communications with a Tag or may damage the Tag if the heater is located near this device. Do not install ID Tags near devices that use the frequency band 13.56 MHz.

3. Power Supply

- Use the power supply specified in this manual.

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4. Installation

- Always turn OFF the power supply to the Handy Terminal before inserting or removing the CF Reader/Writer.
- To protect the system from damage due to static electricity, use a wrist strap or other means of preventing static discharge when touching signal wires for terminals or connectors.
- Insert securely into the CF Port.

5. Cleaning

- Do not use any thinner. Resin material and case paint are dissolved by thinner.

6. Communications

- Power is supplied when opening the COM port on the CF Reader/Writer. Wait for at least 500 ms after opening the COM port before starting communications.

About this Manual

Meaning of Visual Guides

Indicates precautions to be observed in operating the product, advice on operating methods, and important information for maintaining product performance.

Indicates the page numbers where related information can be found.

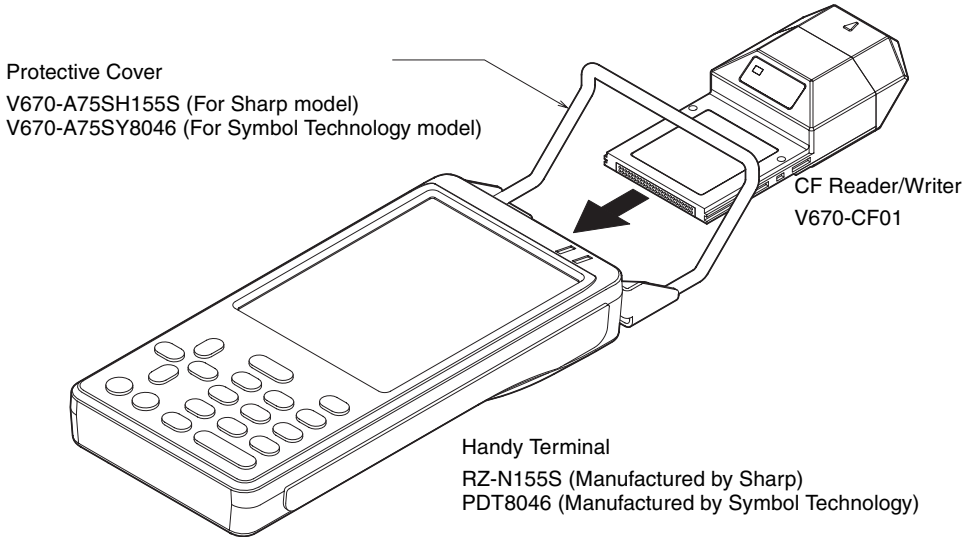
Indicates information related to troubleshooting.

CONTENTS

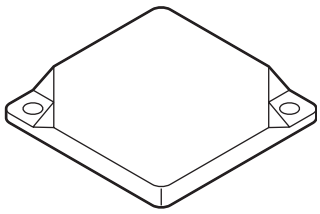
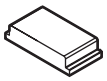
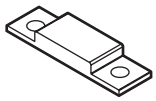
SECTION 1
Product Outline

Features

The V670-CF01 CF Reader/Writer combines the V670-series Antenna and Controller into a single unit with a CF interface. It has superior portability and operability because it can be used by slotting it into a CF card slot (Type II) on a Handy Terminal. Tag data can be read and written using serial communications from the Handy Terminal.



The following three types of ID Tags ("Tags") can be used with the CF Reader/Writer.

Model	Description
V670-D13F03	The V670-D13F03 ID Tag has a memory capacity of 128 bytes. It is a 40 × 40 mm square tag with water-resistant properties. It also uses a highly efficient, non-volatile ferroelectric memory, called FeRAM, as internal memory. FeRAM has a semipermanent life (i.e., it can be accessed 1 billion times). 
V670-D13F01	The V670-D13F01 ID Tag is an 8 × 16 mm rectangular tag. It is highly chemical resistant because a PPS case and highly chemical-resistant epoxy resin is used on the exterior. It has the same memory capacity and performance as the V670-D13F03. 
V670-D13F01H	The V670-D13F01H ID Tag has the same performance and construction as the V670-D13F01. It has holes for easy mounting. 

CHECK!

Refer to *Tags* for detailed Tag specifications.
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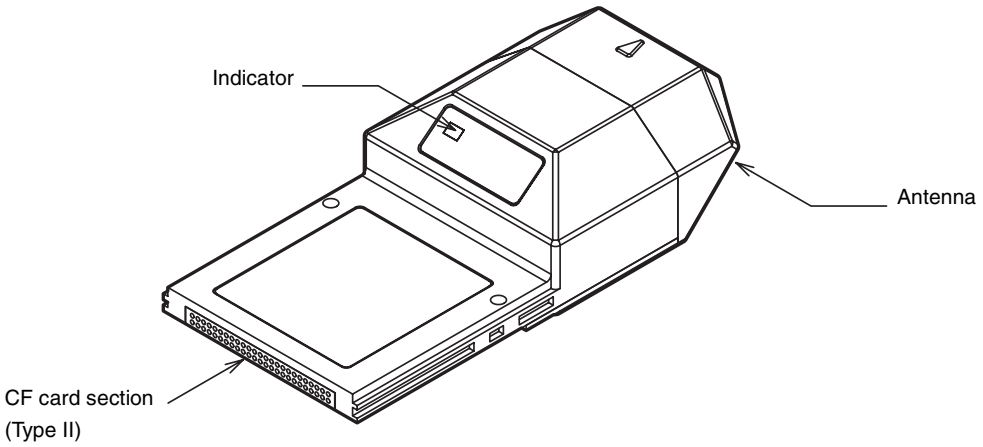
Ferroelectric memory (FeRAM) is a type of non-volatile memory that can write data much faster than previous types of memory, such as EEPROM and flash ROM, and it has a semipermanent writing life. Furthermore, the previous types of memory could no longer hold data if nothing had been written to the memory for a certain period (approximately 10 years). FeRAM, on the other hand, is far better for data storage because it can hold data as long as data is read or written within a specific period of time.

Part Names and Functions



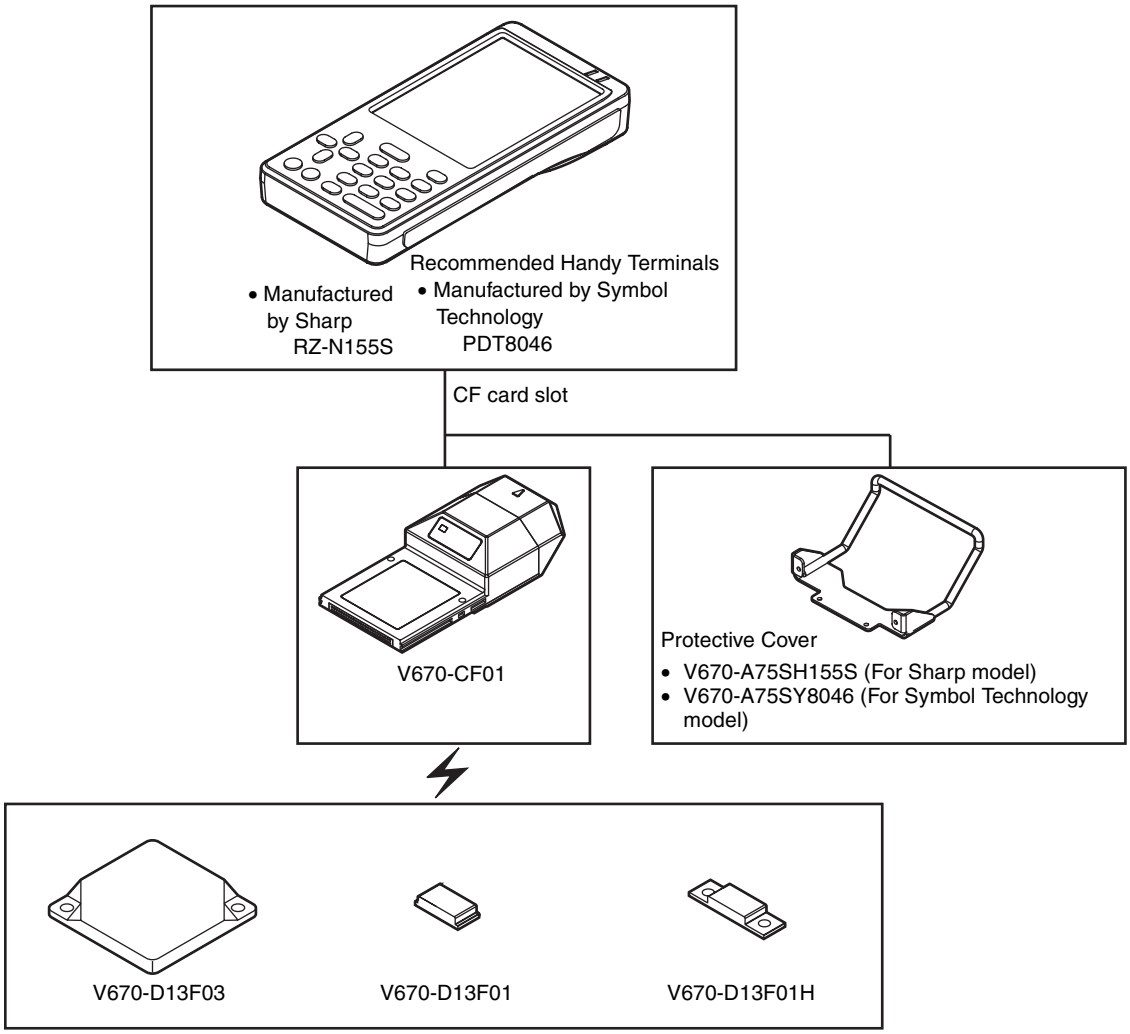
Name	Details		
Antenna	The Antenna is brought close to the Tags in order to communicate with them.		
CF card section (Type II)	The interface for connection with a Handy Terminal. Conforms to the CF Card specification: Compact Flash Specification Revision 2.0.		
Indicator	Status	Description	Lit time and number of flashes
	Green, lit	Command received from Handy Terminal	3 s
		Communications with Tag ended normally	5 s
		When the result is “A” (low noise level) for the Noise Measurement command (NS)	5 s
		When the result is “0” (normal) for the Error Noise Detection command (EN)	5 s
		When the result is “A” (excellent) for the Stability Evaluation command (SF)	5 s
	Green, flashing	After completing initialization when power is turned ON	6 times
		During communications with a Tag	Until communications end
		When the result is “B” (good) for the Stability Evaluation command (SF)	8 times
	Red, lit*	When an error occurs in communications with a Tag	5 s
		When a CPU error occurs	Until power is turned OFF
	Red, flashing	When an error occurs because there is no Tag	10 times
		When an error occurs in communications with the Handy Terminal	5 times
		When the result is “B” (high noise level) for the Noise Measurement command (NS)	15 times
		When the result is “1” (error) for the Error Noise Detection command (EN)	15 times
		When the result is “C” (No good) for the Stability Evaluation command (SF)	15 times

* When a CPU error occurs, the indicator will remain lit until the power supply is turned OFF.

p.62 Diagnosis Function

System Configuration

The CF Reader/Writer is inserted into a Handy Terminal CF card slot (Type II) and it controls communications with Tags using serial communications from the Handy Terminal.



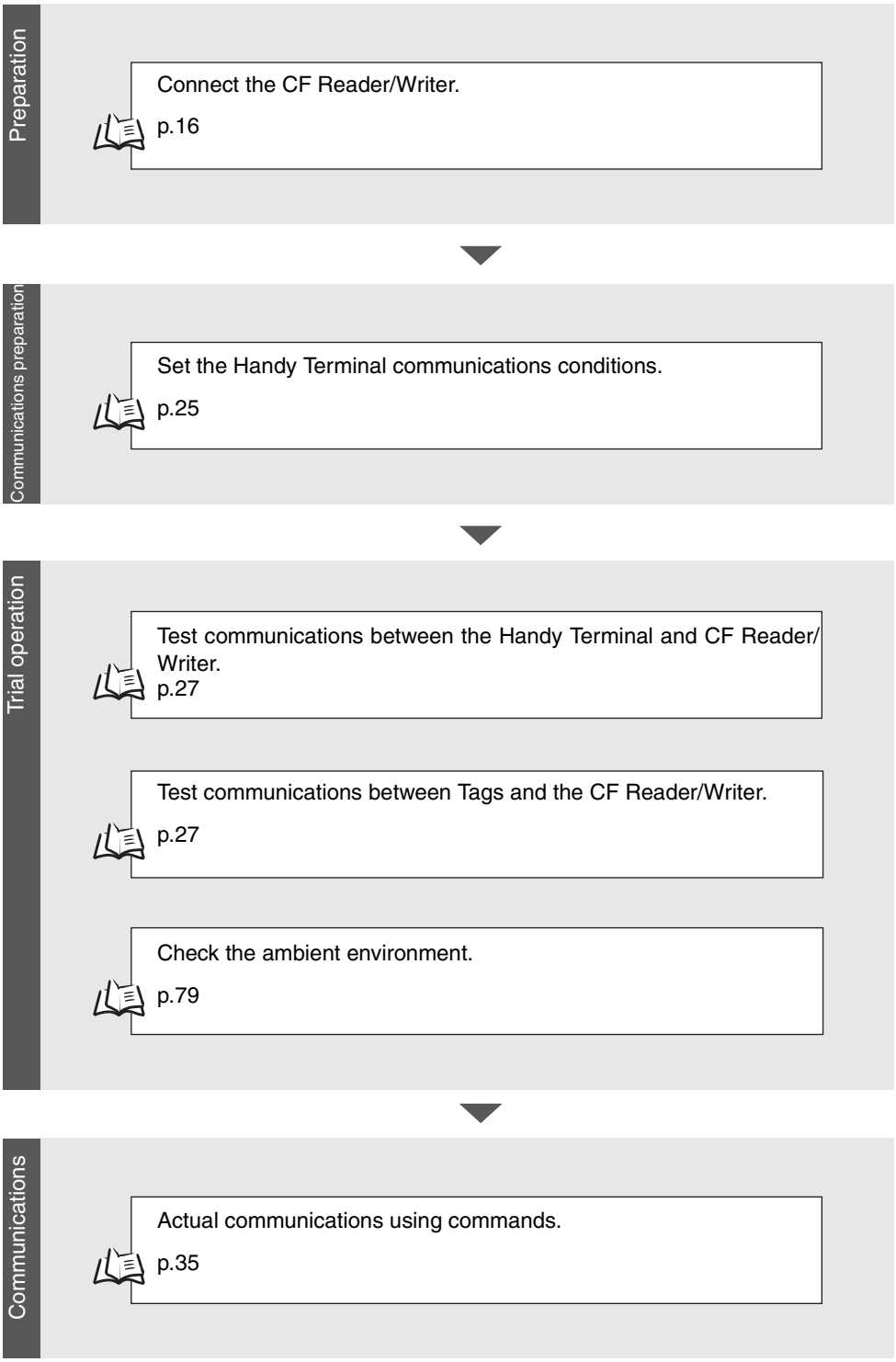
Recommended Handy Terminals

Manufacturer	Symbol Technology*	SHARP
Model	PDT8046	RZ-N155S
OS	PocketPC2002	Windows CE.NET4.2

* The Handy Terminal manufactured by Symbol Technology is recommended for use in the USA, Canada, Europe, and China. Contact your local Symbol Technology representative for further information.
http://www.symbol.com/index.htm

CHECK! Use one of the recommended Handy Terminals listed in the above table. The CF Reader/Writer may not operate correctly if any other Handy Terminal is used. For Handy Terminal operating procedures, refer to the operating instructions provided by the manufacturer.

Application Flowchart



MEMO

SECTION 2
Communications Preparations

Connection

1. Turn OFF the power supply to the Handy Terminal.

CHECK!

Always turn OFF the power supply to the Handy Terminal before connecting or disconnecting the CF Reader/Writer. For Handy Terminal operating procedures, refer to the operating instructions provided by the manufacturer.

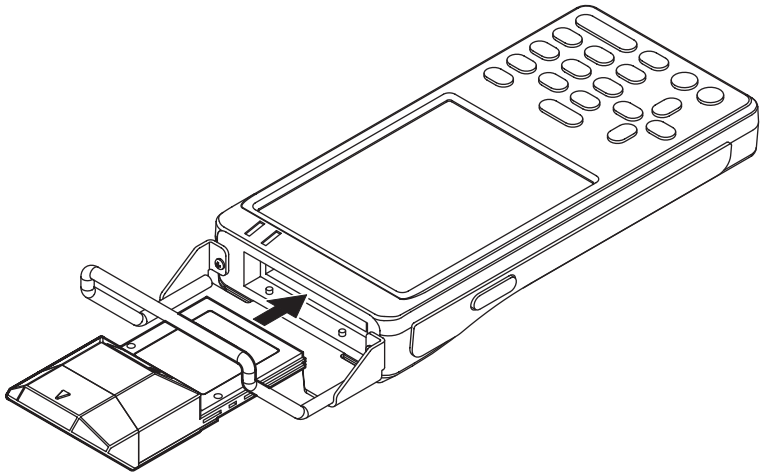
2. Attach the Protective Cover to the end of the Handy Terminal.

