

Ezi-IO[®] EtherCAT[®] AD

Input/Output Module

User Manual



CE



Fast, Accurate, Smooth Motion

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Chapter 1. Safety and Installation Precautions

1.1 Before Operation

- Thank you for purchasing FASTECH Ezi-IO EtherCAT AD products.
- Ezi-IO EtherCAT AD is an Analog Input Module mounted with an EtherCAT Slave Controller chip.
- This manual describes the handling, maintenance, repair, diagnosis, and troubleshooting of Ezi-IO EtherCAT AD.
- Before starting the operation of Ezi-IO EtherCAT, thoroughly read this manual.
- After reading this manual, keep the manual near Ezi-IO EtherCAT AD, so that any user can read this manual whenever needed.

1.2 Precautions

◆ General Precautions



- Contents of this manual are subject to change without prior notice for functional improvements, change of specifications or user's better understanding. Thoroughly read is the manual which is provided with the purchased product.
- In case of manual is damaged or lost, please contact FASTECH or our agents. You can find our contact information on the last page of this manual.
- FASTECH is not responsible for a product breakdown due to the user's dismantling of the product, and such a breakdown is not guaranteed by the warranty.

◆ Safety Precautions

- Before installation, operation, or repairing of the products, thoroughly read the manual and fully understand the contents. Before operating the products, please understand the mechanical characteristics of the products and related safety information and precautions.




- Safety precautions are indicated by **Attention** and **Warning**.




 Attention	If a user does not properly handle the products, the user may be seriously or lightly injured, and damages may occur to the machine.
 Warning	If a user does not properly handle the products, a dangerous situation (such as an electric shock) may occur resulting in deaths or serious injuries.

- Follow all the safety precautions indicated in this manual. Otherwise, serious damage or injury can be resulted depending on the situation.



◆ **Product Status**

 Attention	<p>Check if there is any damage on the product and if any part is missing. Otherwise, the machine may get damaged or the user may get injured.</p>
---	--


◆ **Installation**

 Attention	<p>Carry the product carefully. Otherwise, the product may get damaged or user's foot may get injured by dropping the product.</p>
 Attention	<p>Use non-flammable materials such as metal in the place where the product is to be installed. Otherwise, a fire may occur.</p> <p>When installing multiple products in an enclosed space, use a cooling fan to keep the ambient temperature of the product at or below 50°C. Otherwise, a fire or other kinds of accidents may occur due to overheating.</p>
 Warning	<p>The process of installation, Connection, Operation, Checking and Repairing should be done by a qualified personnel. Otherwise, a fire or other kinds of accidents may occur.</p>


◆ **Cable Connection**

 Attention	<p>Keep the rated range of input voltage for the drive. Otherwise, a fire or other kinds of accidents may occur.</p> <p>Connect cables according to the wiring diagram in this manual. Otherwise, a fire or malfunction of the machine may occur.</p>
 Warning	<p>Before connecting cables, make sure the input power is off. Otherwise, an electric shock or a fire may occur.</p> <p>When the product is isolated from the ground of the internal circuit by the condenser, ground the product properly. Otherwise, an electric shock, a fire or a malfunction of the machine may occur.</p>

◆ **Operation & Setting**

 Attention	<p>Before changing the settings of the product, thoroughly read this manual and fully understand the contents. Otherwise, the machine may get damaged or the product may malfunction.</p>
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◆ Repair & Maintenance

 <p>Warning</p>	<p>Stop supplying power to the main circuit and wait sufficient time before checking or repairing the product. Electricity remained in the condenser may cause an electric shock.</p> <p>Do not change cabling while power is being supplied. Otherwise, the user may get injured or the product and machine may get damaged.</p> <p>Do not reconstruct the product. Otherwise, an electric shock may occur or the product and machine get damaged. And the reconstructed product cannot get after service.</p>
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1.3 Notes on Installation

- This product has been designed for indoor use. Use the product in the ambient temperature 0°~ 50°C.
- When installing the products in an enclosed space, keep the ambient temperature of the product at or below 50°C using a cooling fan.
- Do not install the product under direct rays, near magnetic or radioactive objects.
- When installing more than 2 product units together, keep the distance between two units at least 20mm vertically and 50mm horizontally.

Chapter 2. Specifications and Dimensions

2.1 EtherCAT Specifications

Communication	EtherCAT
Physical Layer	Ethernet – 100BASE-TX
Connector Type	RJ45 IN: EtherCAT input OUT: EtherCAT output
ECAT Device ID	Configured Station Alias Setting by Rotary Switch : 0 ~ 99 Physical Address Setting in Master Unit : 1 ~ 65535
Topology	Line (Configured by I/O modules only) Tree, Star, Ring (When using a switching hub)
Protocol	CoE (CANopen application protocol over EtherCAT) FoE (File Access over EtherCAT)
Control Profile	CiA 401 Profile
Distributed Clock	Free Run, SM Event, DC SYNC Event (Min. Communication Cycle: 250us)
Processing Data	Fixed PDO Mapping
Cable	STP (Shielded Twisted Pair) Cable, Category 5e or higher / Max. 100m

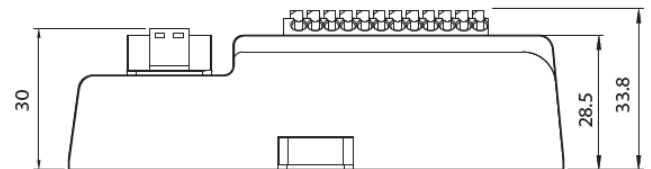
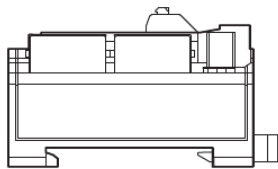
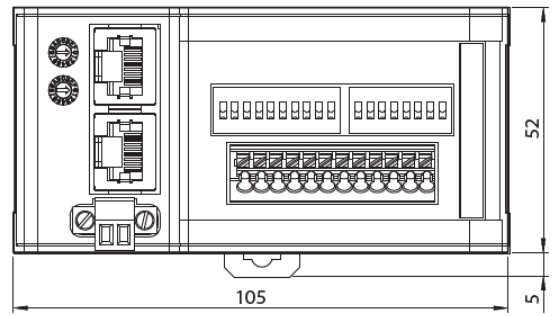
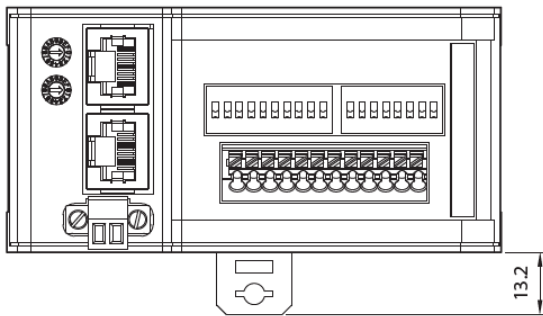
2.2 Module Specifications

Model		Ezi-IO-EC-AD08-T		
Input Mode		Voltage Input	Current Input	
Input Voltage		24VDC \pm 10%		
Current Consumption		Max. 120mA		
Operating Condition	Ambient Temperature	<ul style="list-style-type: none"> · In Use: 0~50°C · In Storage: -20~70°C 		
	Humidity	<ul style="list-style-type: none"> · In Use: 35~85% RH (Non-Condensing) · In Storage: 10~90% RH (Non-Condensing) 		
	Vib. Resist.	0.5g		
Function	Number of Channels	8CH		
	Max. Input Signal	\pm 15V	\pm 30mA	
	Input Range	<ul style="list-style-type: none"> · -10~10V · -5~5V · -2.5~2.5V · 0~10V 	0~20mA	
	Input Range Setting Method	<ul style="list-style-type: none"> · SDO Communications (Separate setting for CH1~8) · DIP Switch (Separate setting for CH1/CH2, CH3/CH4, CH5/CH6, CH7/CH8) 		
	Input Impedance	1M Ω	249 Ω	
	Resolution	13bit		
	Measuring Error	25°C	\pm 0.3%(Full Scale)	\pm 0.3%(Full Scale)
		0~50°C	\pm 0.4%(Full Scale)	\pm 0.6%(Full Scale)
	Analog Conversion Cycle	200 μ s		
	A/D Converted Data	<ul style="list-style-type: none"> · -10~10V : -4096~4095 · -5~5V : -4096~4095 · -2.5~2.5V : -4096~4095 · 0~10V : 0~8191 	0~20mA : 0~8191	
Signal Isolation Method	Digital isolation between analog input and communication connections			
LED Indication	<ul style="list-style-type: none"> · Power Status (PWR) · EtherCAT Communication Status (RUN) · Operation Error (ERR) · EtherCAT Link/Activity Status (LA IN, LA OUT) 			

2.3 Module Dimensions

- Ezi-IO-EC-AD08-T

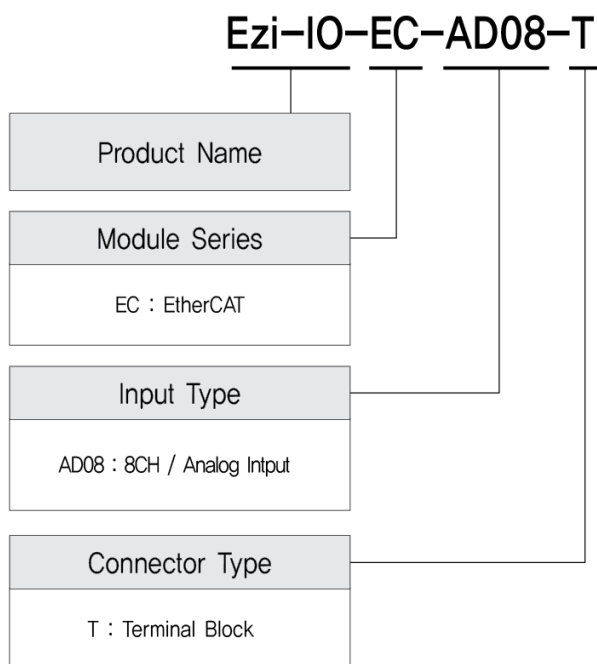
[Unit: mm]



* Can be installed on 35mm DIN Rail.

