


SECTION 6

Troubleshooting

 Troubleshooting

70

Troubleshooting

Errors are indicated by the presence or absence of a response to an Amplifier Unit command, and by the indicators.

List of Error Messages

Type	Response code	Name	Description
Host communications error	14	Format error	There is a mistake in the command format. (For example, the command portion is undefined, or the page or address specification is inappropriate.)
Communications error between the CIDRW Head and ID Tag	70	Communications error	Noise or another hindrance has occurred during communications with an ID Tag, and communications cannot be completed normally.
	71	Verification error	Correct data cannot be written to an ID Tag.
	72	No Tag error	Either there is no ID Tag in front of the CIDRW Head, or the CIDRW Head is unable to detect the ID Tag due to environmental factors (e.g., noise).
	7B	Outside write area error	The ID Tag is at a position where reading is possible but writing is not, so writing does not complete normally.
	7E	ID system error (1)	The ID Tag is in a status where it cannot execute the command processing.
	7F	ID system error (2)	An inapplicable ID Tag has been used.
CPU hardware error	9A	Hardware error in CPU	An error occurred when writing to EEPROM.

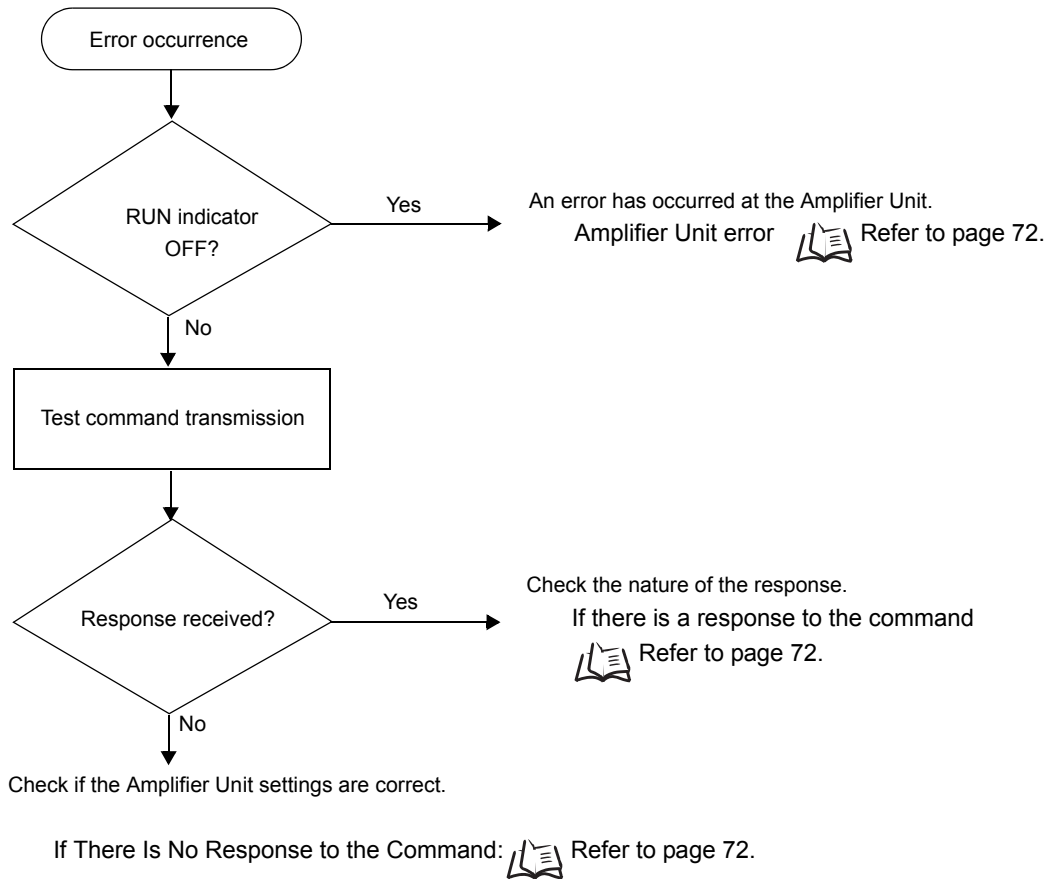
Amplifier Unit Indicators

Name	Indications
RUN (green)	Turns ON when the Amplifier Unit is in normal operation.
COMM (orange)	Turns ON during communications with the host device or during communications with an ID Tag.
NORM (green)	Turns ON when the communications finish with no error.
ERROR (red)	Turns ON when an error occurs during communications with the host device, or during communications with an ID Tag.

Operation Check Flowchart

From Installation to Trial Operation

Errors are indicated by whether or not a response to the test command is received and by the status of the Amplifier Unit indicators.



- If the Test Command Was Received Normally:

Indicators

RUN	COMM	NORM	ERROR
	 (Lights once)		


Response Code for the Response

Type	Response code	Function
Normal	00	The command was received normally.

• **Amplifier Unit Error**

Check the status of the indicators after transmission of the test command.









After taking appropriate corrective action, restart the Amplifier Unit, send the test command again and check again.

RUN	COMM	NORM	ERROR	Main check points
	— (If RUN is OFF, the status of the other indicators can be ignored.)			<ul style="list-style-type: none"> • Influence of background noise (change installation position) • Amplifier Unit power supply If the error cannot be resolved after checking, the Amplifier Unit may be damaged.

• **If There Is No Response to the Command:**

Check the status of the indicators after transmission of the test command.









After taking appropriate corrective action, restart the Amplifier Unit, send the test command again and check again.

RUN	COMM	NORM	ERROR	Main check points
				<ul style="list-style-type: none"> • Amplifier Unit baud rate settings • Node numbers of the Amplifier Units (do not match the node number in the test command) • Connection and wiring of the cable between the host device and Amplifier Unit • Routing of each cable (influence of background noise) If the error cannot be resolved after checking, the Amplifier Unit may be damaged.
			 (Lights once)	<ul style="list-style-type: none"> • Amplifier Unit baud rate settings • Connection and wiring of the cable between the host device and Amplifier Unit • Routing of the cables (influence of background noise)

• **If There Is a Response to the Command:**

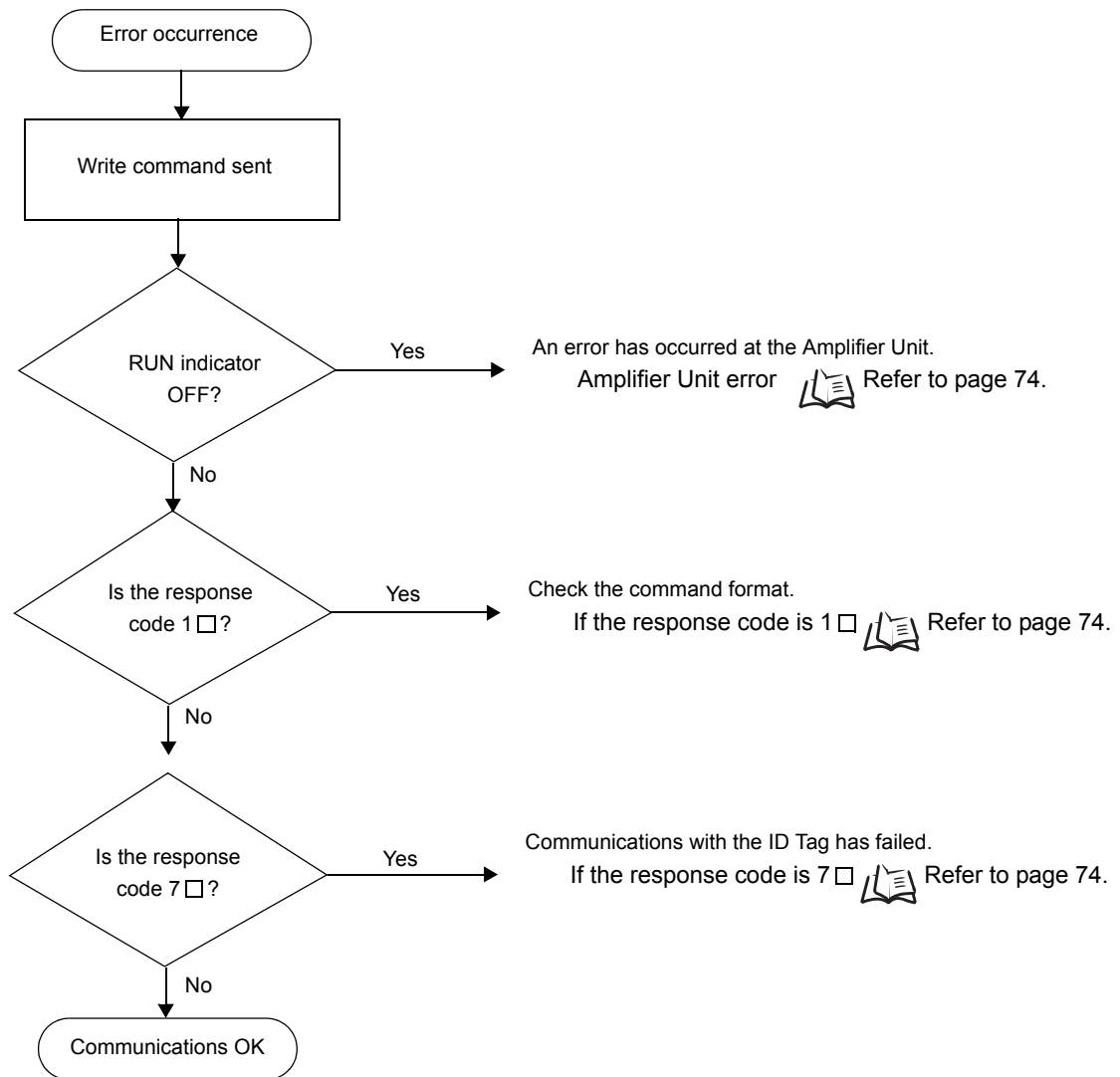
Check the status of the indicators after transmission of the test command.

After taking appropriate corrective action, restart the Amplifier Unit, send the test command again and check again.

RUN	COMM	NORM	ERROR	Main check points
				<ul style="list-style-type: none"> • Node numbers of the Amplifier Units (The same number is set for more than one Unit) If the error cannot be resolved after checking, the Amplifier Unit may be damaged.
			 (Lights once)	There is a mistake in the command format (number of characters, character code, etc.).

■ From Trial Operation to Communications

Errors are indicated by the status of the indicators after transmission of the write command, and by the response code of the response.



- If the ID Tag Was Processed Normally:

Indicators

RUN	COMM	NORM	ERROR
	 (Lights once)	 (Lights once)	

Response Code for the Response

Type	Response code	Function
Normal	00	The ID Tag was processed normally.



If there is no response to the write command, refer to the *From Installation to Trial Operation, Operation Check Flowchart*. Refer to page 71.

• **Amplifier Unit Error**

Check the status of the indicators after transmission of the command. After taking appropriate corrective action, send the write command again and check again.

RUN	COMM	NORM	ERROR	Main check points
●		—		<ul style="list-style-type: none"> • Influence of background noise (Change installation position) • Amplifier Unit power supply If the error cannot be resolved by checking the two points above, the Amplifier Unit may be damaged.
(If RUN is OFF, the status of the other indicators can be ignored.)				

• **If the Response Code is 1□:**

There is a host device communications error.

Check the status of the indicators and the response code of the response after transmission of the command. After taking appropriate corrective action, send the write command again and check again.

RUN	COMM	NORM	ERROR
☉	●	●	☉ (Lights once)

Response code	Main check points
14	Command format (Command code, page designation, address designation, processed data volume, etc.)

• **If the Response Code is 7□:**

There is a communications error in communications between the CIDRW Head and ID Tag.

Check the status of the indicators and the response code of the response after transmission of the command. After taking appropriate corrective action, send the write command again and check again.

RUN	COMM	NORM	ERROR
☉	☉ (Lights once)	●	☉ (Lights once)

Response code	Main check points
70	<ul style="list-style-type: none"> • Background noise levels of the CIDRW Head (Check the surroundings with the environmental noise level measurement function) • Distance to another CIDRW Head • Influence of background noise (Change installation position) If the error cannot be resolved after checking, the Amplifier Unit may be damaged.
71	<ul style="list-style-type: none"> • ID Tag overwrite life (Replace the ID Tag) • Environment of use of the ID Tags (ID Tag breakage due to use in unanticipated ways)
72	<ul style="list-style-type: none"> • Connection to the CIDRW Head • Distance between the ID Tag and CIDRW Head • CIDRW Head background noise levels (Check the surroundings with the environmental noise level measurement function) • Distance to another CIDRW Head
7B	<ul style="list-style-type: none"> • Distance between the ID Tag and CIDRW Head • Background noise levels of the CIDRW Head (Check the surroundings with the environmental noise level measurement function) • Distance to another CIDRW Head • Influence of background noise (Change installation position)
7E	<ul style="list-style-type: none"> • Type/specifications of the ID Tags used
7F	<ul style="list-style-type: none"> • Settings of the ID Tags used (The ID Tag lock function is used.*) • Environment of use of the ID Tags (ID Tag breakage due to use in unanticipated ways)

* The ID Tag has a lock function, but the Amplifier Unit has no function for locking an ID Tag.

SECTION 7

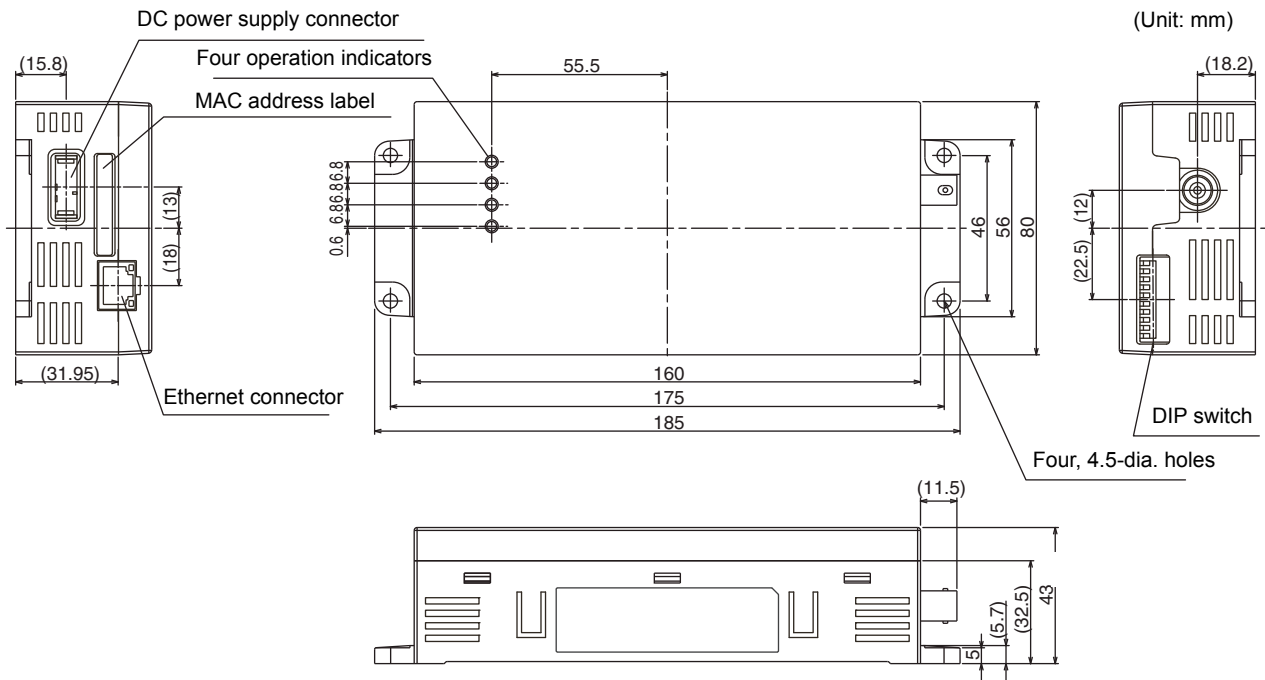
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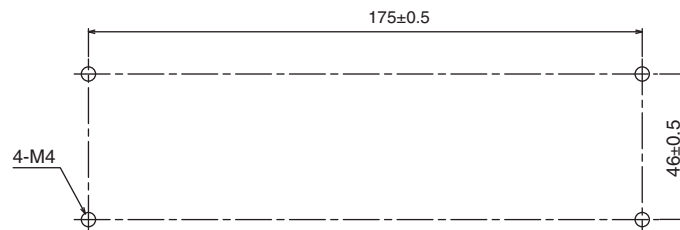
Specifications and Dimensions

Amplifier Units

V640-HAM11-ETN and V640-HAM11-L-ETN



Mounting dimensions



General Specifications

Item	Specifications	
	V640-HAM11-ETN	V640-HAM11-L-ETN
Power supply voltage	24 VDC +10% -15%	
Current consumption	150 mA max.	400 mA max.
Ambient temperature	Operating: 0 to +40°C Storage: -15 to +65°C (with no icing)	
Ambient humidity	Operating/Storage: 35% to 85% (with no condensation)	
Degree of protection	IP20 (IEC60529 standard)	
Insulation resistance	20 MΩ min. between power supply terminals and the frame ground terminal (100 VDC M)	
Dielectric strength	Leak current not to exceed 5 mA on application of 1000 VAC (50/60 Hz for 1 minute) between both power supply terminals and the frame ground terminal	
Vibration resistance	Frequency: 10 to 150 Hz; double amplitude: 0.20 mm; acceleration: 15 m/s ² for 8 minutes, 10 times each in X, Y, and Z directions	
Shock resistance	Shock of 150 m/s ² in X, Y, and Z directions, 3 times each for 18 repetitions	
Ground	Ground to 100 Ω or less.	
Case material	PC/ABS resin	
Shape	80×185×43 mm (W×D×H)	
Weight	Approx. 250 g	
CIDRW Head	V640-HS61	V640-HS62

■ Host Communications Specifications

Item	Description
Compliant standards	10Base-T and 100Base-TX
Protocol	TCP/IP
Applicable port	TCP/IP: port 7090
MTU	1,500 bytes



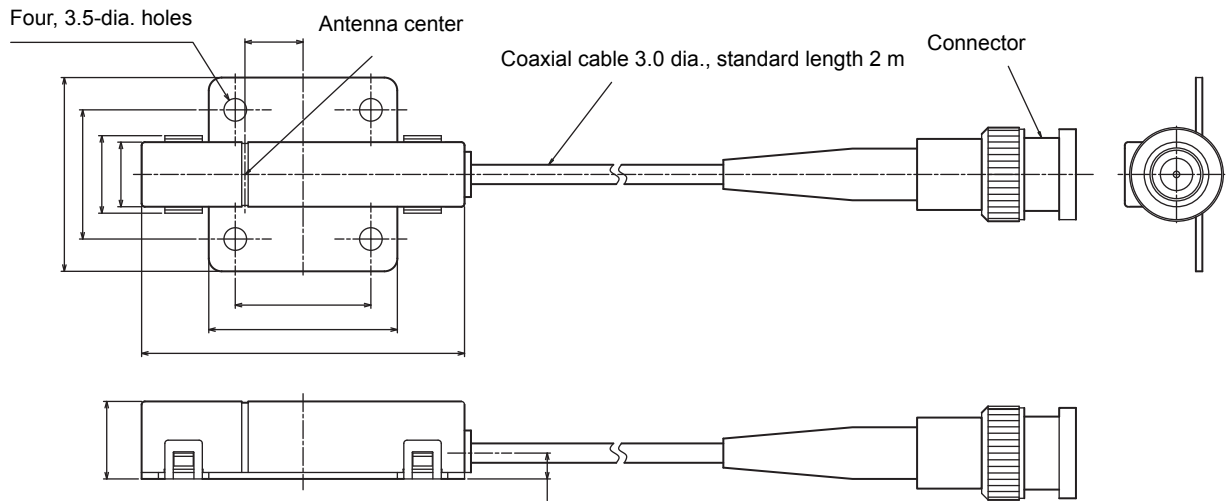
Access to an Amplifier Unit is possible from only one host device at a time. If a host device (A) is connected to an Amplifier Unit and another host device (B) connects to the Amplifier Unit, the connection between host device A and the Amplifier Unit will be automatically broken and host device B will have the control right.



