

EMP-2848M Website User Manual

English

Ver. 1.1, JUN. 2024



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SUPPORT

EMP-2848M

Revision History

Revision	Date	Description	Firmware Version
1.0	2024/04	- Web page interface update, modify the following instructions and images: - Web interface introduction figure. - Navigation area figure. - Offline configuration right-click menu figure. - Scanning slave instructions. - Configure the single-axis motion control right-click menu figure. - Software update instructions. - Quick start instructions. - Remove the Enable/Disable EtherCAT status area display button. - Rename the Build ENI File button to New ENI File button and explain the Append axes to motion control option in the dialog box. - ENI Merge button renamed ENI Update button. - EtherCAT network comparison table display format updated, modified network comparison table descriptions. - Add "Archive All" description to ENI file list right-click menu and update the right-click menu figure. - Add "Archive All" description to ESI file list right-click menu and update the right-click menu figure. - Remove Alias Mode and add ID Mode from slave addressing mode. - Remove the Configuration Alias information from the slave page and add the ID information. - Remove Configured Station Alias from slave page. - Add Set Slave ID description to the slave page. - Toolbar has been added to show the name of the last ENI file reloaded by the EtherCAT Runtime. - Toolbar add button to select ENI file and restart EtherCAT operation task. - Toolbar remove Import/Export buttons. - Added EtherCAT Category chapter. - Added OPC UA chapter.	EtherCAT Web server, v1.0.1
1.0	2022/08	Initial issue	EtherCAT Web server, v1.0.0

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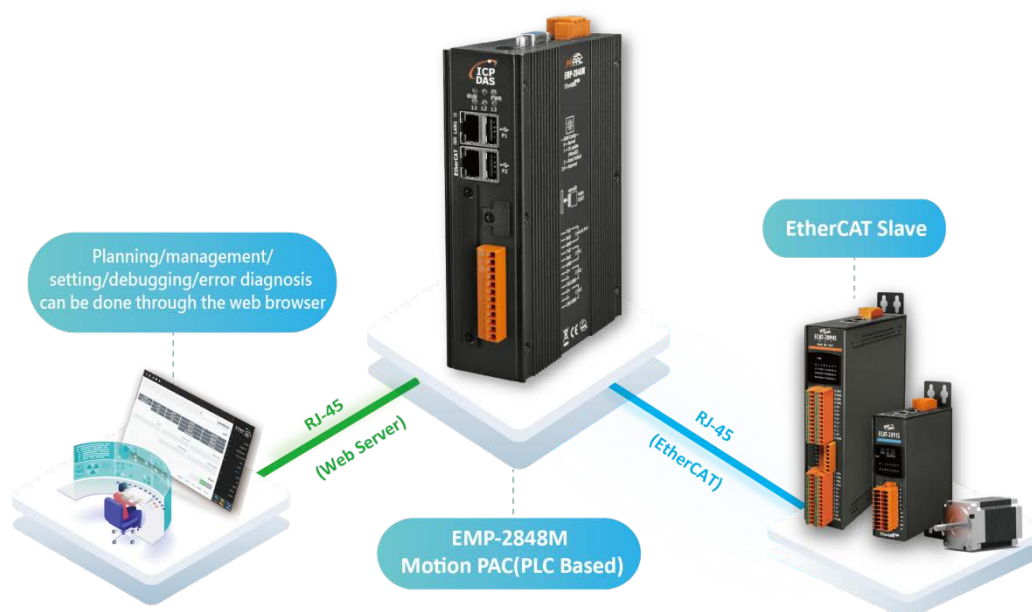
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1. Introduction

EMP-2848M is integrated with the web server which allows users to use a web browser to connect to the web server through the Ethernet network to configure EtherCAT ENI files. The ENI configuration file provides the parameters required for the initialization of EtherCAT Master Runtime, such as: master communication cycle, slave information, slave PDO Mapping, initialization parameters of the motion control axis, etc.