CHECK!

Refer to *Protective Covers* for the attachment method for the Protective Cover.

p.21 Protective Covers

3. Insert the CF Reader/Writer into the Handy Terminal CF card slot.



CHECK!

Insert the CF Reader/Writer into the CF card slot as shown above. Insert it completely to the back of the CF card slot.

4. After the CF Reader/Writer has been inserted, turn ON the power supply to the Handy Terminal.

The indicator on the CF Reader/Writer will flash after the Handy Terminal power has been turned ON.

Tags

Installation Environment

Do not use Tags in the following locations.

- Locations with corrosive gases, flammable gases, or dust
- Locations with an ambient temperature not between –10 and 70°C and locations subject to sudden temperature fluctuations that may cause condensation
- Inside microwave ovens

Mounting Method

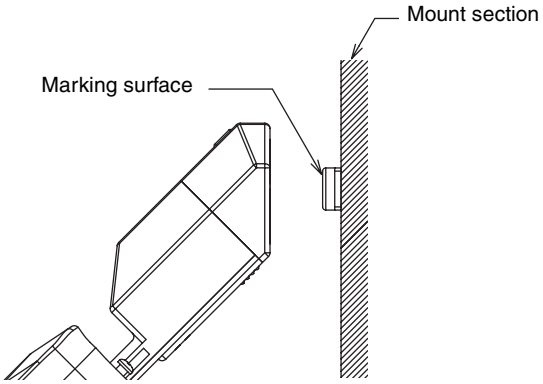
Observe the following precautions when mounting Tags.

- Do not chip or make holes in Tags.
- Do not apply excessive force to Tags.
- Do not mount Tags side-by-side or close to metallic objects.

* Tags may warp if used in an environment subject to repeated high and low temperatures, but this will not affect Tag functions.

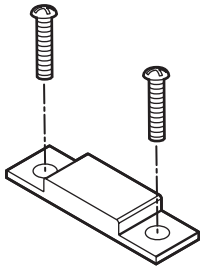
■ V370-D13F01(H)

• Mounting Direction

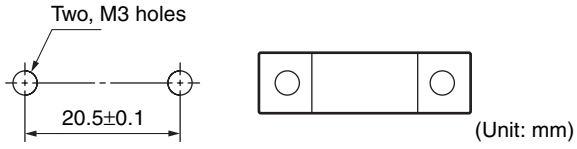


• Mounting Example

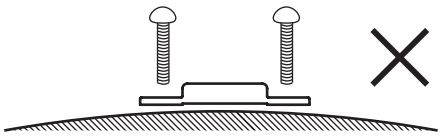
Use two M3 screws to mount a Tag.



Mounting Hole Dimensions



* Tags must be mounted on flat surfaces. Do not mount Tags on curved surfaces.
  The Tag may be damaged due to tightening stress if it is mounted on a curved surface.



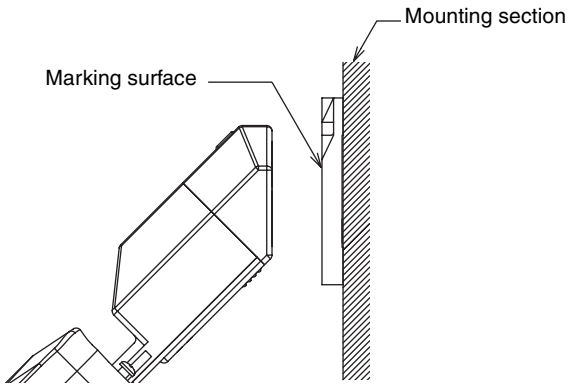
CHECK!

Tighten the M3 screws to a torque of 5 N·m or less.

■ V670-D13F03

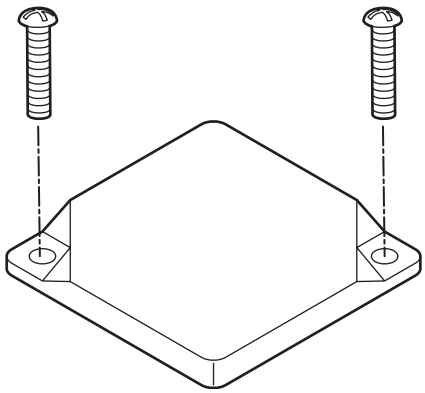
• Mounting Direction

Mount the V670-D13F03 Tag so that the front is parallel to the CF Reader/Writer.

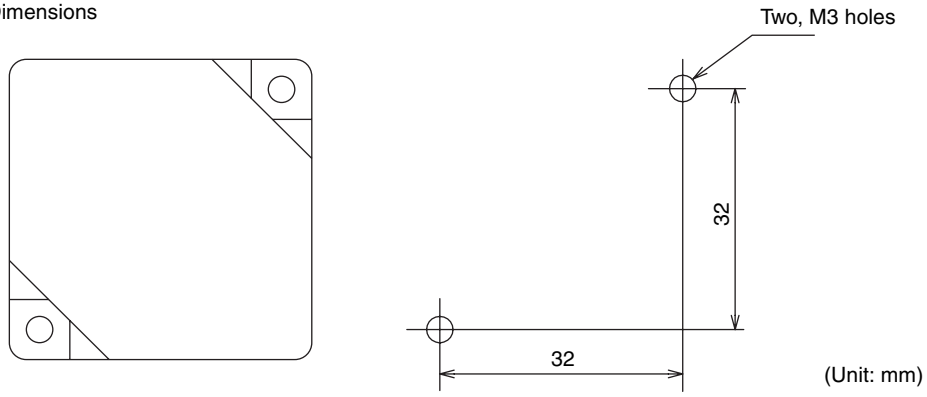


• Mounting Example

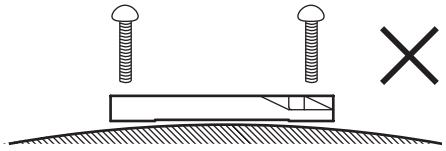
Use two M3 screws to mount a Tag.



Mounting Hole Dimensions



* Tags must be mounted on flat surfaces. Do not mount Tags on curved surfaces.
  The Tag may be damaged due to tightening stress if it is mounted on a curved surface.



CHECK! Tighten the M3 screws to a torque of 0.6 N·m or less.

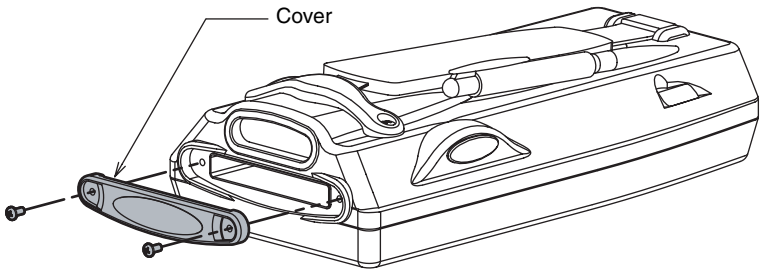
Protective Covers

Mounting Method

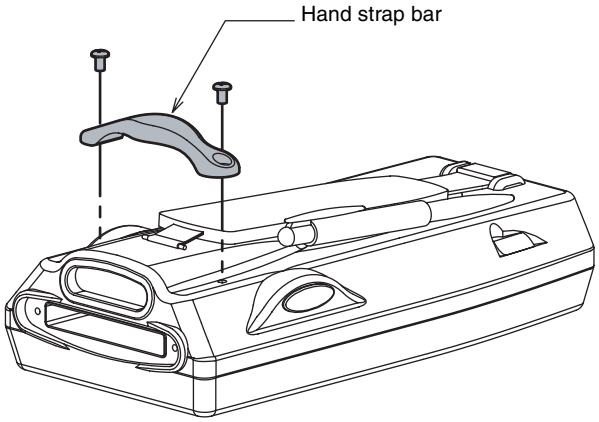
Protective Covers are mounted with screws.

■ V670-A75SY8046 (for Handy Terminals from Symbol Technology)

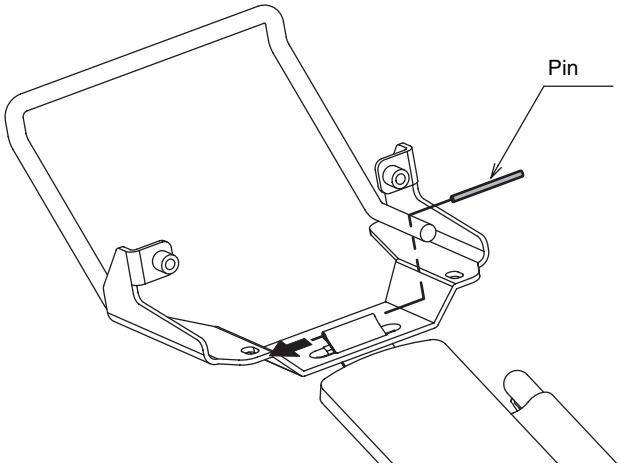
1. Loosen the screws on the cover at the end of the Handy Terminal and remove the cover.



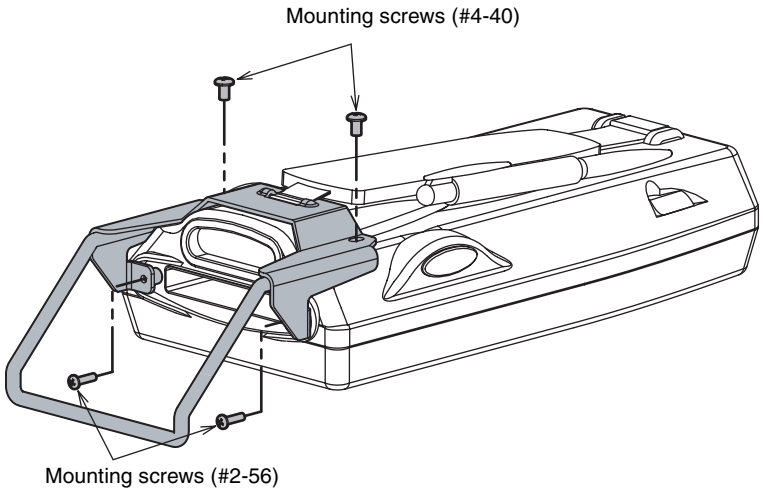
2. Remove the screws from the hand strap bar and remove the bar.



3. Insert the pin as shown in the following diagram to attach the hand strap to the Protective Cover.



4. Secure the Protective Cover to the Handy Terminal with two #4-40 screws and two #2-56 screws.

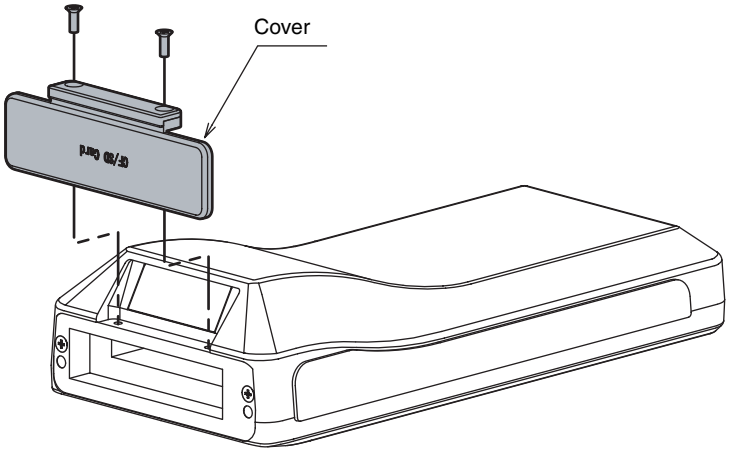


CHECK!

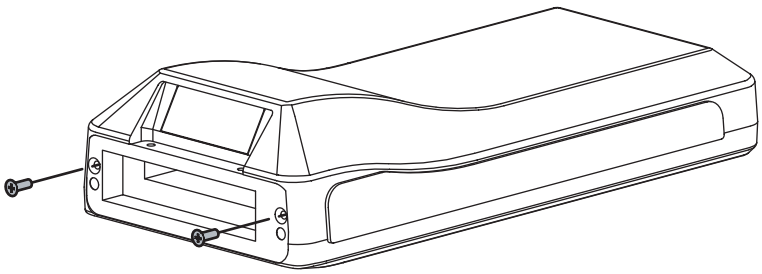
Tighten mounting screws #4-40 to a torque of 0.3 N·m or less, and mounting screws #2-56 to a torque of 0.15 N·m or less.

■ V670-A75SH155S (for Handy Terminals from Sharp)

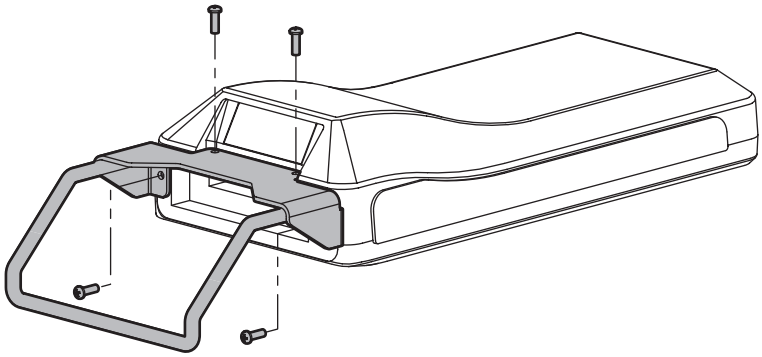
1. Loosen the mounting screws on the cover at the end of the Handy Terminal and remove the cover.



2. Remove the screws shown below from the Handy Terminal.



3. Secure the Protective Cover to the Handy Terminal with the four M2 screws provided with the Protective Cover.



CHECK!

Tighten the mounting screws to a torque of 0.15 N·m or less.

Setting Handy Terminal Communications Conditions

1. Set the same communications conditions for the Handy Terminal and the CF Reader/Writer.

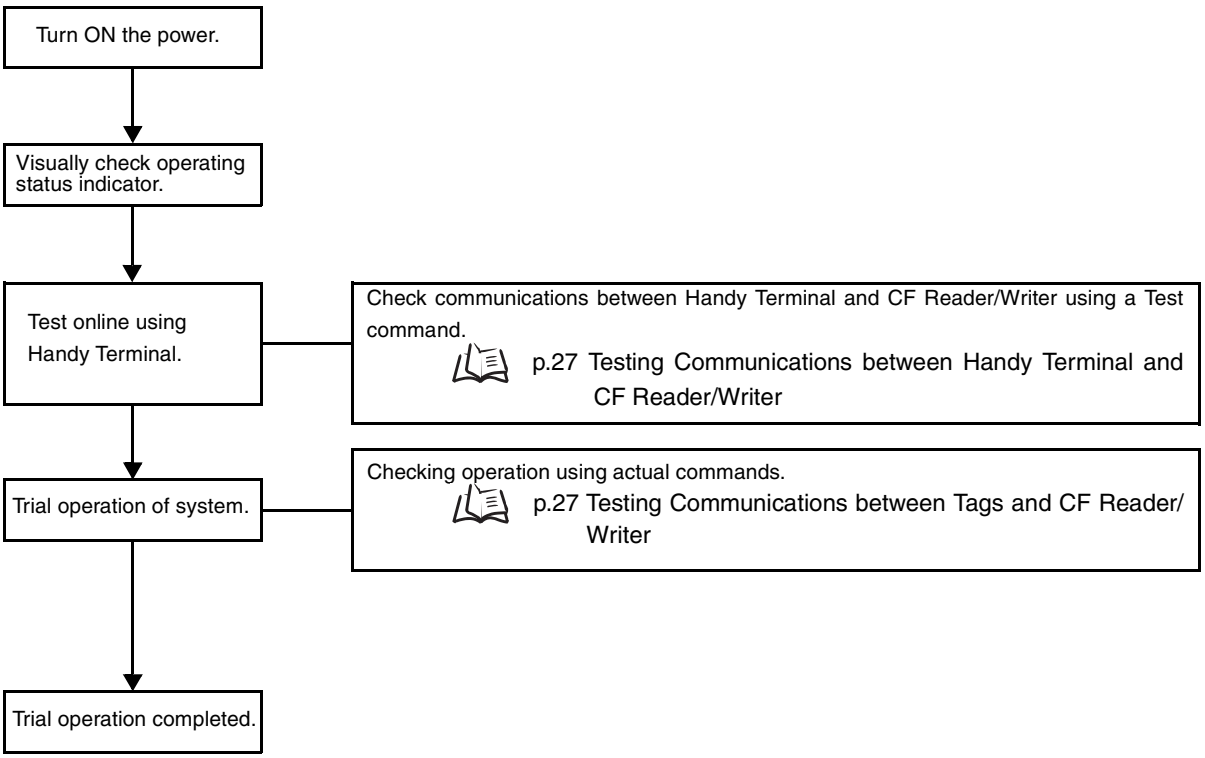
The default settings for the CF Reader/Writer are as follows: Baud rate: 38,400 bps, Data bits: 8 bits, Parity: even, Stop bits: 1 bit.