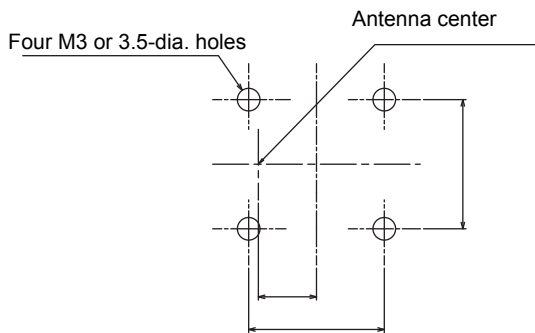
Communications with the ID Tag will be aborted if the Ethernet cable is disconnected or the connection is broken while the Amplifier Unit is communicating with an ID Tag.

CIDRW Heads
V640-HS61

(Unit: mm)



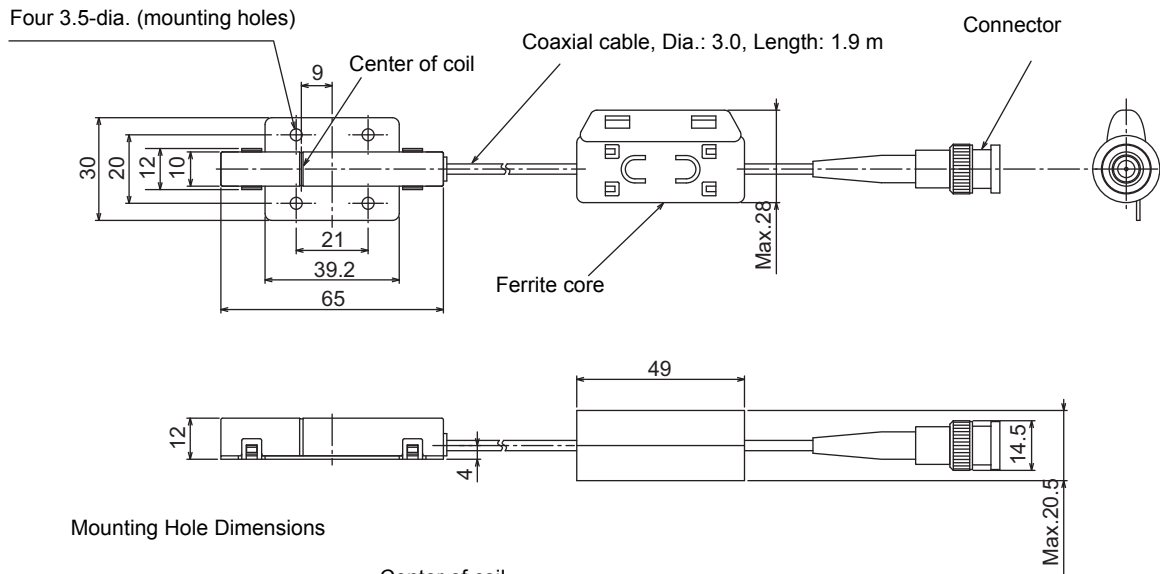
Mounting dimensions



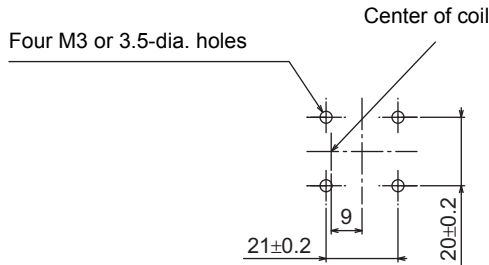
Item	Specifications
Transmission frequency	134 kHz
Ambient temperature	Operating: 0 to +40°C Storage: -15 to +65°C (with no icing)
Ambient humidity	Operating/Storage: 35% to 85% (with no condensation)
Degree of protection	IP60 (IEC60529)
Insulation resistance	20 MΩ min. between all terminals and the case (100 VDC M)
Dielectric strength	Leak current not to exceed 5 mA on application of 1000 VAC (50/60 Hz for 1 minute) between all terminals and the case
Vibration resistance	Frequency: 10 to 150 Hz; double amplitude: 0.20 mm; acceleration: 15 m/s ² for 8 minutes, 10 times each in X, Y, and Z directions
Shock resistance	Shock of 150 m/s ² in X, Y, and Z directions, 3 times each for 18 repetitions
Casing material	ABS/epoxy resin Stainless steel mount
Weight	Approx. 70 g
Cable length	2 m
Cable specification	3-mm-dia. coaxial cable

V640-HS62

(Unit: mm)



Mounting Hole Dimensions

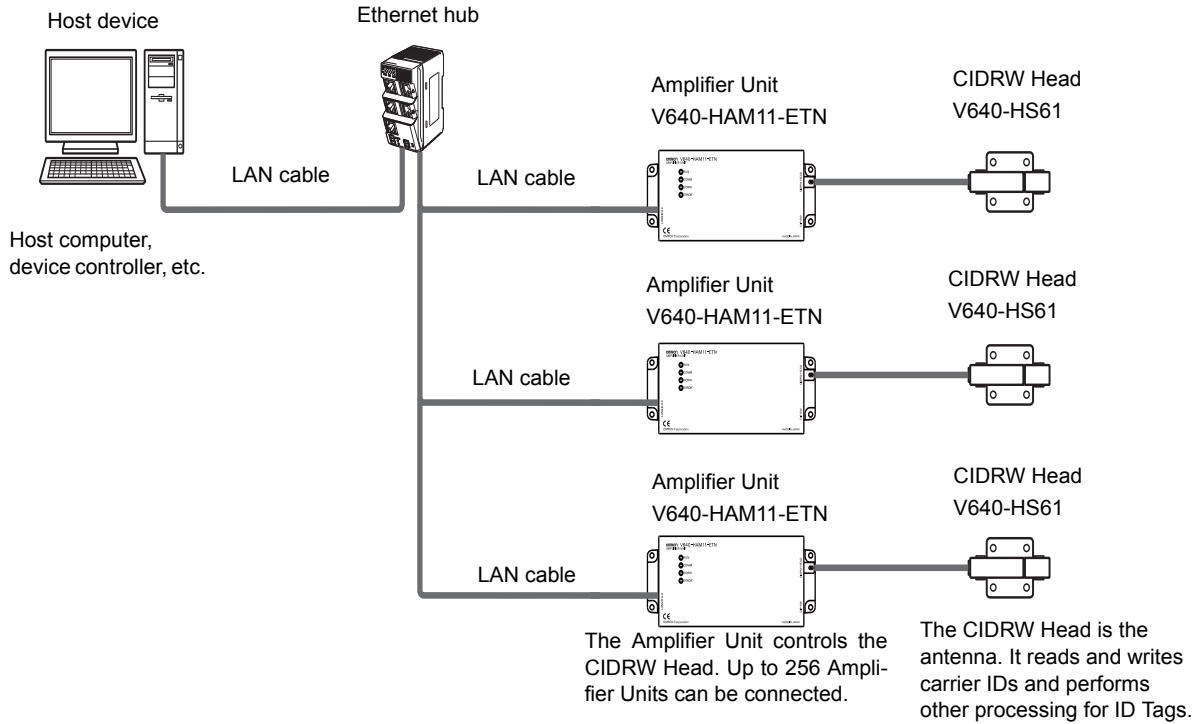


Item	Specifications
Transmission frequency	134 kHz
Ambient temperature	Operating: 0 to +40°C Storage: -15 to +65°C (with no icing)
Ambient humidity	Operating/Storage: 35% to 85% (with no condensation)
Degree of protection	IP60 (IEC60529)
Insulation resistance	20 MΩ min. between all terminals and the case (100 VDC M)
Dielectric strength	Leak current not to exceed 5 mA on application of 1000 VAC (50/60 Hz for 1 minute) between all terminals and the case
Vibration resistance	Frequency: 10 to 150 Hz; double amplitude: 0.20 mm; acceleration: 15 m/s ² for 8 minutes, 10 times each in X, Y, and Z directions
Shock resistance	Shock of 150 m/s ² in X, Y, and Z directions, 3 times each for 18 repetitions
Casing material	ABS/epoxy resin Stainless steel mount
Weight	Approx. 100 g
Cable length	1.9 m
Cable specification	3-mm-dia. coaxial cable

Connection Examples

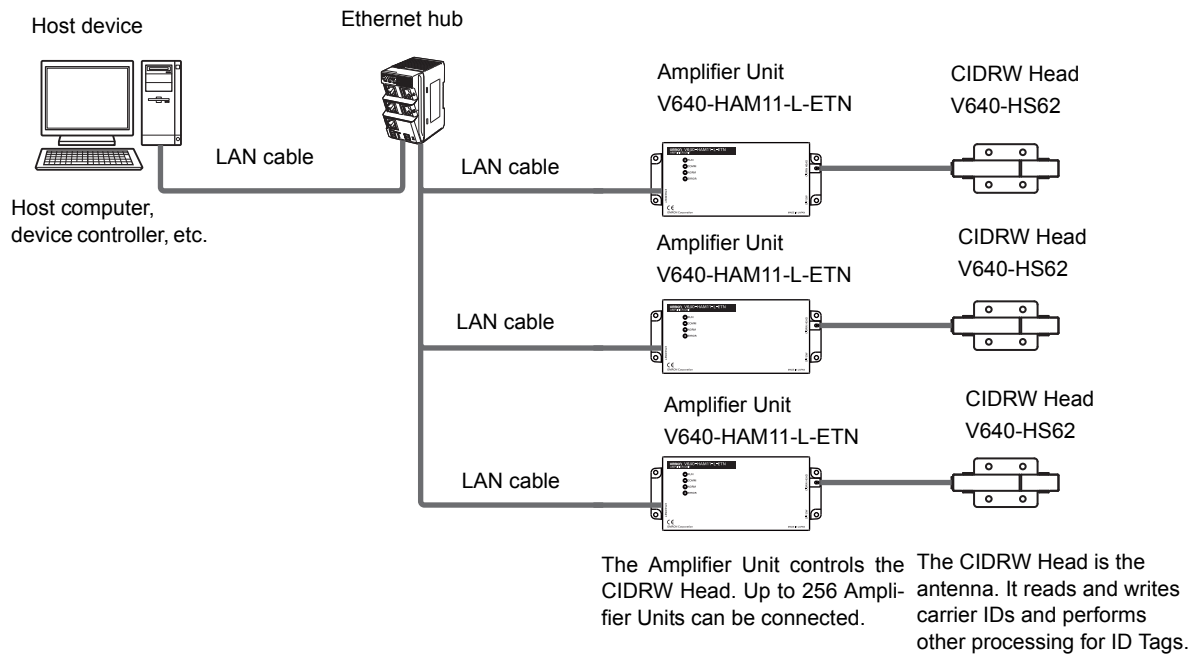
V640-HAM11-ETN

Connect the host device and Amplifier Unit using a LAN cable.



V640-HAM11-L-ETN

Connect the host device and Amplifier Unit using a LAN cable.



Characteristic Data According to Conditions of Use

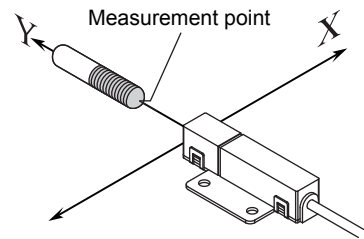
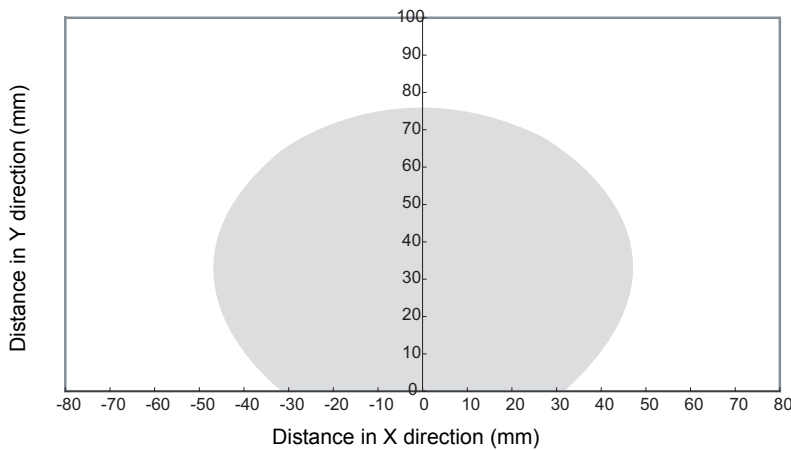
Maps of Communications Areas (Reference Only)

The figures given below for communications areas (communications distances) are reference values only. The maps of communications areas will vary according to the ID Tags that you use, the background metals, the ambient noise, the effects of temperature and so on, and should be thoroughly confirmed on installation. The direction of the ID Tags will affect communications performance. Check the direction of the coils in the ID Tags before using the ID Tags.

■ V640-HAM11-ETN

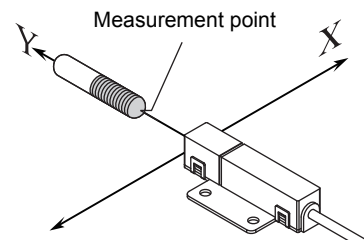
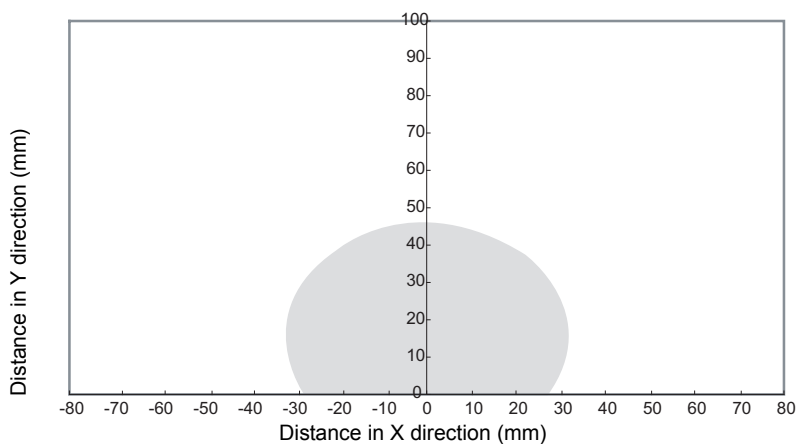
- Coaxial Mounting (RI-TRP-DR2B)
 - READ

Communications Area (READ)

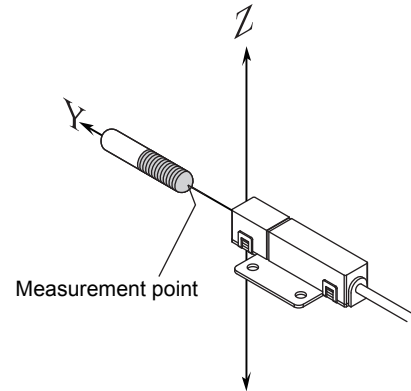
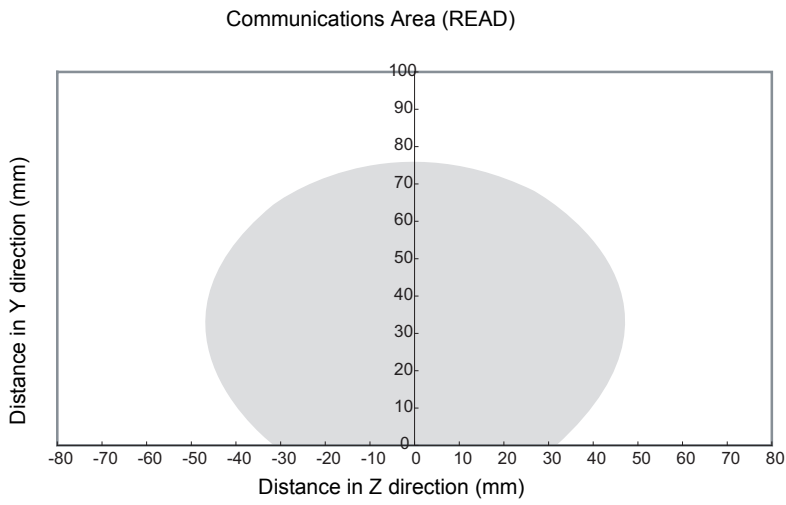