After the ENI file is configured and reloaded, the users can operate various functions on different working pages. For example: the EtherCAT packet diagnosis function can be performed to diagnose the packet on the master page. On the Slave page, the PDO and SDO functions can be performed; the slave module can also be configured on this page. The testing of motion control can be performed on the axis test page. And on the PLC operation page, the PLC task information (name, version, cycle time, cycle time status) can be accessed and the PLC Tasks (start, stop, pause, resume, delete) can be performed on this page. This manual will give detailed description of functions on each work page.



2. Getting Started

2.1. Login into the webpage

Please complete the network settings of the PC before entering the webpage. The factory default settings of the hardware LAN network are as follows:

Factory Default		
Network Setting	IP (LAN1)	192.168.255.1
	Netmask	255.255.0.0
	Gateway	192.168.1.1

1. Change the network settings of the PC to the same network segment as the hardware, for example:

Network Setting	IP (LAN1)	192.168.255.10
	Netmask	255.255.0.0
	Gateway	192.168.1.1

2. Make sure the hardware and PC are properly connected to the network. Start the browser and type "http://192.168.255.1" in the address bar to enter the login page.
3. Enter the account and password on the login page, and click the "Login" button to log in.
 - Default account: admin
 - Default password: admin



 Username

 Password

Login

4. When using the default account and password to log in for the first time, the system will require the user to change the password. Please log in again after changing the password.



You must change your password before logging on the first time.

Username

admin

Old password

New password

Confirm new password

Change

5. After logging into the webpage, change the hardware network settings according to the actual network environment. For detailed network setting, please refer to the section Network.
6. Users can also modify the network settings through the eSearch Utility software. For details, please refer to Appendix A. eSearch Tool Software.

2.2. Web Interface Introduction

As shown in Figure 2-1, the web interface consists of the following parts:

1. Toolbar
2. Navigation area
3. Workspace
4. EtherCAT Status Area
5. Error/Message Notification Box

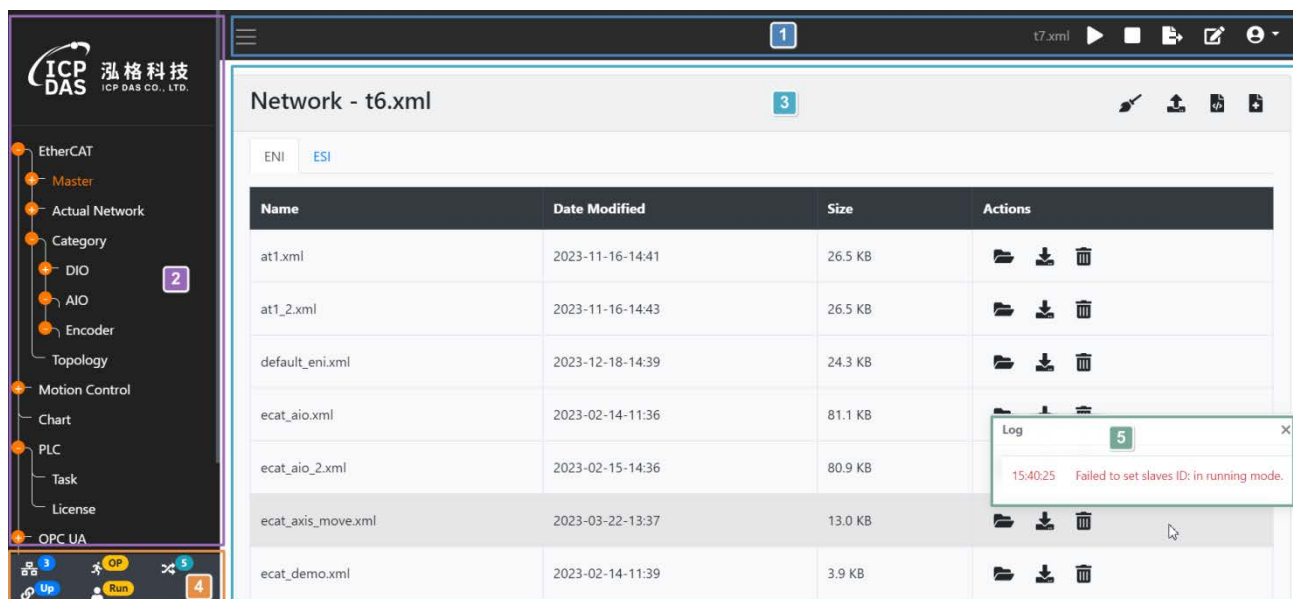


Figure 2-1

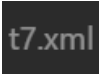
2.2.1. Toolbar

The toolbar (shown as Figure 2-2) is always displayed at the top of the web interface.