For Handy Terminal operating procedures, refer to the operating instructions provided by the manufacturer.
Refer to *Interface Specifications* for details on the communications settings for the CF Reader/Writer.

p.68 Interface Specifications

Communications Test

Procedure for Trial Operation



Testing Communications between Handy Terminal and CF Reader/Writer

A Test command is used to test communications between the CF Reader/Writer and Handy Terminal. This enables checking the CF card slot connection and communications processing before performing trial operation of the system.

1. Send a Test command from the Handy Terminal.

CHECK!

Refer to *Test (TS)* for information on using the Test command.

p.55 Test (TS)

2. The CF Reader/Writer will return the received data if the communications network is operating normally.

CHECK!

Refer to *Errors and Countermeasures* if there is no response from the CF Reader/Writer.

p.63 Errors and Countermeasures

Testing Communications between Tags and CF Reader/Writer

Actual commands are used to test communications between Tags and the CF Reader/Writer.

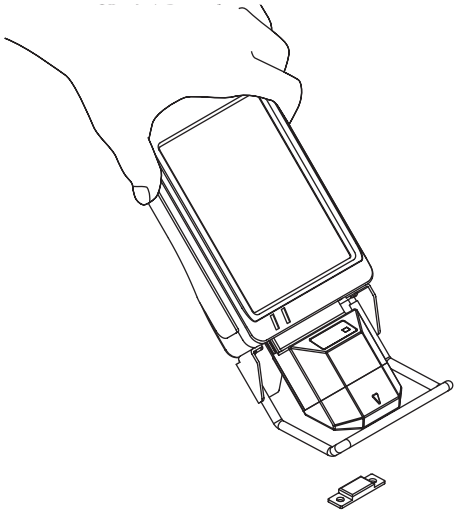
1. Enter the Read command from the Handy Terminal.

CHECK!

Refer to *Commands* for information on how to use the command.

p.35 Commands

2. Bring the antenna on the CF Reader/Writer close to the Tag.



CHECK!

Keep the surface of the antenna on the CF Reader/Writer parallel to the Tag surface.

3. When the CF Reader/Writer is within the communications area, the data in the Tag's internal memory will be read and displayed on the Handy Terminal.

SECTION 3
Functions

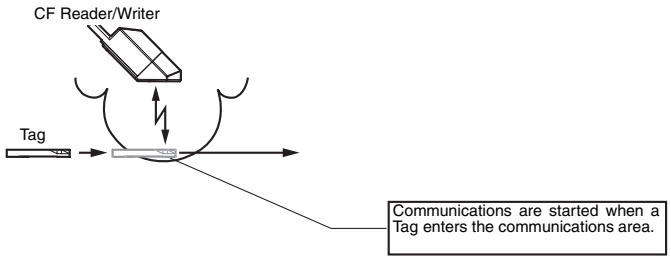
Communications Designation Function

The CF Reader/Writer automatically detects Tags for the communications commands given in the following table.

Symbol	Name	Description
SA	Single Auto command	After the Single Auto command has been received, a communication is executed when a Tag is detected in the communications area and a response is returned.
RA	Repeat Auto command	The operation specified under SA is repeatedly executed. The CF Reader/Writer communicates only once with each Tag, even if that Tag continues to be in the communications area.

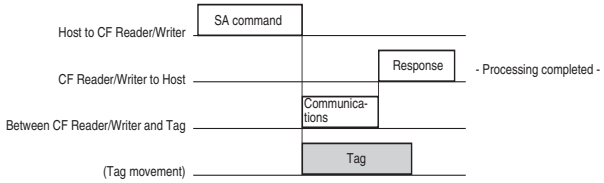
Communications Designations (SA/RA)

SA and RA automatically detect Tags and communicate with them.



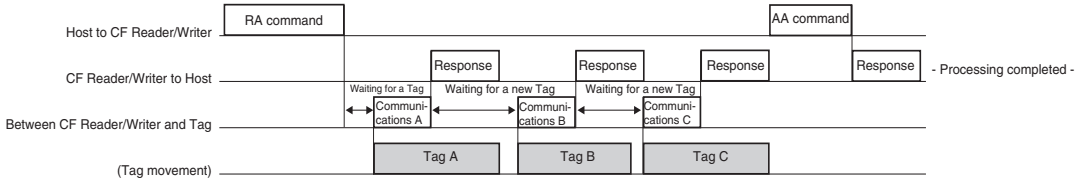
■ SA Designation

When the Single Auto command (SA) is specified, command processing is completed when communications have been completed.



■ RA Designation

When the Repeat Auto command (RA) is specified, the CF Reader/Writer waits for the next Tag each time communications are completed. Once communications have been performed with a Tag, there are no more communications with that Tag until the Tag has moved outside the communications area. This processing is repeated until it is ended when the Command Processing Abort command (AA) is received.



Setting Operating Parameters

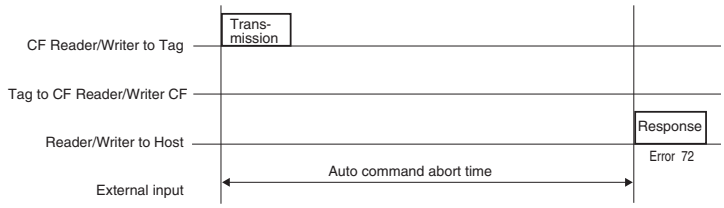
The operating parameters outlined below can be set to optimize CF Reader/Writer performance and reliability, and to optimize the system itself. If changing the operating parameters, always do so with the power turned ON. Normally, there are no problems in using the default settings.

- Auto command abort time
- Write verification

CHECK! The CF Reader/Writer is initialized when the power is turned OFF and the operating parameter settings are not stored. Refer to *Parameter Setting (SP)* for information on using the Parameter Setting (SP) command.
p.53

Auto Command Abort Time

When an Auto command is received, the CF Reader/Writer waits until a Tag is detected in the communications area and then starts communications. If, however, a Tag is not detected within a set period, processing is aborted and a No Tag error (72) is returned.
A command error will be returned if "00" is set as the Abort auto command time.



Setting range
01 to 60 s

* The default setting is 10 s.

Write Verification

Write verification checks that any data written to Tags is correct. A verification error (71) will be returned if the data is not written correctly.

Setting range
0 (write verification disabled) 1 (write verification enabled)

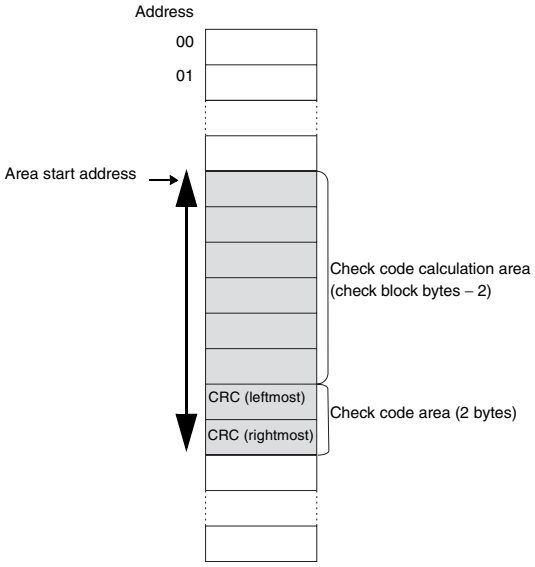
* The default setting is 1 (write verification enabled).

Memory Check Function

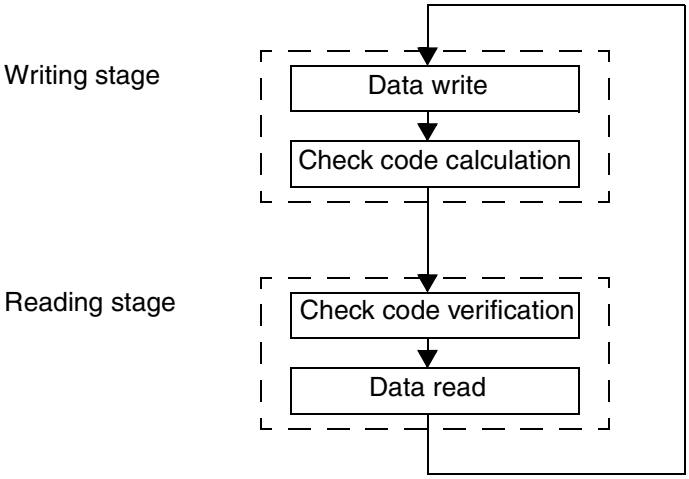
A check code can be added to the data in a Tag to detect errors from memory write life or unexpected causes. The polynomial $X^{16} + X^{12} + X^5 + 1$ is used to generate a CRC code as the check code.
Use the Memory Check command (MD) to write and verify commands.

In the check block, which is specified using the start address and the number of bytes, all but the last two bytes are the calculation area. The last two bytes of the block are the check code area.

When a Check Code Write command is sent, the CRC code for the data in the calculation area is calculated and written to the check code area. When a Data Verify command is sent, the CRC code for the data in the calculation area is calculated and compared to the data in the check code area. When the data matches, "0" is returned as the response status flag to indicate that the data is normal. If the data does not match, "1" is returned as a warning.



Calculate and write the check code using the Memory Check command (MD) after writing data and verify the check code before reading data. This enables detecting in advance data corruption in Tags that can occur while the Tags are not being accessed.



CHECK!

Refer to *Memory Check (MD)* when using the Memory Check function.
p.48

Write Protection

The write protection function is a protective function designed to prevent fixed data, such as palette information or product information, stored in a Tag memory from being erased by accidental overwriting. Any area of specified addresses can be write protected (a maximum of two areas) by setting protection information in the Tag. A protection error will occur if a write is executed for any write-protected page.
Part of the user data area ($0000 to $0003) is used for protection area information.
To enable write protection, write the protection area information to a specified address and then use the Tag Function Setting command (TF) to specify “Protection Setting” in the process designation parameter. Similarly, to disable write protection, specify “Disable” in the process designation parameter.


CHECK!

Refer to *Tag Function Designation (TF)* when using the write protection function.
p.49

Relationship between Protection Information and Protection Area

User address	Description	Data example
$0000	Start address of write protection area 1	05h
$0001	End address of write protection area 1	10h
$0002	Start address of write protection area 2	70h
$0003	End address of write protection area 2	75h
$0004	User area	
$0005		Write protection area 1
. .		
$0010		
$0011		
. .		
$006F		
$0070		Write protection area 2
. .		
$0075		
$0076		
$007F		

* Range for protection area: 0004h to 007Fh


CHECK!

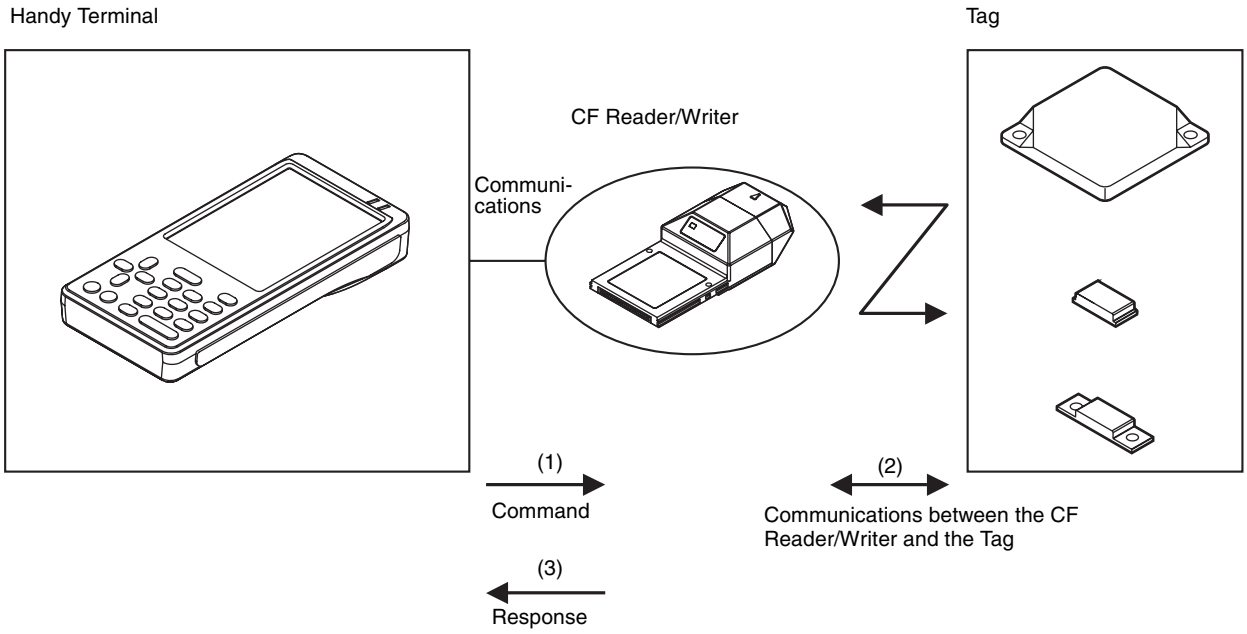
Area $0000 to $0003 cannot be used as data area if the write protection function is used.

MEMO

SECTION 4
Commands

CF Reader/Writer Operation Status

A command (1) sent from the connected Handy Terminal initiates communication between the CF Reader/Writer and a Tag (2). The CF Reader/Writer then returns the result as a response (3) to the Handy Terminal.



■ CF Reader/Writer Operation Status

• Command Standby Status

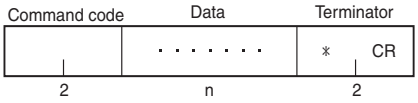
This is the status where the CF Reader/Writer is not processing any commands, but can accept any command except subcommands. When a command is received, the CF Reader/Writer enters the command processing status.

• Command Processing

Once a command has been received, the CF Reader/Writer ignores the next command until processing of the received command has been completed. Command processing abort and reset commands, however, can always be received.

Command Response Format

Command Frames



Name	Description
Command code	Specifies the command.
Data	Specifies the parameters for command execution (address, number of bytes, etc.) or specifies the data to be written.
Terminator	Indicates the end of a command, using the two characters "*" ($2A) and the carriage return code ($0D).

Response Frames

Name	Description		
Command code	The same data as the sent command frame is added and returned.		
End code	Shows the command execution result.		
Retry flag	Always 0.		
Status flag	A code that shows the status of command execution.		
	0	Normal	Indicates that the processing was completed normally.
	1	Tag data status	Indicates that the verification result of the Memory Check command (MD) detected an error, or that an overflow/underflow occurred in the calculation of a Computation Write command (CW).
	2	Abort status	Indicates a communication with a Tag was aborted after it was started, using the aborting command (AA).
Data	Provides the data read according to the command.		
Terminator	Indicates the end of a command, using the two characters "*" ($2A) and the carriage return code ($0D).		

Data Type Designation

The data type to be used when transmitting read or write data between the CF Reader/Writer and the Handy Terminal can be specified in a command. Either ASCII or hexadecimal can be used.

■ ASCII (JIS8 Unit Code) Designation "A"

One byte of data in a Tag is transmitted directly as ASCII or JIS8 unit code. Each transmitted character is equivalent to 1 byte of data in the Tag. Character data can be directly read or written, but do not use the carriage return (CR) control code in send data. If the CR control code is used in write data, a command error will occur.

• Data Write Example

If "V670" is specified as the write data for 4 bytes of memory beginning with the address 10h, the data is written to the Tag memory as shown in the diagram.

Command

W	T	S	A	A	1	0	0	1	0	0	4	V	6	7	0	*	CR
Command		Communications designation		ASCII designation	Antenna designation	Start address				No. of bytes		Write data					

• Data Read Example

If 4 bytes of memory is read starting with address 10h, the read data will be "V670" for the data shown in the diagram.