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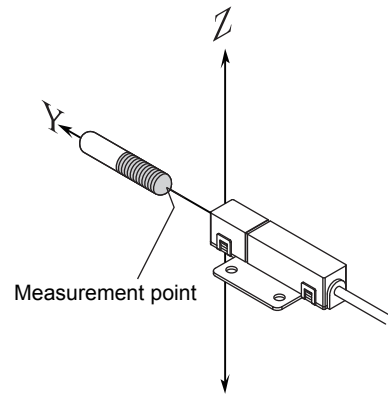
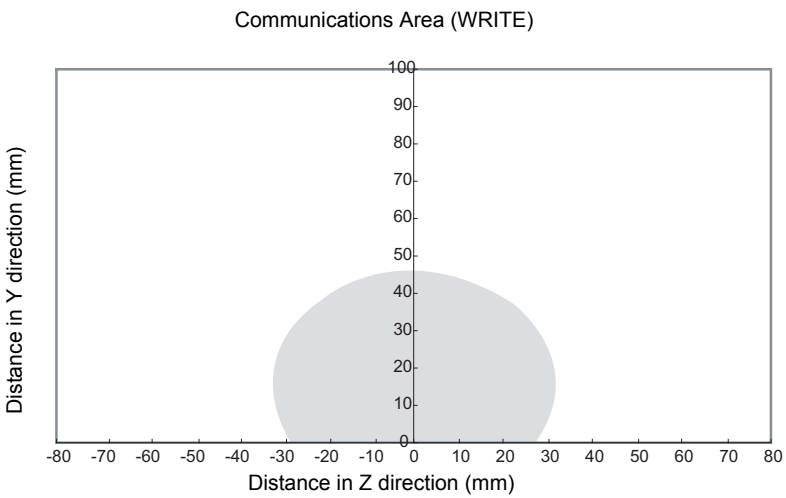
Communications Area (WRITE)



- Coaxial Mounting (RI-TRP-DR2B)
 - READ



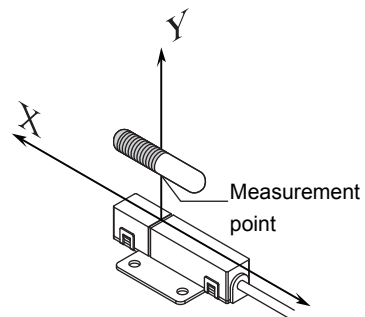
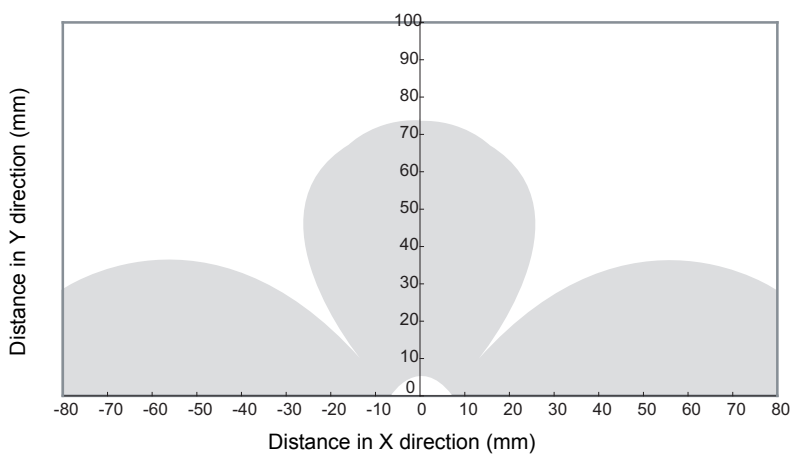
- WRITE



• Parallel Mounting (RI-TRP-DR2B)

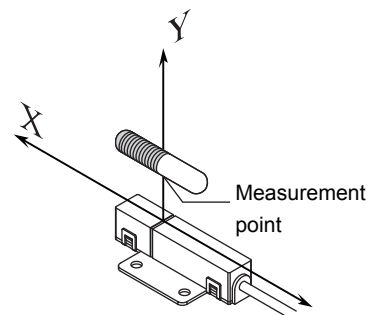
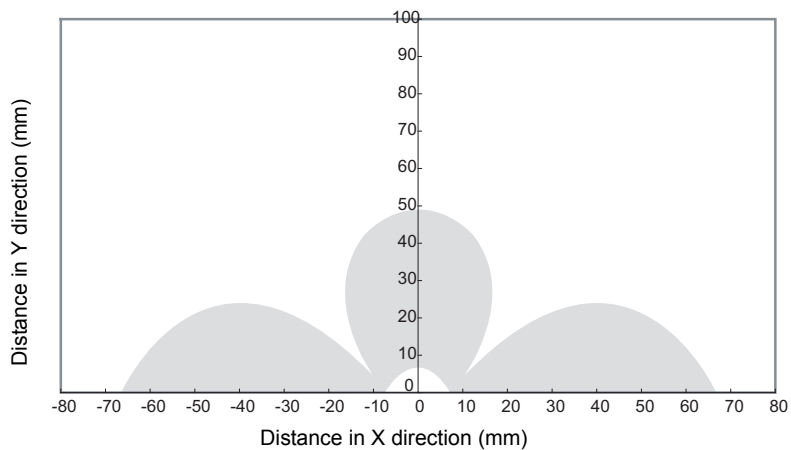
- READ

Communications Area (READ)



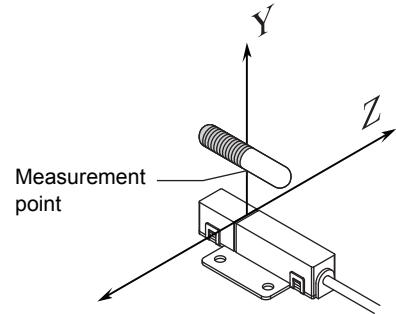
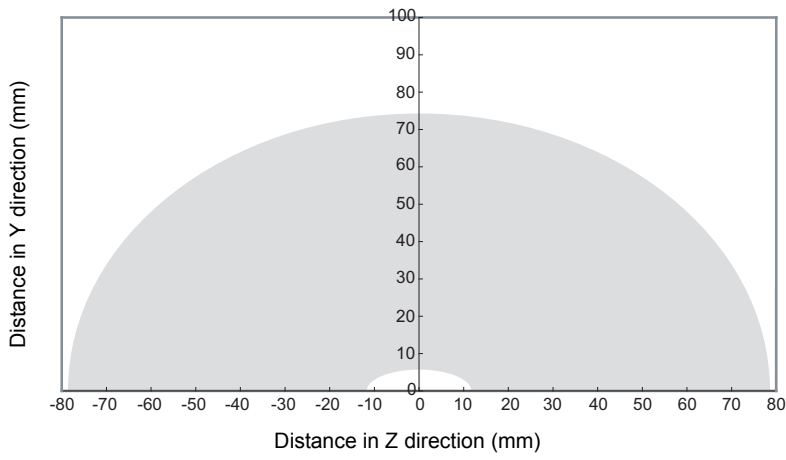
- WRITE

Communications Area (WRITE)



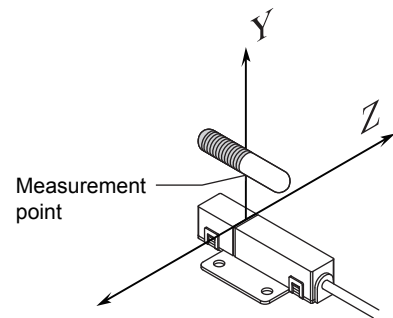
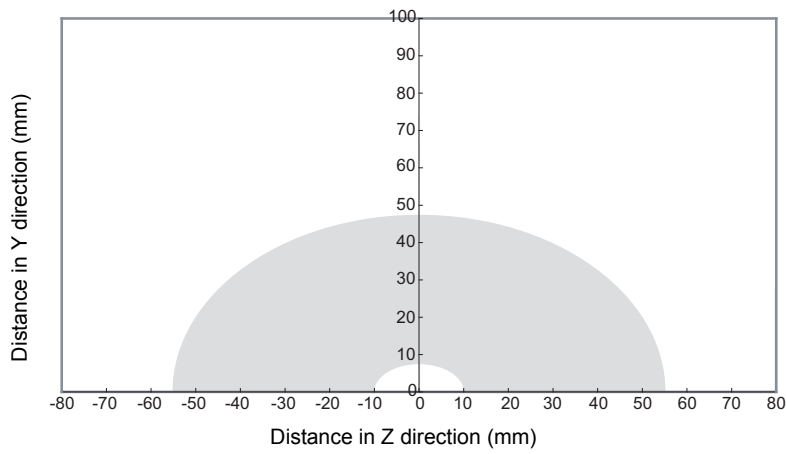
- Parallel Mounting (RI-TRP-DR2B)
 - READ

Communications Area (READ)



- WRITE

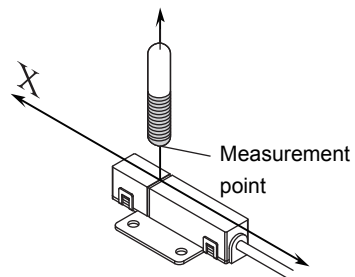
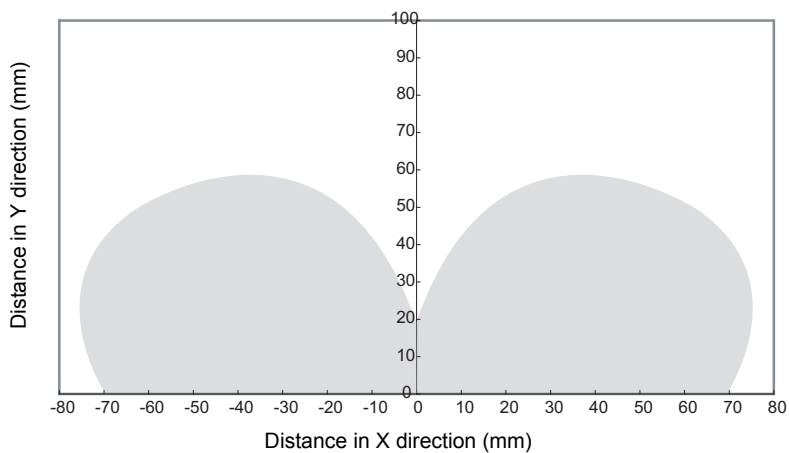
Communications Area (WRITE)



• Vertical Mounting (RI-TRP-DR2B)

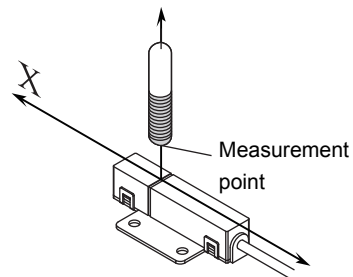
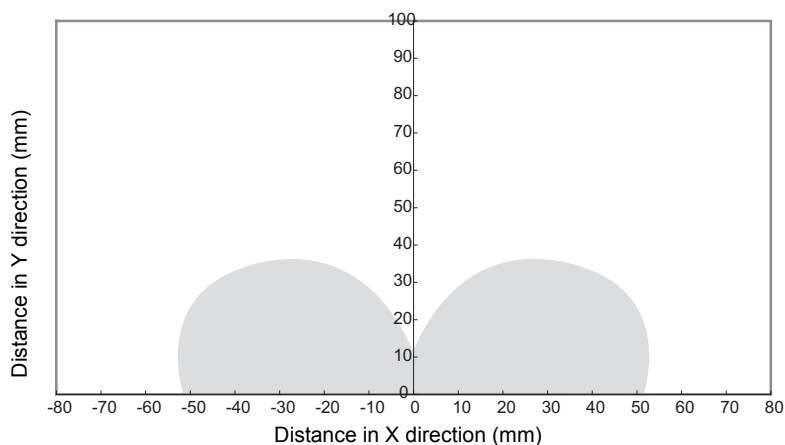
- READ

Communications Area (READ)



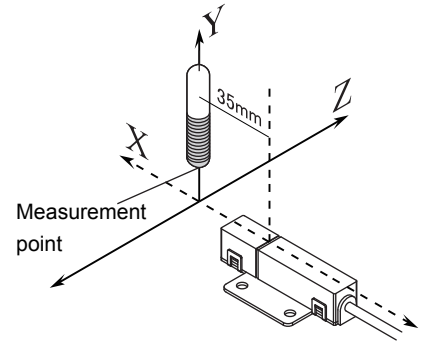
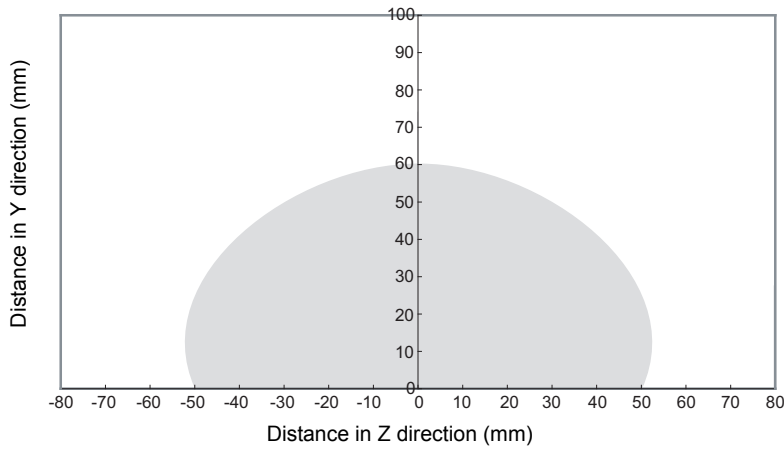
- WRITE

Communications Area (WRITE)



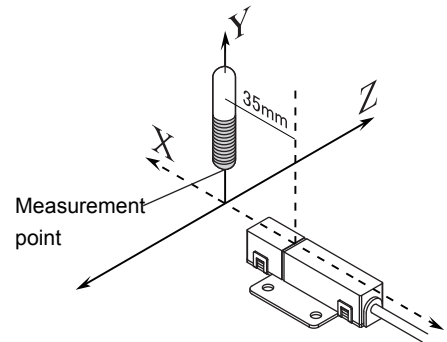
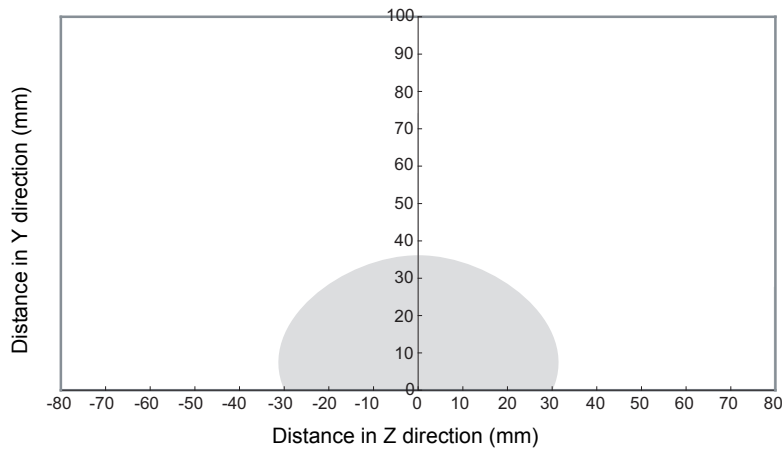
- Vertical Mounting (RI-TRP-DR2B)
 - READ

Communications Area (READ)



- WRITE

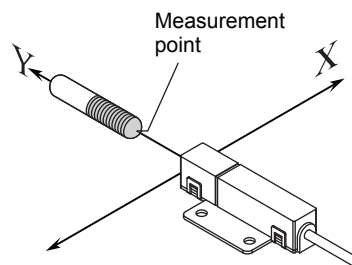
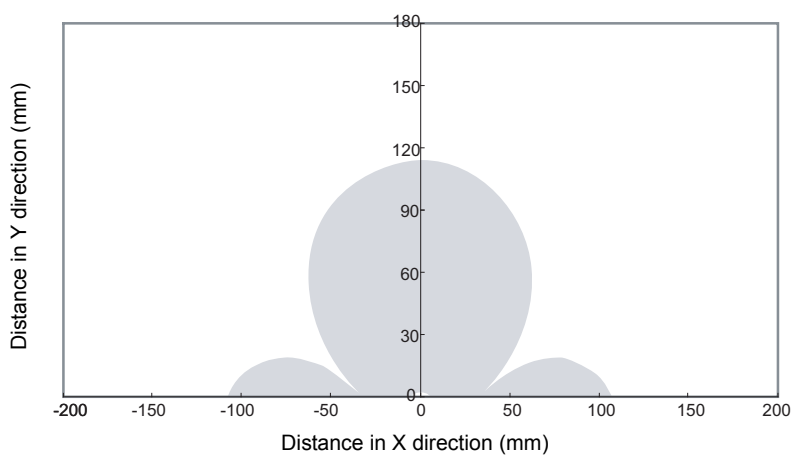
Communications Area (WRITE)



• Coaxial Mounting (RI-TRP-WR2B)