Figure 2-2

The toolbar has the following controls:

-  - Show/Hide “Navigation area” button.
-  - Display the file name of the last reloaded ENI on EtherCAT Runtime.
-  - Start the EtherCAT operation task button.
-  - Stop EtherCAT operation task button.
-  - Select ENI file and restart EtherCAT operation task button. When you click this button, the following dialog box will appear, you can select the ENI file to be reloaded by the EtherCAT Runtime, clicking "OK" will reload the selected ENI file and restart the EtherCAT task, before restarting the EtherCAT task, the Win-GRAF Runtime program will be stopped to make sure that it will not cause any unexpected results.
-  - Save settings button, after completing the settings in the work area, click this button to submit and save the settings
-  - Account drop down menu.
 -  admin - Login account name.
 -  Password - To change the password, please refer to the section: Account Settings for detailed information.
 -  Logout - Log out of account.

2.2.2. Navigation Area

The Navigation Area is shown in Figure 2-3, which is located on the left side of the web interface. You can use the toolbar "Show/Hide Navigation Area Button" to display and hide it. The default is the display state. The main purpose of the Navigation Area is to switch the workspace to different work pages.

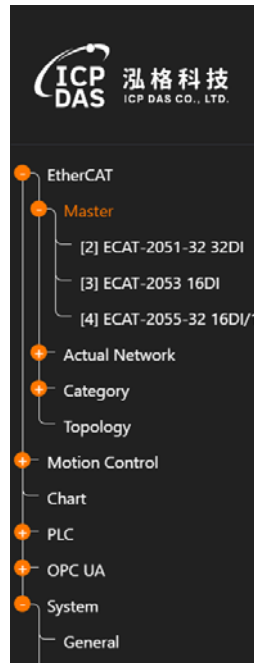


Figure 2-3

The following work pages are accessible:

- EtherCAT->Master
The user can create a new ENI file or open a previously saved ENI file for editing on this page. Please refer to section EtherCAT Master for detailed information.
- EtherCAT->Slave
This page can perform DC, PDO Mapping settings and other advanced operations for the configured slave modules. Please refer to section EtherCAT Slave for further instructions.
- EtherCAT->Actual Network->Slave
The Slave node will appear after the EtherCAT network is scanned and find there are slave modules connected. This page will show the information of connected slave modules and operations of SDO and FoE. Please refer to section EtherCAT Actual Slave for more detailed information.
- Motion Control->Axes->Axis
Users can initialize parameter settings such as: axis type, PPU, maximum speed, maximum acceleration, etc. for axes that have been configured with motion control

functions on this page. Please refer to section Motion Control Axis for detailed information.

- Motion Control->Axis Test

After the motion control function is configured and starting the EtherCAT operation task, the users can perform single-axis motion control test on this page. Please refer to section Motion Control Axis Test for detailed information.

- Chart

After the EtherCAT task is operated, a trend graph of variables over time can be draw on this page. The variables can be PDO variables or motion control variables. Please refer to the section Chart for detailed information.

- PLC->Task

This page displays information of PLC control tasks (name, version, cycle time, cycle time status, etc.) and can perform operations of control tasks (start, stop, pause, resume, delete, etc.). Please refer to section PLC Task for detailed information.

- PLC->License

This page displays the authorization status and activation of the PLC Runtime. Please refer to section PLC License for detailed information.

- System->General

The user can set system parameters such as: host name, network settings, date & time, software updates, etc. on this page. Please refer to section System General for detailed information.