Chapter 3. Configuration

3.1 Ezi-IO EtherCAT AD Part Numbering

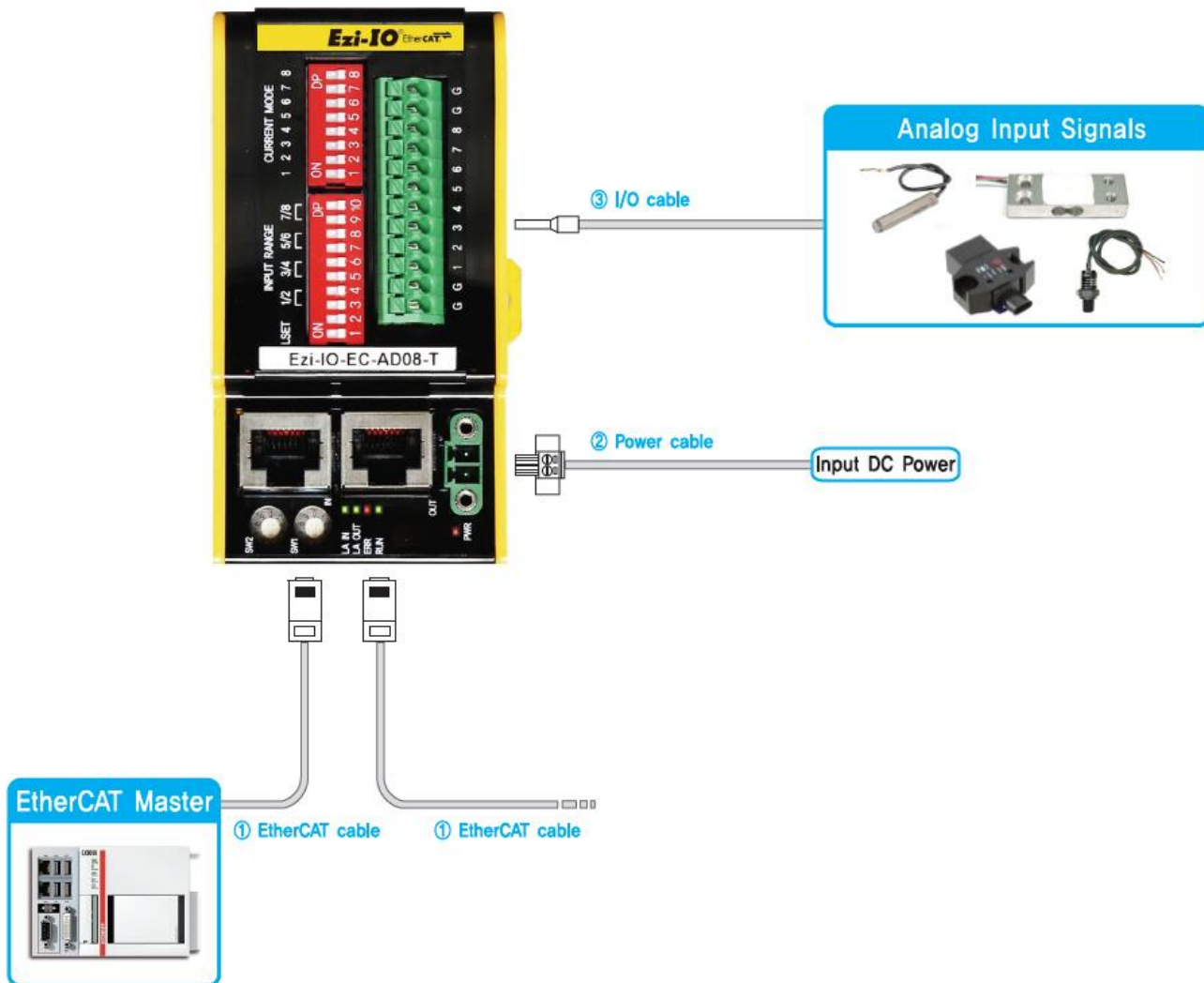


3.2 Ezi-IO EtherCAT AD Part Number

Part Number
Ezi-IO-EC-AD08-T

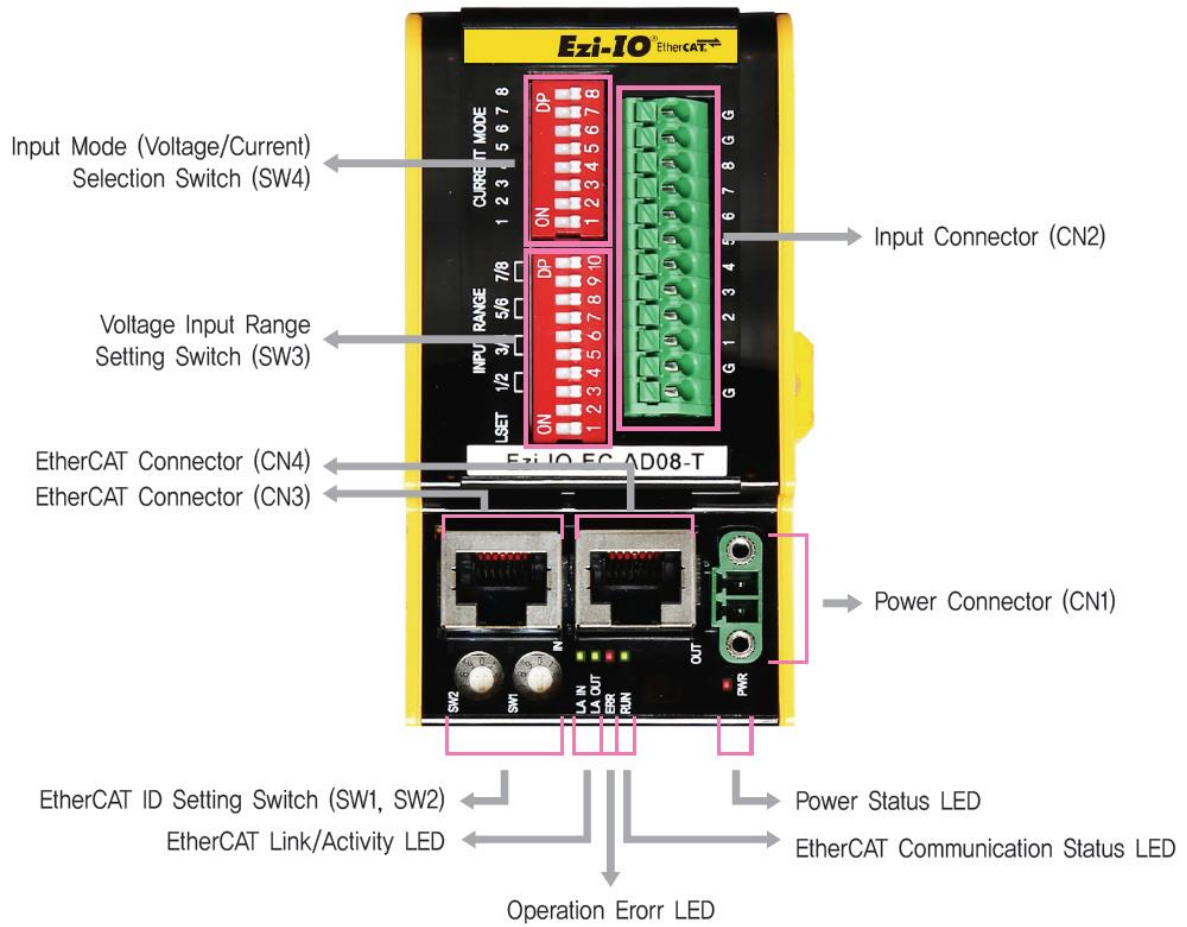
3.3 System Configuration

3.3.1 Ezi-IO-EC-AD08-T



Chapter 4. Connection Panel View

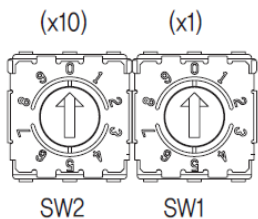
4.1 Names and Functions (Ezi-IO-EC-AD08-T)



4.1.1 EtherCAT ID Setting Switches (SW1, SW2)

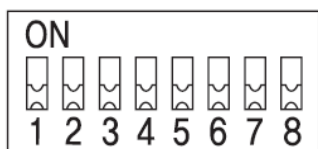
Use two rotary switches to set EtherCAT ID (ECAT Device ID). Set ones digit (x1) of EtherCAT ID on the right rotary switch (SW1), and set tens digit (x10) of EtherCAT ID on the left rotary switch (SW2).

Setting Range is 0 ~ 99.



* The Configured Alias ID set by the rotary switches is applied when the power is supplied to the I/O module.

4.1.2 Input Mode (Voltage/Current) Selection Switch (SW4)



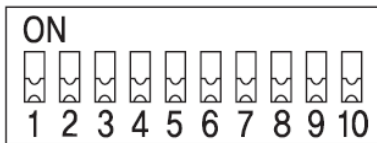
Select either Voltage or Current Input Mode for each channel with SW4 referring to the chart.

		CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
		SW4.1	SW4.2	SW4.3	SW4.4	SW4.5	SW4.6	SW4.7	SW4.8
Mode	Voltage Input	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
	Current Input	ON	ON	ON	ON	ON	ON	ON	ON

* Select the input mode for each channel with the Input Mode Selection Switch (SW4) before supplying power to the module.

4.1.3 Voltage Input Range Setting Switch (SW3)

Select the voltage input range by SW3 referring to the chart. Analog signals are converted to the digital data according to the selected range of input voltage.



