EH-IOCA
EtherCAT® Slave Controller Instruction manual

HX EHV+

HITACHI
Inspire the Next

Thank you for purchasing a Hitachi Programmable Logic Controller.
To operate it safely, please read this instruction manual and all the user manuals carefully. Please be sure to use the latest versions of user manuals and keep them at hand of end users for future reference.

Caution
1. All rights reserved.
2. The content of this manual may be changed without notice.
3. While efforts have been made on this manual to be accurate, please contact us if any mistakes or unclear part is found.

■ Warranty period and coverage
The warranty period is either 18 months after manufacturing date (MFG. No.) or 12 months after installation.
Examination and repair within the warranty period is covered. However within the warranty period, the warranty will be void if the fault is due to ;
    (1) Incorrect use from instructed in this manual and the application manual.
    (2) Malfunction or failure of external other devices than this unit.
    (3) Attempted repair by unauthorized personnel.
    (4) Natural disasters.
The warranty is for the PLC only, any damage caused to third party equipment by malfunction of the PLC is not covered by the warranty.

■ Repair
Any examination or repair after the warranty period is not covered. And within the warranty period any repair and examination which results in information showing the fault was caused by any of the items mentioned above, the repair and examination cost are not covered. If you have any questions regarding the warranty or repair cost, please contact your supplier or the local Hitachi Distributor. (Depending on failure part, repair might be impossible.)

■ Ordering spare parts and inquiries
Please contact your local suppliers for ordering products/spare parts or any inquiries with providing the following information.
  (1) Product name
  (2) Manufacturing number (MFG. No.)
  (3) Details of failure

■ Definitions and Symbols

⟨!⟩ **DANGER** — Identifies information about practice or circumstances, which may lead to personal injury or death, property damage, or economic loss.

⚠ **CAUTION** — Identifies information about practice or circumstances, which may lead to personal injury, property damage, or economic loss.

■ Safety precautions

⟨!⟩ **DANGER**

- Do not touch terminals while power is ON. There is a risk of electric shock and/or injury.
- Appropriate emergency stop circuit, interlock circuitry and similar safety measures should be added to the PLC system to ensure safety in the event of incorrect, missing or abnormal signals caused by broken signal lines, momentary power interruptions or other causes.

⚠ **CAUTION**

- Always use the power supply voltage listed in specifications. Using other voltage may damage the equipment or present a risk of fire.
- The wiring operation should be performed by a qualified personnel. Failure to do so could result in fire, damage or electric shock.

⏚ **COMPULSION**

- The PLC must be grounded. Failure to do so could result in injury to personnel or causing it to malfunction.

🚫 **PROHIBITION**

- Do not attempt to disassemble, repair or modify any part of the PLC. Electric shock, malfunction or failure may result.
- Do not connect or disconnect cable unless power has been switched off or the area is known to be Non-Hazardous.
  (This unit is not industrial control equipment for use in hazardous locations "class I, Division2, Groups A,B,C,D")

⚠ **CAUTION**

- DO NOT CONNECT DIRECTLY TO LINE VOLTAGE. LINE VOLTAGE MUST BE SUPPLIED BY A SUITABLE, APPROVED ISOLATING TRANSFORMER HAVING SHORT CIRCUIT CAPACITY NOT EXCEEDING 150VA MAXIMUM.

⚠ **MISE EN GARDE**

- NE PAS CONNECTER DIRECTEMENT A LA TENSION D'ALIMENTATION.CELLE-CI DOIT ETRE FOURNIE PAR UN TRANSFORMATEUR D'ISOLATION POSSEDANT UNE CAPACITE DE COURT-CIRCUIT N'EXCEDANT PAS 150 VA.

■ Reference manual
Read the following application manual carefully to use the PLC safely and properly. Be sure to keep the latest version.

Manual name	Manual No.
EtherCAT® Slave Controller APPLICATION MANUAL	NJI-599*(X)

* Alphabet before (X) indicates version (A,B…).