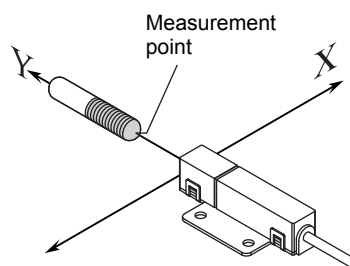
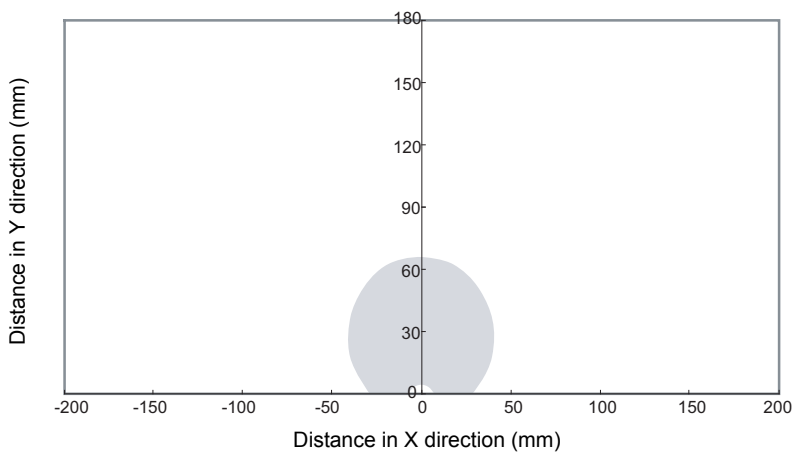
- READ

Communications Area (READ)

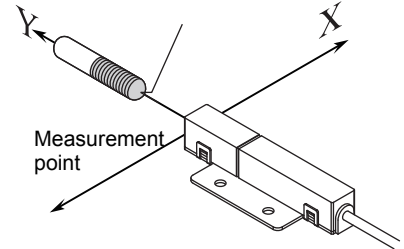
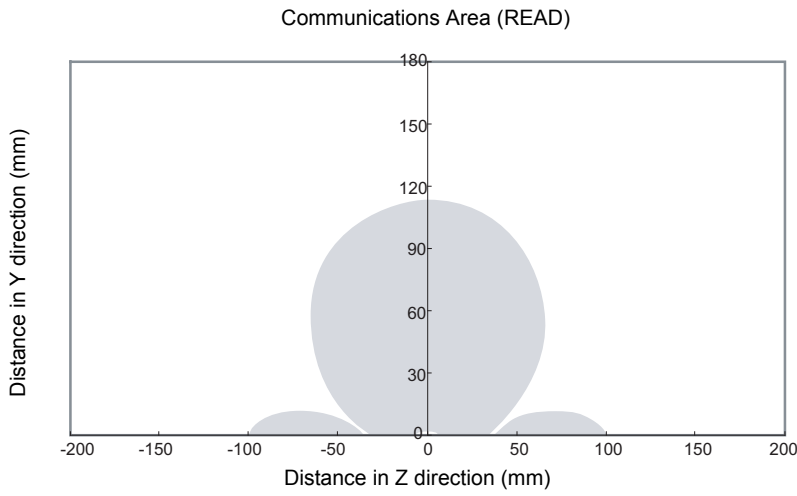


- WRITE

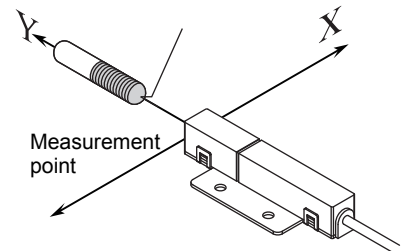
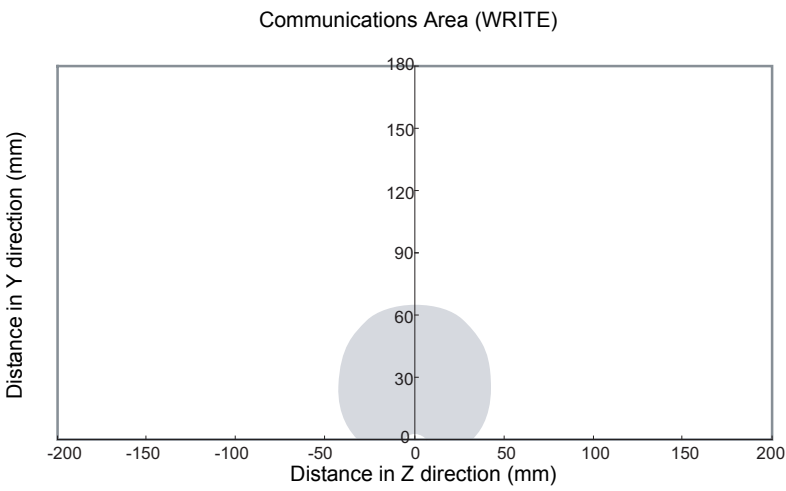
Communications Area (WRITE)



- Coaxial Mounting (RI-TRP-WR2B)
 - READ

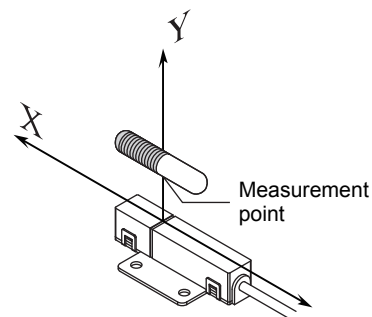
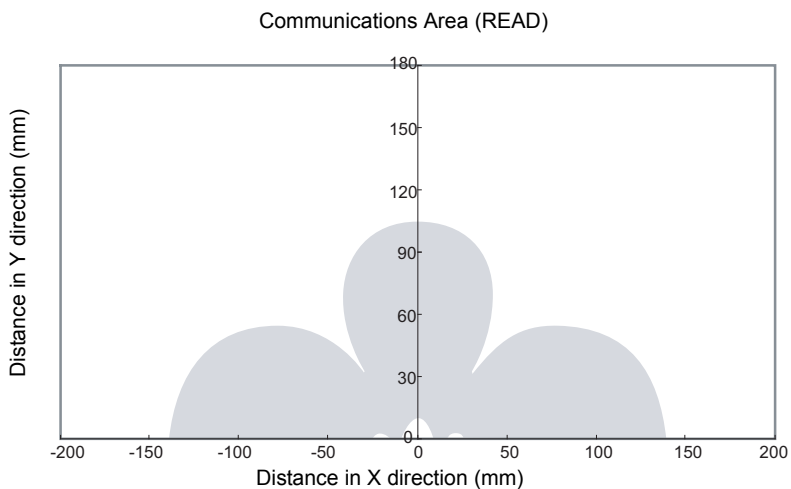


- WRITE

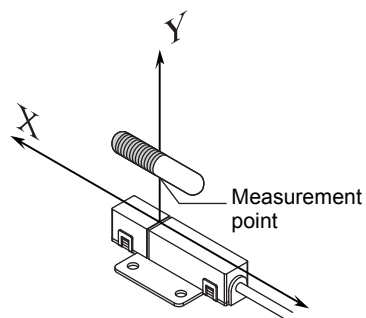
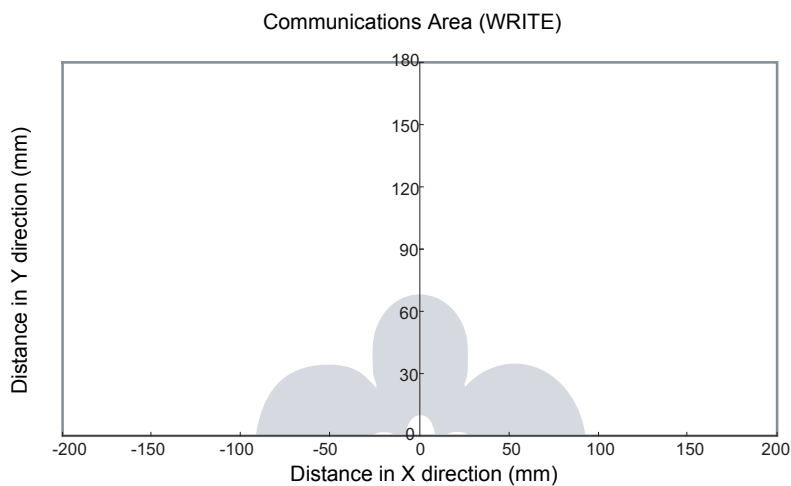


• Parallel Mounting (RI-TRP-WR2B)

- READ

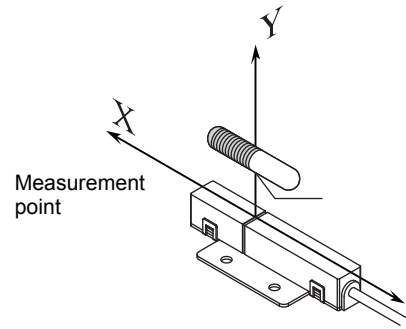
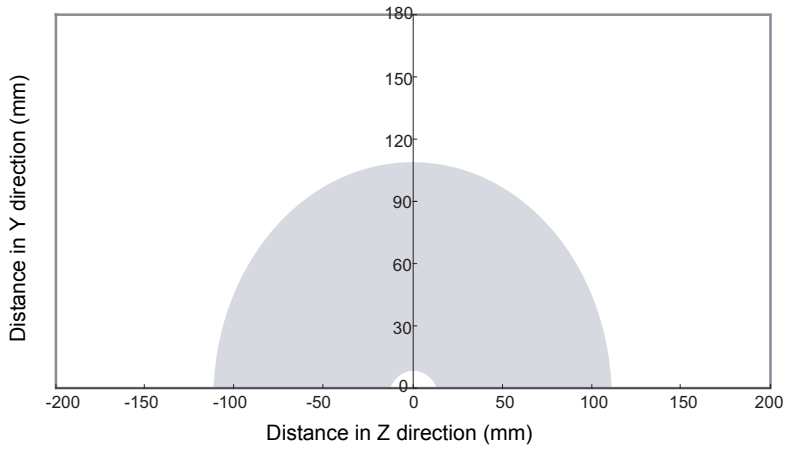


- WRITE



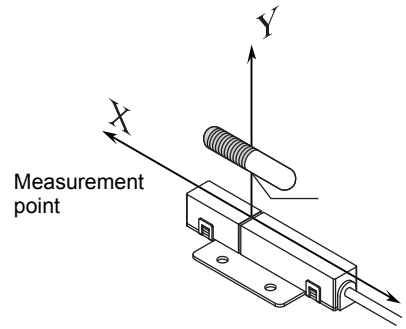
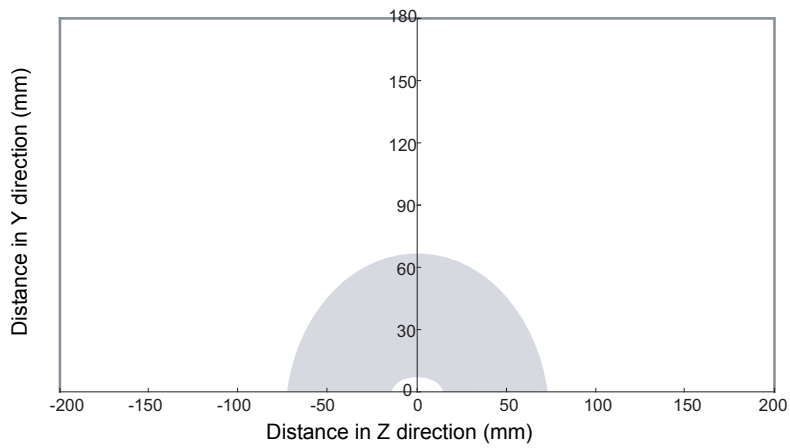
- Parallel Mounting (RI-TRP-WR2B)
 - READ

Communications Area (READ)



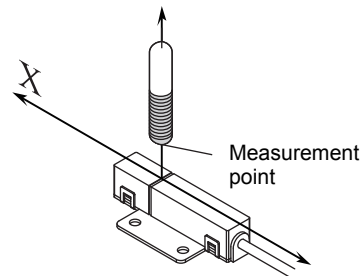
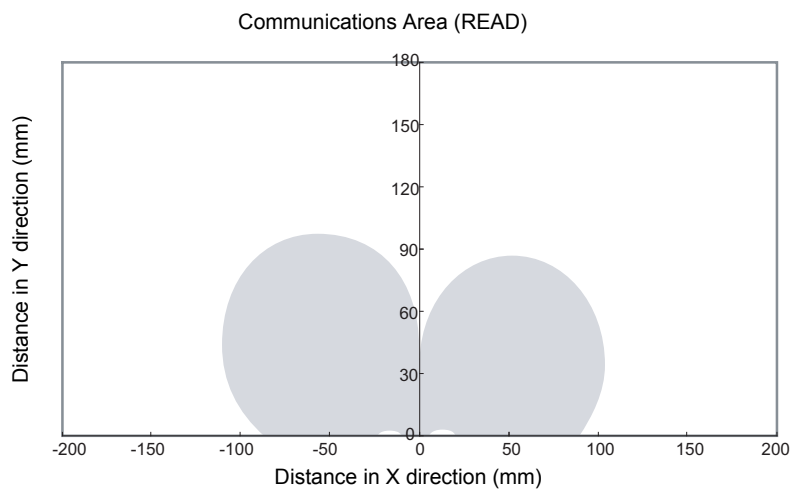
- WRITE

Communications Area (WRITE)

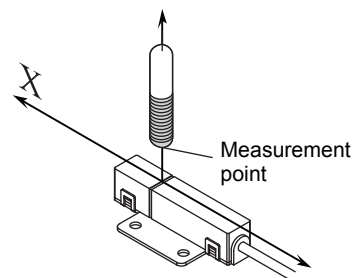
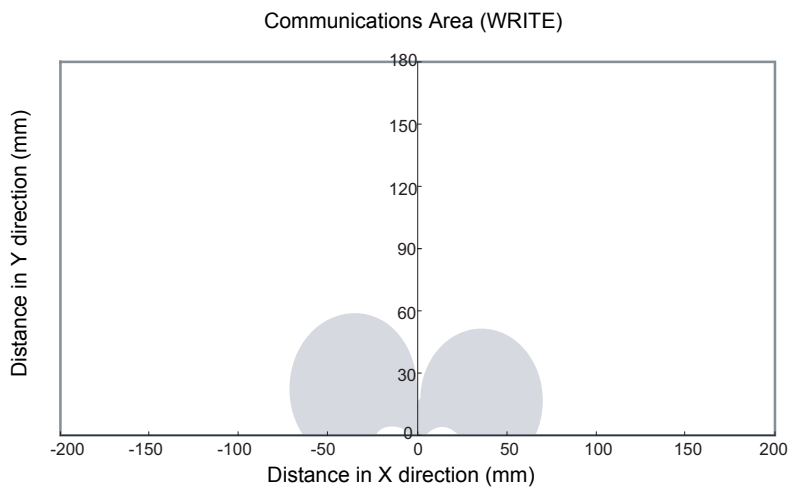


• Vertical Mounting (RI-TRP-WR2B)

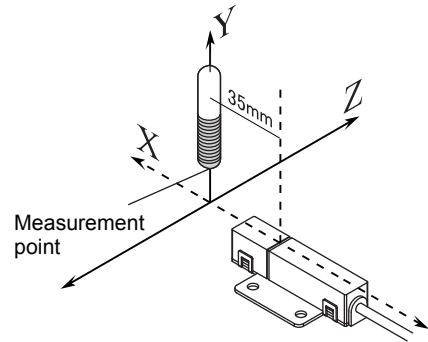
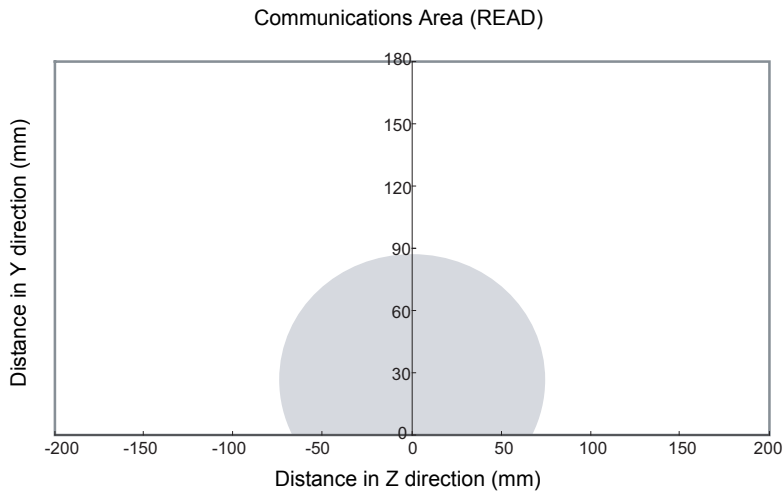
- READ



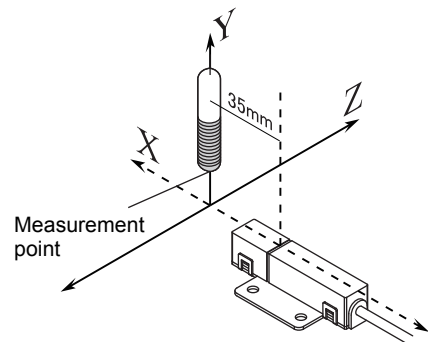
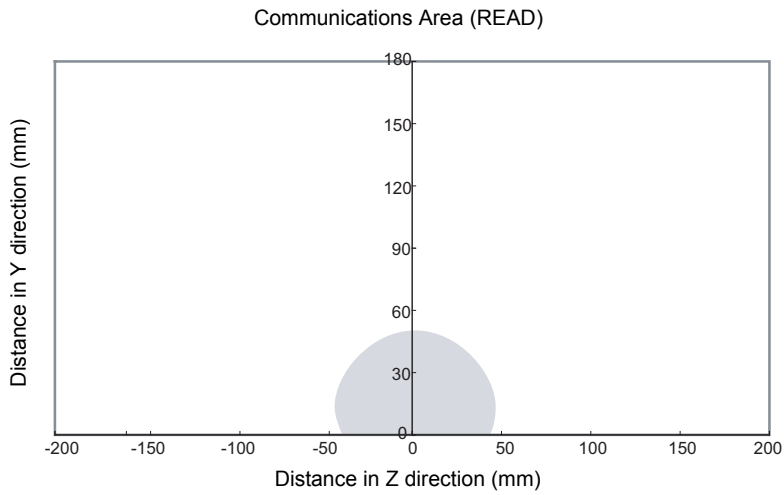
- WRITE