[Selecting Input Setting Method]

		LSET	Description
		SW3.1	
Setting Method	DIP Switch	ON	Setting voltage input range with DIP switches (SW3.3~SW3.10)
	SDO Communication	OFF	Setting voltage/current input range through EtherCAT SDO communication

* If you use any channel in the current input mode, select the SDO Communication for the setting method (SW3.1=OFF).

* Set SW3.1 before supply power to the module.

* SW3.2 is not used.

When using the DIP Switch for the setting method (SW3.1= ON), select voltage input range referring to the chart.

[Selecting Voltage Input Range]

		CH1/CH2		CH3/CH4	
		SW3.3	SW3.4	SW3.5	SW3.6
Input Voltage Range	-10 ~ 10V	OFF	OFF	OFF	OFF
	-5 ~ 5V	OFF	ON	OFF	ON
	-2.5 ~ 2.5V	ON	OFF	ON	OFF
	0 ~ 10V	ON	ON	ON	ON
		CH5/CH6		CH7/CH8	
		SW3.7	SW3.8	SW3.9	SW3.10
Input Voltage Range	-10 ~ 10V	OFF	OFF	OFF	OFF
	-5 ~ 5V	OFF	ON	OFF	ON
	-2.5 ~ 2.5V	ON	OFF	ON	OFF
	0 ~ 10V	ON	ON	ON	ON

4.1.4 LED Indication

LED	Color	Status	Description
PWR	Red	OFF	Power is OFF.
		ON	Power is ON.

LED	Color	Status	Description
RUN	Green	OFF	INIT Status or Power OFF
		Blinking	PRE-OPERATIONAL Status
		Single Flash	SAFE-OPERATIONAL Status
		ON	OPERATIONAL Status
		Flickering	BOOTSTRAP Status

* Refer to [7.3.2 EtherCAT Communication Status Indication](#)

LED	Color	Status	Description
ERR	Red	OFF	No Error or Power OFF
		Blinking	Invalid Configuration
		Single Flash	Local Error
		Double Flash	Watchdog Time Out

* Refer to [7.3.2 EtherCAT Communication Status Indication](#)

LED	Color	Status	Description
Link/ Activity	Green	OFF	Link is not established physically.
		ON	Link is established physically.
		Flickering	Link is active in operation.

4.1.5 Power Connector (CN1)

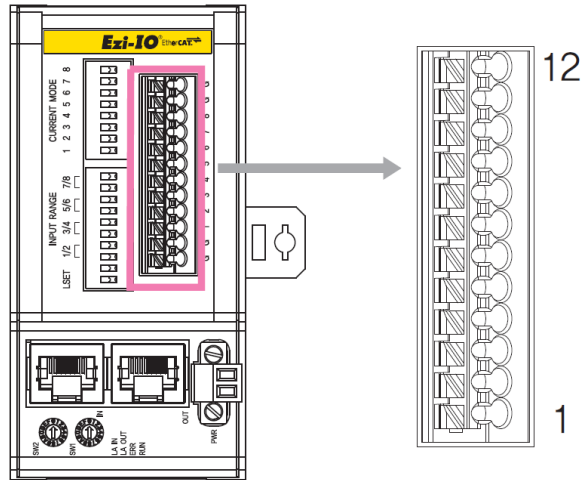
NO.	Function	I/O
1	24VDC	Input
2	GND	Input



* Supply rated power source to the connector.

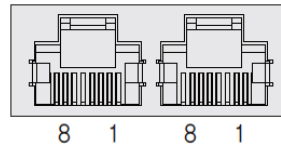
4.1.6 Input Connector (CN2)

NO.	Function	I/O
1	GND	Input
2	GND	Input
3	Analog In 1	Input
4	Analog In 2	Input
5	Analog In 3	Input
6	Analog In 4	Input
7	Analog In 5	Input
8	Analog In 6	Input
9	Analog In 7	Input
10	Analog In 8	Input
11	GND	Input
12	GND	Input



4.1.7 EtherCAT Connectors (CN3, CN4)

NO.	Function	NO.	Function
1	TD+	6	RD-
2	TD-	7	----
3	RD+	8	----
4	----	Connector Hood	F.GND
5	----		



4.1.8 EtherCAT Cable (separate purchase)

Part Number	Cable Length [m]	Remarks
CGNR-EC-001F	1	<ul style="list-style-type: none">• STP (Shielded Twisted Pair) cable• Category 5e or higher• Maximum cable length: 100m• For fixed installation
CGNR-EC-002F	2	
CGNR-EC-003F	3	
CGNR-EC-005F	5	

* If you need another length of cable (in unit of m), please contact FASTECH.

4.1.9 Connector (supplied)

Function	Item	Part Number	Manufacturer
Power Connector (CN1)	Terminal Block	MC421-38102	DECA

* The connector above is the most suitable model for Ezi-IO EtherCAT AD. Another equivalent connector can be used.

Chapter 5. IO Connector Wiring

Ezi-IO EtherCAT AD is supplied with push-in spring type terminal blocks which are connected with wires in a simple and easy way using ferrule connectors. Connections of analog devices to Ezi-IO EtherCAT AD are also simplified.

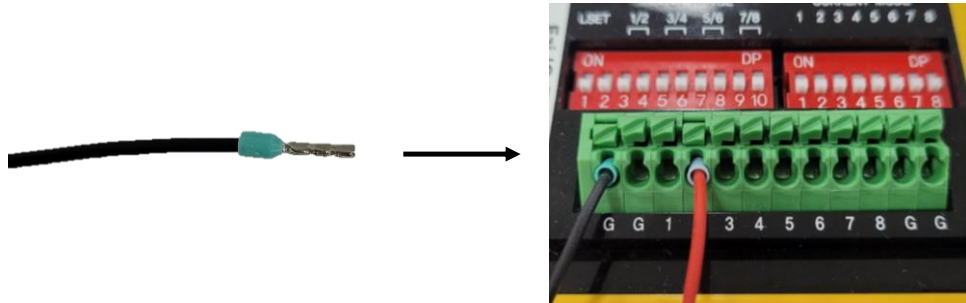


Figure 5-1. Ferrule Connection

5.1 Signal Wiring (Ezi-IO-EC-AD08-T)

Ezi-IO EtherCAT AD has one terminal block which has 8 input pins. Users can connect up to 8 analog input signals from local devices to Ezi-IO EtherCAT AD.

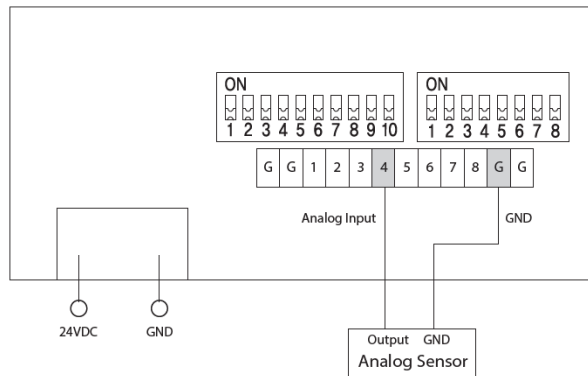


Figure 5-2. Wiring Diagram of Ezi-IO-EC-AD08-T

5.2 Internal Circuit Diagram

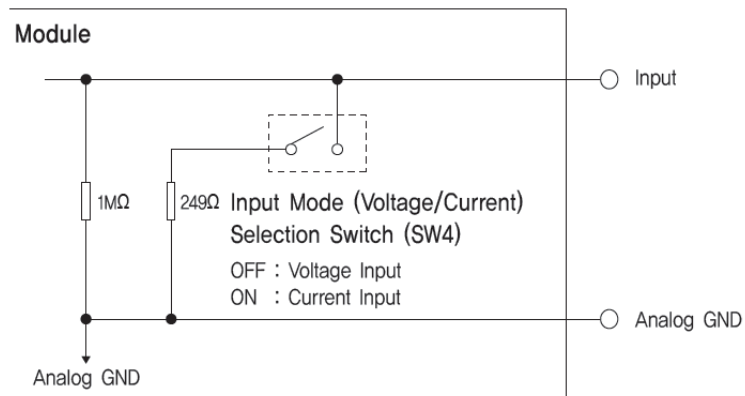


Figure 5-3. Internal Circuit Diagram of Ezi-IO-EC-AD08-T

Chapter 6. Setting Input Mode (Voltage/Current)

6.1 Setting Voltage Input Mode

To use Ezi-IO EtherCAT AD in Voltage Input Mode, select either SDO communication or DIP switch setting method for setting input voltage range.

6.1.1 Setting Voltage Input Mode through SDO Communication

In Voltage Input Mode, set DIP switches as the **Figure 6-1** for setting input voltage range using SDO communication.

(Example) Setting Channel 2

- ① Set LSET switch (SW3.1) of INPUT RANGE to OFF before supplying power to the module.
- ② Set Channel 2 to Voltage Input Mode with the Input Mode Selection Switch (SW4.2=OFF) before supplying power to the module.
- ③ Connect the analog input signal and ground to the pin 2 and GND of Input Connector (CN2).

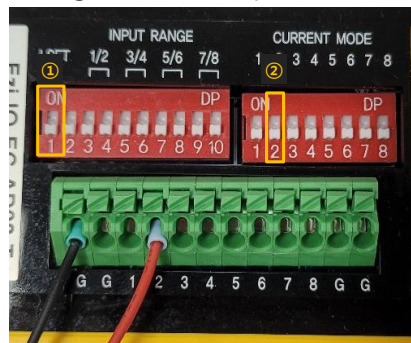


Figure 6-1. Setting Voltage Input Mode through SDO Communication

6.1.2 Setting Voltage Input Mode with DIP Switches

In Voltage Input Mode, set DIP switches as the **Figure 6-2** for setting input voltage range using DIP switches.

(Example) Setting Channel 2 to -5~5V Input Range

- ① Set LSET switch (SW3.1) of INPUT RANGE to ON before supplying power to the module. Set the voltage input range of Channel 2 with SW3.3~SW3.4 switches.
- ② Set Channel 2 to Voltage Input Mode with the Input Mode Selection Switch (SW4.2=OFF) before supplying power to the module.
- ③ Connect the analog input signal and ground to the pin 2 and GND of Input Connector (CN2).