■ Mounting

- Mount the PLC on a metal plate and install in a cabinet as follows.
- Be sure to ground the cabinet and the metal plate, otherwise there is a risk of malfunction.
- Install the PLC as described in reference manual.
- Take appropriate measures when the PLC system installed in locations :
  - Influenced easily due to noise or static electricity or other forms of noise.
  - Under strong electromagnetic field.
  - Close to power supplies.
- Be sure to tighten mounting screws, terminal screws and connector screws.
- Be sure to check that devices with lock mechanism, such as an expansion cable or terminal blocks, are locked properly.

■ Wiring for Power Supply

- Appropriate emergency circuitry, interlock circuitry and similar safety measures should be added to the system.
- Appropriate safety measures should be included in the system for unexpected breaking of wire or malsignal caused from instantaneous power failure.
- Applied voltage must be in the range specified in the manual. Otherwise, there is a danger of breakdown and/or injury and/or fire.
- Install external earth leakage breakers to avoid short circuit accident.
- In case of the following operations, turn off power. Otherwise, there is a danger of breakdown and/or injury and/or fire.
  - Mounting or dismounting CPU and I/O modules.
  - Assembling cabinet or machine including PLC.
  - Wiring.
- Install net filter specified in Table 1 or similar. The input and output cable of the net filter should be separated as much as possible. Be sure to ground the net filter.
  Use shielded cable for input of net filter.

Table 1 Specifications of the net filter

Item	Spec.
Rated voltage (VAC)	250
Rated current (A)	5
Withstand voltage (V) (between Terminal and case)	1,500
Insulation resistance (MΩ) (500 V DC, 1min., between terminal and case)	100 (min.)
Attenuation Freq. range (MHz)	Differential mode more than 40 dB	0.5 to 30
	Common mode more than 40 dB	0.15 to 30

Reference : EMC filter ZAC2205-00U (TDK), MC1206 (DENSEI-LAMBDA)

- A shielded and insulated transformer is recommended.
- The basic and expansion unit should be connected to common power source and powered up together as shown in Figure 1
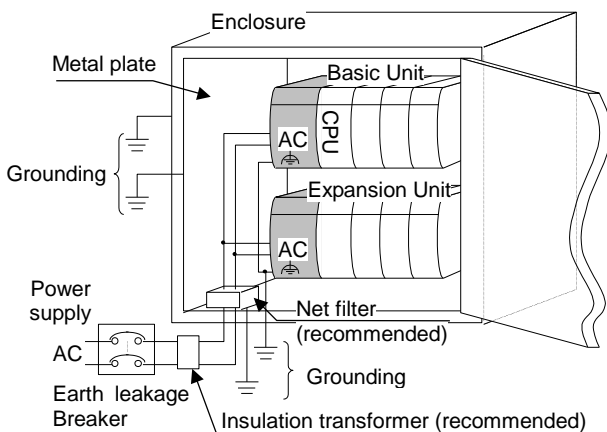- Recommends installing a lightning arrester to prevent lightning damages.

Figure 1 Power wiring example

■ Wiring for I/O Connections

- Be sure that the input/output voltage matches the specified voltage. Otherwise, there is a danger of breakdown and/or fire.
- Use shielded cable for relay outputs module, and connect shields to a functional ground for one side or both sides depending on applications.
- Route the AC power line and I/O lines separated as much as possible. Do not route both cables in a same duct.
- Route the I/O lines and data lines as close as possible to the grounded surfaces such as cabinet elements, metal bars and cabinets panels.
- Refer to table 2 for details of recommend wires specifications.

Table 2 Recommended wires

Wire			Terminal tightening torque
Size	Material	Type	
22-14 AWG	Copper	Single / twisted wire available	9in. –1bs (1.02 Nm)

■ Common precautions

- Use proper cable ferrules for terminals. Using improper cable ferrules or connecting bare wires to terminals directly might result in fire.
- Do not turn on power, if the unit appears damaged.
- Be sure to check all field wiring before PLC power on. Otherwise, there is a risk of fire.
- Do not cover vent holes of the housing.
- Do not pull on cables or bend cables beyond their natural limit. Otherwise, there is a risk of breaking of wire.
- Check carefully your PLC program before operation.
- Keep PLC modules in their boxes during storage and transport.
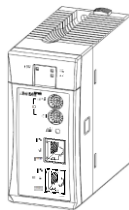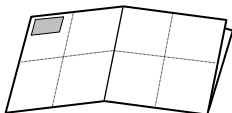
■ Installation environment

Avoid the following locations to install the PLC.
- Excessive dusts, salty air, or conductive materials (iron powder, etc.)
- Direct sunlight.
- Temperature less than 0 °C or more than 55 °C.
- Humidity less than 5 % or more than 95 %.
- Dew condensation.
- Direct vibration or impact to the unit.
- Corrosive, explosive or combustible gases.
- Water, chemicals or oil splashing on the PLC.
- Close to noise emission devices.