- Vertical Mounting (RI-TRP-WR2B)
 - READ



- WRITE

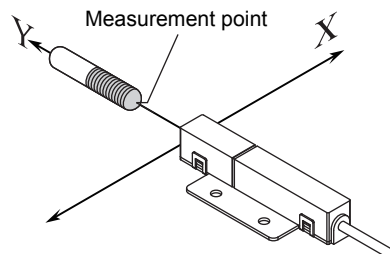
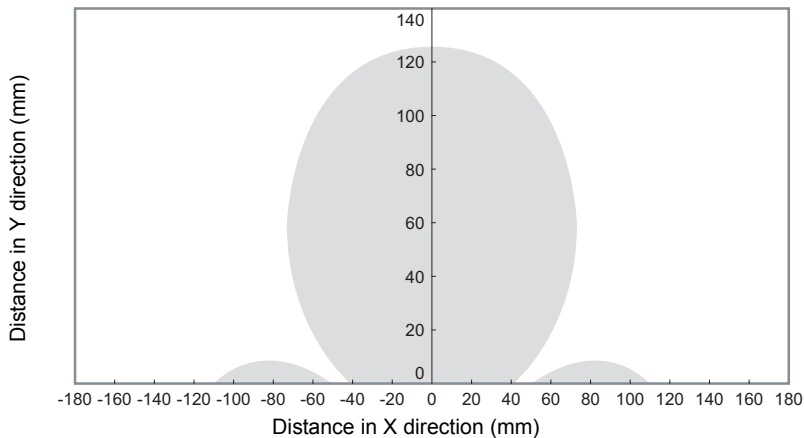


■ V640-HAM11-L-ETN

- Coaxial Mounting (RI-TRP-DR2B)

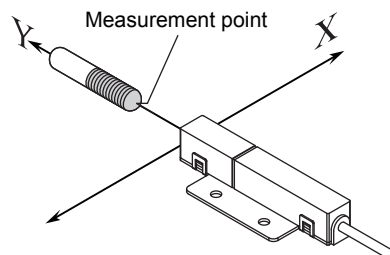
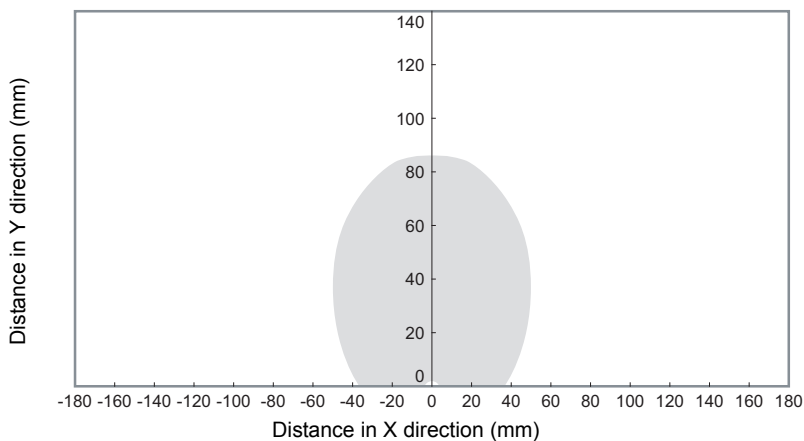
- READ

Communications Area (READ)



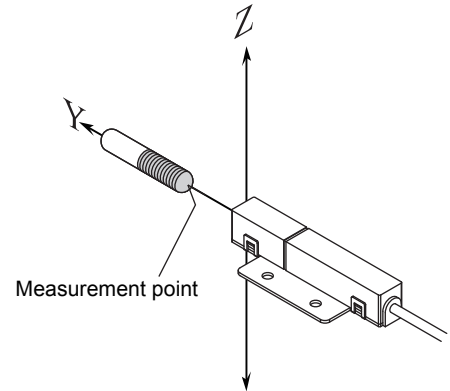
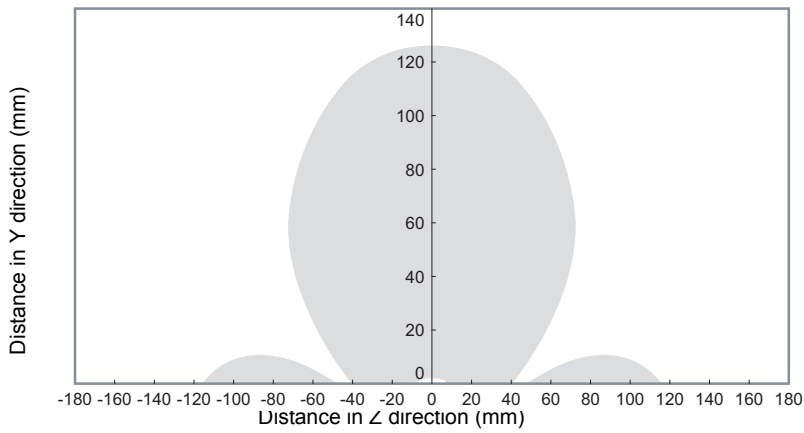
- WRITE

Communications Area (READ)



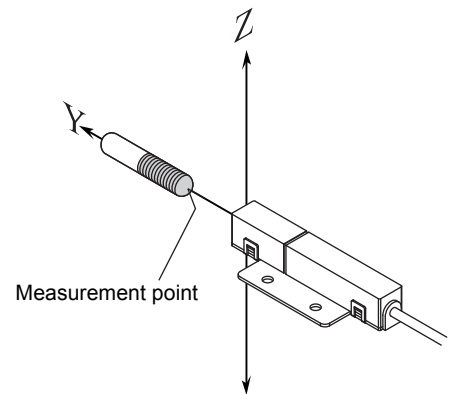
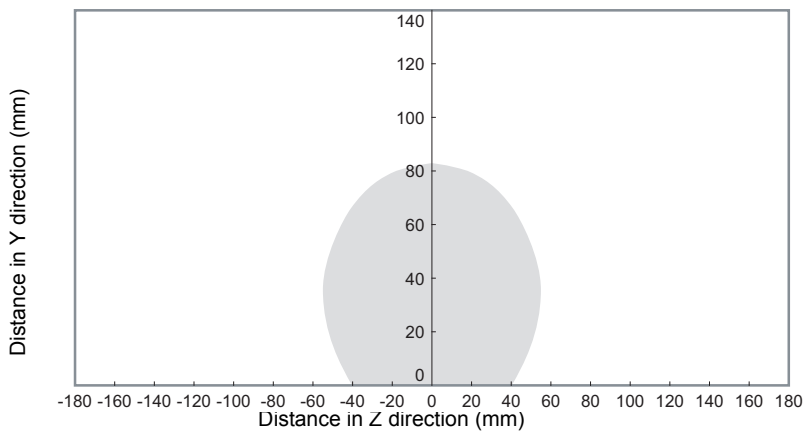
- Coaxial Mounting (RI-TRP-DR2B)
 - READ

Communications Area (READ)



- WRITE

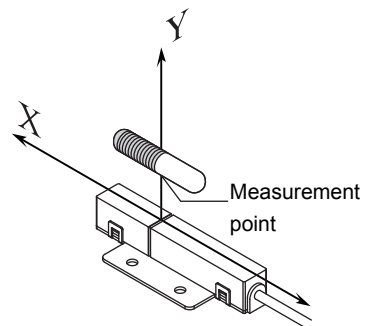
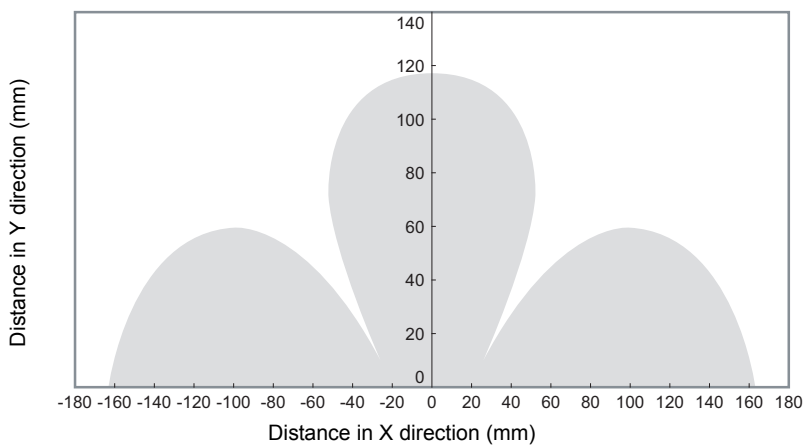
Communications Area (READ)



• Parallel Mounting (RI-TRP-DR2B)

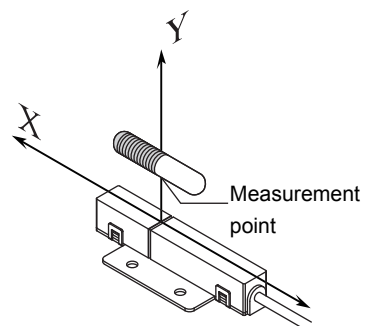
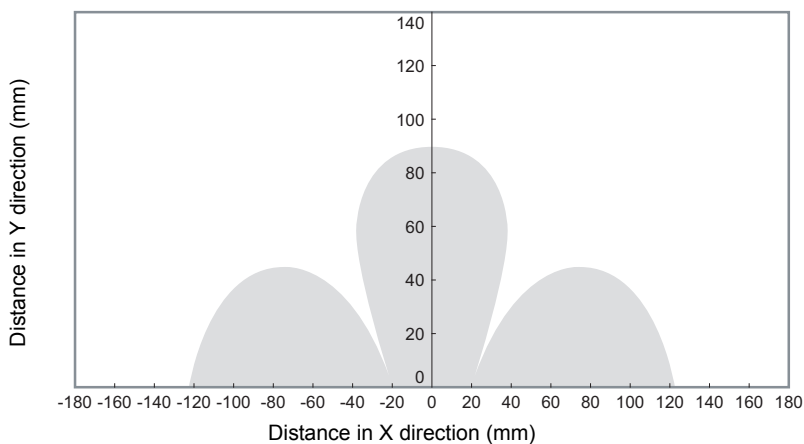
- READ

Communications Area (READ)



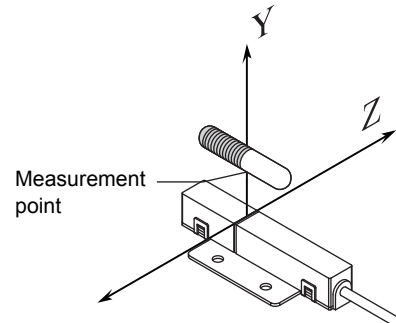
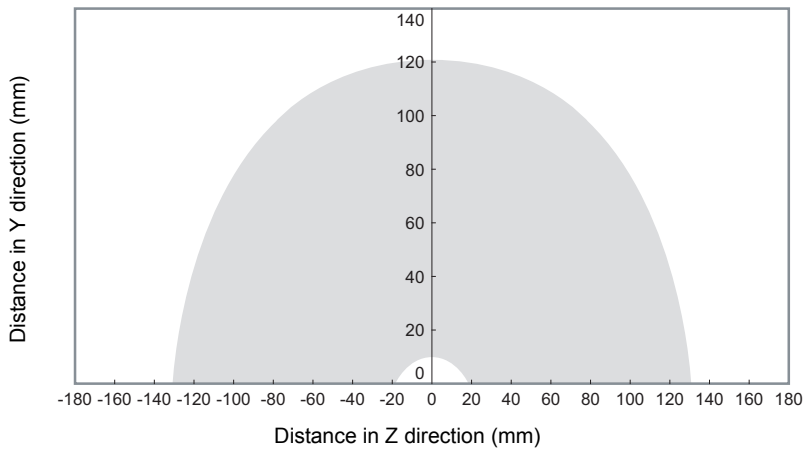
- WRITE

Communications Area (READ)



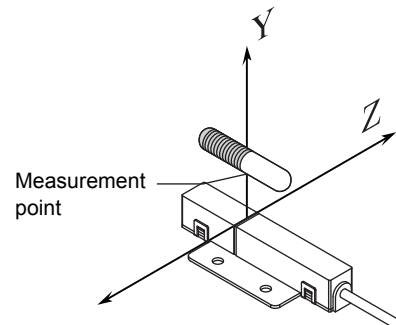
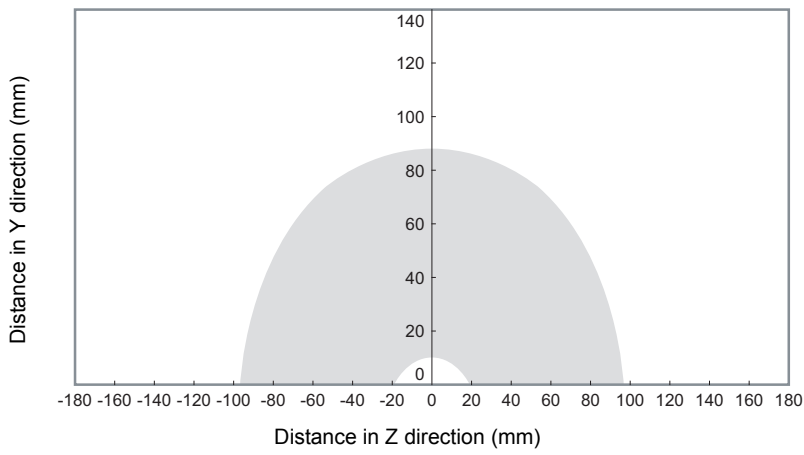
- Parallel Mounting (RI-TRP-DR2B)
 - READ

Communications Area (READ)



- WRITE

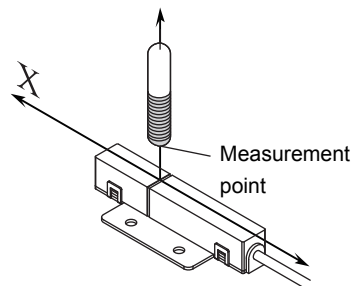
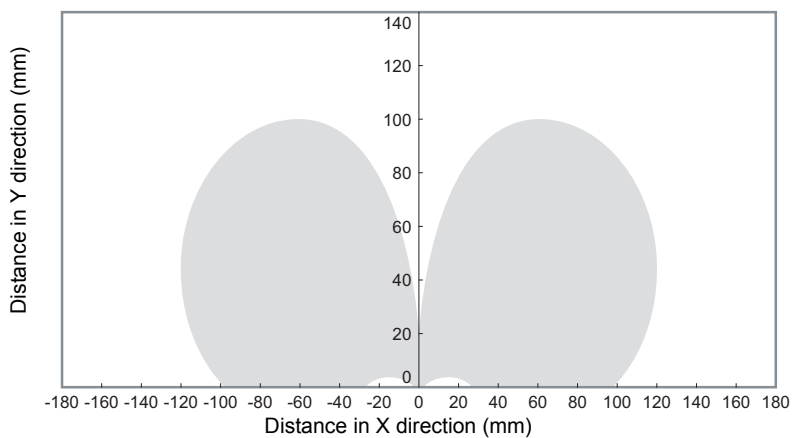
Communications Area (READ)



• Vertical Mounting (RI-TRP-DR2B)

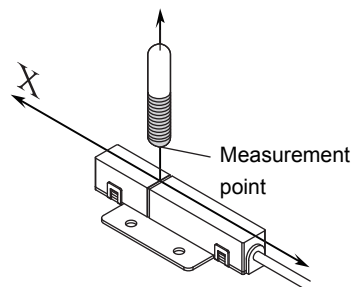
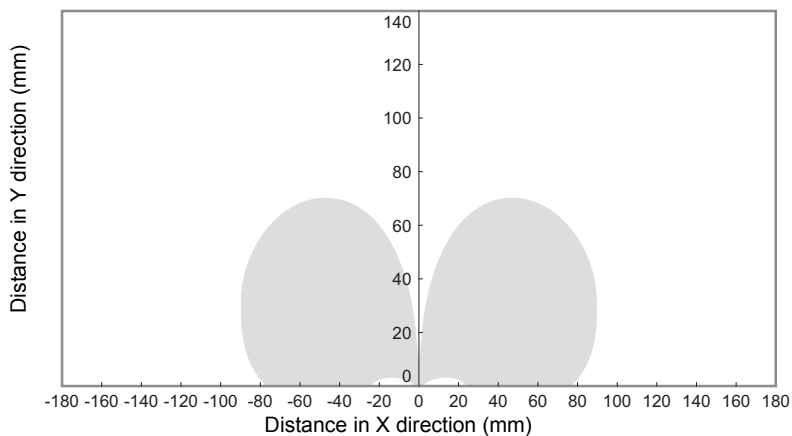
- READ

Communications Area (READ)

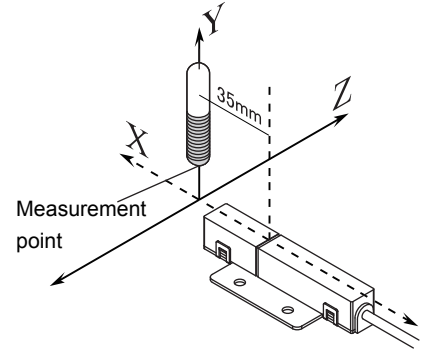
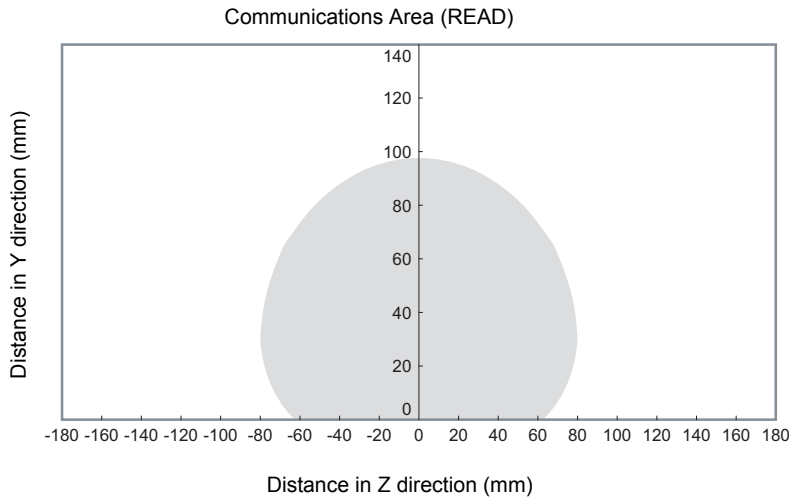