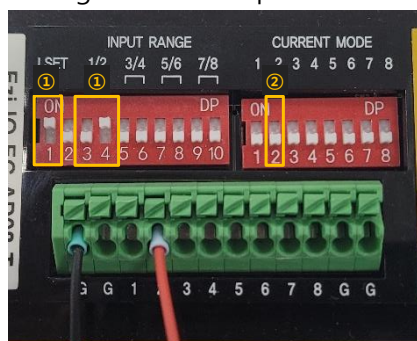


Figure 6-2. Setting Voltage Input Mode with DIP Switches

6.2 Setting Current Input Mode

To use Ezi-IO EtherCAT AD in Current Input Mode, set DIP switches as the **Figure 6-3**.

If you use any channel in Current Input Mode, select the SDO Communication for setting method (SW3.1=OFF).

(Example) Setting Channel 2

- ① Set LSET switch (SW3.1) of INPUT RANGE to OFF before supplying power to the module.
- ② Set Channel 2 to Current Input Mode with the Input Mode Selection Switch (SW4.2=ON) before supplying power to the module.
- ③ Connect the analog input signal and ground to the pin 2 and GND of Input Connector (CN2).

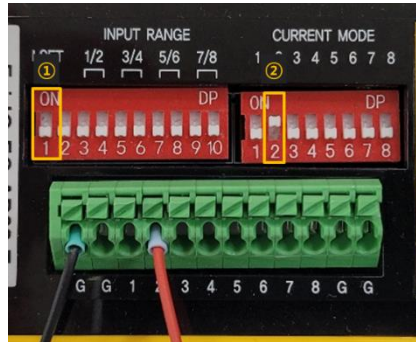


Figure 6-3. Setting Current Input Mode

Chapter 7. Communication Function

7.1 CAN Application Protocol Over EtherCAT

Ezi-IO EtherCAT AD is an analog input module that supports CAN application protocol over EtherCAT (CoE). Ezi-IO EtherCAT AD has the following communication structure.

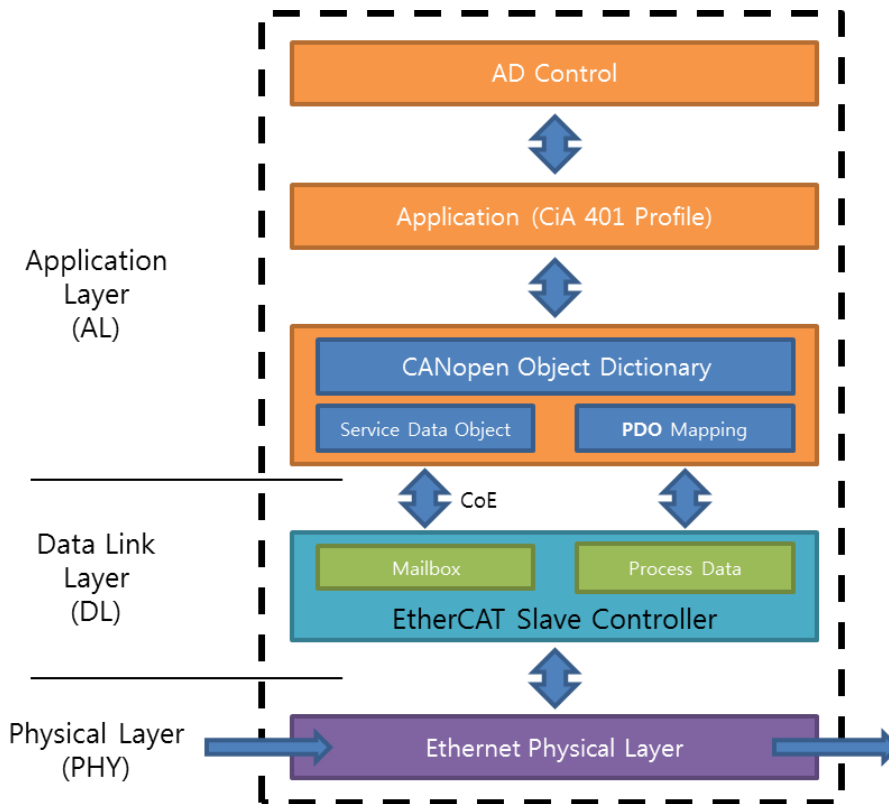


Figure 7-1. Communication Structure of Ezi-IO EtherCAT AD

7.1.1 Object Dictionary

The Object Dictionary is the group of data objects which are saved in an EtherCAT slave unit. EtherCAT masters can read and write data through the index or sub-index of objects.

7.1.2 Mailbox Communication

In the Mailbox (SDO) communication, a master and a slave exchange the service data object (SDO). It is a message transmission and reception method. If the master sends a command, the slave Ezi-IO EtherCAT AD answers to it.

The SDO communication is used for setting or checking objects in the Object Dictionary when the Ezi-IO EtherCAT AD is in Pre-Operational, Safe-Operational, or Operational status.

7.1.3 Process Data Communication

In Process Data (PDO) communication, a slave exchanges the process data object (PDO) with a master every cycle. The data to be exchanged is pre-determined by PDO Mapping in the communication initialization status. The PDO communication of Ezi-IO EtherCAT AD is classified into a transmission PDO (Tx PDO) which transmits the analog input data to the master and is used when the Ezi-IO EtherCAT AD is in Operational or Safe-Operational status.



Figure 7-2. EtherCAT PDO Communication

7.2 PDO Mapping

Through the PDO Mapping, sets the application objects to be exchanged through the PDO communication.

7.2.1 PDO Mapping

The mapping information of TxPDO, which receives the master command, is set in Object 1A00h. In the mapping table, it records the object IDs and sub-index values and data length (in bit) of exchanging data.

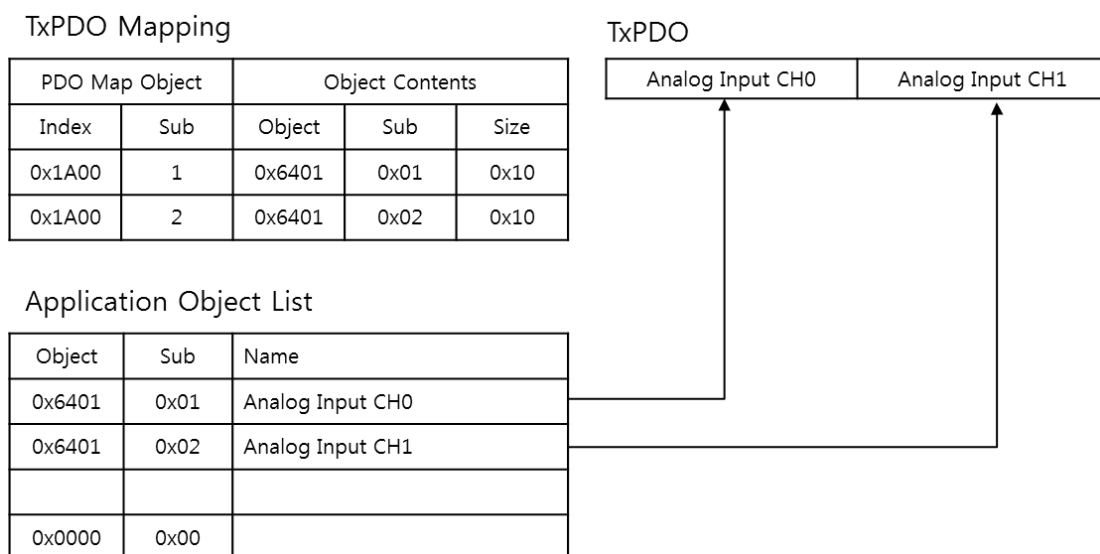


Figure 7-3. PDO Mapping

7.2.2 PDO Assign

By the PDO Assign, sets the PDO Mapping Object which is assigned to the SyncManager. Object 1C13h assigns TxPDO, and it also assigns an object for the TxPDO Object, 1A00h.



Figure 7-4. PDO Assign

7.3 EtherCAT Communication Status

7.3.1 EtherCAT State Machine

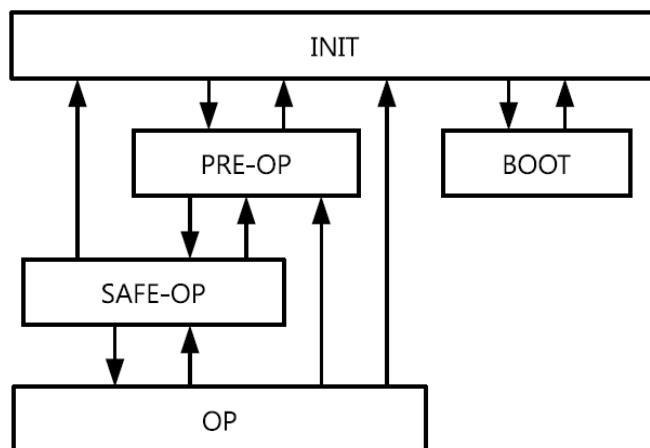


Figure 7-5. EtherCAT State Machine

The operational states of EtherCAT products are controlled by EtherCAT masters.

State	SDO	Tx PDO	Description
INIT	Disabled	Disabled	EtherCAT communication is initialized. Communication is disabled.
PRE-OP	Enabled	Disabled	After the communication initialization is done, this state begins. Network settings are initialized. Only Mailbox communication is enabled.
SAFE-OP	Enabled	Enabled	Tx PDO communication is enabled.
OP	Enabled	Enabled	All the communications are enabled.
BOOT	Enabled	Disabled	Only Mailbox communication is enabled. FoE is enabled, and the product firmware can be updated via FoE protocol.