- System->Service

The user can manually control the start or stop of EtherCAT Runtime and PLC Runtime on this page. It can also display various log information. Please refer to section System Service for detailed information.

2.2.3. Workspace

The workspace is located at the right side of the web interface; it will display the work page the user selected from the Navigation area. The content of the work page is composed of multiple card content container as shown in Figure 2-4, each card represents a function, and these functions can be status, parameter setting or operations of functions.



The screenshot shows a web interface titled "Network -". Below the title bar, there are two tabs: "ENI" and "ESI", with "ESI" being the active tab. The main content area displays a table with the following data:

Name	Date Modified	Size	Actions
default_eni.xml	2022-05-03-16:32	14.4 KB	[Folder icon] [Download icon] [Delete icon]
t1.xml	2022-05-04-15:56	14.4 KB	[Folder icon] [Download icon] [Delete icon]

Figure 2-4

2.2.4. EtherCAT Status

The EtherCAT status area is shown in Figure 2-5. It is located at the bottom of the left side of the web interface. EtherCAT status will be displayed or hidden along with navigation area, it will display statuses of EtherCAT operation tasks.



Figure 2-5

The status area includes the following information:

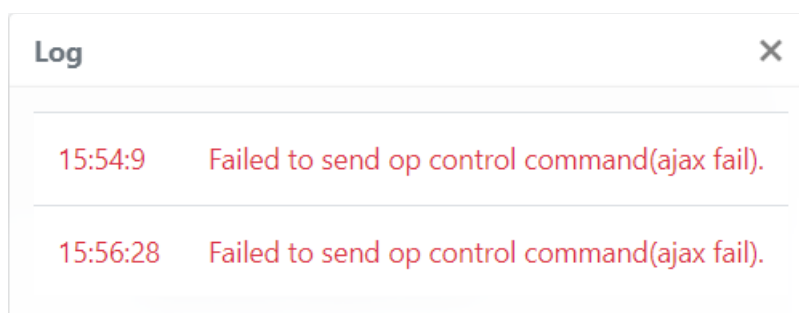
- The actual number of connected slave modules.
- EtherCAT AL Status. Display the AL status of all slave modules, this is a composite display. For example, if the status is OP, it indicates that all slave stations are in Operational State. If the status is P, S, it indicates that there are some slave stations are in Pre-Operational State, and some slave stations are in Safe-Operational State.
 - Init** - Init State
 - Pre** - Pre-Operational State
 - Safe** - Safe-Operational State
 - OP** - Operational State
 - I,S** - Init, Safe-Operational State
 - P,S** - Pre-Operational, Safe-Operational State
 - I,P,S** - Init, Pre-Operational, Safe-Operational State
 - I,O** - Init, Operational State
 - P,O** - Pre-Operational, Operational State
 - I,P,O** - Init, Pre-Operational, Operational State
 - S,O** - Safe-Operational, Operational State
 - I,S,O** - Init, Safe-Operational, Operational State
 - P,S,O** - Pre-Operational, Safe-Operational, Operational State
 - I,P,S,O** - Init, Pre-Operational, Safe-Operational, Operational State
- Workings Counter status.
- EtherCAT socket connection status.
 - Up: Connecting.
 - Down: disconnected.
- EtherCAT Runtime operation task status.
 - Edit: The operation task is stopped, and is in editing mode.
 - Run: The operation task is running.

2.2.5. Error / Message Notification Box

The error/message notification box usually will not appear on the web interface, it only pops up when there is an error or message requires to be notified to the user. Notification boxes includes the following types:

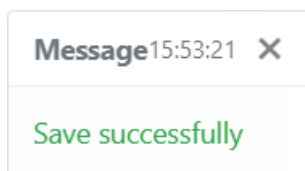
- Error notification box

When an error occurs during the operation of web interface, this notification box will pop up and inform the user of the detailed error message. The notification box will appear on the web interface, and the last error message will be added to the list and will not be cleared until the user closes the notification box.



- Message notification box

The message notification box will notify the user whether the operations on the web interface is successful or not and will prompt additional information if required. After the notification box pops up, it will appear for 3 seconds, and will automatically close after 3 seconds.