NJI-578A(X)

Specifications

■**Package items**

No.	Product name	Model name	Appearance	Numbers	Remarks
1	EtherCAT® slave controller	EH-IOCA		1	—
2	Instruction manual	NJI-578A(X)		1	This document

■**General specifications**

Item	Specifications
Operating ambient temperature	0 to 55 °C
Storage ambient temperature	-10 to 75 °C
Operating ambient humidity	5 to 95 % RH (no condensation)
Storage ambient humidity	5 to 95 % RH (no condensation)
Vibration resistance	Conforms to IEC 60068-2-6
Noise resistance	○ Noise voltage 1,500 Vpp Noise pulse width 100 ns, 1μs (Noise input by a noise simulator across input terminals of a power module according to measuring method of Hitachi-IES.) ○ Based on IEC61131-2 ○ Static noise: 3,000 V at metal exposed area
Insulation resistance	20 MΩ or more between the AC external terminal and case ground (FE) terminal (based on 500 V DC)
Dielectric withstand voltage	1,500 V AC for 1 minute between the AC external terminal and case ground (FE) terminal
Grounding	Class D grounding (ground with power supply module)
Usage environment	No corrosive gases, no excessive dust
Structure	Open, wall-mount type
Cooling	Natural air cooling

■Performance specification

From HARDWARE REV.02, the redundancy function and the refresh cycle auto setting function were added.

	Item	Specifications	H/W Rev.02 New function
Communication specifications	Communication protocol	EtherCAT® protocol	
	Transmit modulation method	Base band	
	Transmit speed	100 Mbps	
	Physical layer	100 BASE-TX (IEEE802.3)	
	Connector	RJ45 (IN, OUT)	
	Topology	Daisy-chain	
	Cable redundancy	Support *2	✓
	Recommended cable	CAT5 or higher, STP cable	
	Maximum segment length	100 m	
	Communication cycle	200 µs or over *1	
	Node address range	1 to 99 : Fixed node address 1 to 65,535 : Auto increment address	
	Process data	Fixed PDO mapping	
	Mailbox	Support	
	Cycle mode	Free Run mode (asynchronous)	
	Output hold	Support	
Functional specifications	Support base unit	EH-BS3A/5A/6A/8A/11A/8R	
	Number of modules	22 modules / EH-IOCA	
	Number of I/O points	1,408 points : Digital I/O 176 ch : Analog I/O	
	Expansion unit	1	
	Refresh cycle	Auto (62.5 / 125 / 250 / 500 µs), Fix (500 µs)	✓
	Self-check	WDT check	
	Error indication	LED	
	Supported ESI file	HITACHI_IES_EH-IOCA_2_0.xml	
	Current consumption	400 mA	