Response

R	D	0	0	0	0	V	6	7	0	*	CR
Command		End code		Retry flag	Status flag	Read data					

Tag memory

Address			
10h	5	6	"V"
11h	3	6	"6"
12h	3	7	"7"
13h	3	0	"0"

■ Hexadecimal (JIS8 Unit Code) Designation "H"

One byte of Tag data is converted to two hexadecimal characters (00 to FF) and transmitted. Each transmitted character is equivalent to 1 byte of data in the Tag. Always set write data in the 2-character units 00 to FF (i.e., as an even number of characters). A command error will occur if an odd number of characters is accidentally set.

• Data Write Example

If "56363730" is specified as the write data for 4 bytes of memory beginning with the address 10h, the data is written to the Tag memory as shown in the diagram.

Command

W	T	S	A	H	1	0	0	1	0	0	4	5	6	3	6	3	7	3	0	*	CR
Command		Communications designation		HEX designation	Antenna designation	Start address				No. of bytes		Write data									

• Data Read Example

If you read 4 bytes of memory starting with address 10h, the read data will be "56363730" for the data shown in the diagram.

Response

R	D	0	0	0	0	5	6	3	6	3	7	3	0	*	CR
Command		End code		Retry flag	Status flag	Read data									

Tag memory

Address		
10h	5	6
11h	3	6
12h	3	7
13h	3	0

Ranges for Start Address and Number of Bytes

The following table shows the commands and available designation range for specifying start addresses and number of bytes in commands. If a value outside the available range is specified, a command error will occur.

Command code	Ranges for start address and number of bytes		Other restrictions
Read (RD)	A) Start address: B) No. of bytes:	0000h to 007Fh 01h to 80h	A+B ≤ 80h*
Write (WT)	A) Start address: B) No. of bytes:	0000h to 007Fh 01h to 80h	A+B ≤ 80h*
Computation Write (CW)	A) Start address: B) Calculation area:	0000h to 007Fh 01h to 04h	A+B ≤ 80h*
Data Fill (DF)	A) Start address: B) End address:	0000h to 007Fh 0000h to 007Fh	A ≤ B
Memory Check (MD)	A) Start address: B) No. of check bytes:	0000h to 007Dh 03h to 80h	A+B ≤ 80h*

* If the start address is 20h and the number of bytes is 70h, the result is A + B = 90h, which gives a command error.

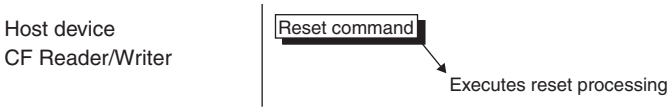
Command Response Flow

The command received from the Handy Terminal by the CF Reader/Writer may be different to the response sent to the Handy Terminal from the CF Reader/Writer, depending on the type of command and the communications designation.

No Response

If the CF Reader/Writer receives a reset command, it sends no response, performs reset processing, and waits for the next command.

The indicator will light green when the CF Reader/Writer receives a command. After sending a command, check the indicator to be sure that the CF Reader/Write has received the command.

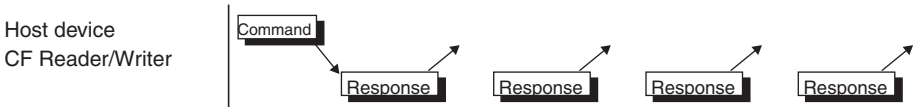


Single Response

One response is returned for one command when single auto (SA) is specified in a command for communicating with Tags, when commands that are not for communicating with Tags (communications subcommand, controller control commands, or host commands) are specified, when appraisal commands are specified, etc.

Multiple Responses

Multiple responses are returned for one command when repeat auto (RA) is specified in a command for communicating with Tags.



Command List

There are 5 main types of commands.

■ Communications Commands

Communications commands to communicate with Tags.

Command code	Name	Description	Reference page
RD	Read	Reads Tag memory data.	p.44
WT	Write	Writes data to Tag memory.	p.45
CW	Computation Write	Writes memory data and the calculation result to Tags.	p.46
DF	Data Fill	Writes designated data to a designated area.	p.47
MD	Memory Check	Sets and verifies Tag memory check codes.	p.48
TF	Tag Function Designation	Sets/clears the write protection for Tags.	p.49
ID	ID Read	Reads the Tag user ID.	p.51

■ Communications Subcommand

The communications subcommand aborts command execution.

Command code	Name	Description	Reference page
AA	Command Processing Abort	Aborts communications with a Tag.	p.52

■ Controller Control Commands

Controller control commands stop communications with Tags, reset the CF Reader/Writer., etc.

Command code	Name	Description	Reference page
SP	Parameter Setting	Sets all CF Reader/Writer parameters.	p.53
XZ	Reset	Resets the CF Reader/Writer.	p.54

■ Host Commands

Host commands test communications between the CF Reader/Writer and the Handy Terminal.

Command code	Name	Description	Reference page
TS	Test	Checks the status of communications between the Handy Terminal and the CF Reader/Writer. Returns data received from the Handy Terminal to as is.	p.55
VS	Version Information	Reads the CF Reader/Writer model information, software version, and creation date.	p.55

■ Appraisal Commands

Appraisal commands investigate the occurrence of ambient noise and evaluate communications stability.

Command code	Name	Description	Reference page
NS	Noise Measurement	Detects noise level.	p.56
EN	Error Noise Detection	Detects noise above a certain level.	p.57
SF	Stability Evaluation	Reads data from the Tag and evaluates the received data.	p.58

Communications Designations

The following two communications designations can be specified using communications commands.

Communications designation code	Name	Description
SA	Single auto	After the Single Auto command has been received, a communication is executed when a Tag is detected in the communications area and a response is returned.
RA	Repeat auto	The operation specified under SA is repeatedly executed. The CF Reader/Writer communicates only once with each Tag, even if that Tag continues to be in the communications area. Processing can be canceled by the Command Processing Abort command and the Parameter Setting command (auto command abort time).

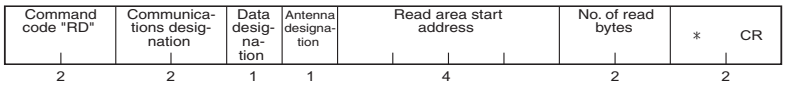
Communications Commands

This section describes the commands used for communicating with Tags.

Read (RD)

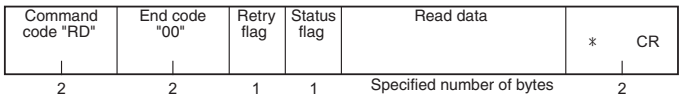
Reads data from the area specified by start address and number of bytes.

Command



Communications designation	Specifies the method for communicating with a Tag. Refer to *Communications Designations* for details. p.43
Data designation	Specifies the data format when sending the read data response. “A”: ASCII “H”: Hexadecimal
Antenna designation	Always “1”.
Read area start address	Specifies the start address in the Tag memory area for reading data in four hexadecimal digits. Specification range: 0000h to 007Fh
No. of read bytes	Specifies the number of bytes of data to be read from the Tag in two hexadecimal digits. The maximum number of characters that can be read at one time is 256. Specification range: 01h to 80h

Response



Read data	Data read from the Tag. The number of characters is the number of read bytes in ASCII, and the number of read bytes times 2 in hexadecimal.

Example: Reading 8 Bytes of Data Starting from Address 0000h (Single Auto, Hexadecimal)

Send data: RDSAH1000008*[CR]

Receive data: RD0000123456781234567 8*[CR]

CHECK!

Specify the total number of read bytes so that the sum of the read area start address and the number of bytes does not exceed the Tag memory capacity (128 bytes).

Example: The number of bytes can be specified between 01h and 70h for a start address of 0010h.

Write (WT)

Writes the specified number of bytes of data starting from the specified start address to a Tag.

Command

Command code "WT"	Communications designation	Data designation	Antenna designation	Write area start address	No. of write bytes	Write data	*	CR
2	2	1	1	4	2	Specified number of bytes	2	

Communications designation	Specifies the method for communicating with a Tag. Refer to *Communications Designations* for details. p.43
Data designation	Specifies the data format when sending write data to Tags. “A”: ASCII “H”: Hexadecimal
Antenna designation	Always “1”.
Write area start address	Specifies the start address in the Tag memory area for writing data in four hexadecimal digits. Specification range: 0000h to 007Fh
No. of write bytes	Specifies the number of bytes of data to be written to the Tag in two hexadecimal digits. Specification range: 01h to 80h
Write data	Data written to Tags. There will be 2 characters per byte if hexadecimal is specified.

Response

Command code "WT"	End code "00"	Retry flag	Status flag	*	CR
2	2	1	1	2	

Example: Writing 4 Bytes of Data (“11223344”) from Address 0010h (Single Auto, Hexadecimal)

Send data: WTSAH100100411223344*[CR]

Receive data: WT0000*[CR]

CHECK!

Specify the total number of write bytes so that the sum of the write area start address and the number of bytes does not exceed the Tag memory capacity (128 bytes).

Example: The number of bytes can be specified between 01h and 70h for a start address of 0010h.

Computation Write (CW)

Performs a hexadecimal calculation using the data in Tag memory and the calculation data and writes the result to the Tag. If an overflow occurs for addition or an underflow occurs for subtraction, the data is not written to the Tag and “1” is returned for the status flag.

Command

Command code "CW"	Communications designation	Process designation	Antenna designation	Calculation area start address	No. of bytes in calculation area	Calculation data	*	CR
2	2	1	1	4	2	Specified number of bytes	2	

Communications designation	Specifies the method for communicating with a Tag. Refer to *Communications Designations* for details. p.43
Process designation	Specifies the calculation method. “A”: Hexadecimal addition “S”: Hexadecimal subtraction
Antenna designation	Always “1”.
Calculation area start address	Specifies the start address in the Tag memory area for calculating data in four hexadecimal digits. Specification range: 0000h to 007Fh
No. of bytes in calculation area	Specifies the number of bytes of calculation data in the calculation area in two hexadecimal digits. Specification range: 01h to 04h
Calculation data	Specifies in hexadecimal the number to be used in the calculation.

Response

Command code "CW"	End code "00"	Retry flag	Status flag	Results data	*	CR
2	2	1	1	Specified number of bytes	2	

Results data	Returns the calculation results data written to the Tag. The data before the calculation was performed will be returned if addition gives an overflow or subtraction gives an underflow. The status flag will be “1” in these cases.

Example: Writing 2 Bytes of Data, the Result of Subtracting the Subtraction Data “0002” from “0010”, the Data Starting at Address 0001h (Single Auto, Initial Value: “0010”)

Send data: CWSAS10001020002*[CR]

Receive data: CW0000000E*[CR]

CHECK!

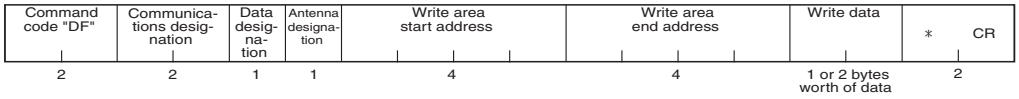
This command performs hexadecimal calculations, so specify hexadecimal for all data being handled. Also, set the calculation area so that it is contained within one page. If the calculation area is not contained within one page, a command error will occur.

p.83 Memory Map

Data Fill (DF)

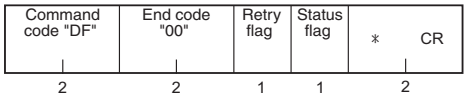
Writes one or two bytes of the same data to a specified Tag area. The write data is specified in hexadecimal.

Command



Communications designation	Specifies the method for communicating with a Tag. Refer to *Communications Designations* for details. p.43
Data designation	Specifies the size of the write data. “B”: Bytes “W”: Words (2 bytes)
Antenna designation	Always “1”.
Write area start address	The address in the Tag for writing data is specified in four hexadecimal digits. Specification range: 0000h to 007Fh
Write area end address	The end address in the Tag for writing data is specified in four hexadecimal digits. Specification range: 0000h to 007Fh
Write data	Data written to Tags. Set one byte of hexadecimal if “B” is specified under Data designation, two bytes if “W” is specified.

Response



Example: Writing Fill Data “00FF” from Address 0000h to 007Fh (Single Auto, Writing 2 Bytes)

Send data: DFSAW10000007F00FF*[CR]

Receive data: DF0000*[CR]

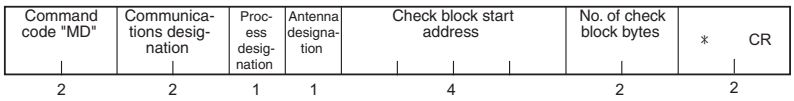
CHECK!

The volume of data communications with the Handy Terminal can be reduced by writing fill data to a specified area, so the use of this command can improve the efficiency of the system.

Memory Check (MD)

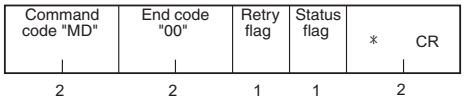
Calculates the check code for the specified block using the polynomial $X^{16} + X^{12} + X^5 + 1$, and verifies the result against the check code attached to the check block.

Command



Communications designation	Specifies the method for communicating with a Tag. Refer to *Communications Designations* for details. p.43
Process designation	Specifies the check process. “K”: Check code calculation “C”: Check code verification
Antenna designation	Always “1”.
Check block start address	Specifies the check block start address in four hexadecimal digits. Specification range: 0000h to 007Dh
No. of check block bytes	Specifies the number of check block bytes in two hexadecimal digits. Specification range: 03h to 80h

Response



Status flag	Shows the check code verification result. “0”: Verification normal “1”: Verification error

Example: Adding a Check Code to 4 Bytes of Data from Address 0010h (Single Auto)

Send data: MDSAK1001006*[CR]

Receive data: MD0000*[CR]

* The specified number of bytes will be 6, with 2 bytes of check code attached to 4 bytes of data.

CHECK! Do not write required data in the last two bytes of the area. These two bytes are used to record the check code.
Refer to *Memory Check Function* for details.
p.32

Tag Function Designation (TF)

Sets/clears write protection for Tags.

Command

Command code "TF"	Communications designation	Process designation	Antenna designation	*	CR
2	2	1	1	2	

Communications designation	Specifies the method for communicating with a Tag. Refer to *Communications Designations* for details. p.43
Process designation	Specifies setting or clearing the function. “P”: Sets protection. “R”: Clears protection.
Antenna designation	Always “1”.

Response

Command code "TF"	End code	Retry flag	Status flag	*	CR
2	2	1	1	2	

■ Setting Example

Relationship between Protection Information and Protection Area

User address	Description	Data example
$0000	Start address of write protection area 1	05h
$0001	End address of write protection area 1	10h
$0002	Start address of write protection area 2	70h
$0003	End address of write protection area 2	75h
$0004	User area	
$0005		Write protection area 1
. .		
$0010		
$0011		
. .		
$006F		
$0070		Write protection area 2
. .		
$0075		
$0076		
$007F		

* Protection area setting range: 0004h to 007Fh

• No Write Protection

When write protection is not set for the Tag:

Send data: TFSAR1*[CR]

Receive data: TF0000*[CR]

• Write Protection Specified for One Location

When setting write protection for Tag memory addresses 0005h to 0010h (single auto, hexadecimal)

Setting Protection Area Information

Send data: WTSAH100000405100510*[CR]

Receive data: WT0000*[CR]

Setting Write Protection

Send data: TFSAP1*[CR]

Receive data: TF0000*[CR]

When setting write protection for only one location, set the same data to addresses 0002h and 0003h and to addresses 0000h and 0001h.

• Write Protection Specified for Two Locations

When setting write protection for Tag memory addresses 0005h to 0010h and addresses 0070h to 0075h (single auto, hexadecimal)

Setting Protection Area Information

Send data: WTSAH100000405107075*[CR]

Receive data: WT0000*[CR]

Setting Write Protection

Send data: TFSAP1*[CR]

Receive data: TF0000*[CR]

Refer to *Write Protection* for details on write protection.

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ID Read (ID)

Reads the Tag's user ID.

Command

Command code "ID"	Communications designation	Data designation	Antenna designation	*	CR
2	2	1	1	2	

Communications designation	Specifies the method for communicating with a Tag. Refer to *Communications Designations* for details. p.43
Data designation	Always "H" (hexadecimal).
Antenna designation	Always "1".

Response

Command code "RD"	End code "00"	Retry flag	Status flag	Read data	*	CR
2	2	1	1	Specified number of bytes	2	

Read data	User ID data read from a Tag. 00000000 to 3FFFFFFF The leftmost 2 bits are system bits and are always 0.

Example: Reading Tag User ID (Single Auto, User ID: "12345678")

Send data: IDSAH1*[CR]

Receive data: ID000012345678*[CR]

All Tags store their own unique ID. The ID Read command can be used for very fast communications if all that is required is to detect whether or not there is a Tag in the communications area.