3. EtherCAT Master

This working page can be used to open and create an ENI file, and set the initial parameters of the master station before starting the EtherCAT operation task. The following will explain the function of each card.

3.1. ENI/ESI Editor

The ENI/ESI editor is shown in Figure 3-1. The user can open or create an ENI file here, and upload/download/delete ENI and ESI files on this page. The "ENI", "ESI" tabs can be used to switch between different editors.



Figure 3-1

3.1.1. ENI Editor

The left half of the card title displays the name of the currently opened ENI file, as shown in Figure 3-2, and the right half is the function buttons, the functions are as follows:

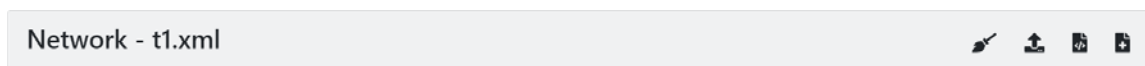


Figure 3-2

-  - Upload ENI file
-  - New ENI file. Click this button and the dialog box shown in Figure 3-3 will appear. If the "Append actual network" is checked, it will scan the actually connected slave module and automatically create the ENI file content from the ESI. If the "Append actual network" is unchecked, an empty ENI file will be created. When Append axes to motion control is checked, the motion control axes will be created automatically according to the connection sequence if the actual connected slave is CiA402 motion control module. Input the file name and press OK to create a new ENI file. If the file name already exists, a warning message will appear under the dialog box and Replace button will appear, as shown in Figure 3-4. Click Replace button to overwrite the old file. If you don't want to overwrite the old file, change the file name and press the OK button to save the new file.

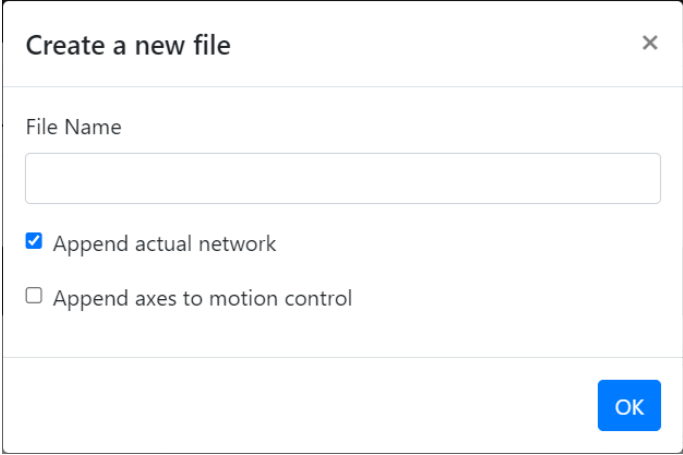


Figure 3-3 shows a dialog box titled "Create a new file". It contains a "File Name" input field, two checkboxes ("Append actual network" and "Append axes to motion control"), and an "OK" button.

Figure 3-3

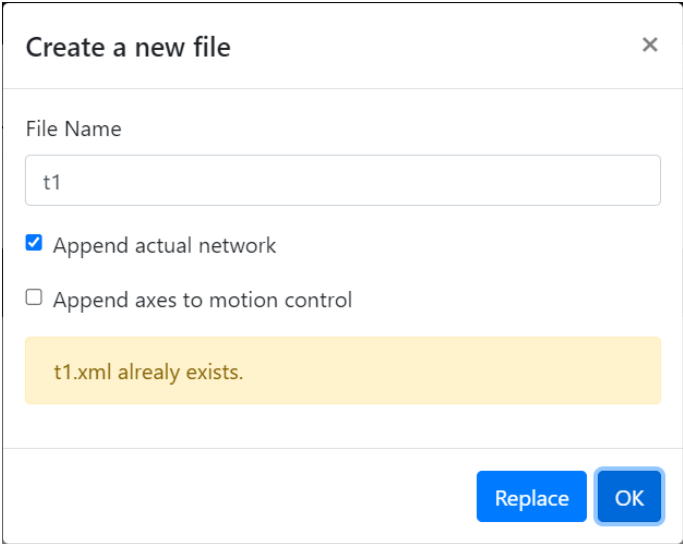


Figure 3-4 shows the same dialog box, but with the "File Name" field containing "t1". A yellow message box indicates "t1.xml already exists.". The "Replace" and "OK" buttons are now visible at the bottom right.