Table 7-1. EtherCAT Operational State

* FoE = File over EtherCAT. It is an EtherCAT slave node through which the product firmware can be updated.

7.3.2 EtherCAT Communication Status Indication

The RUN LED indicates EtherCAT communication status of the product.

LED	Color	Status	Description
RUN	Green	OFF	INIT State or Power OFF
		Blinking	PRE-OPERATIONAL State
		Single Flash	SAFE-OPERATIONAL State
		ON	OPERATIONAL State
		Flickering	BOOTSTRAP State

Table 7-2. EtherCAT Communication Status LED

The ERR LED indicates operational errors of the product.

LED	Color	Status	Description
ERR	Red	OFF	No Error or Power OFF
		Blinking	Invalid Configuration
		Single Flash	Local Error
		Double Flash	Watchdog Time Out

Table 7-3. Operational Error LED

Refer to **Figure 7-6** to see the indication pattern of RUN LED and ERR LED.

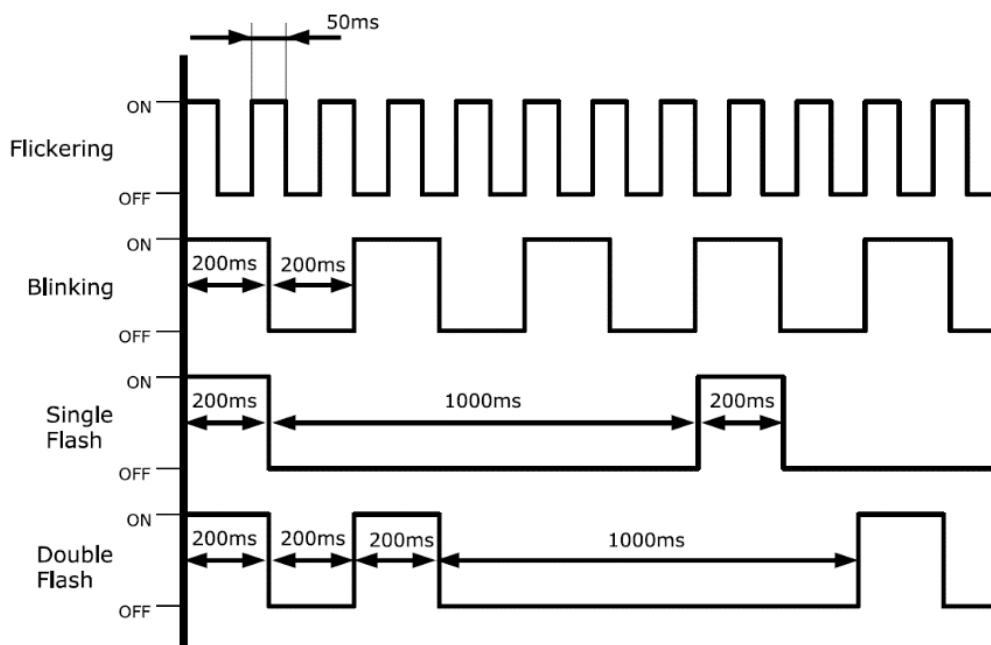


Figure 7-6. EtherCAT LED Indication Pattern

7.4 Synchronization

Ezi-IO EtherCAT AD provides the following synchronization modes.

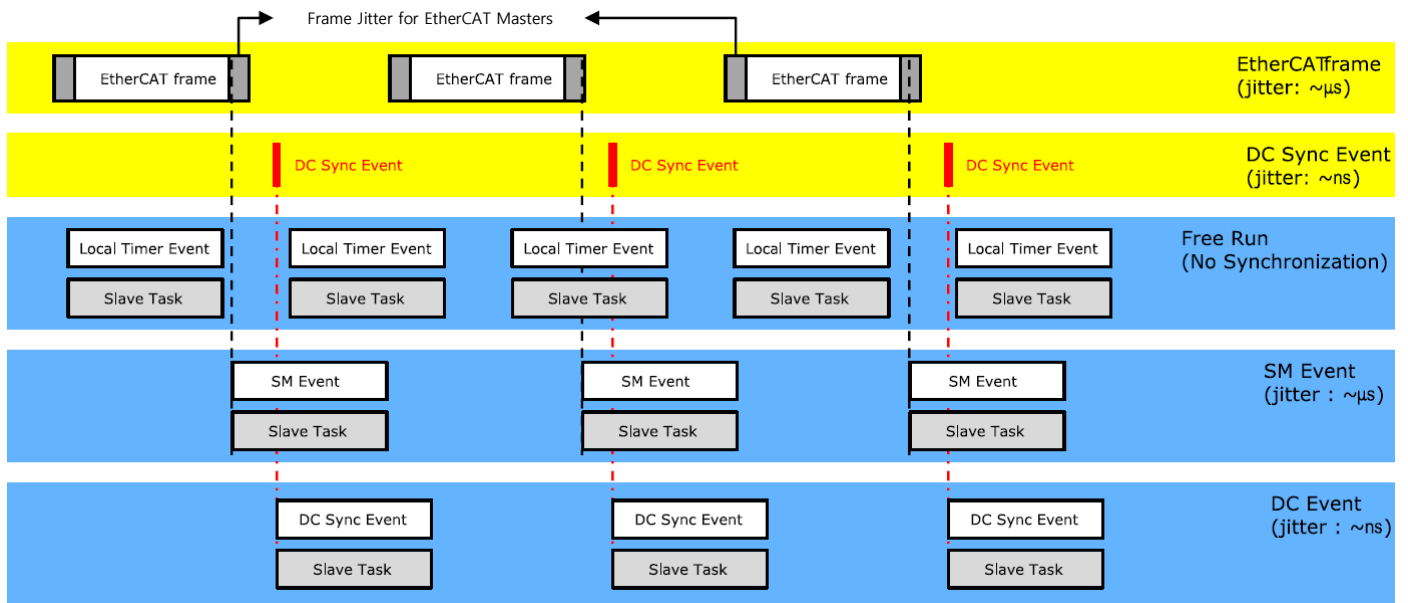


Figure 7-7. Types of EtherCAT Synchronization

7.4.1 Free Run

The I/O module operates without being synchronized with the master. In Free Run mode, the master and I/O module operate in their own cycles independently.

7.4.2 SM Event

The I/O module operates synchronously with the SyncManager (SM) Event of EtherCAT communication. SM Event occurs when an EtherCAT Frame is received by the module, and each SM Event synchronized module has a range of jitter in μs or less.

7.4.3 DC Sync Event

The I/O module operates synchronously with the Sync-Interrupt generated according to Distributed Clock (DC). DC is a synchronized time clock that is shared by the master and I/O module. Using DC, it generates perfectly synchronized interrupts so that the I/O module executes commands in exact timing. Each product has a range of jitter in ns or less.

7.5 EtherCAT Slave Information

To connect the I/O module to an EtherCAT master, an EtherCAT Slave Information file (XML file) is required. In the file, the information of slave device which is developed based on the EtherCAT specification is included in XML format. The Slave device can set up the PDO and SDO simply as it writes the XML file to the EtherCAT master through the EtherCAT setting device.

Information

Download XML files from the [DOWNLOADS](#) page on the [FASTECH](#) website.

7.6 EtherCAT Device ID

To use the EtherCAT Network, you must configure a master and all slaves. The master must assign the EtherCAT Device IDs to the slaves to identify them and to send messages to each node. The EtherCAT Device ID is either Configured Station Alias or Physical Address. Configured Station Alias is set by rotary switches or the master, and it can be changed flexibly by user. Physical Address is automatically assigned by the master according to the connected order of slaves.

Chapter 8. Setting and Operation

Operate the product according to the following procedure.

1. Install the product according to installation conditions. First, apply power to the product and make sure the product operates normally. Then, connect the loads (input signals) to the product. Refer to the [Safety and Installation Precautions](#).
2. Make sure to connect the power cable, I/O connector, EtherCAT communication cable, etc. to the module correctly. Refer to the System Configuration.
3. Turn ON the power of module. Then, check the following.
 - Check the power status LED (PWR) turns Red.
 - After connecting the communication, check EtherCAT Link/Activity LED (LA IN, LA OUT) turns Green.
 - Activate EtherCAT communication.
 - Check the EtherCAT Communication Status LED (RUN) turns Green.
4. Run the software of EtherCAT Master. (Example of Master Software: Beckhoff TwinCAT)
5. Run the TwinCAT in the following sequence.
 - ① Click 'New TwinCAT Project'.
 - ② Go to 'New Project'→ 'TwinCAT XAE Project'.
 - ③ Select the project name or path, then click 'OK'.

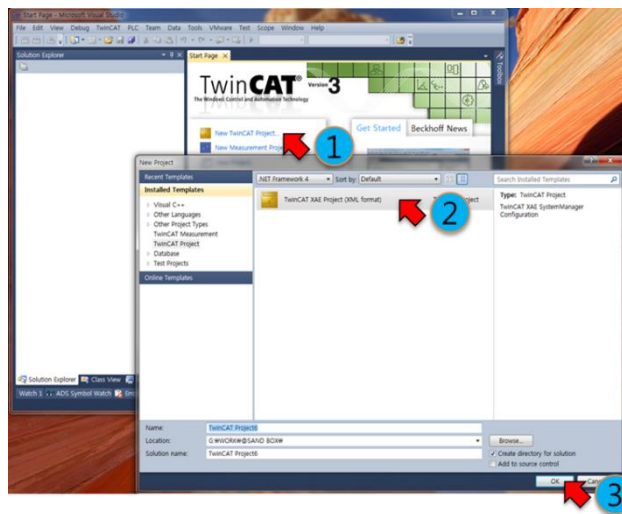


Figure 8-1. Running TwinCAT

6. If TwinCAT is in 'Run Mode', new connection and setting may be disabled. Set TwinCAT to 'Config Mode'.



Stop Mode: Indicated in Red



Config Mode: Indicated in Blue



Run Mode: Indicated in Green (Unable to connect)

7. After creating a project,

- ① Go to "Solution Explorer" → 'I/O. Right-click on the 'Device' and open the menu.
- ② Select 'Scan' on the menu.
- ③ When a 'Hint' pops up, click 'OK'.
- ④ On the 'new I/O devices found' window, check correct devices and click 'OK'.