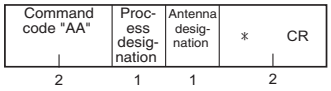
Communications Subcommand

The communications subcommand is used in combination with communications commands. No communications processing is performed with Tags when the communications subcommand is used alone.

Command Processing Abort (AA)

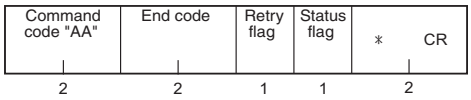
Aborts processing of a command being executed and returns to the command standby status. Command Processing Abort can be executed during the processing of any command.

Command



Process designation	Always “0”.
Antenna designation	Always “1”.

Response



When command processing has been aborted after a Tag is detected, the status flag will be “2”.

Example: Aborting Command Processing during Execution

Send data: AA01*[CR]

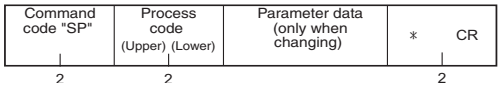
Receive data: AA0000*[CR]

Controller Control Commands

Parameter Setting (SP)

This command sets communications conditions by setting the parameters in the CF Reader/Writer.

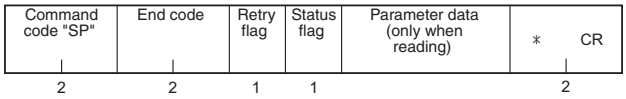
Command



Process code (upper digit)	Specifies the process to be performed for the parameter. "0": Change "1": Read "9": Initialize (default setting)	
Process code (lower digit)	Specifies the parameter. "4": Auto command abort time "C": Write verification	
Parameter data (only when changing the parameter)	Parameter*	Setting range
	4	Set two decimal digits 01 to 60 (unit: 1 s). A command error will occur if 00 is set. Default: 10 s.
	C	0: OFF, 1: ON, Default: 1 (Write verification enabled)

* The parameter number for the parameter data is the number specified in the lower digit of the process code. Set the parameter data within the setting range given for the parameter number specified in the lower digit of the process code.

Response



Example: Setting Character Interval Monitoring Time to 500 ms

Send data: SP010500*[CR]

Receive data: SP0000*[CR]

Reset (XZ)

Resets the CF Reader/Writer.

Command

Command code "XZ"	*	CR
2	2	

Response

No response is sent.

A response is not returned for the Reset (XZ) command. The indicator will flash green when this command is received. Check the indicator after sending this command to confirm that it has been received.

Example: Resetting the CF Reader/Writer

Send data: XZ*[CR]

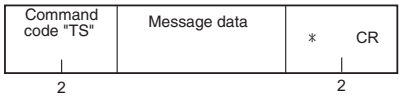
Receive data: None

Host Commands

Test (TS)

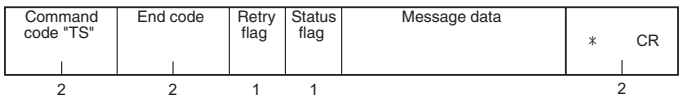
Returns the message sent by the Handy Terminal directly as the response. The Test command is used to test communications between the CF Reader/Writer and a Handy Terminal.

Command



Message data	Any character string for testing communications.

Response



Example: Sending Message Data “OMRON” from the Handy Terminal

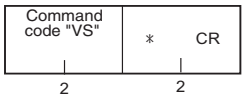
Send data: TSOMRON*[CR]

Receive data: TS0000OMRON*[CR]

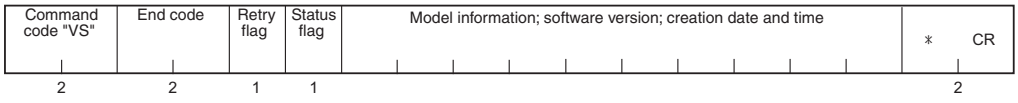
Version Information (VS)

Reads the CF Reader/Writer model information, software version, and creation date and time.

Command



Response



Example: Reading the CF Reader/Writer Software Version

Send data: VS*[CR]

Receive data: VS0000V670-CF01$00000000;1.00;2004/04/01*[CR]

Appraisal Commands

If errors are frequent during communications with Tags, one of the causes may be ambient noise. The appraisal commands are used to investigate whether or not noise is the cause of errors. It can also be used to check noise generation at installation sites before installing V670-series Tags or Antennas and Controllers.
Even if read results are normal, reception waveforms may exhibit interference. These commands can be used to check for noise at the waveform level to provide more detailed information on the actual status of the waveforms.

Noise Measurement Command (NS)

Investigates the noise level when commands are received.

Command

Command code "NS"	*	CR
2	2	

Response

Command code "NS"	End code	Retry flag	Status flag	Result of noise level measure-ment	*	CR
2	2	1	1	1	2	

Noise evaluation result	The noise level is evaluated as the maximum absolute value in the measured data. “A”: Low noise level (0.0 V to 2.0 V); indicator will light green. “B”: High noise level (2.0 V to 3.3 V); indicator will flash red.

Example: Investigating Ambient Noise Level
Send data: NS*[CR]
Receive data: NS00000A*[CR]

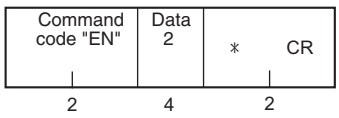
Error Noise Detection Command (EN)

The Error Noise Detection command detects noise above a specified level.
When deciding where to mount Tags and Antennas, use this command to investigate where the noise level is high.

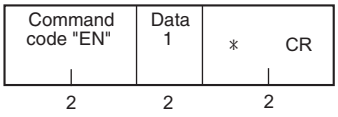
Command

Specifying Data 1 and Data 2

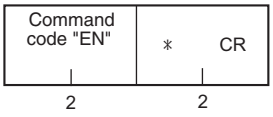
Omitting Data 1



Omitting Data 2



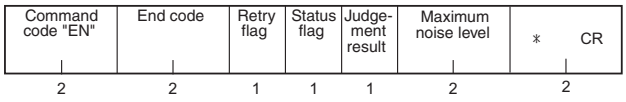
Omitting Data 1 and Data 2



Data 1 Error noise level	Specifies the error noise level in two decimal digits. (This setting may be omitted*). Specification range: 00 to 33 (× 0.1 V) Default: 2.0 V When “00” is specified: 100%
Data 2 Measurement time	Specifies the error noise measurement time in four decimal digits. (This setting may be omitted*). Specification range: 0000 to 0100 s Default: 0060 s When “0000” is specified: Noise level when command is received is returned in the response.

* When both data 1 and data 2 are omitted, noise detection is performed using the previously specified values. If they are omitted the first time this command is set after turning ON the power supply, the default settings will be used for noise detection.

Response



Judgment result	The noise level is evaluated as the maximum absolute value in the measured data. “0”: Normal; indicator will light green. “1”: Error; indicator will flash red.
Maximum noise level	Gives the maximum noise level (V) detected during the measurement period in two decimal digits. Unit: 0.1 V

Example: Detecting Noise at 3.3 V or Greater during a Period of 5 s

Send data: EN330005*[CR]

Receive data: EN0000020*[CR]

CHECK! The Error Noise Detection command can be canceled using the Command Processing Abort command (AA), because no response is given for a set period of time.

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Stability Evaluation Command (SF)

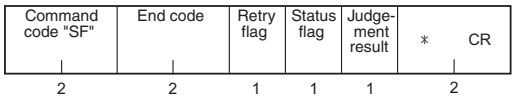
The Stability Evaluation command evaluates the stability of received data.
Data is read from the Tag, the received data is evaluated, and the evaluation results are returned in the response and through the indicator. Forty bytes of data is read starting from address 0000h.

Evaluation Criteria

Response	Meaning	Evaluation criteria	Indicator
A	Excellent	Min. 80% within distribution range	Lit green.
B	Good	Min. 60% within distribution range	Flashing green.
C	No good	Less than 60% within distribution range	Flashing red.

Command

Response



Example: Investigating Communications Stability

Send data: SF*[CR]

Receive data: SF0000A*[CR]

End Code List

Type	End code	Name	Description
Normal end	00	Normal end	Command execution has ended correctly.
Host communications error*1	10	Parity error	A parity error has occurred in the characters in the command.
	11	Framing error	A framing error has occurred in the characters in the command.
	12	Overrun error	An overrun error has occurred in the characters in the command.
	14	Format error	The command format is incorrect. The character interval exceeds the set time.
	18	Frame length error	A command string longer than 300 characters was received.
Tag communications error	70	Communications error	An error occurred during communications with a Tag, and the communications could not be completed normally.
	71	Verification error	The correct data could not be written to the Tag (only possible when verification is enabled).
	72	No-tag error	There is no Tag in the CF Reader/Writer communications area.
	7A	Address designation error	The designated processing address is not suitable, and the execution is impossible.
	7D	Write protection error	Data was written to a write-protected page.
	7E*2	Lock error	Write was specified for a locked area.
	7F*2	Tag error	Communications were attempted with a Tag for which communications are not enabled (e.g., no password setting).

*1 Communications between the CF Reader/Writer and the Handy Terminal are called host communication.

*2 “7E” (lock error) and “7F” (tag error) are most likely Tag errors. If these errors occur no matter how many times communications are attempted, replace the Tag.

CHECK!

Refer to *Part Names and Functions* for details on the indicator.

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MEMO

SECTION 5
Troubleshooting

Diagnosis Function

When errors occur with the CF Reader/Writer, the type of error can be determined through the indicator, i.e., by whether the indicator lights red or flashes red.

Errors

The errors detected by the diagnostic function can be classified into two types of errors. One terminates operation (fatal errors) and the other does not terminate any operation (nonfatal errors).

■ Fatal Errors

When a CPU error has occurred in the CF Reader/Writer, CPU operation is terminated and the indicator lights red. The indicator will remain lit red until the power supply is turned OFF. Check the information in the following table and take appropriate corrective actions before restarting operation.

Indicator	Status	Description	Error code
Lights red	CPU error	Turn OFF the power supply and then turn it back ON to return to initial status	---


CHECK!

If the above procedure does not correct the problem, the CF Reader/Writer may be faulty.

■ Nonfatal Errors

When errors occur during communications between the CF Reader/Writer and the Handy Terminal or between the CF Reader/Writer and Tags, the indicator lights or flashes red. The indicator will turn OFF after lighting or flashing and the command will be received. Check the information in the following table and take appropriate corrective actions before restarting operation.

Indicator	Status	Description	Error code
Lights red	Error in communications with Tag	Ambient noise interference p.56 Appraisal Commands	70
		Tag write life expired (replace Tag).	71
		Processing address specification p.39 Ranges for Start Address and Number of Bytes	7A
		Tag write protection settings p.49 Tag Function Designation (TF)	7D
		Model or specifications of the Tags being used	7E, 7F
		Settings (e.g., lock setting) of the Tags being used	7E, 7F
		Tag operating environment (Tags destroyed by unanticipated usage.) Try communicating with a different Tag. If communications are possible, there is an error in the Tag.	71, 7E, 7F
Flashes red	Tag missing error	Distance between CF Reader/Writer and Tag p.75 Communications Distance Specifications	72
		Tag operating environment (Tags destroyed by unanticipated usage.) Try communicating with a different Tag. If communications are possible, there is an error in the Tag.	72
	Communications error with the Handy Terminal	Command format p.35 Commands	14
		Handy Terminal communications specifications p.68 Interface Specifications	---


CHECK!

If the problem cannot be solved after performing the above checks, the CF Reader/Writer may be faulty.

Errors and Countermeasures

Problems with the CF Reader/Writer are normally caused by one of the following four problems.

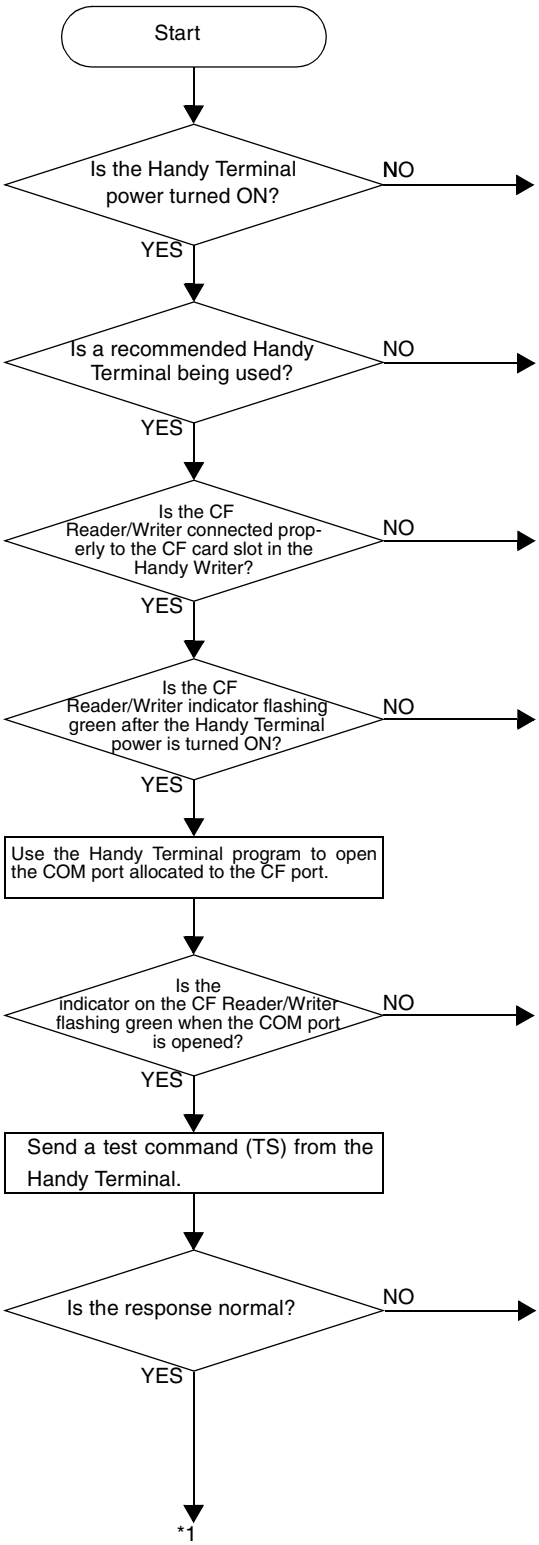
- Handy Terminal is faulty.
- CF Reader/Writer is faulty.
- Tag is faulty.
- Other

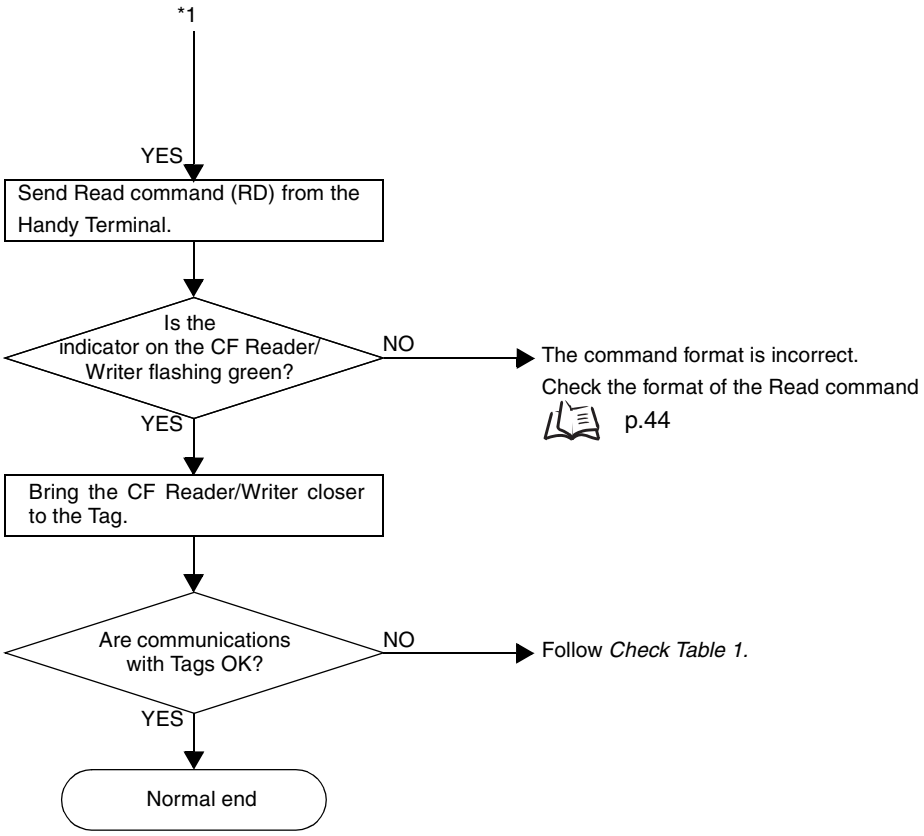
Repairs are required if a device is faulty.