Figure 3-4

-  - Update ENI file. When the EN file is opened, if there are newly added or disconnected slave modules, the update function can be used for comparisons. The module with the same setting value will be kept and the one with different values will be added or deleted. Click the update ENI file, the following dialog box will be shown as bellow, and the descriptions of the fields in the comparison table are as follows:

Update with Actual Network							✕	
ENI Configuration			Comparison	Actual Configuration				
Pos.	ID	Name		Pos.	ID	Name		
0	20	[20] ECAT-2051-32 32DI	ID matched	0	20	ECAT-2051-32 32 Ch. Dig. In. Dry/Wet 50V		
		---	Newly added	1	31	ECAT-2053 16 Ch. Dig. In. Wet 50V		
1	40	[40] ECAT-2055-32 16DI/16DO	ID matched	2	40	ECAT-2055-32 16 Ch. Dig. In. Dry/Wet 50V, 16 Ch. Dig. Out. Sink		
2	60	[60] ECAT-2051 DC Sync 16DI	Removed			---		
							OK	

Field		Description
ENI Configuration	Pos.	Slave configuration position in ENI file.
	ID	Slave configuration ID in ENI file.
	Name	Slave name in ENI file.
Comparison	The comparison results are defined as follows:	
	Result	Description
	ID matched	The comparison result is the same, so the set value is kept.
	Not matched	The comparison result is not the same.
	Newly added	There is no configuration setting in the ENI file but there is a slave module actually connected, new configuration settings will be added.
	Removed	There are configuration settings in the ENI file but there is no slave module actually connected, the configuration settings will be deleted.
Actual Configuration	Pos.	Actual slave connection position.
	ID	Actual slave ID.
	Name	Actual slave name.

The content under the "ENI" tab is the list of established ENI files, as shown in the figure below, each field indicates the name, modification date, size and function buttons.

ENI

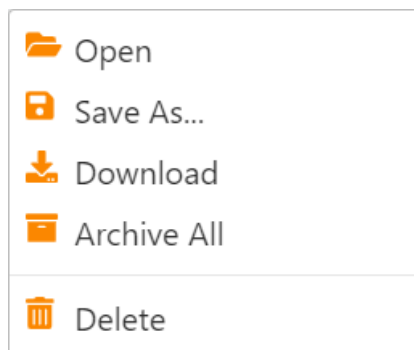
ESI

Name	Date Modified	Size	Actions
default_eni.xml	2022-05-03-16:32	14.4 KB	  
t1.xml	2022-05-04-15:56	14.4 KB	  

The function buttons are as follows:

-  - Open the ENI.
-  - Download ENI file.
-  - Delete ENI file.

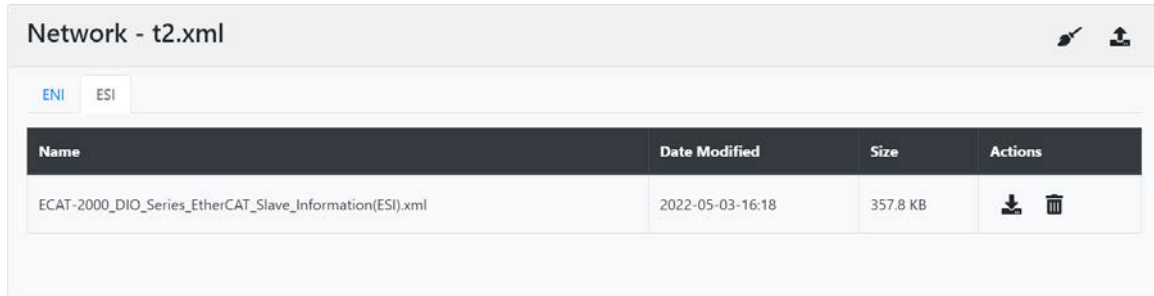
The right-click menu is shown below.