- WRITE

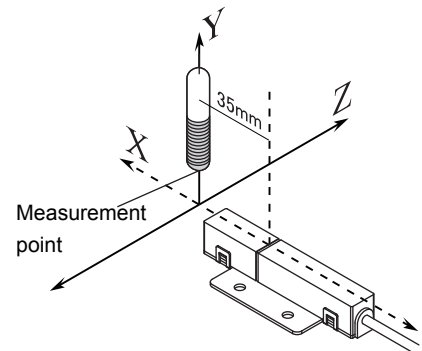
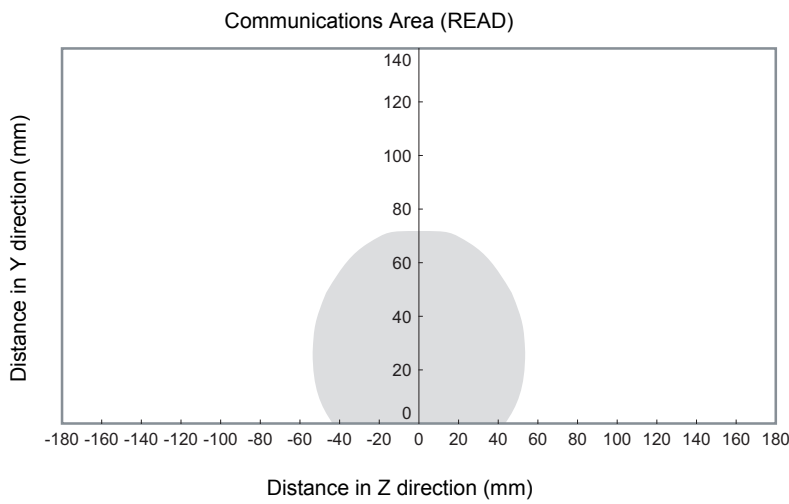
Communications Area (READ)



- Vertical Mounting (RI-TRP-DR2B)
 - READ

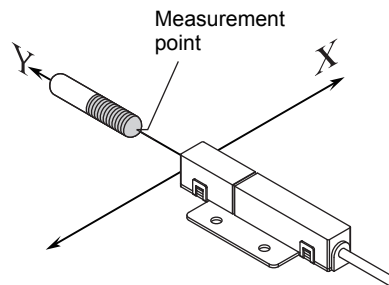
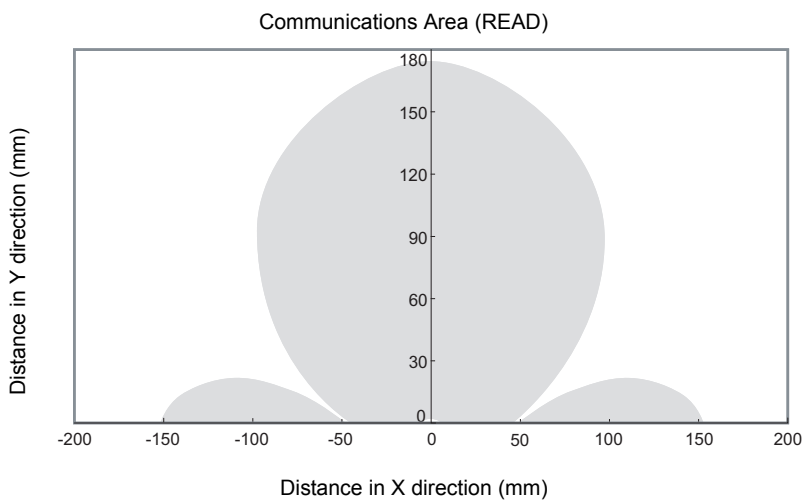


- WRITE

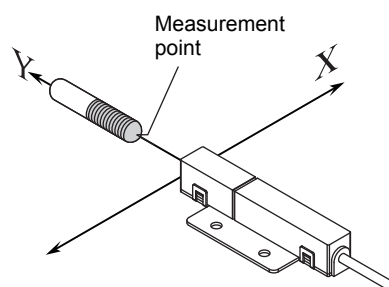
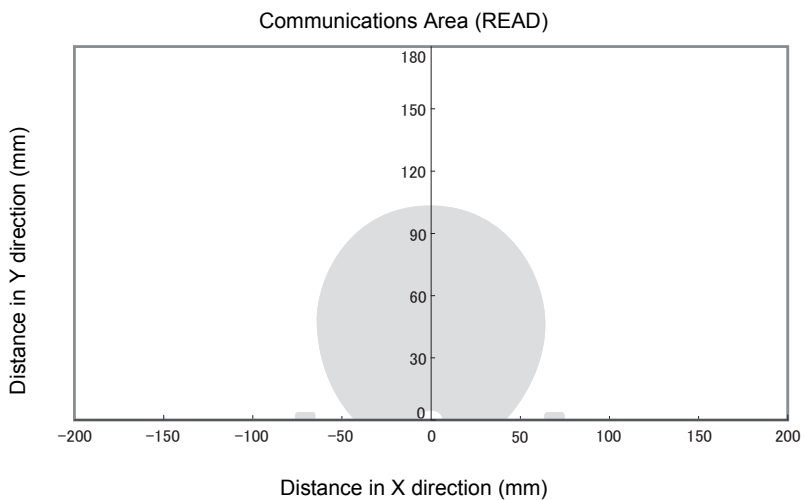


• Coaxial Mounting (RI-TRP-WR2B)

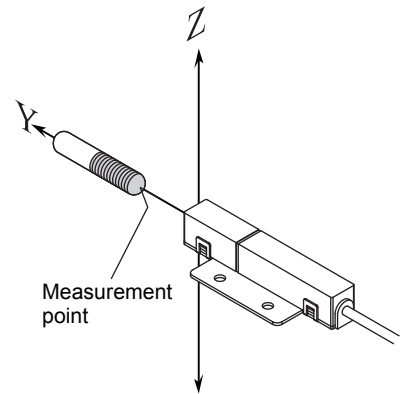
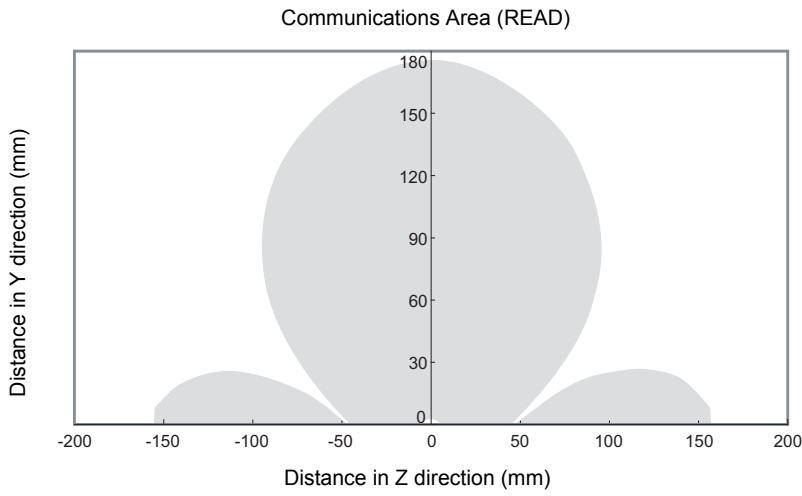
- READ



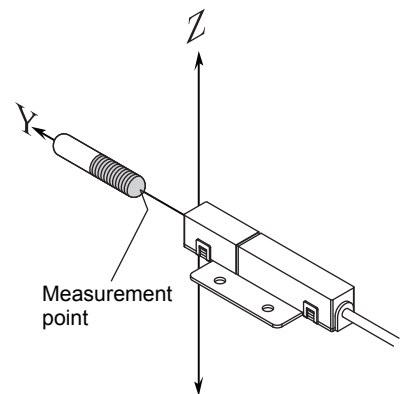
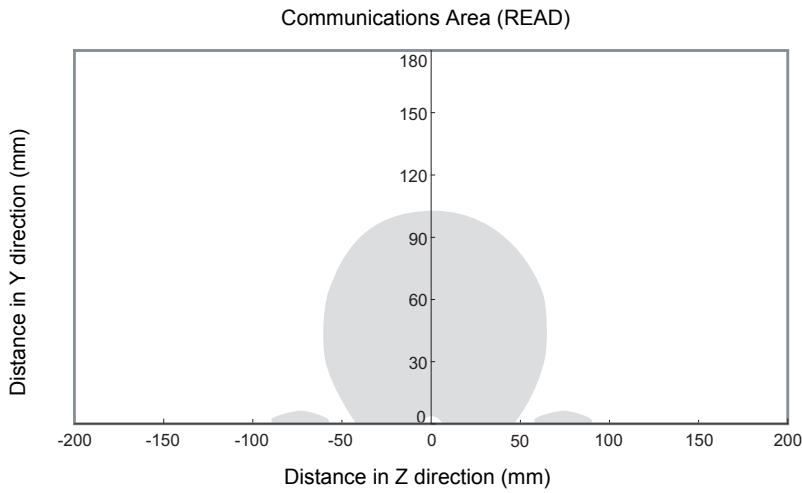
- WRITE



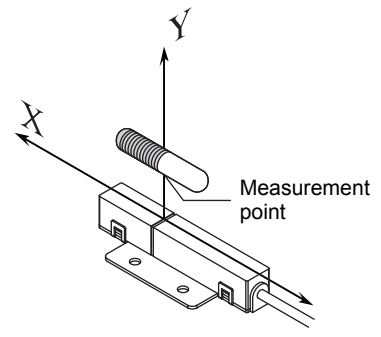
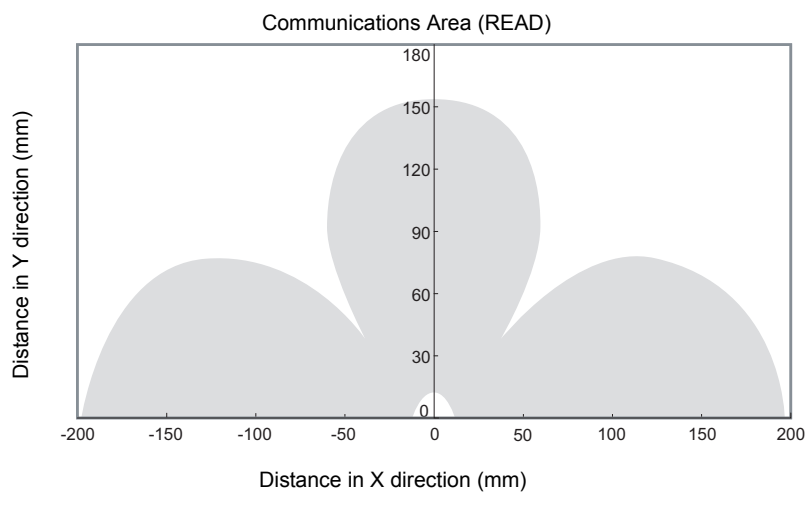
- Coaxial Mounting (RI-TRP-WR2B)
 - READ



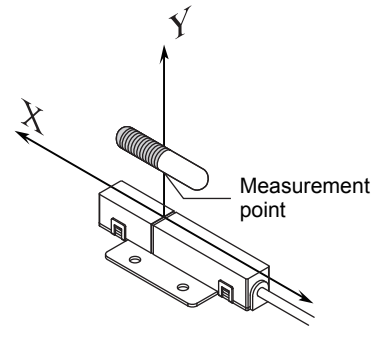
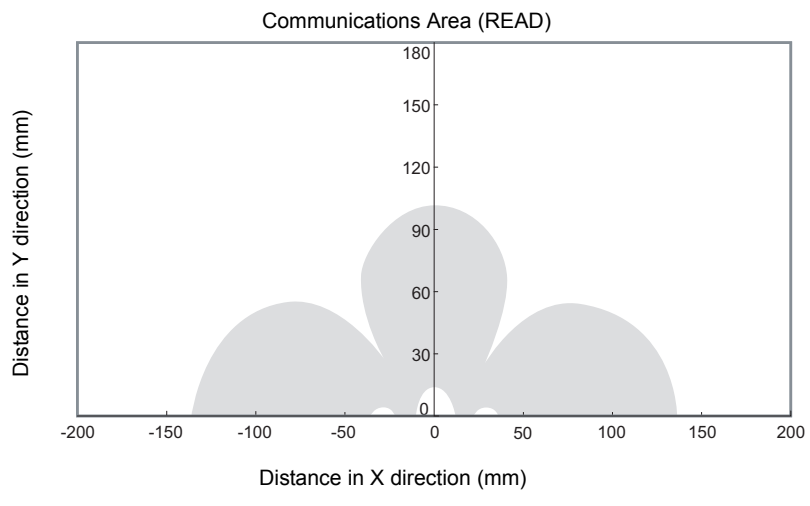
- WRITE



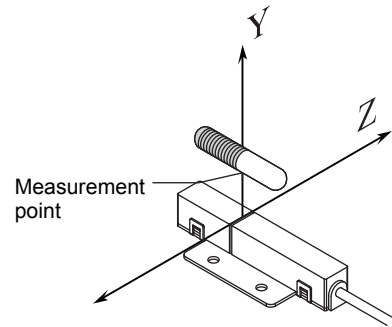
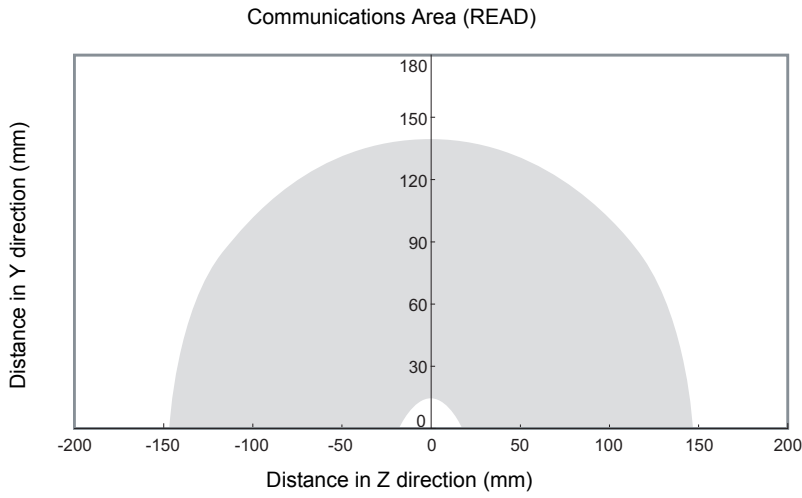
- Parallel Mounting (RI-TRP-WR2B)
- READ



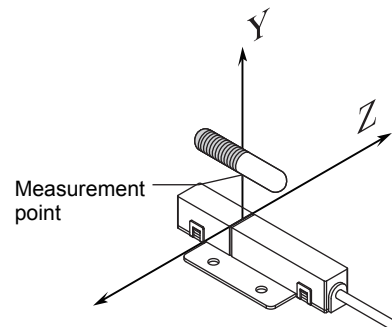
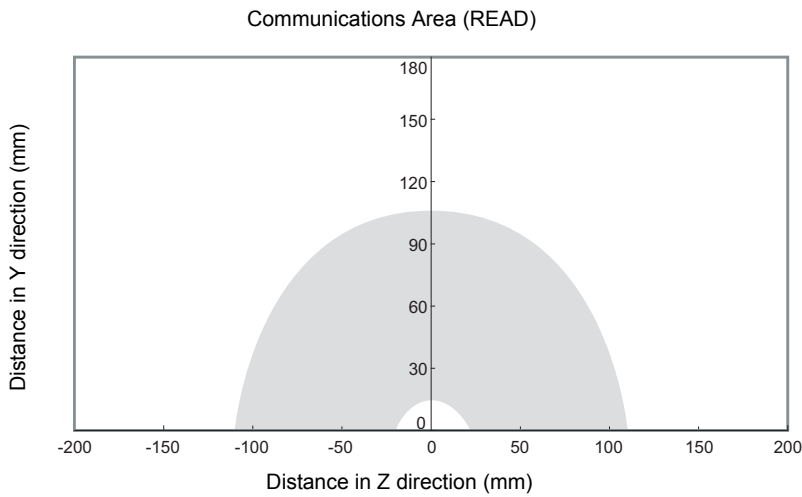
- WRITE



- Parallel Mounting (RI-TRP-WR2B)
 - READ

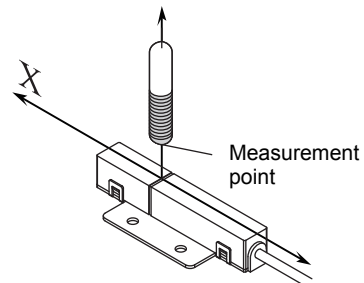
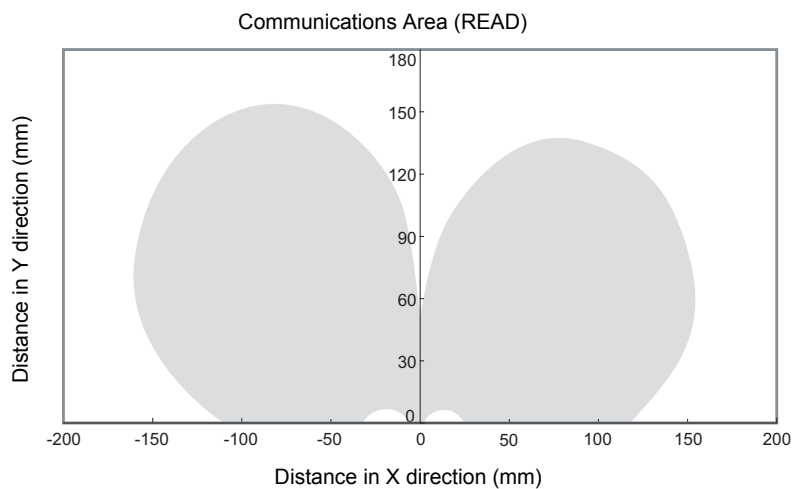