(If no device is found on the 'new I/O devices found' window, check the power and cable connection for the product and try again.)

- ⑤ When 'Scan for boxes' pops up, click 'Yes'.
- ⑥ Make sure a device or box is added under the 'Device'. When 'Activate Free Run' pops up, click 'Yes'.

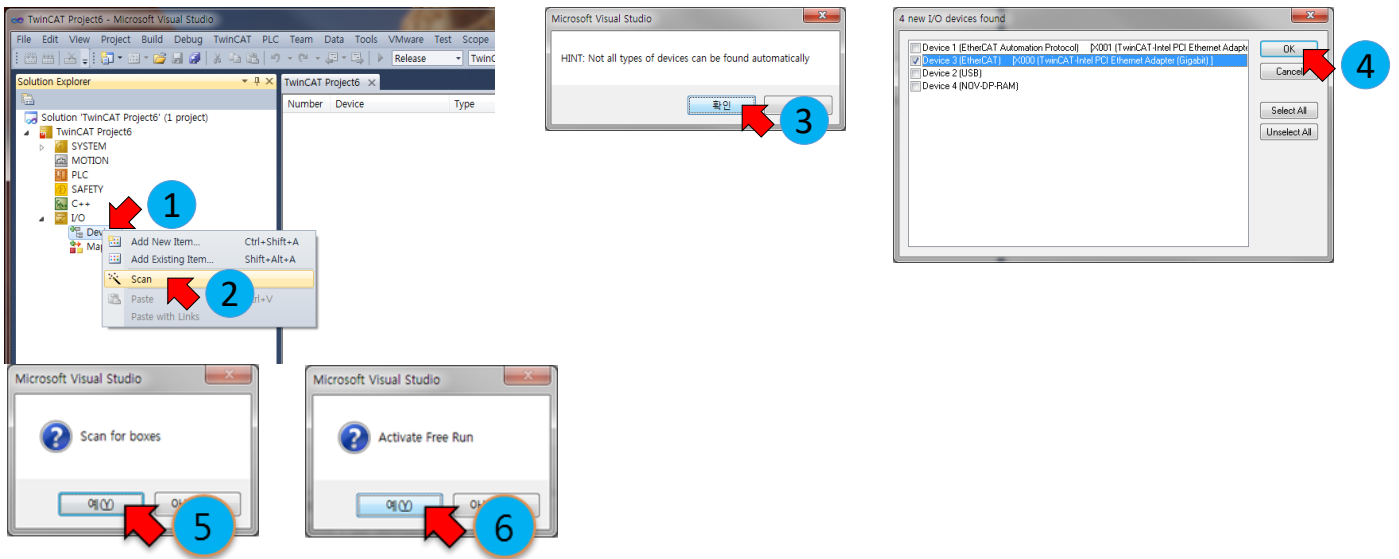


Figure 8-2. Order of Product Scanning

8. You can configure and control local devices with EtherCAT network by setting and programming in your preferences.

Chapter 9. Functions of Ezi-IO EtherCAT AD

Ezi-IO EtherCAT AD converts analog voltage and current inputs such as sensor signals to digital data and transfers them to the EtherCAT Master. In addition, it has the Channel On/Off, Input Range, Filter Buffer Length, and Set ADC Offset functions for convenient product use.

Each function of Ezi-IO EtherCAT AD is described in the following.

9.1 Channel On/Off

The Channel On/Off function is set by Object 220x:01h. It activates each channel using the Channel On/Off function and converts analog input signals to digital data.

* Change in Channel On/Off for each channel is updated after the reboot.

Channel On/Off Value	Description
0	Channel Off. The channel is inactive (Unable to use any function).
1	Channel On. The channel is active (Enable to use all the functions).

Table 9-1. Channel On/Off Function

- Channel Off

Channel On/Off value is 0. The channel is inactive. The converted data of analog input is always '0'.

When Channel Off, it is unable to use any function for the channel.

- Channel On

Channel On/Off value is 1. The channel is active. The analog input signal is converted to digital data.

When Channel On, it is enabled to use all the functions for the channel.

9.2 Input Range

The Input Range function is set by Object 220x:02h. It indicates selected range of analog input signals. The analog signals are converted to digital data in the ranges shown on **Table 9-2**.

Input range of analog voltage is selectable among -10 ~ 10[V], -5 ~ 5[V], -2.5 ~ 2.5[V] and 0 ~ 10[V]. Input range of analog current is 0~20[mA]. If the input signal is out of range, it is converted to the minimum or maximum data.

* Change in Input Range is updated after the reboot.

* [When using the Input Range Setting Switch \(SW3\), select an input range for each channel before supplying power to the module.](#)

Value	Input Range	Input Mode
0	-10 ~ 10V	Voltage
1	-5 ~ 5V	
2	-2.5 ~ 2.5V	
3	0 ~ 10V	
4	0 ~ 20mA	Current

Table 9-2. Input Range

9.2.1 Input Range: -10 ~ 10[V]

When the Input Range value is 0, the range of analog input is -10 ~ 10[V] in Voltage Input Mode. The analog input signals are converted to digit data -4096 ~ 4095 (Full Scale). If the input signal is out of range, it is converted to the minimum or maximum data.

Every 1[V] of the analog signal is converted to 409.6 digital data (After the conversion, the decimal places are removed).

Input Range	Converted Data
0 (-10 ~ 10[V])	-4096 ~ 4095 (-10 ~ 10[V])

Table 9-3. Data Conversion for Input Range -10 ~ 10[V]

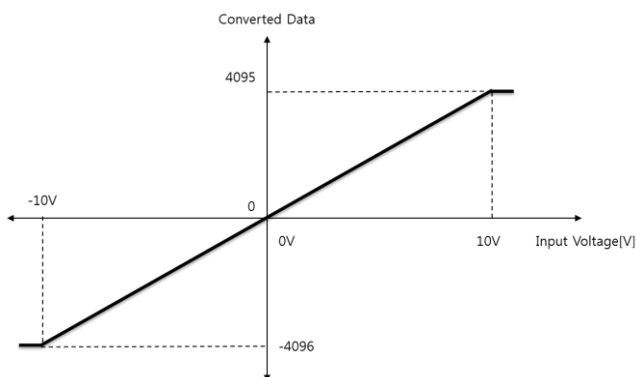


Figure 9-1. Data Conversion for Input Range -10 ~ 10[V]

9.2.2 Input Range: -5 ~ 5[V]

When the Input Range value is 1, the range of analog input is -5 ~ 5[V] in Voltage Input Mode. The analog input signals are converted to digit data -4096 ~ 4095 (Full Scale). If the input signal is out of range, it is converted to the minimum or maximum data.

Every 1[V] of the analog signal is converted to 819.2 digital data data (After the conversion, the decimal places are removed).

Input Range	Converted Data
1 (-5 ~ 5[V])	-4096 ~ 4095 (-5 ~ 5[V])

Table 9-4. Data Conversion for Input Range -5 ~ 5[V]

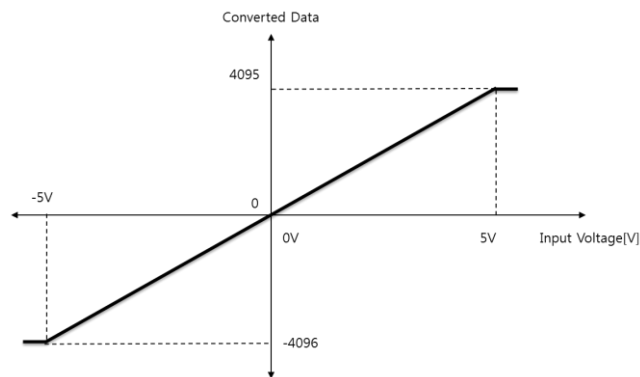


Figure 9-2. Data Conversion for Input Range -5 ~ 5[V]

9.2.3 Input Range: -2.5 ~ 2.5[V]

When the Input Range value is 2, the range of analog input is -2.5 ~ 2.5[V] in Voltage Input Mode. The analog input signals are converted to digit data -4096 ~ 4095 (Full Scale). If the input signal is out of range, it is converted to the minimum or maximum data.

Every 1[V] of the analog signal is converted to 1638.4 digital data data (After the conversion, the decimal places are removed).

Input Range	Converted Data
2 (-2.5 ~ 2.5[V])	-4096 ~ 4095 (-2.5 ~ 2.5[V])

Table 9-5. Data Conversion for Input Range -2.5 ~ 2.5[V]

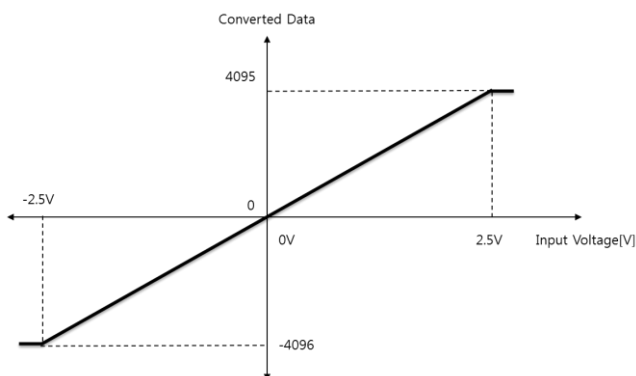


Figure 9-3. Data Conversion for Input Range -2.5 ~ 2.5[V]

9.2.4 Input Range: 0 ~ 10[V]

When the Input Range value is 3, the range of analog input is 0 ~ 10[V] in Voltage Input Mode. The analog input signals are converted to digit data 0 ~ 8191 (Full Scale). If the input signal is out of range, it is converted to the minimum or maximum data.