*1 The communication cycle is dependent on the specification of the EtherCAT® Master.
*2 When using the cable redundancy function, The EtherCAT® master also needs to support the cable redundancy function.
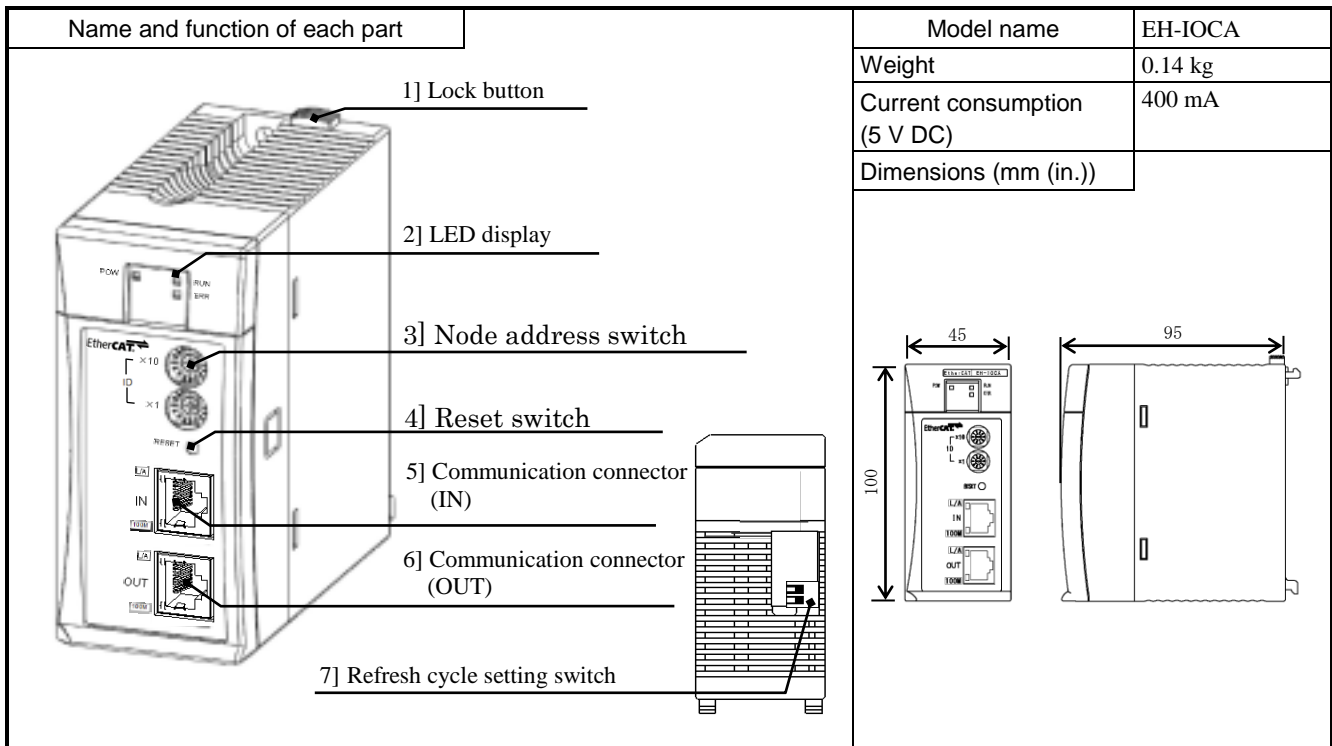

⚠ CAUTION

Digital I/O module, Analog I/O module, Resistance temperature detective input module, Thermocouple input module, counter module and positioning module are supported on the base unit using EH-IOCA. Note that the others are not supported.
Do not mount these modules on the slave base unit.

For information on the ESI files for EH-IOCA, contact your local supplier.
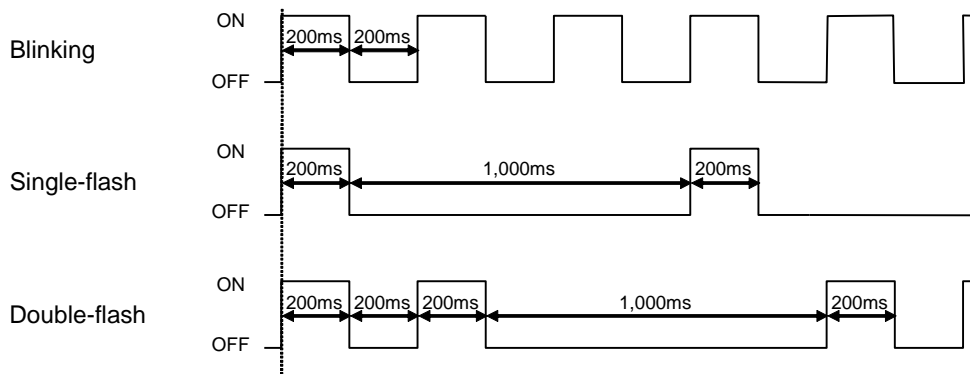
■Name and function of each part

Name and function of each part		Model name	EH-IOCA
		Weight	0.14 kg
		Current consumption (5 V DC)	400 mA
		Dimensions (mm (in.))	