- Open: Open ENI file.
- Save As...: Save as ENI file.
- Download: Download as ENI file.
- Archive All: Compress all ENI files into zip archive.
- Delete: Delete ENI file.

3.1.2. ESI Editor

The content under the "ESI" tab is the list of ESI files, as shown in the figure below, each field indicates the name, modification date, size and function buttons.



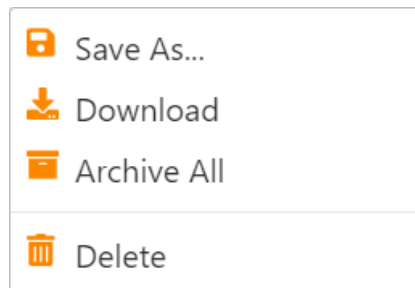
The screenshot shows a web interface titled "Network - t2.xml". It has two tabs: "ENI" and "ESI". The "ESI" tab is active, displaying a table with the following data:

Name	Date Modified	Size	Actions
ECAT-2000_DIO_Series_EtherCAT_Slave_Information(ESI).xml	2022-05-03-16:18	357.8 KB	 

The function buttons on the right hand side of the list are as follows:

-  - Upload ESI file.
-  - Download ESI file.
-  - Delete ESI file.

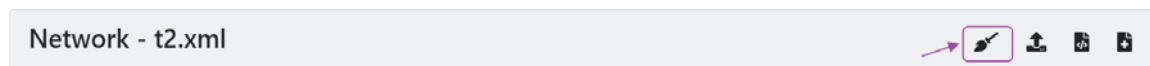
The right-click menu is shown below.



- Save As...: Save as ESI file.
- Download: Download as ESI file.
- Archive All: Compress all ESI files into zip archive.
- Delete: Delete ESI file.

3.1.3. Reset EtherCAT Errors

As shown in the figure below, this button is located in the function buttons of the card title. When an EtherCAT operation task is started, the  button can be clicked to reset the errors if the errors states are set to be kept (for example: Working Counter error).



3.2. Settings

The initialization parameters of the master station are shown in Figure 3-5; they can be set after starting or creating an ENI file. When starting the EtherCAT operation task, the parameters can be initialized according to the settings. The description of each parameter is as follows:

Figure 3-5

- **Cycle Time(us)**
EtherCAT operation task communication cycle, in microseconds.
- **Domain(Tx,Rx)**
The Domain type of TX/RX data can be set as follows:
 - **Combine:**
Combined type, TX/RX data are in the same Domain, EtherCAT Datagram is packaged by LRW command during communication.
 - **Separate:**
Separated type, TX/RX data are separated in separate Domain, EtherCAT Datagram uses LRD/LWR command to pack TX/RX data separately during communication.
- **Process Image Variable**
Process Image variable type, the values to be set are as follows:
 - **Individual:**
Independent type, each variable is generated according to the item (Entry) of the PDO Mapping, and no more parent variable will be generated when the name has a double bottom line "__", as shown in the following figure.

Status_Latch extern valid	BOOL	1	49	0
Status_Set counter done	BOOL	1	50	0
Status_Counter underflow	BOOL	1	51	0
Status_Counter overflow	BOOL	1	52	0
Status_Status of extern latch	BOOL	1	60	0
Status_Sync error	BOOL	1	61	0
Status_TxPDO Toggle	BOOL	1	63	0

- Combine("__"):

In the combine type, each variable is generated according to the item (Entry) of the PDO Mapping. When the name has a double bottom line "__", a parent variable will be generated, as shown in the following figure.

▼ Status	UINT	16	48	0
Latch extern valid	BOOL	1	49	0
Set counter done	BOOL	1	50	0
Counter underflow	BOOL	1	51	0
Counter overflow	BOOL	1	52	0
Status of extern latch	BOOL	1	60	0
Sync error	BOOL	1	61	0
TxPDO Toggle	BOOL	1	63	0

- Working Counter Error

The number of working counter errors. When the set value is greater than zero, the error flag will be set to true when the number of consecutive errors of the Working Counter is greater than or equal to the set value. It can be cleared by the "Reset EtherCAT Errors". When the set value is equal to zero, the error flag is set to true when the Working Counter is invalid and false when the Working Counter is correct.