Troubleshooting

When an error occurs, study the situation fully, determine if the error will recur and its relation to other devices, and then check the error according to the following flowchart.

■ Operation Check Flowchart





- Check Table 1

Check point	Corrective action
Distance to CF Reader/ Writer	Bring the CF Reader/Writer closer to the Tag so that it is within the communications range.
Tag write protection	Release the Tag write protection settings.
Ambient metal	Remove metal objects from near the Tag or change the mounting location of the Tag.
Noise	Measure the noise level and take appropriate noise countermeasures.
Tags	Communicate with the Tag with a different device to see if the Tag is functioning properly.

Error Tables

■ Host Communications Errors

Host communications errors are errors in communications between the CF Reader/Writer and the Handy Terminal. The indicator will flash red when a host communications error occurs.

Error code	Name	Description
10	Parity error	A parity error has occurred in characters in the command.
11	Framing error	A framing error has occurred in characters in the command.
12	Overrun error	An overrun error has occurred in characters in the command.
14	Format error	The command format is incorrect. The character interval exceeded the set time.
18	Frame length error	A command string longer than 300 characters was received.

Refer to *Errors* for corrective actions for the above errors.
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■ Tag Communications Errors

Tag errors are errors in communications between the CF Reader/Writer and a Tag. The indicator will flash red when a “Tag missing” tag error occurs and will light red when any other tag error occurs.

Error code	Name	Description
70	Communications error	An error occurred during communications with a Tag, and the communications could not be completed normally.
71	Verification error	The correct data could not be written to the Tag (possible only when verification is enabled).
72	No-tag error	There is no Tag in the CF Reader/Writer communications area.
7A	Address designation error	The designated processing address is not suitable, and the execution is impossible.
7D	Write protection error	Data was written to a write-protected page.
7E	Lock error	Write was specified to a locked area.
7F	Tag error	Communications were attempted with a Tag for which communications are not enabled (e.g., no password setting).

Refer to *Errors* for corrective actions for the above errors.
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SECTION 6
Appendices

Specifications and Dimensions

CF Reader/Writer

■ General Specifications

Item	Specifications
Power supply voltage	3.3 V ±5%, 5.0 V ±5%
Ambient operating temperature	0 to 40°C
Ambient operating humidity	35% to 85% (with no condensation)
Ambient storage temperature	–25 to 65°C
Ambient storage humidity	35% to 85% (with no condensation)
Weight	Approx. 28 g
Current consumption	200 mA max. (power supply voltage 3.3 V)
Material	ABS (black), SUS
Vibration resistance	1 to 150 Hz, single amplitude 0.1 mm, acceleration 15 m/s^2 Performed 10 sweeps for 8 minutes each in upward, downward, right, left, forward, and backward directions along 3 axes.
Shock resistance	Imposed impact of 150 m/s^2 3 times each in upward, downward, left, right, forward, and backward directions.
Insulation resistance	20 MΩ min. (at 100 VDC) between connector terminals and case
Dielectric strength	1,000 VAC (50/60 Hz, 1 min) Impressed between connector terminals and case, leakage current: 1 mA max.

■ Performance Specifications

Item	Specifications
Communications function	Single, repeat, and write protection functions Memory check function, noise measurement function, communications stability evaluation function

■ Interface Specifications

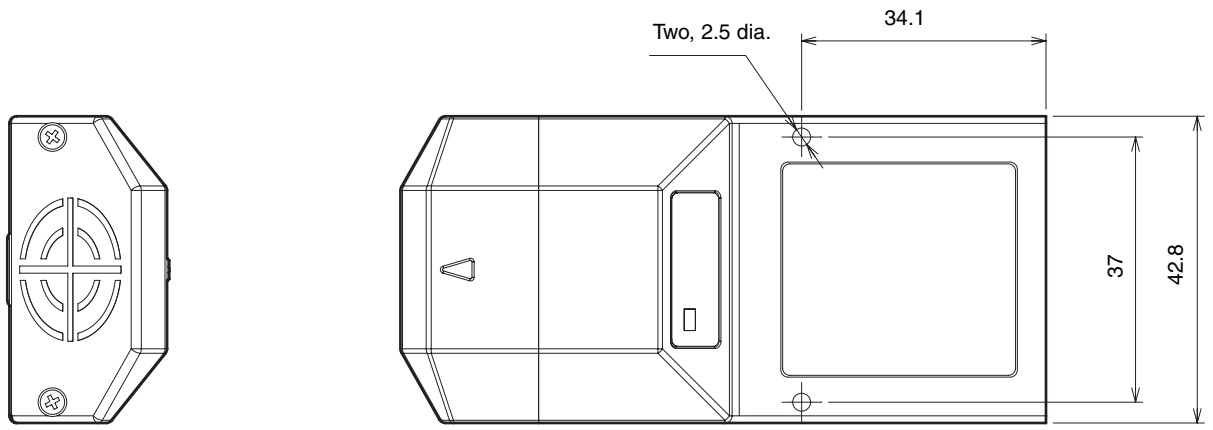
Item	Description			
Connector	CF Card connector: Type II			
Communications method	1:1			
Synchronization method	Start-stop synchronization			
Baud rate	38,400 bps			
Communications control protocol	1:1			
Communications control method	CR control (Character control not supported.)			
Character format	Start bits	Data bits	Parity	Stop bits
	1	8	Even	1

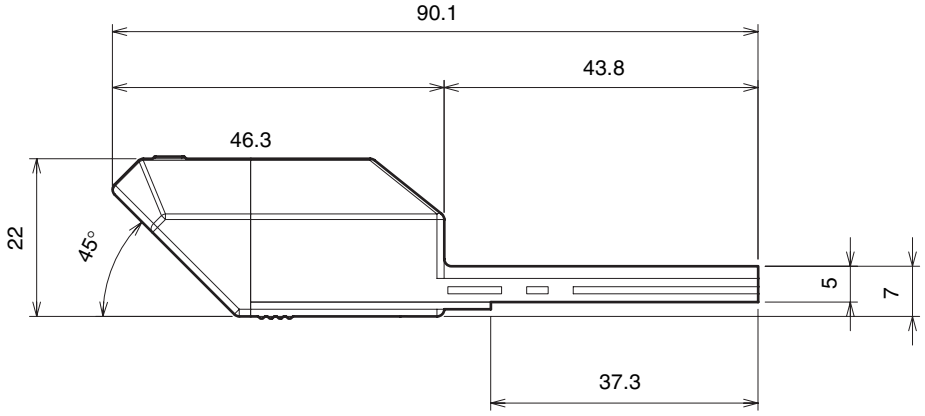
■ Electrical Interface Specifications

The electrical specifications for the interface conform to the CF Card specification: Compact Flash Specification Revision 2.0.

■ Dimensions

(Unit: mm)





Tags

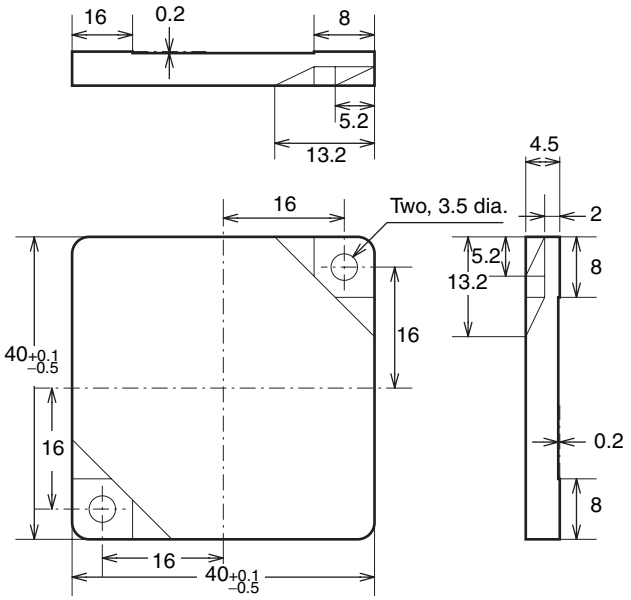
■ Specifications

Item	Description		
Model	V670-D13F01	V670-D13F01H	V670-D13F03
Memory capacity	128 bytes		
Memory type	FeRAM (non-volatile ferroelectric memory)		
Memory life	No. of times accessed (See note.): 1 billion		
Data holding time	10 years (after access using write or read commands)		
Ambient operating temperature	−10 to 70°C		
Ambient storage temperature	−10 to 70°C		
Ambient operating humidity	35% to 95%		35% to 85%
Enclosure rating	IP67 (IEC60529 standard)		
Vibration resistance	10 to 2,000 Hz, double amplitude 1.5 mm, acceleration 150 m/s^2 Performed 10 sweeps for 15 minutes in upward, downward, left, right, forward, and backward directions.		
Shock resistance	500 m/s^2 3 times each in upwards, downwards, left, right, forwards, and backwards directions, i.e., 18 times in total		
Material	PPS/epoxy resin filling material		ABS/epoxy resin filling
Mass	Approx. 1 g	Approx. 1 g	Approx. 6 g
Communications distance	0 to 3 mm	0 to 3 mm	0 to 8 mm

* The number of times accessed refers to the total number of read and write communications.

■ Dimensions

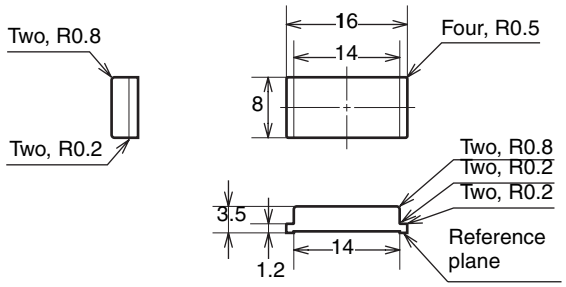
• V670-D13F03



Case material	ABS resin
Filling material	Epoxy resin

(Unit: mm)

• V600-D13F01

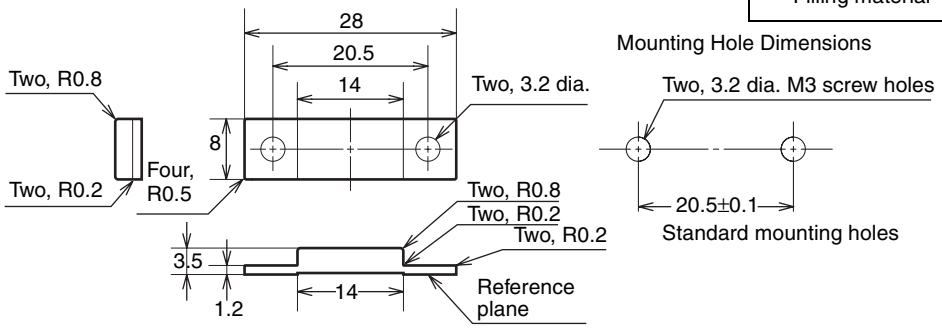


Case material	PPS resin
Filling material	Epoxy resin

(Unit: mm)

• V600-D13F01H

Case material	PPS resin
Filling material	Epoxy resin



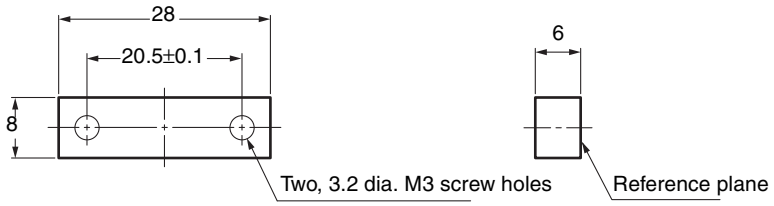
(Unit: mm)

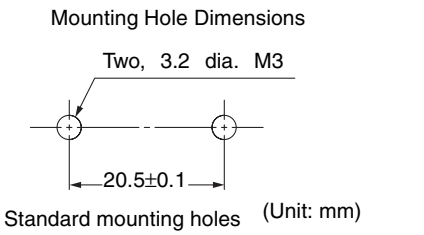
■ V670-A81 Attachment for V670-D13F01H Tag

The communications range of a Tag will be reduced when Tags are attached to metal objects. The V670-A81 Attachment is specifically designed for V670-D13F01H Tags. When combined with this Attachment, V670-D13F01H Tags retain their original communications range even when installed on metal objects.

Target Tag model: V670-D13F01H

• Dimensions





(Unit: mm)

Material	PPS resin

• Mounting Method

Place the attachment on the reference plane of the Tag and adjust its position until the mounting holes are aligned. Secure it with M3 screws.

CHECK!

Tighten the M3 screws to a torque of 5 N·m max.

• General Specifications

Conforms to Tag specifications.

• Effect of Metal behind Tags

Use of this Attachment increases the distance between the Tag and the metal surface to 6 mm. Refer to *Influence of Metal behind Tags (Reference)* before using the Attachment.

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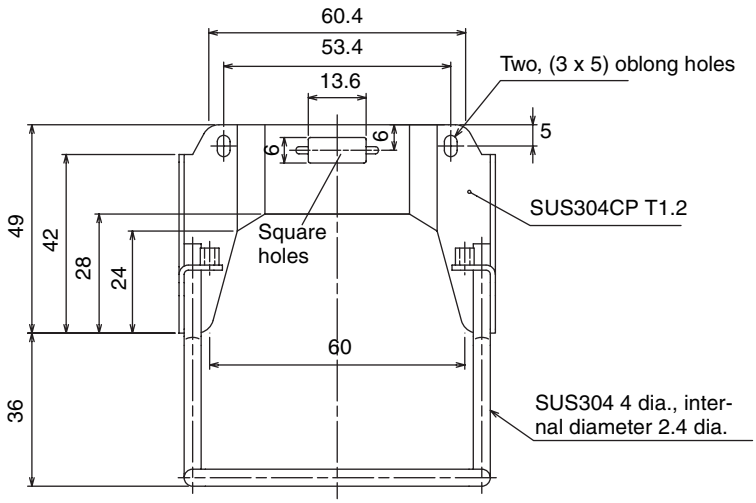
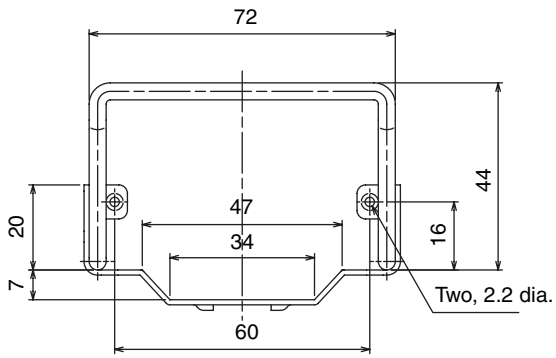
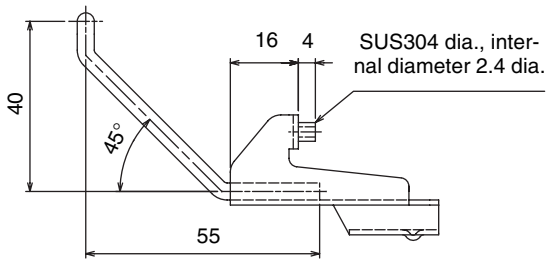
Protective Covers

■ Dimensions

• V670-A75SY8046 (for Symbol Technology Handy Terminals)

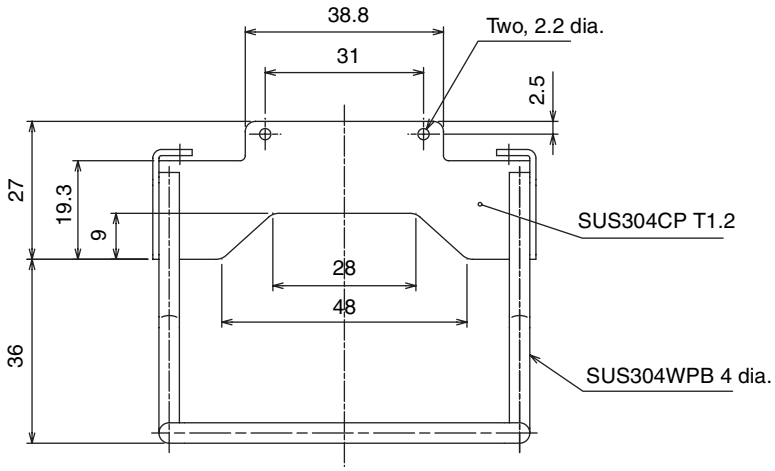


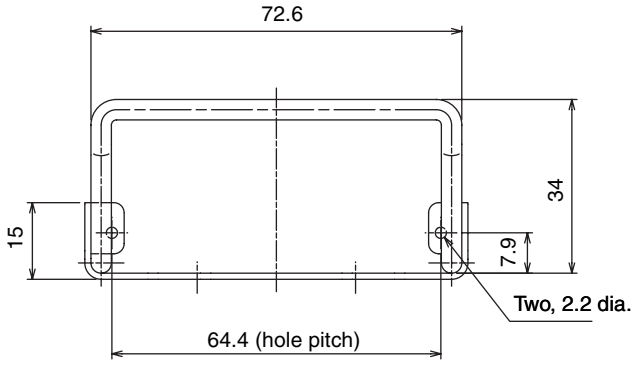


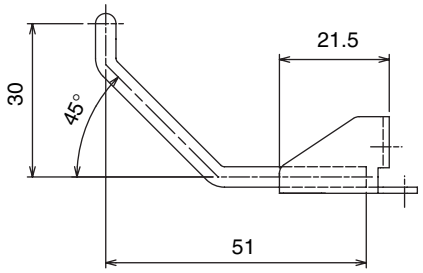


Accessories: Mounting screws, #4-40: 2 screws
Mounting screws, #2-56: 2 screws

• V670-A75SH155S (for SHARP Handy Terminals)







Accessories: Mounting screws (M2) 4 screws

Communications Distance Specifications

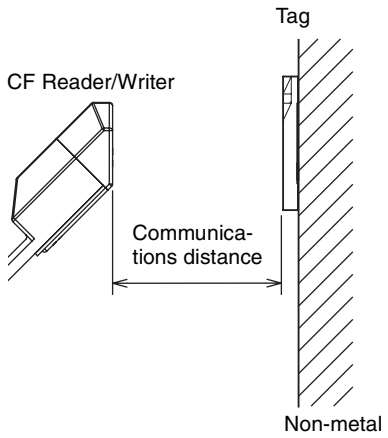
The communications distance depends on the mounting conditions. Carefully check the conditions listed here.