1] Lock button

2] LED display

3] Node address switch

4] Reset switch

5] Communication connector (IN)

6] Communication connector (OUT)

7] Refresh cycle setting switch

45   95   100

No.	Name	Function	Remarks
1]	Lock button	Press this button to dismount. Module can be fixed firmly by a screw of M4 × 10mm (0.39in).	―
2]	LED display	The status of module is displayed on this LED.	―
3]	Node address switch	This is a switch to set the node address.	―
4]	Reset switch	The module can be reset by pressing this switch when error such as the module abnormal occurred.	―
5]	Communication connector (IN)	This is a connector to connect a cable for communication.	―
6]	Communication connector (OUT)	This is a connector to connect a cable for communication.	―
7]	Refresh cycle setting switch	This is a switch to set the refresh cycle of the mounted module.	―

■Description of LED display

LED	LED name	Indication	Details
	POW	Power supply (Green)	On : indicates that the 5 V DC power is supplied. Off : indicates that the 5 V DC power is not supplied or reset switch is on.
	RUN	Status (Green)	Display an EtherCAT® communication status. | State	Details
---	---
Off	INIT
Blinking	PRE-OPERATIONAL
Single-flash	SAFE-OPERATIONAL
On	OPERATIONAL	
	ERR	Error (Red)	Display EtherCAT® error status or EH-IOCA hardware status. | State	Details
---	---
Off	No error
Blinking	Configuration error
Double-flash	Application watchdog timeout	

The state of LED is indicated below.
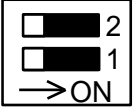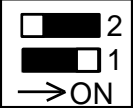
■Description of node address switch
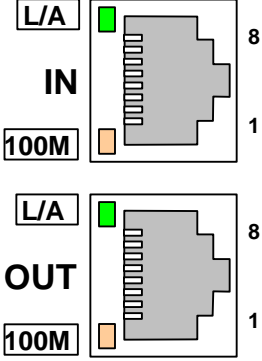
Switch	Symbol	Meaning	Details of setting
×10 ID ×1 [Default setting : U=0, L=0]	U (upper)	Station No. (1 to 99)	The Station No. of EtherCAT® network is set from 1 to 99. The ten's place set by upper node address switch. The one's place set by lower node address switch.
	L (lower)		

Node address of EH-IOCA is set by node address method of EtherCAT® master unit. If EtherCAT® master use fixed node address method, node address switch of EH-IOCA is valid. If EtherCAT® master use logic node address method or auto increment address method, node address switch of EH-IOCA is invalid. If EtherCAT® master use logic nodes address method or auto increment address method, please set the node address switch to "00".

■Description of refresh cycle setting switch

Switch	Details of setting
No.2 OFF No.1 OFF □ ■ 2 □ ■ 1 →ON [Default setting: OFF]	Set the refresh cycle of the mounted module to 500 µs fixed. It is HARDWARE REV.01 compatibility mode.
No.2 OFF No.1 ON □ ■ 2 ■ □ 1 →ON	The refresh cycle of the mounted module is automatically selected according to the size of the mounting module. | Total number of words of the mounting module	refresh cycle
1 to 22 words	62.5 µs
23 to 44 words	125 µs
45 to 88 words	250 µs
89 to 176 words	500 µs	

■Description of Connector

Connector	Symbol	Indication	Details
L/A [green] IN 100M [orange] 8 ... 1 L/A [green] OUT 100M [orange] 8 ... 1	IN OUT	Communication connector	RJ45 connector. Terminal layouts are shown below. | Pin No.	Details
---	---
1	Send data + (TD+)
2	Send data - (TD-)
3	Receive data + (RD+)
4	NC
5	NC
6	Receive data - (RD-)
7	NC
8	NC	
	L/A	Link status LED (Green)	LINK LED light up after LINK establishment of EtherCAT® communication, and it blinks during operation.
	100M	Communication Speed LED (Orange)	100M LED light up when LINK is established at 100 Mbps.

■Recommended cable

Recommended cable of EH-IOCA is shown below. But if EH-IOCA is used in noisy environment, we recommend cables with double, aluminum tape and braided shielding.