- WRITE

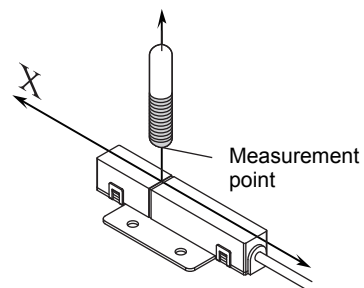
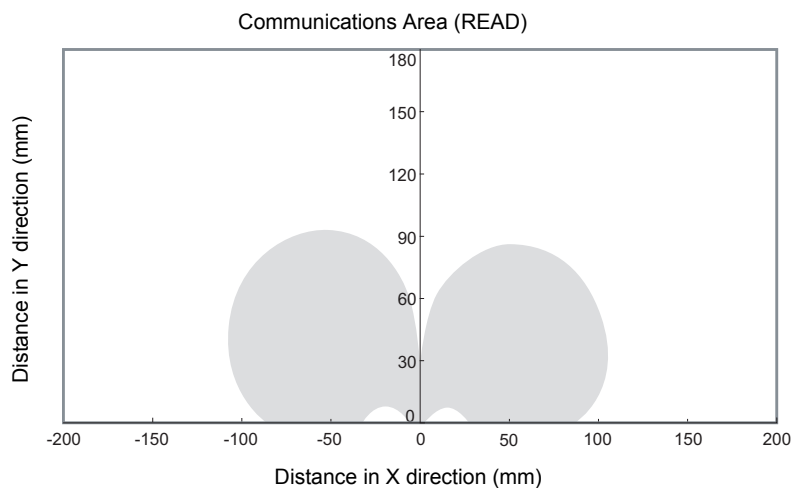


• Vertical Mounting (RI-TRP-WR2B)

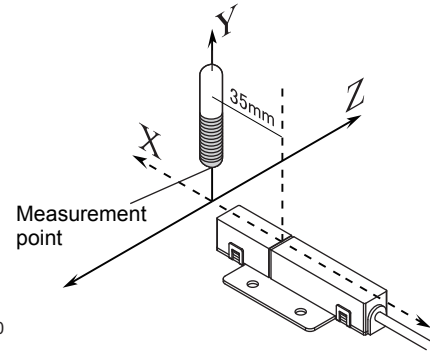
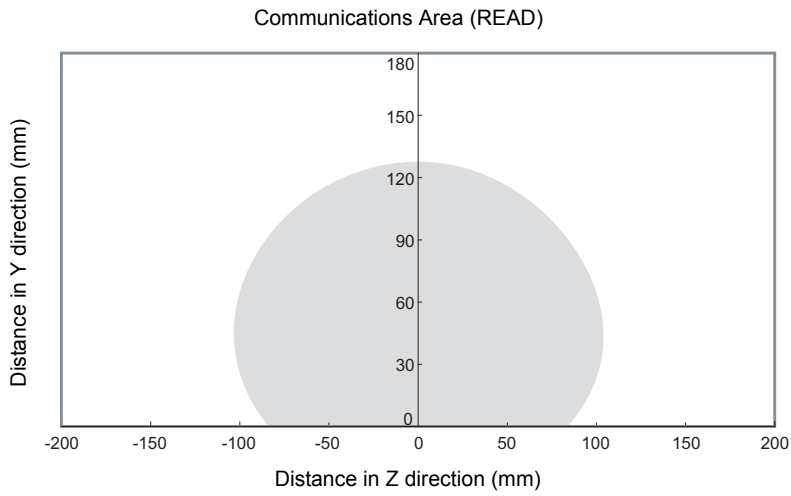
- READ



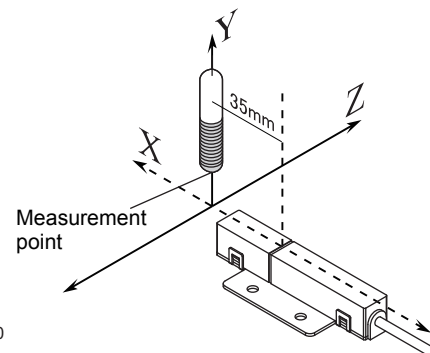
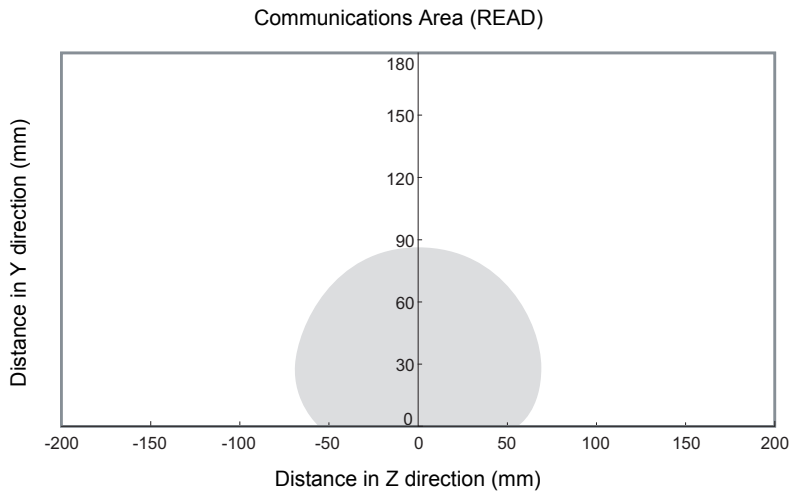
- WRITE



- Vertical Mounting (RI-TRP-WR2B)
 - READ



- WRITE



Mutual Interference Distances (Reference Only)

If Amplifier Units are connected using multidrop connections and multiple CIDRW Heads are used, the CIDRW Heads will not process commands simultaneously. In this case, install the CIDRW Heads at least 0.1 m apart from each other.

Distance between Antennas and Changes in Communications Distances (Reference Only)

• V640-HS61

Distance between Antennas	Change in communications distance
1,000 mm	100%
900 mm	100%
800 mm	100%
700 mm	99%
600 mm	90%
500 mm	74%
400 mm	55%
300 mm	40%
200 mm	15%

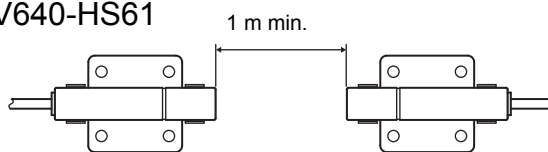
• V640-HS62

Distance between Antennas	Change in communications distance
2,000 mm	99%
1,600 mm	99%
1,400 mm	95%
1,200 mm	84%
1,000 mm	68%
800 mm	53%
600 mm	34%
400 mm	15%
200 mm	0%

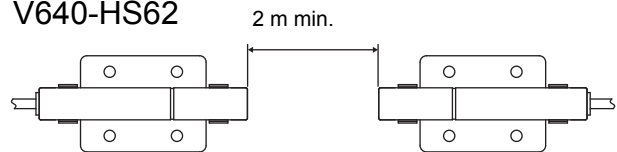
If CIDRW Heads in separate CIDRW systems process commands simultaneously when the CIDRW Systems are installed close to each other, mutual interference between the Heads can result in malfunctions. If this is a problem, install the CIDRW Heads separated at least by the distances shown in the following illustrations.

■ For Coaxial Installation

• V640-HS61

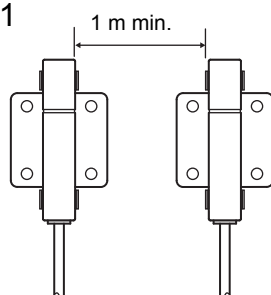


• V640-HS62

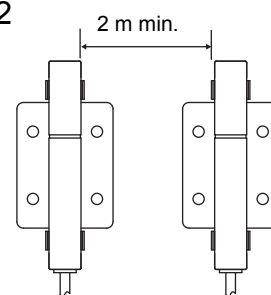


■ For Parallel Installation

• V640-HS61

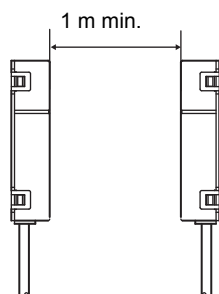


• V640-HS62

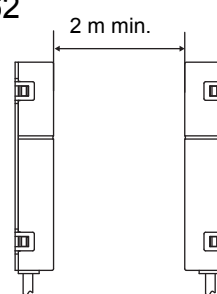


■ For Face-to-Face Installation

• V640-HS61

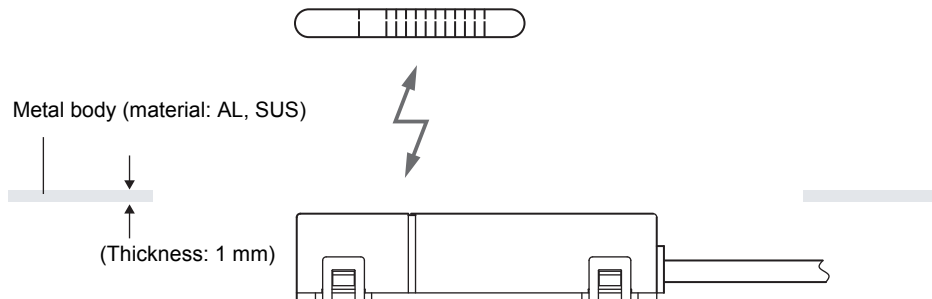


• V640-HS62



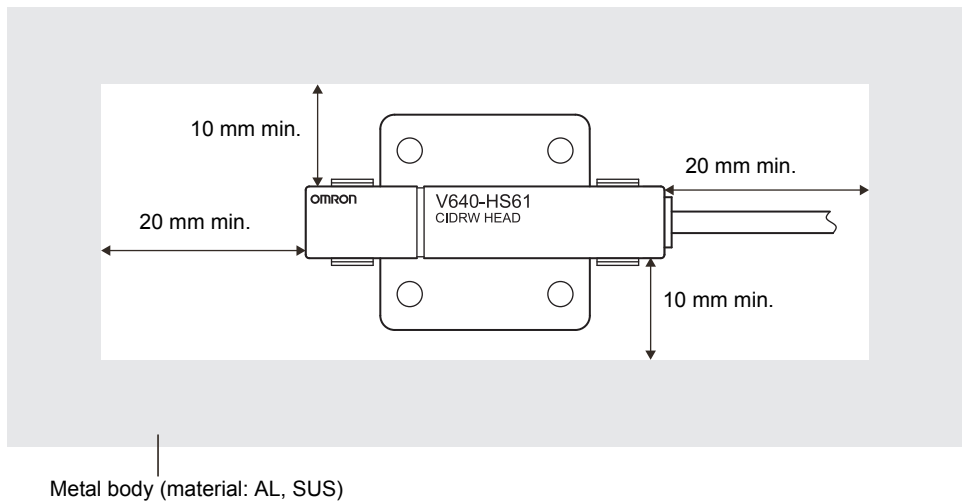
Influence of Background Metals (Reference Only)

The CIDRW Head can also communicate from an opening in a ceiling panel (metal body).

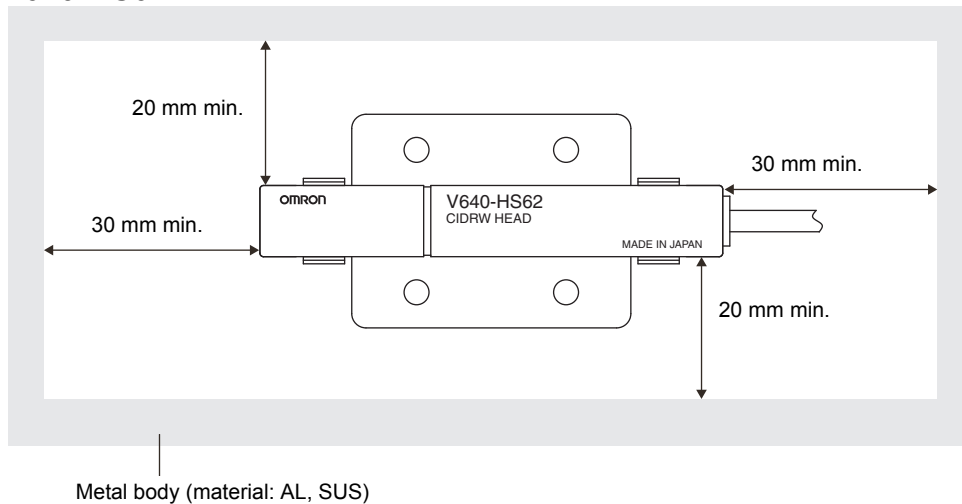


However, ensure the distances indicated below between the CIDRW Head and the metal body. If you do not ensure these distances the communications distance will be substantially shortened.

- V640-HS61

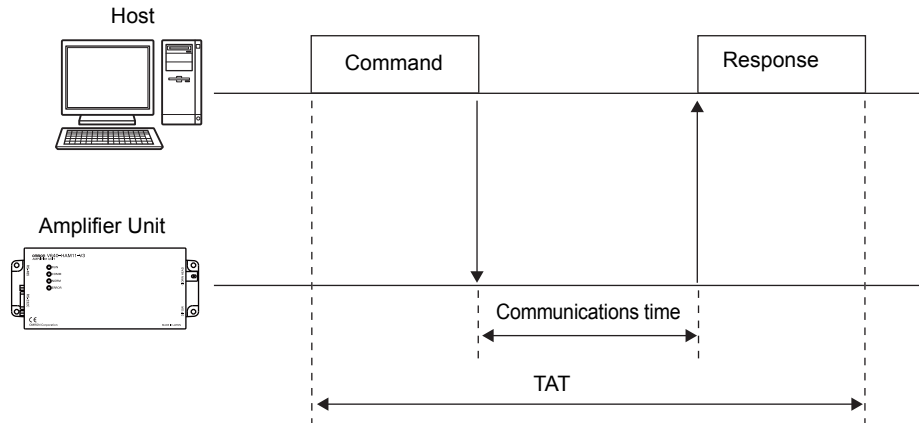


- V640-HS62



Communications Time

Regardless of whether SECS is used or not, take the time required for processing between the host device and Amplifier Units into account when designing the system.



Time	Description
Communications time	This is the time required for communications between an ID Tag and the CIDRW Head.
TAT	This is the time required for processing at the Amplifier Unit, seen from the host device.

Communications time calculation formula (unit: ms)

$$\text{READ: } 150.5 \times (\text{number of pages}) + 6.1$$

$$\text{SAME WRITE: } 468.6 \times (\text{number of pages}) + 80.3$$

$$\text{BYTE WRITE: } 468.6 \times (\text{number of pages}/8) + 229.9$$

┌──────────┐
|
Rounding up

TAT calculation formula (units: ms)

$$\text{TAT} = \text{command and response transmission time} + \text{communications time}$$

The command and response transmission time differs depending on the number of characters sent and the communications conditions.

$$\text{Transmission time (ms)} = \frac{\text{Number of bits per character (bits)}}{\text{Baud rate (bps)}} \times \text{total number of characters of command and response}$$

This calculation applies to continuous transmission in which the Controller uses no spaces between command characters.