■ Maximum Communications Distances (Specification Values)

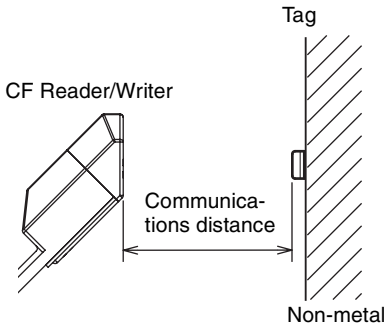
Tag model	Communications distance
V670-D13F03	0 to 8mm
V670-D13F01	0 to 3 mm
V670-D13F01H	0 to 3 mm

■ Measurement Conditions

- **V670-D13F03**



- **V670-D13F01/V670-D13F01H**

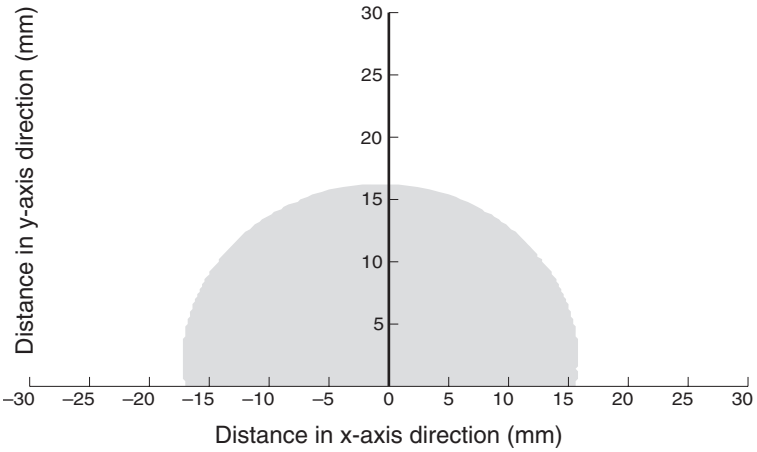


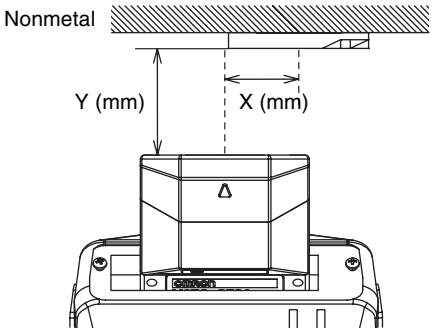
■ Communications Area (Reference)

CHECK!

The communications area varies depending on how the Tag is installed. The communications areas shown in the following diagrams are based on OMRON tests and are not intended to imply any guarantee of the performance of the V670-series Electromagnetic Inductive RFID System.

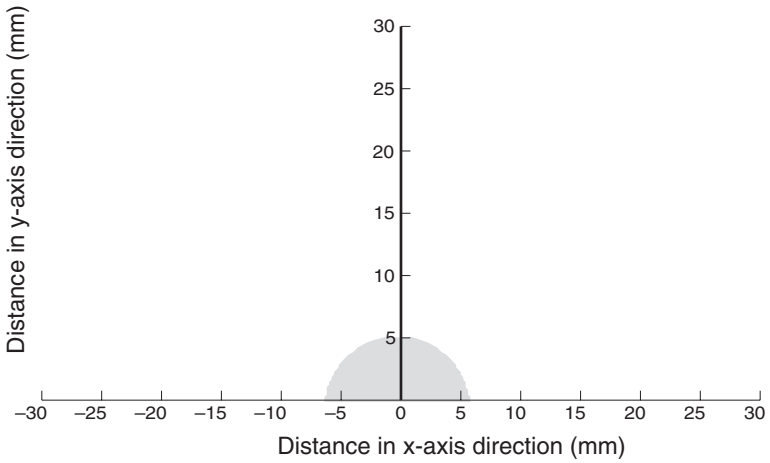
• V670-D13F03

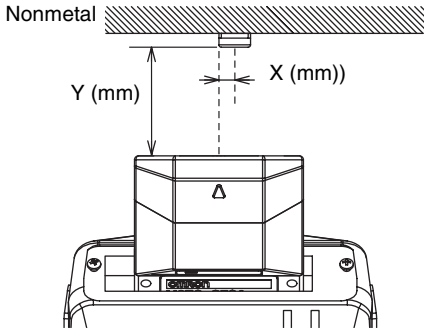




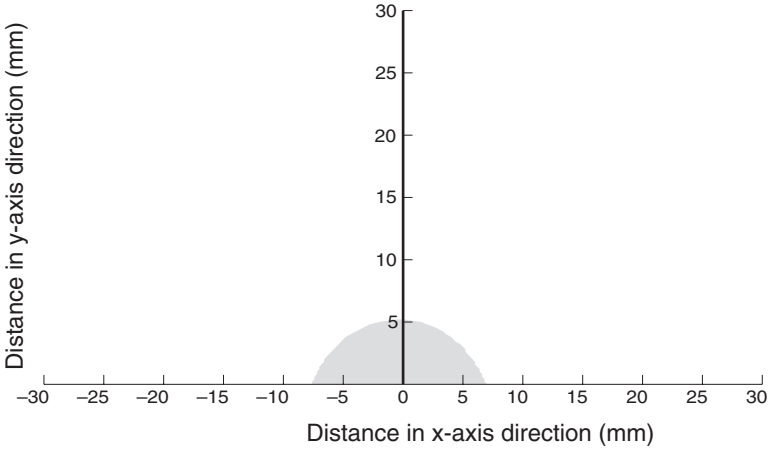
• V670-D13F01/V670-D13F01H

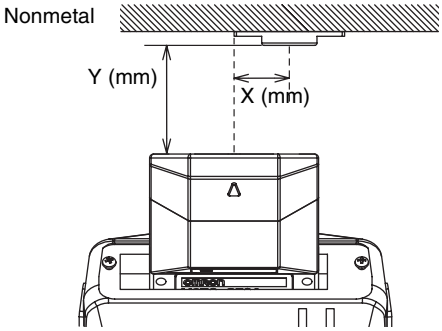
Tag Attached Perpendicular in Relation to Passing Direction (X Direction) (Example)





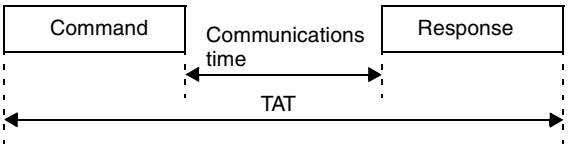
Tag Attached Horizontally in Relation to Passing Direction (X Direction) (Example)





■ Operation Time (Reference)

Operation time includes the TAT (Turn Around Time) and communications time.

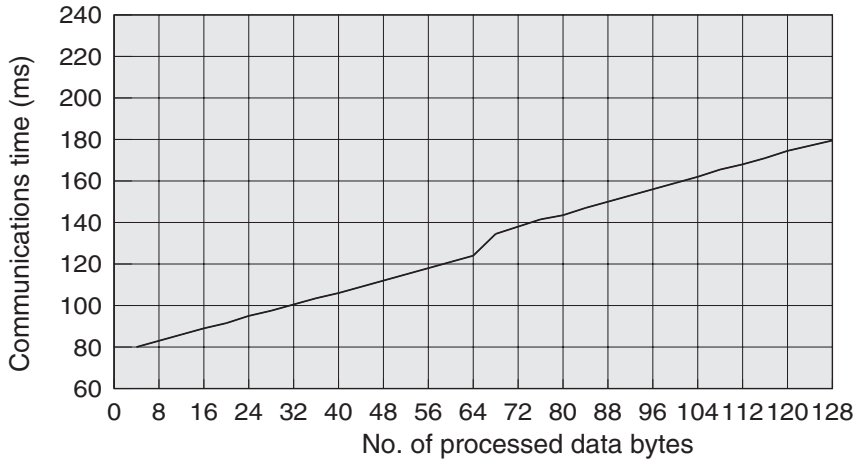


The TAT is the total processing time required to operate the CF Reader/Writer, from the viewpoint of the Handy Terminal. The communications time is the time required for communications between the CF Reader/Writer and a Tag, and does not include communications with the host device.

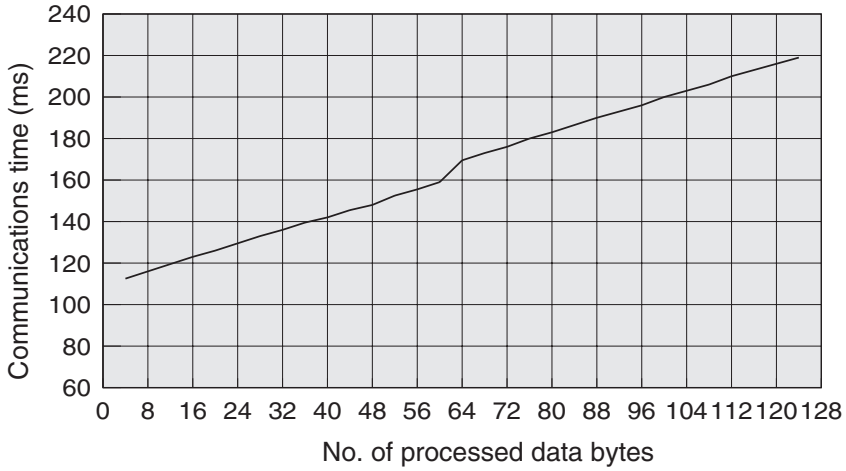
• Communications Time

The communications time is the time required for communications between CF Reader/Writers and a Tag. The time depends on the amount of data to be read or written. Refer to the following charts for the communications time.

• Read



• Write (with Verification)



Read and write communications with Tags is performed in 4-byte units. This means that the communications time can be minimized by specifying the address and number of bytes so that the write start address is a multiple of 4.
Example: If 4 bytes of data is to be written from address 0001h, change the address to 0000h.
If the system configuration is such that the address cannot be changed like this, the times on the following table must be added to the communications time.

When write protection is used	+2.9 ms
When the start address is not a multiple of 4	+2.9 ms
When the end address (start address + number of addresses) is not a multiple of 4	+2.9 ms

- **TAT**

The TAT is the time from the start of command transmission by the host device to the end of response reception by the Handy Terminal. TAT can be calculated from the communications time and the number of command/response characters. The formula is shown below.

TAT = Command transmission time + Communications time + Response transmission time

$$\text{Transmission time} = \frac{\text{Bits per character}}{\text{Baud rate (bps)}}$$

* The transmission time depends on the number of bits per character and the communications conditions (baud rate, data length, parity, and stop bits).

This formula applies when there is no interval between Handy Terminal command characters, i.e., when characters are continually transmitted.
If the number of command characters is A, the number of response characters is B, the baud rate is 38,400 bps, the data length is 8 bits, the parity is even, and there is 1stop bit, the following formula can be used.

$$\text{TAT} = \frac{11 \times (A + B)}{38400} + \text{communications time}$$


CHECK!

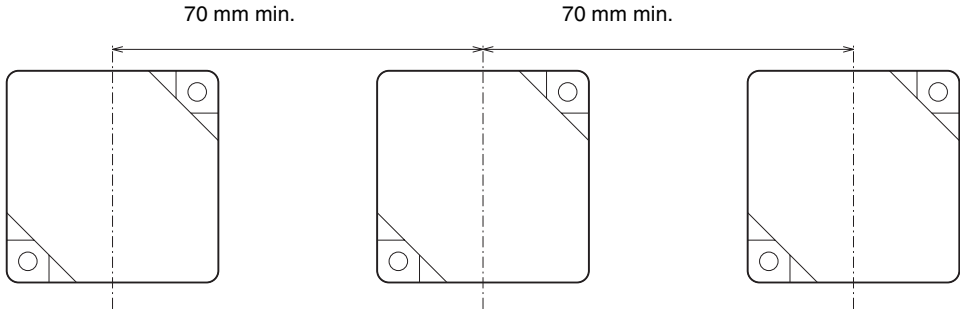
The above formula finds the time when processing is started (command transmitted) with the Tag inside the communications area of the CF Reader/Writer. The time depends on the communications mode and the Tag status.

Characteristics Data Based on Operating Conditions

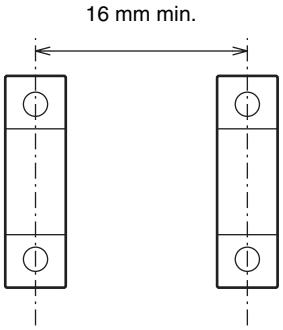
Mutual Interference between Tags

When using multiple Tags, maintain the distances between Tags shown below to prevent malfunction due to mutual interference.

- **V670-D13F03**



■ V670-D13F01(H)



CHECK!

Using the above information as reference, carry out preliminary tests or take other appropriate measures to ensure proper installation.

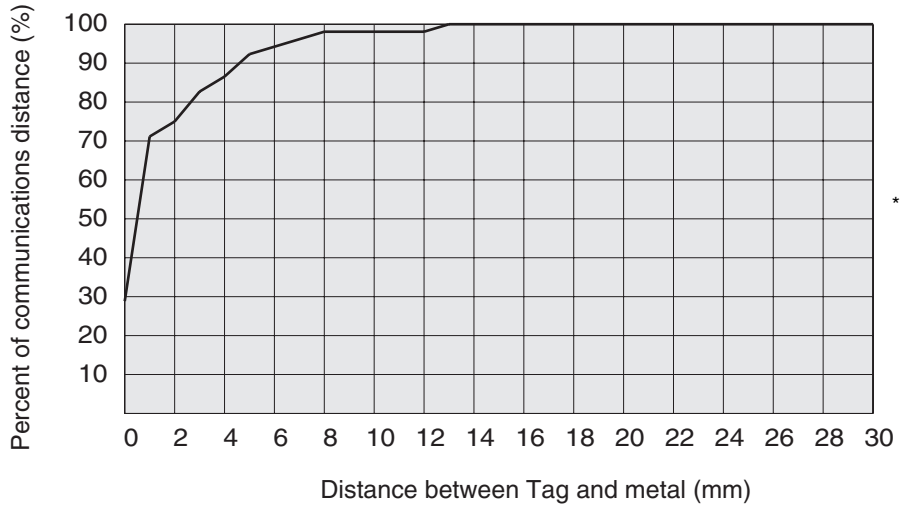
Influence of Metal behind Tags (Reference)

Take into consideration the influence of metal behind Tags when installing them.

The communications range deteriorates if there is any metal material behind the Tag. The following graphs show the deterioration in the communications distances depending on the distance between the Tag and the metal behind the Tag (same size as the Antenna).