Item	Details
Twisted pair cable	100BASE-TX (CAT 5 or higher) STP cable
RJ45 connector	CAT 5 or higher, Shielded

The maximum cable length between connected nodes is 100 m. Note that some cables do not guarantee 100 m. In general, if the conductors are strand wire, the transmission performance will be lower than solid wire and the operation at 100 m distance cannot be guaranteed. Confirm details with the cable manufacturer.

■Connect communication cable

(1) When the redundancy function is not used

Connect the communication cable from EtherCAT® master unit to the IN connector of EH-IOCA. Connect another communication cable from OUT connector of the first slave unit to the IN connector of next slave unit. Note that nothing should be connected to the OUT connector of the slave unit at the terminal end of the network.

EtherCAT® master unit

Slave unit   Slave unit   Terminal slave unit
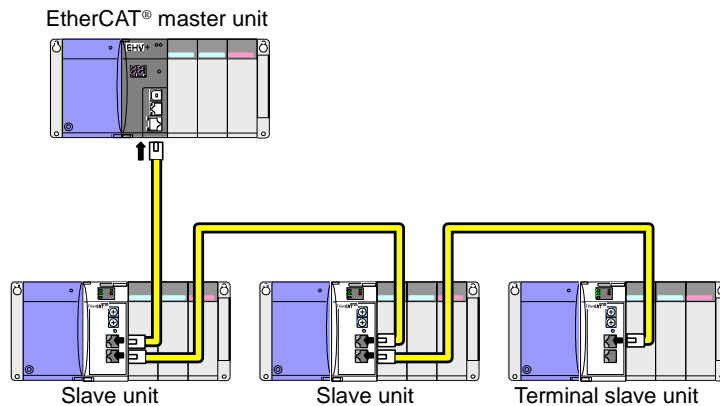
(2) When using the redundancy function

Connect the communication cable from EtherCAT® master unit to the IN connector of EH-IOCA. Connect another communication cable from OUT connector of the first slave unit to the IN connector of next slave unit.

The OUT connector of the slave unit at the end of the network connects to the communication connector of the EtherCAT® master.

Redundancy function support EtherCAT® master unit

Slave unit   Slave unit   Terminal slave
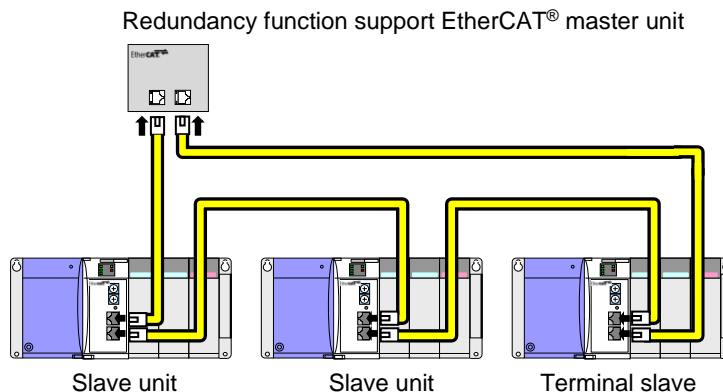
Connect the connector of the communications cable surely.