Every 1[V] of the analog signal is converted to 819.2 digital data data (After the conversion, the decimal places are removed).

Input Range	Converted Data
3 (0 ~ 10[V])	0 ~ 8191 (0 ~ 10[V])

Table 9-6. Data Conversion for Input Range 0 ~ 10[V]

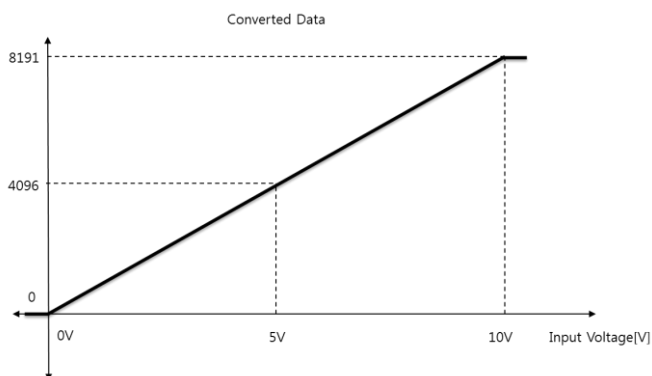


Figure 9-4. Data Conversion for Input Range 0 ~ 10[V]

9.2.5 Input Range: 0 ~ 20[mA]

When the Input Range value is 4, the range of analog input is 0 ~ 20[mA] in Current Input Mode. The analog input signals are converted to digit data 0 ~ 8191 (Full Scale). If the input signal is out of range, it is converted to the minimum or maximum data.

Every 1[mA] of the analog signal is converted to 409.6 digital data data (After the conversion, the decimal places are removed).

* Turn OFF the Input Range Setting Switch (SW3.1) before supplying power to the module (Setting by SDO communication).

* Select Current Input Mode with the Input Mode Selection Switch (SW4) before supplying power to the module (SW4=ON).

* Through the SDO communication, set the Input Range to '4'.

Input Range	Converted Data
4 (0 ~ 20[mA])	0 ~ 8191 (0 ~ 20[mA])

Table 9-7. Data Conversion for Input Range 0 ~ 20[mA]

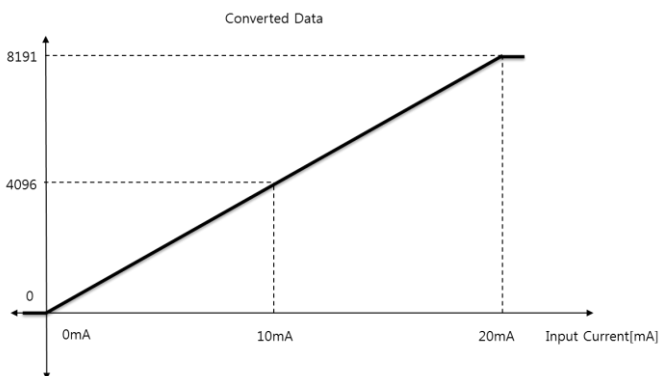


Figure 9-5. Data Conversion for Input Range 0 ~ 20[mA]

9.3 Filter Buffer Length

The Moving Average Filter function is set by Object 220x:03h.

It is used to smooth input analog signals when they fluctuate due to noise or other reasons.

The selectable time range of Moving Average Filter is 0 ~ 100[msec].

* Time Range of Moving Average Filter = Analog Conversion Cycle (200μsec) x Filter Buffer Length

* Change in Filter Buffer Length is updated after the reboot.

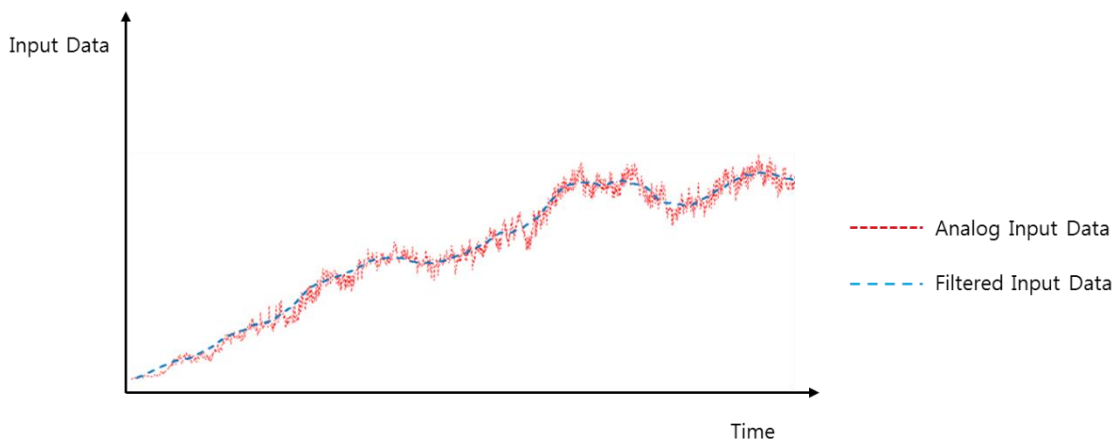


Figure 9-6. Moving Average Filter

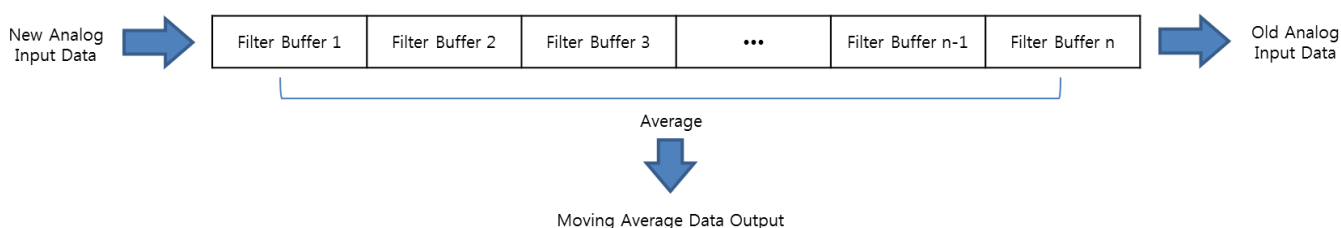


Figure 9-7. Moving Average Filter Algorithm

Filter Buffer Length	Time Range of Filter
0	0ms
100	20ms
200	40ms
300	60ms
400	80ms
500	100ms

Table 9-8. Time Range of Moving Average Filter (example)

The Moving Average Filter is set for each channel. Each Moving Average Filter is defined by setting the Filter Buffer Length for each channel, and the Filter Buffer Length means the number of buffers where the input data is saved as shown in **Figure 9-7** (Max. number of buffers=500).

The default value for each Filter Buffer is 0. In every analog conversion cycle 200[μsec], new input data is saved in the Filter Buffer in order. If all the available buffers (n) are filled with data, new data is stored in the buffer which has the oldest data.

- Filtered Input Data Generation

Filtered Input Data is the average of the data values saved in the Filter Buffer.

$$\text{Filtered Input Data} = \frac{\text{Sum of Filter Buffer Data}}{\text{Filter Buffer Length (n)}}$$

If Filter Buffer Length (n) is 0 or 1, Filtered Input Data is the same as the most recently saved input data so the Filter function does not work.

9.4 Setting ADC Offset

The ADC Offset function is set by Object 220x:04h.

The deviation of voltage and current input data, which is caused by installing or device conditions, can be corrected by setting the ADC Offset.

You can set the ADC Offset for the voltage or current input for each channel. The converted data of input signals is adjusted as much as the ADC Offset value.

* When using the ADC Offset, it is indicated as Analog Data – Offset.

* **Change in ADC Offset value is applied immediately.**

Chapter 10. EtherCAT Object Dictionary

10.1 Object Description Format

The following table shows the format of the Object description.

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2200h	0	Number of Entries	U8	RO	No	No	—	4
	1	Channel On/Off	U8	RW	Yes	No	0 ~ 1	0
	2	Input Range	U8	RW	Yes	No	0 ~ 4	0
	3	Filter Buffer Length	I16	RW	Yes	No	0 ~ 500	0
	4	Set ADC Offset	I16	RW	Yes	No	-1000 ~ 1000	0

The Objects which stores fixed data such as Device Name (1008h) is described in the following format.

Index	Sub Index	Name	Type	Access	Constant Value
1008h	0	Device Name	STR(20)	RO	Ezi-IO EtherCAT AD08

10.1.1 Index and Sub-Index

The following areas are assigned with Object Index of four-digit hexadecimal numbers as shown in **Table 10-1**.

Index	Area	Description
0000h ~ 0FFFh	Data Type Area	Definitions of data types
1000h ~ 1FFFh	CoE Communication Area	Definitions of variables for dedicated communications used by all servers
+	Manufacturer Specified Area	Definitions of variables dedicated for FASTECH modules
6000h ~ 9FFFh	Device Profile Area	Definitions of variables for CiA 401 module profile
A000h ~ FFFFh	Reserved Area	Other variables

Table 10-1. Index of Objects

If an Object is combined with multiple variables, use sub-Index.

Refer to the Sub-Index 0: 'Number of Entries' to set the maximum number of sub-Index.

10.1.2 Name

Name of Object which describes the Object.

10.1.3 Data Types

Data types for Objects.

Data Type	Length of Data	Range
U8	1 byte	0 ~ 255
U16	2 bytes	0 ~ 65535
U32	4 bytes	0 ~ 4294967295
I8	1 byte	-128 ~ 127
I16	2 bytes	-32768 ~ 32767
I32	4 bytes	-2147483648 ~ 2147483647
BOOL	1 bit	0 ~ 1
STR(n)	n bytes	n-byte long string

Table 10-2. Data Types

10.1.4 Access

The following table shows access types for each Object.

Access	Description
RO	Read Only / Variables for read-only.
RW	Read/Write / Variables for read or write

Table 10-3. Access Type of Object

10.1.5 SAVE

The Object values are automatically saved in EEPROM.