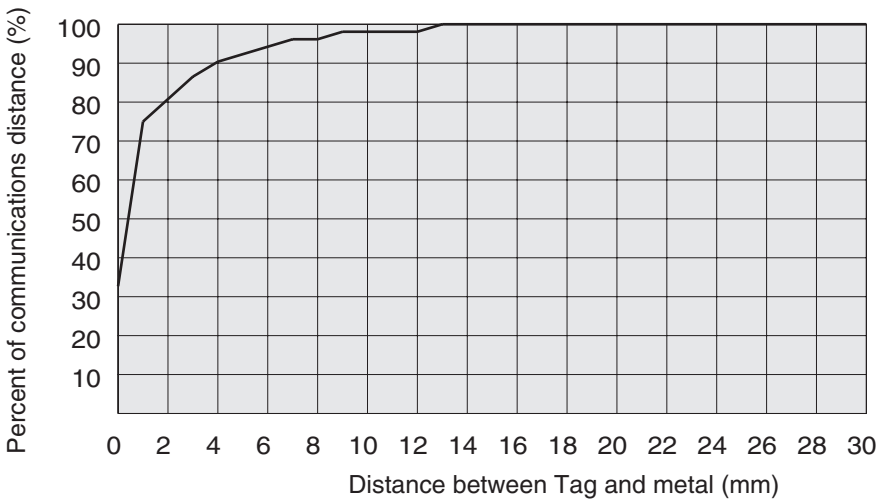
■ V670-D13F01H

- **Metal: Aluminum**

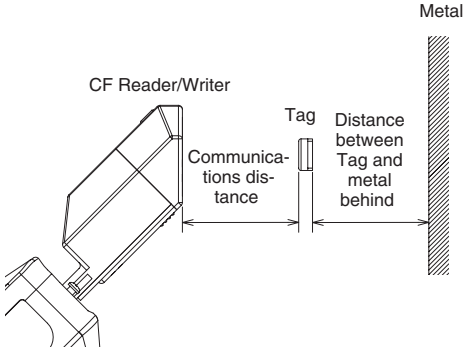


* The communications distance without metal is 100%.

- **Metal: Iron**

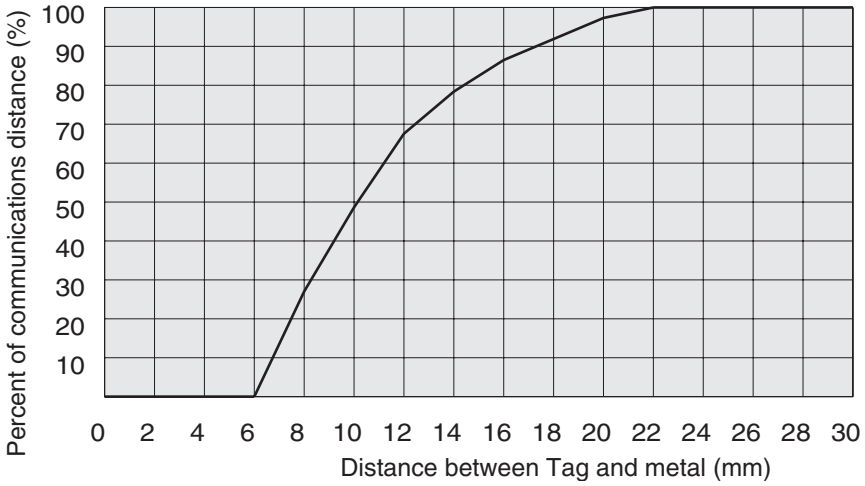


* The communications distance without metal is 100%.



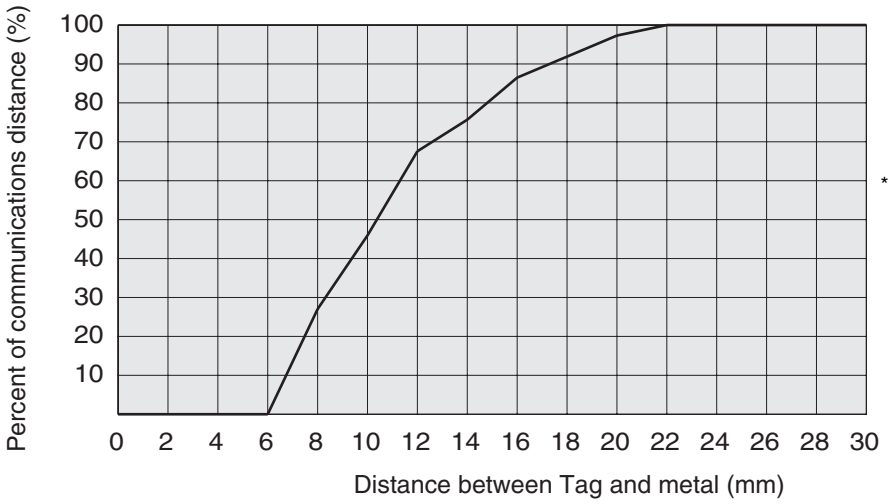
■ V670-D13F03

• Metal: Aluminum

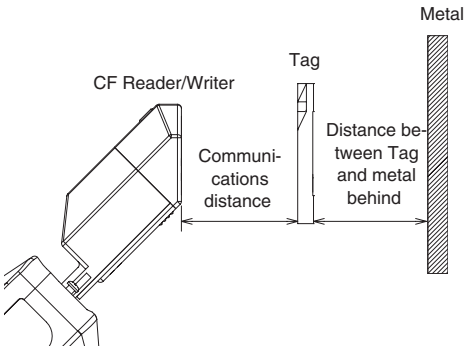


* The communications distance without metal is 100%.

• Metal: Iron



* The communications distance without metal is 100%.



CHECK!

Using the above information as reference, carry out preliminary tests or take other appropriate measures to ensure proper installation.

Chemical Resistance of Tags

Chemicals that affect Tags are shown below.

ABS resin is used for case material and epoxy resin for filling material. Refer the following lists and do not use chemicals that effect ABS and epoxy resin. Use only chemicals that do not effect these resins. Tags cannot be used in applications with explosion-proof specifications.

Chemicals That Cause Deformations, Cracks, etc.

ABS resin	Epoxy resin
Trichlene, acetone, xylene, toluene, gasoline, creosol, methylene chloride, phenol, microhexanone, aqua regia, chromic acid, sulfur (90% RT), methyl ethyl ketone, aniline, nitrobenzene, monochlorobenzene, pyridine, nitric acid (60% RT), and formic acid (80% RT)	Aqua regia, chromic acid, sulfuric acid (90% RT), nitric acid (60% RT), liquid ammonia, acetone, methylene chloride, phenol, and trichlene.

Chemicals That May Cause Discoloration, Swelling, etc.

ABS resin	Epoxy resin
Hydrochloric acid, alcohol, freon, sodium hydroxide, hydrogen peroxide, benzine, sulfuric acid (10% RT), nitric acid (10% RT), phosphoric acid (85% RT), liquid ammonia	Sulfuric acid (10% RT), nitric acid (10% RT), hydrochloric acid (30% RT), acetic acid (50% RT), nitric acid, calcium hydroxide, benzene, creosol, alcohol, microhexanone, toluene, xylene, benzine, and grease.

Chemicals That Do Not Affect ABS Resin or Epoxy Resin

ABS resin	Epoxy resin
Ammonia, kerosene, mineral oil, developer, YUSHIROKEN S50, CHEMICOOL Z, VELOCITY NO. 3, YUSHIROKEN EEE-30Y, petroleum, grease, acetic acid, nitric acid, calcium hydroxide, phosphoric acid (30% RT), hydrochloric acid (10% RT), and potassium hydroxide.	Ammonia, hydrochloric acid (10% RT)), potassium hydroxide, petroleum, gasoline, YUSHIROKEN S50, CHEMICOOL Z, VELOCITY NO. 3, and YUSHIROKEN EEE-30Y.

CHECK!

The above results are from tests conducted at room temperature (23°C). Even if the chemicals do not affect the ABS or epoxy resins at room temperature, they may affect the resins at higher or lower temperatures. Always contact the manufacturer of the chemicals and check the chemicals carefully in advance.

Memory Map

Tag memory has a user area and an ID code. The memory capacity of the user area is 128 bytes. One byte of data is written to one address. The memory area is divided into pages of 4 bytes, 0000h to 0003h, 0004h to 0007h, etc.

■ Memory Map

<table>
<tr><th rowspan="2">Page</th><th rowspan="2">User address</th><th colspan="2">User area</th></tr>
<tr><th>Write protection not used</th><th>Write protection used</th></tr>
<tr><td rowspan="4">1</td><td>$0000</td><td rowspan="12">User area</td><td rowspan="4">Specified address in protected area</td></tr>
<tr><td>$0001</td></tr>
<tr><td>$0002</td></tr>
<tr><td>$0003</td></tr>
<tr><td rowspan="8">.
.
.
.
.</td><td>$0004</td><td rowspan="8">User area</td></tr>
<tr><td>.
.
.
.
.</td></tr>
<tr><td>$007F</td></tr>
</table>

* If write protection is used, addresses 0000h to 0003h are used for protection address information and cannot be used as part of the user area.
For details, refer to *Write Protection*.
p.33 Write Protection

■ ID Codes

This is a 4-byte area where a Tag identification number (unique Tag number) is written. The ID code is written at shipment and cannot be changed. The ID code can be read using the ID read command.

Maintenance and Inspection

To maintain the CF Reader/Writer in optimum condition, daily or periodic inspections are required.
The CF Reader/Writer mainly consists of semiconductor components, which have a long life. The following malfunctions, however, may occur depending on the environment and operating conditions.

(1) Deterioration of elements due to overvoltage or overcurrent
(2) Deterioration of elements due to long-term stress caused by operation in locations with high ambient temperatures
(3) Deterioration of insulation or imperfect connector contact due to humidity or dust
(4) Imperfect connector contact or corrosion of elements due to corrosive gas.

Inspection item		Inspection details	Criteria	Required equipment
Fluctuation in power supply voltage		Check at the power supply terminal block that the criteria area satisfied.	Within the specifications for power supply voltage.	Tester
		Check whether instantaneous power failure occurs frequently and whether voltage fluctuates considerably.	Within allowable voltage fluctuation range.	Power supply analyzer
Ambient environment	Temperature	Check if within specifications.	Within the specifications.	Lowest temperature thermometer Hygrometer
	Humidity			
	Vibration and shock	Check for vibration or shock from machines.		
	Dust	Check for adherence or sedimentation of dust or foreign matter.	No dust or foreign matter.	
	Corrosive gas	Check for discoloration or corrosion in metal parts.		
Mounting state		Check that the CF Reader/Writer is completely inserted.	There is no looseness. The CF must be Type II.	Phillips screwdriver
		Check that the protective cover is firmly mounted.	The cover must be secured by screws.	

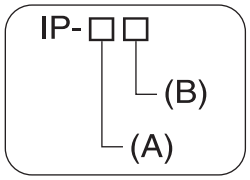
Table of JIS8 Unit Code (ASCII)

Left digits / Right digits: b8 to b5	0000	1001	0010	0011	0100	0101	0110	0111	1000	1101	1010	1011	1100	1101	1110	1111
b4 to b1 / Col Row	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0000	0	NUL	TC7 (DLE)	(SP)	0	@	P	`	p	Undefined	Undefined	Unde-fined	－	タ	ミ	Undefined	Undefined
0001	1	TC1 (SOH)	DC1	!	1	A	Q	a	q			。	ア	チ	ム		
0010	2	TC2 (STX)	DC2	"	2	B	R	b	r			「	イ	ツ	メ		
0011	3	TC3 (ETX)	DC3	#	3	C	S	c	s			」	ウ	テ	モ		
0100	4	TC4 (EOT)	DC4	$	4	D	T	d	t			、	エ	ト	ヤ		
0101	5	TC5 (NEQ)	TC8 (NAK)	%	5	E	U	e	u			・	オ	ナ	ユ		
0110	6	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v			ヲ	カ	ニ	ヨ		
0111	7	BEL	TC10 (ETB)	'	7	G	W	g	w			ァ	キ	ヌ	ラ		
1000	5	FE0 (BS)	CAN	(	8	H	X	h	x			ィ	ク	ネ	リ		
1001	9	FE1 (HT)	EM	)	9	I	Y	i	y			ゥ	ケ	ノ	ル		
1010	10	FE2 (LF)	SUB	*	:	J	Z	j	z			ェ	コ	ハ	レ		
1011	11	FE3 (VT)	ESC	+	;	K	[	k	{			ォ	サ	ヒ	ロ		
1100	12	FE4 (FF)	IS4 (FS)	,	<	L	\	l	|			ャ	シ	フ	ワ		
1101	13	FE5 (CR)	IS3 (GS)	-	=	M	]	m	}			ュ	ス	ヘ	ン		
1110	14	SO	IS2(RS)	.	>	N	^	n	‾			ョ	セ	ホ	゛		
1111	15	SI	IS1(US)	/	?	O	_	o	DEL			ッ	ソ	マ	゜		

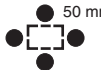
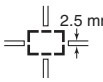
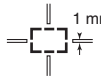
Degree of Protection

IP-□□ is classified by the test method described below. Check sealing in a working environment and operating conditions in advance. IP refers to the International Protection code.

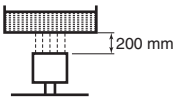
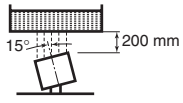
■ IEC (International Electrotechnical Commission) Standards (IEC60529: 1989-11)

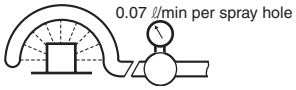
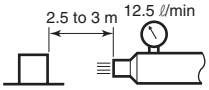
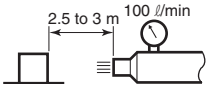
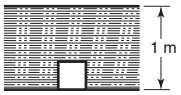


(A) Protective Classification for "1st symbol" Solid Foreign Objects

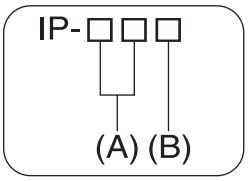
Class	Protection level	
0		No protection.
1		Solid foreign material 50 mm or more in diameter (e.g., a hand) cannot enter.
2		Solid foreign material 12.5 mm or more in diameter (e.g., a finger) cannot enter.
3		Solid foreign material 2.5mm or more in diameter (e.g., wire) cannot enter.
4		Solid foreign material 1 mm or more in diameter (e.g., wire) cannot enter.
5		Dust, in a volume that interferes with the normal operation of devices or reduces safety, cannot enter.
6		No dust can enter.

(B) Protective Classification for "2nd symbol" Water Penetration

Class	Protection level		Test method overview (tested with fresh water)
0	No particular protection	No particular protection against water penetration.	No test.
1	Protection against drops of water 	Not to be affected by water drops from vertically above.	Drop water for 10 minutes using a water drop tester. 
2	Protection against drops of water 	Not to be affected by water drops from within 15° of a vertical line.	Drop water to an object set at an incline of 15° for 10 minutes (2.5 minutes in each direction) using a water drop tester. 

Class	Protection level		Test method overview (tested with fresh water)
3	Protection against water spray 	Not to be affected by water spray from within 60° of a vertical line.	Spray water in an area within 60° to the right and left from a vertical line for 10 minutes, using the tester shown in the following figure. 
4	Protection against water splash 	Not to be affected by water splash from any direction.	Spray water for 10 minutes from all directions, using the tester shown in the following figure. 
5	Protection against water jet flow 	Not to be affected by direct water jet flow from any direction.	Spray water from all directions for 1 minute per surface area 1 m², for a total of 3 minutes or more, using the tester shown in the following figure. 
6	Protection against extreme water jet flow 	Not to be affected by extreme direct water jet flow from any direction.	Spray water from all directions for 1 minute per surface area 1 m², for a total of 3 minutes or more, using the tester shown in the following figure. 
7	Protection against water soaking 	No water penetration, even if the object is immersed in water of a specified pressure for a specified time.	Immerse the object to a depth of 1 m (when the height of the device is less than 850 mm), for 30 minutes. 
8	Protection against water immersion 	Can be used when always immersed in water.	Agreement to be reached between the manufacturer and the device user.

■ JEM (Japan Electrical Manufacturers Association) Standard (JEM1030: 1991)



(A) Complies with 1st and 2nd symbols of IEC60529.

(B) Protective Classification for Oil Penetration

Class	Protection level	
f	Oil-retaining type	No adverse affect from oil drops or oil spray from any direction.
g	Oil-resistant type	Oil drops and oil spray from any direction do not enter.

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

■ NEMA (National Electrical Manufacturers Association)

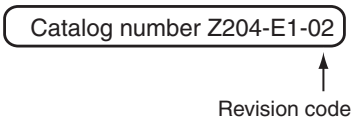
Table for conversion from NEMA enclosure classifications to IEC60529. (Conversion from IEC60529 to NEMA enclosure classifications is not available.)

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

MEMO

Manual Revision History

A manual revision code is added to the end of the catalog number shown at the bottom of the front and back covers.



Revision code	Date of revision	Reason for revision/revised page
01	August 2004	Original production
02	March 2005	Added table with standards compliance information for different languages.

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