Example of TAT calculation:

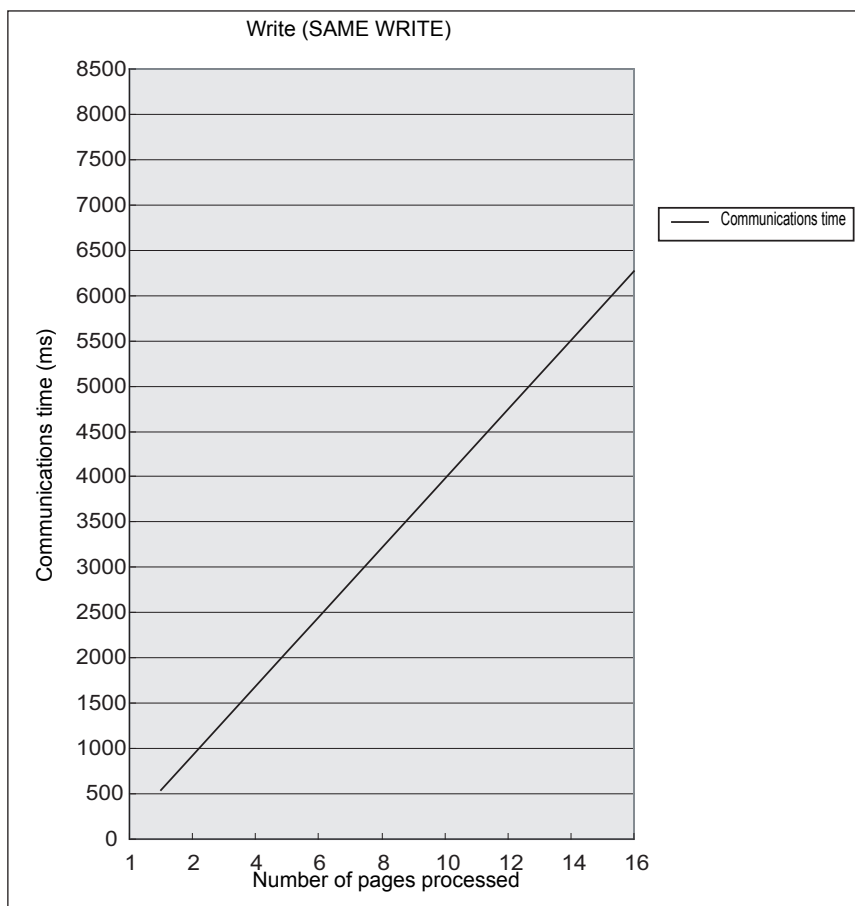
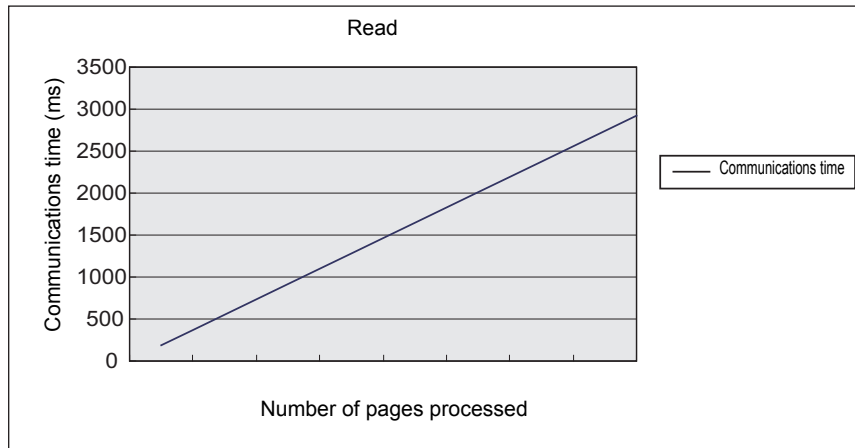
Number of command characters: A; number of response characters: B

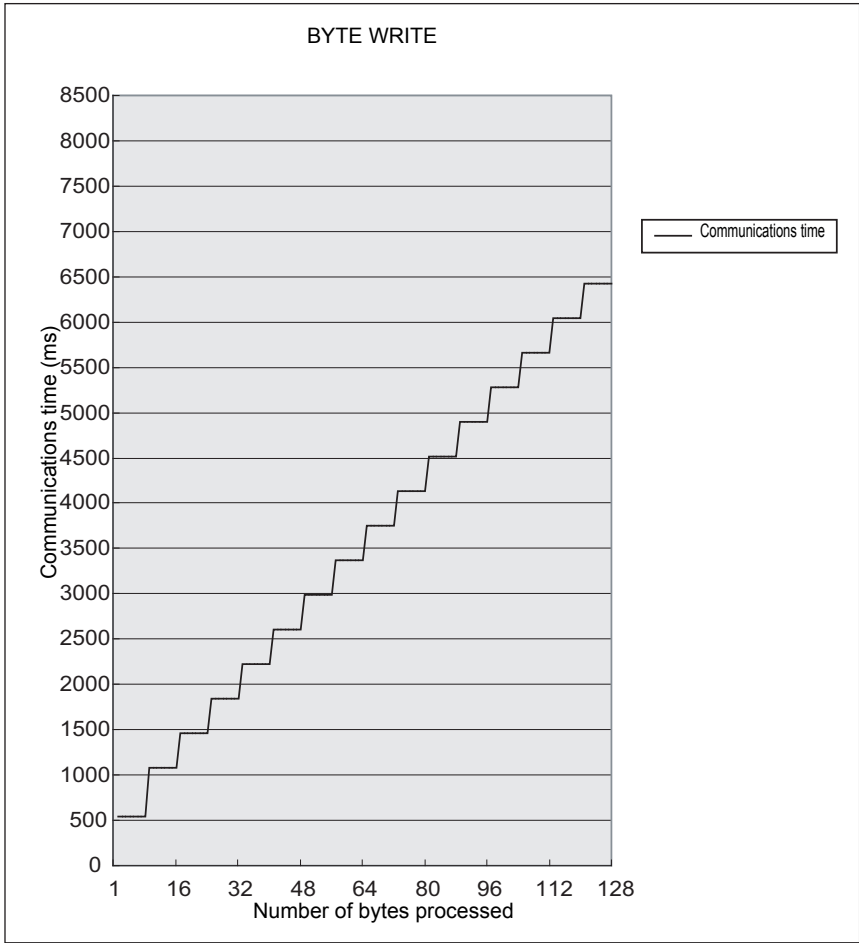
Baud rate: 9600 bps, data length: 8 bits, non parity, 1 stop bit

$$\text{TAT (ms)} = \frac{10}{9600} \times (A + B) + \text{Communications time (ms)}$$

The graph for communications time for communications between the ID Tag and CIDRW Head, and TAT (when the baud rate is 9600 bps), is shown below.

The communications time and TAT, however, may increase substantially according to the conditions of use.






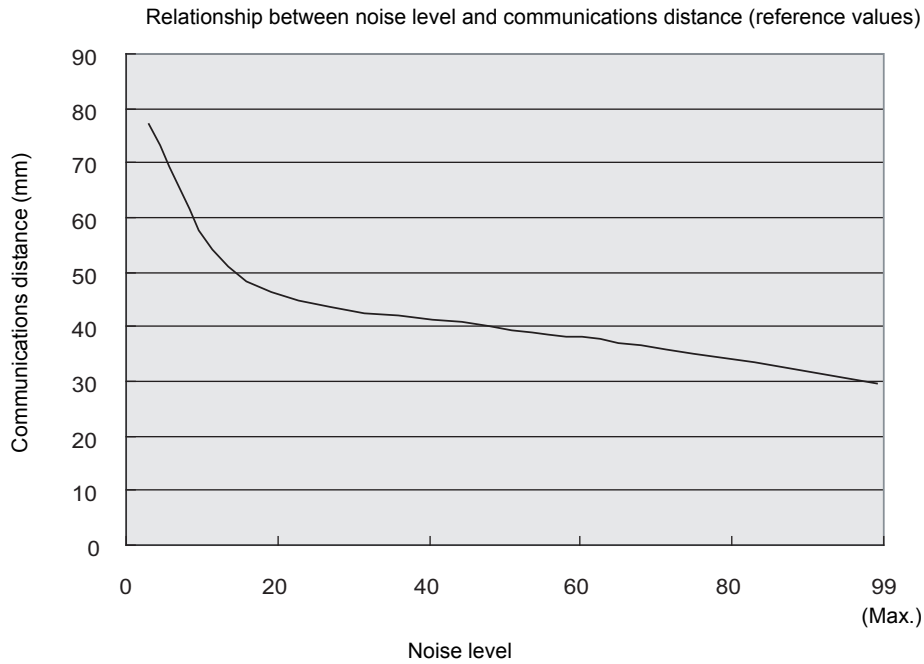
Communications Distance Characteristics vs. Ambient Noise

The graph below compares the results of measurement using the noise measurement function with communications distances.

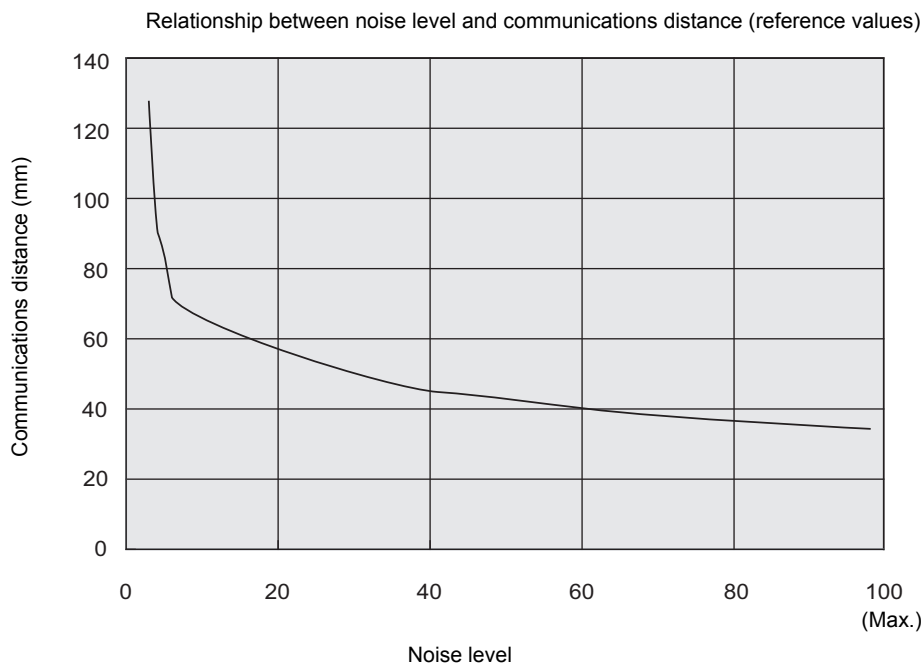
At installation implement measures in regard to metal in the vicinity of the CIDRW Head, power supply noise, and atmospheric noise, to ensure that the noise level does not exceed 10.

NOISE MEASUREMENT command (applies only when SECS is not used)  Refer to page 49.

■ V640-HAM11-ETN



■ V640-HAM11-L-ETN



ID Tag Memory Maps

The memory maps of the RI-TRP-DR2B and RI-TRP-WR2B ID Tags are given below.

RI-TRP-DR2B

ID Tag Memory Map

Page	8 bytes/1 page									Example of data segment settings	
										DATASEG	LENGTH
1	00h	01h	02h	03h	04h	05h	06h	07h	Carrier ID (16 byte)	Carrier ID	16
2	08h	09h	0Ah	0Bh	0Ch	0Dh	0Eh	0Fh		"S01"	8
3	10h	11h	12h	13h	14h	15h	16h	17h	Data area (Total of 120 bytes)	"S02"	8
4	18h	19h	1Ah	1Bh	1Ch	1Dh	1Eh	1Fh		"S03"	8
5	20h	21h	...	...				27h		"S04"	8
6	28h	29h	...	...				2Fh		"S05"	8
7	30h	31h	...	...				37h		"S06"	8
8										"S07"	8
9								:		"S08"	8
10	:							:		"S09"	8
11	:									"S10"	8
12										"S11"	8
13										"S12"	8
14	68h	69h	...	...				6Fh		"S13"	8
15	70h	71h	...	...				77h		"S14"	8
16	78h	79h	...	...				7Fh		"S15"	8
17	80h	81h	...	...				87h			



- The carrier ID memory area starts from page 1 (fixed).
- 00h to 87h in the table are addresses.
- The RI-TRP-WR2B has a memory capacity of 136 bytes.

CHECK!

RI-TRP-WR2B

ID Tag Memory Map

Page	8 bytes/1 page									Example of data segment settings	
										DATASEG	LENGTH
1	00h	01h	02h	03h	04h	05h	06h	07h	Carrier ID (8 byte)	Carrier ID	8



- The RI-TRP-WR2B has a memory capacity of 8 bytes.

CHECK!

Regular Inspection

In order to maintain optimum performance of the functions of the CIDRW system, daily and periodic inspections are necessary.

Inspection item		Detail	Criteria	Tools required
Supply voltage fluctuation		Check that the supply voltage fluctuation at the power supply terminal block is within the permissible range.	To be within supply voltage rating.	Multimeter
		Check that there are no frequent instantaneous power failures or radical voltage drops.	To be within permissible voltage fluctuation range.	Power supply analyzer
Environment	Ambient temperature	Check that the ambient temperature and humidity are within specified range.	To be within the specified range.	Maximum and minimum thermometer Hygrometer
	Ambient humidity			
	Vibration and shock	Check that no vibration or shock is transmitted from any machines.	To be none.	
	Dust	Check that the system is free of dust accumulation.		
	Corrosive gas	Check that no metal part of the system is discolored or corroded.		
I/O power supply	Voltage fluctuation	Check on the I/O terminal block that the voltage fluctuation and ripple are within the permissible ranges.	To be within the specified range.	Multimeter Oscilloscope
	Ripple			
Mounting condition		Check that each device is securely mounted.	There must be no loose screws.	—
		Check that each connector is securely connected.	Each connector must be locked or securely tightened with screws.	
		Check that no wire is broken or nearly broken.	There must be no wire that is broken or nearly broken.	
		Check if grounding to 100 Ω or less has been done.	To be grounded to 100 Ω or less.	

ASCII Code Table

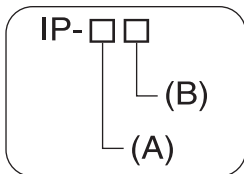
Leftmost bits Rightmost bits	b8 to b5	0000	1001	0010	0011	0100	0101	0110	0111	1000	1101	1010	1011	1100	1101	1110	1111	
	b4 to b1	Row Line	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0000	0	NUL	TC7(DLE)	(SP)	0	@	P	`	p	Undefined	Undefined	Undefined	Undefined	Undefined	Undefined	Undefined	Undefined	Undefined
0001	1	TC1(SOH)	DC ₁	!	1	A	Q	a	q									
0010	2	TC2(STX)	DC ₂	"	2	B	R	b	r									
0011	3	TC3(ETX)	DC ₃	#	3	C	S	c	s									
0100	4	TC4(EOT)	DC ₄	\$	4	D	T	d	t									
0101	5	TC5(NEQ)	TC ₈ (NAK)	%	5	E	U	e	u									
0110	6	TC6(ACK)	TC ₉ (SYN)	&	6	F	V	f	v									
0111	7	BEL	TC ₁₀ (ETB)	'	7	G	W	g	w									
1000	8	FE0(BS)	CAN	(	8	H	X	h	x								
1001	9	FE1(HT)	EM	)	9	I	Y	i	y								
1010	10	FE2(LF)	SUB	*	:	J	Z	j	z									
1011	11	FE3(VT)	ESC	+	;	K	[	k	{								
1100	12	FE4(FI)	IS ₄ (FS)	,	<	L	\	l	|									
1101	13	FE5(CR)	IS ₃ (GS)	-	=	M	]	m	}								
1110	14	S0	IS ₂ (RS)	.	>	N	^	n	ÄP									
1111	15	S1	IS ₁ (US)	/	?	O	_	o	DEL									

Protective Construction

IP-□□ is governed by the test methods described below. Check in advance the seal characteristics under the actual environment and conditions of use.

IP is the abbreviation of International Protection.

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




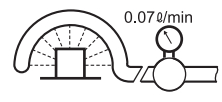

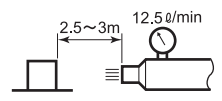

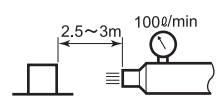

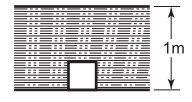



(A) First numeral in code: Class of protection against entry of solid foreign material

Class	Degree of protection	
0		No protection
1		Protected against access by solid objects with a diameter of 50 mm or greater (e.g., human hands).
2		Protected against access by solid objects with a diameter of 12.5 mm or greater (e.g., fingers).
3		Protected against access by wires and solid bodies with a diameter of 2.5 mm or greater.
4		Protected against access by wires and solid bodies with a diameter of 1 mm or greater.
5		Entry of volumes of dust that would cause difficulties in normal operation of devices or compromise safety is prevented.
6		Entry of dust is prevented.

(B) Second numeral of code: Class of protection against the entry of water

Class	Degree of protection	Outline of test methods (tests using water)	
0	No special protection	No protection against the entry of water.	No test
1	Protection against droplets of water 	The product suffers no ill effects from droplets of water falling vertically onto it.	Water droplets are sprayed onto the product from directly above for 10 minutes by water droplet exposure test apparatus.
2	Protection against droplets of water 	The product suffers no ill effects from droplets of water directed at it at an angle of up to 15° to vertical.	The water droplet exposure test apparatus is set to 15° from vertical and water droplets sprayed onto the product for 10 minutes (total of 25 minutes in each direction).

Class	Degree of protection		Outline of test methods (tests using water)
3	Protection against spraying water 	The product suffers no ill effects from a water spray directed at it at up to 60° from vertical.	Using the test apparatus shown in the figure to the right, water is sprayed from both directions, onto both sides of the product, at angles up to 60° from vertical for 10 minutes.  0.07 L/min. per hole in the spray nozzle
4	Protection against splashing water 	The product suffers no ill effects from water splashed on it from all directions.	Using the test apparatus shown in the figure to the right, water is splashed onto the product from all directions for 10 minutes.  0.07 l/min
5	Protection against water jets 	The product suffers no ill effects from a water jet aimed directly at it from all directions.	Using the test apparatus shown in the figure to the right, a water jet is directed at the product from all directions for 1 minute per square meter of outer casing, with a minimum total exposure of 3 minutes.  Diameter of spray nozzle head: 6.3
6	Protection against powerful jets of water 	Water does not enter the product when a powerful jet of water is directed at it from all directions.	Using the test apparatus shown in the figure to the right, a water jet is directed at the product from all directions for 1 minute per square meter of outer casing, with a minimum total exposure of 3 minutes.  Diameter of spray nozzle head: 12.5
7	Protection against immersion in water 	No entry of water on immersion in water at the stipulated pressure for the stipulated time.	Immerse in water for 30 minutes at a depth of 1 meter (when the height of the apparatus is less than 850 mm). 
8	Protection against immersion in water 	The product can be used while continually immersed in water.	Depends on arrangements made between the manufacturer and the user of the product.

Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

Cat. No. Z308-E1-01



Revision code

The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
01	September 2010	Original production

OMRON Corporation Industrial Automation Company

Tokyo, JAPAN

Contact: www.ia.omron.com

Regional Headquarters

OMRON EUROPE B.V.

Sensor Business Unit

Carl-Benz-Str. 4, D-71154 Nufringen, Germany
Tel: (49) 7032-811-0/Fax: (49) 7032-811-199

OMRON ELECTRONICS LLC

One Commerce Drive Schaumburg,
IL 60173-5302 U.S.A.

Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON ASIA PACIFIC PTE. LTD.

No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967

Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON (CHINA) CO., LTD.

Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China

Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

Authorized Distributor:

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Cat. No. Z308-E1-01

Printed in Japan
0910