10.1.6 PDO Mapping

Indicates whether the Object is valid for the PDO communication of EtherCAT or not.

PDO Type	Description
No	The Object is NOT valid for PDO Mapping.
Tx PDO	The Object is valid for Tx PDO Mapping.
Rx PDO	The Object is valid for Rx PDO Mapping.

Table 10-4. PDO Mapping

10.1.7 Constant Value

Constant Value is a fixed value stored in the Object. The value varies depending on the product model and version.

10.1.8 Value Range

Value Range indicates the range of input signal stored in the Object. The range can have a random range or a range of Data Type.

10.1.9 Default Value

Default value of the Object. Restores the default values using the Restore Default Parameters (1011h).

10.2 Communication Object

10.2.1 Object 1000h: Device Type

Index	Sub Index	Name	Type	Access	Constant Value
1000h	0	Device Type	U32	RO	0084 0191h

This Object includes the data about device type.

Bit	Name	Value	Description
0 ~ 15	Device Profile Number	0191h	CiA 401 Profile
16 ~ 22	I/O Function	04h	Analogue Input
23	M (PDO Applied)	1h	Supported PDO Mapping for each device
24 ~ 31	Special Function	00h	

Table 10-5. Object for Device Type

10.2.2 Object 1001h: Error Register

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1001h	0	Error Register	U8	RO	No	No	—	00h

This Object indicates types of error that occurred in the product.

Bit	Description
0	General Error
1	Current Error
2	Voltage Error
3	Temperature Error
4	Communication Error
5	Device Profile Error
6	Reserved
7	Manufacturer Specified Error

Table 10-6. Object for Errors

When an error occurs, the corresponding bit is set.

10.2.3 Object 1008h: Device Name

Index	Sub Index	Name	Type	Access	Constant Value
1008h	0	Device Name	STR(20)	RO	Ezi-IO EtherCAT AD08

This Object indicates the device name.

10.2.4 Object 1009h: Hardware Version

Index	Sub Index	Name	Type	Access	Constant Value
1009h	0	Hardware Version	STR(5)	RO	01.00

This Object indicates the hardware version of the product. The data varies depending on the product version.

10.2.5 Object 100Ah: Software Version

Index	Sub Index	Name	Type	Access	Constant Value
100Ah	0	Software Version	STR(5)	RO	01.00

This Object indicates the software version. The data varies depending on the product version.

10.2.6 Object 1011h: Restore Default Parameters

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1011h	0	Number of Entries	U8	RO	No	No	—	1
	1	Restore Default Parameters	U32	RW	No	No	—	

Information

Object values are reset to default values when the product is restarted.

It commands that the Object values saved in EEPROM are restored with default values. To reset the Objects with the factory default values, enter '64616F6Ch' to the Sub-Index 01h.

	MSB			LSB
ASCII	'd'	'a'	'o'	'l'
Hex	64h	61h	6Fh	6Ch

Table 10-7. Restore Parameters

10.2.7 Object 1018h: Identity

Index	Sub Index	Name	Type	Access	Constant Value
1018h	0	Number of Entries	U8	RO	4
	1	Vendor ID	U32	RO	0FA0 0000h
	2	Product Code	U32	RO	0000 2203h
	3	Revision Number	U32	RO	0001 0000h
	4	Serial Number	U32	RO	0000 0000h

This Object indicates the device information.

* Each data for the Identity varies depending on the product version.

10.2.8 Object 10F1h: Error Setting

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
10F1h	0	Number of Entries	U8	RO	No	No	—	2
	1	Local Error Reaction	U32	RO	No	No	—	0000 0000h
	2	Sync Error Counter Limit	U32	RW	No	No	—	0000 000Ch

10.3 PDO Mapping Object

10.3.1 Object 1A00h: TxPDO-Map

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1A00h	0	Number of Entries	U8	RO	No	No	0 ~ 32	8
	1	1st PDO Object	U32	RW	Yes	No	—	6401 0110h
	2	2nd PDO Object	U32	RW	Yes	No	—	6401 0210h
	3	3rd PDO Object	U32	RW	Yes	No	—	6401 0310h
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	8	8th PDO Object	U32	RW	Yes	No	—	6401 0810h
	9	9th PDO Object	U32	RW	Yes	No	—	0000 0000h
	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	31	31th PDO Object	U32	RW	Yes	No	—	0000 0000h
	32	32th PDO Object	U32	RW	Yes	No	—	0000 0000h

This Object indicates the TxPDO-Map setting.

Read Analogue Input 16bit (6401h) Object is mapped.

TxPDO-Map is not changeable. Refer to [7.2 PDO Mapping](#).

10.3.2 Object 1C12h: RxPDO Assign

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C12h	0	Number of Entries	U8	RO	No	No	—	1
	1	RxPDO Assign	U16	RW	No	No	—	0000 0000h

10.3.3 Object 1C13h: TxPDO Assign

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C13h	0	Number of Entries	U8	RO	No	No	—	1
	1	TxPDO Assign	U16	RW	No	No	—	1A00h

10.4 Sync Manager Object

10.4.1 Object 1C00h: Sync Manager Type

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C00h	0	Number of Entries	U8	RO	No	No	—	4
	1	SM0	U8	RO	No	No	—	01h
	2	SM1	U8	RO	No	No	—	02h
	3	SM2	U8	RO	No	No	—	03h
	4	SM3	U8	RO	No	No	—	04h

Sync Manager Type	Description
1	Mailbox Out
2	Mailbox In
3	PDO Output
4	PDO Input

Table 10-8. Sync Manager Type Value

10.4.2 Object 1C32h: SM Output Parameter

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C32h	0	Number of Entries	U8	RO	No	No	—	32
	1	Synchronization Type	U16	RW	No	No	—	0002h
	2	Cycle Time	U32	RO	No	No	—	0000 0000h
	4	Synchronization Type Supported	U16	RO	No	No	—	401Fh
	5	Minimum Cycle Time	U32	RO	No	No	—	0003 D090h
	6	Calc And Copy Time	U32	RO	No	No	—	0000 2710h
	8	Get Cycle Time	U16	RW	No	No	—	0000h
	9	Delay Time	U32	RO	No	No	—	0000 0000h
	10	Sync0 Cycle Time	U32	RW	No	No	—	0000 0000h
	11	SM-Event Missed	U16	RO	No	No	—	0000h
	12	Cycle Time Too Small	U16	RO	No	No	—	0000h
	32	Sync Error	BOOL	RO	No	No	—	0000h

10.4.3 Object 1C33h: SM Input Parameter

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C33h	0	Number of Entries	U8	RO	No	No	—	32
	1	Synchronization Type	U16	RW	No	No	—	0002h
	2	Cycle Time	U32	RO	No	No	—	0000 0000h
	4	Synchronization Type Supported	U16	RO	No	No	—	401Fh
	5	Minimum Cycle Time	U32	RO	No	No	—	0003 D090h
	6	Calc And Copy Time	U32	RO	No	No	—	0000 2710h
	8	Get Cycle Time	U16	RW	No	No	—	0000h
	9	Delay Time	U32	RO	No	No	—	0000 0000h
	10	Sync0 Cycle Time	U32	RW	No	No	—	0000 0000h
	11	SM-Event Missed	U16	RO	No	No	—	0000h
	12	Cycle Time Too Small	U16	RO	No	No	—	0000h
	32	Sync Error	BOOL	RO	No	No	—	0000h

10.5 IO Module Profile Object

10.5.1 Object 6401h: Read Analogue Input 16 bit

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6401h	0	Number of Entries	U8	RO	No	No	—	8
	1	Analog Input CH1	I16	RO	No	Tx PDO	—	0
	2	Analog Input CH2	I16	RO	No	Tx PDO	—	0
	3	Analog Input CH3	I16	RO	No	Tx PDO	—	0
	4	Analog Input CH4	I16	RO	No	Tx PDO	—	0
	5	Analog Input CH5	I16	RO	No	Tx PDO	—	0
	6	Analog Input CH6	I16	RO	No	Tx PDO	—	0
	7	Analog Input CH7	I16	RO	No	Tx PDO	—	0
8	Analog Input CH8	I16	RO	No	Tx PDO	—	0	

This Object indicates the analog input data for all channels.

If the Filter Buffer Length > 1, data with the Moving Average Filter is indicated.

10.6 Manufacturer Specific Object

10.6.1 Object 2200h ~2207h: Input 1 ~ Input 8 Configuration

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2200h	0	Number of Entries	U8	RO	No	No	—	4
	1	Channel On/Off	U8	RW	Yes	No	0 ~ 1	0
	2	Input Range	U8	RW	Yes	No	0 ~ 4	0
	3	Filter buffer Length	I16	RW	Yes	No	0 ~ 500	0
	4	Set ADC Offset	I16	RW	Yes	No	-1000 ~ 1000	0

This Object sets the functions for input analog data.

With the Channel On/Off value, enable or disable the channel. The channel is Off when the value is 0, and the channel is On when the value is 1. Only when the Channel On/Off value is 1, the input analog signal is converted to the digital data for the channel.

Value	Description
0	The channel is Off.
1	The channel is On.

Table 10-9. Channel On/Off Value

With the Input Range value, select the input range of analog voltage or current. Refer to **Table 10-10** for the selectable input range. The analog signals are converted to digital data according to the selected ranges.

Value	Description
0	-10V ~ 10V
1	-5V ~ 5V
2	-2.5V ~ 2.5V
3	0V ~ 10V
4	0mA ~ 20mA

Table 10-10. Input Range

With setting the Filter Buffer Length (Max. 500), the Object stores the Moving Average Filter applied input data. You can set the ADC Offset (-1,000 ~ 1,000) for the voltage or current input for each channel. The Object stores converted data of input signals which is adjusted as much as the ADC Offset value.

(* Refer to [9.4 Setting ADC Offset](#))

Information

Changes in all the Objects for functions are updated after the reboot except the Object for Set ADC Offset.



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