Do not put the communications cable in a duct same as other power lines and a wiring duct of I/O.
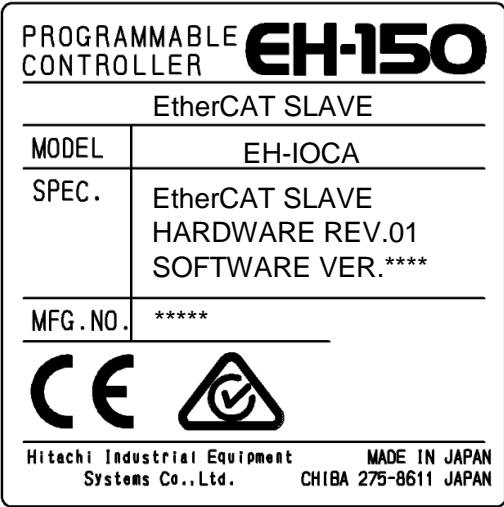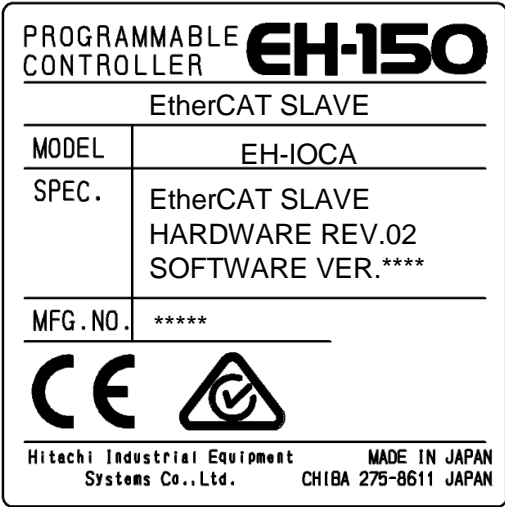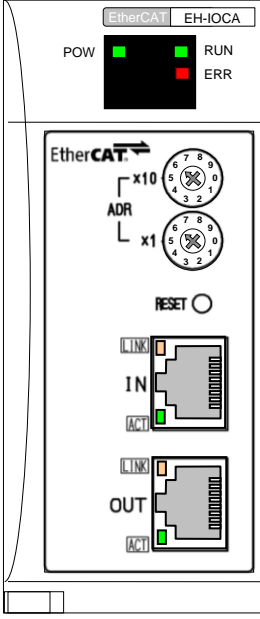
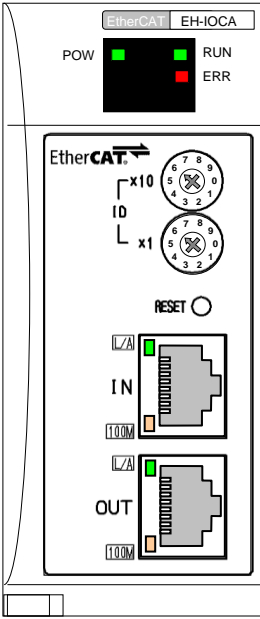Separate approximately 300 mm from other ducts.

It may be improved when put a ferrite core in a cable as measures to the induction noise for the communications cables.

⚠ **CAUTION**

When EH-IOCA gets into communication with EtherCAT® master unit, the communication may not establish depending on the master unit. In that case, follow the operations below.
(1)   Reconnect the connector of the communication cable.
(2)   Push the Reset switch of EH-IOCA.

■Connection with EtherCAT® master made by Hitachi Industrial Equipment Systems

- EHV+ EtherCAT® master library version 3.5.3.0 or older do not support EH-IOCA.

- EHV+, HX does not support redundancy function.

■The differences of between HARDWARE REV.01 and HARDWARE REV.02

Item	HARDWARE REV.01	HARDWARE REV.02
Name plate	Displayed as HARDWARE REV.01 in SPEC column. PROGRAMMABLE CONTROLLER **EH-150** EtherCAT SLAVE MODEL: EH-IOCA SPEC.: EtherCAT SLAVE HARDWARE REV.01 SOFTWARE VER.**** MFG.NO.: ***** CE Hitachi Industrial Equipment Systems Co.,Ltd. MADE IN JAPAN CHIBA 275-8611 JAPAN	Displayed as HARDWARE REV.02 in SPEC column. PROGRAMMABLE CONTROLLER **EH-150** EtherCAT SLAVE MODEL: EH-IOCA SPEC.: EtherCAT SLAVE HARDWARE REV.02 SOFTWARE VER.**** MFG.NO.: ***** CE Hitachi Industrial Equipment Systems Co.,Ltd. MADE IN JAPAN CHIBA 275-8611 JAPAN
Front	Displayed Node address switch as ADR. LED of connector is LINK and ACT.	Displayed Node address switch as ID. LED of connector is L/A and 100M.

■Combination of EH-IOCA and ESI file

	EH-IOCA HARDWARE REV.01	EH-IOCA HARDWARE REV.02
ESI file (REV.01) EH_IOCA.xml	Possible	Impossible
ESI file (REV.02) HITACHI_IES_EH-IOCA_2_0.xml	Possible	Possible

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⚠ CAUTION

When using EH-IOCA of HARDWARE REV.02 please use HITACHI_IES_EH-IOCA_2_0.xml for the ESI file. If EH-IOCA.xml corresponding to HARDWARE REV.01 is used, the system may malfunction.