- Addressing Slaves

Slave addressing mode, the values to be set are as follows:

- Position

The EtherCAT operation task is addressed according to the connection location when editing.

- ID

The EtherCAT operation tasks is addressed according to the ID value.

- Slaves(CiA402) PDO Assignment button

All CiA402 slave modules perform automatic PDO assignment. Please refer to the information in section regarding CiA402 PDO Assignment.

- Slaves DC Enable button

Set all slave modules to "Enable DC", if the slave modules support this function, it will be automatically set to enable.

3.3. Process Image

Process Image variable operation is shown in Figure 3-6. When starting an EtherCAT operation task, use the Inputs/Outputs tab to switch the variable list to read and write the variables. The function buttons feature the following functions:

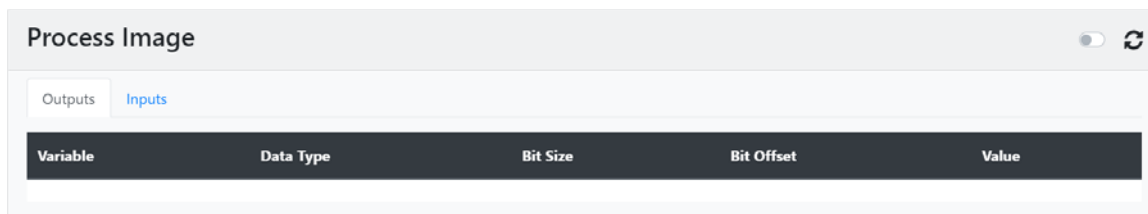


Figure 3-6

-  - Enable/Disable the automatic update of all variable values.
-  - Manually update all variable values.

Each fields of the Outputs/Inputs variable form are as follows:

- Variable
The name of the variable.
- Data Type
The data type of the variable.
- Bit Size
The size of the variable (in bits).
- Bit Offset
The offset of the variable in the Process Image (in bits).
- Value
The content value of the variable

Process Image variables are described as follows:

- Outputs
Currently no variables are defined. The function is reserved.
- Inputs
 - Status
 - Error - error status flag
 - Run Mode - currently is in edit mode

- Link Down - disconnection error
- OP - error of all slaves do not enter OP state
- WC - Working Counter error
- Cycle Exceed - Communication cycle timeout error
- Slave - Slave error
- Network - Slave communication error
- Slave Count - the number of slaves configured in the ENI file

3.4. Diagnostics

The EtherCAT packet diagnosis function (shown in Figure 3-7) can obtain the count of errors when EtherCAT packet pass through the 4 ports of the slave module. The function buttons are as follows:

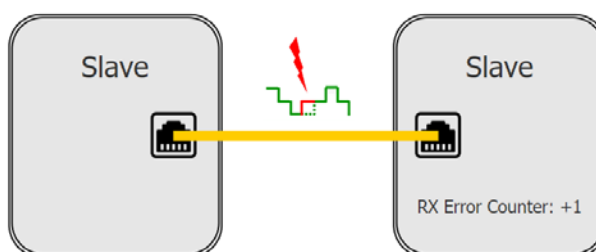
Diagnostics																
Slave	Port 0				Port 1				Port 2				Port 3			
	CRC	PHY	FWD	LINK	CRC	PHY	FWD	LINK	CRC	PHY	FWD	LINK	CRC	PHY	FWD	LINK
0	0	0	0	0	1	23	0	1	-	-	-	-	-	-	-	-
1	0	132	0	1	0	0	0	0	-	-	-	-	-	-	-	-
2	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-

Figure 3-7

-  - Clear counter.
-  - Enable/Stop auto update counter.
-  - Update counter.

The description of error counters are as follows:

- CRC - Frame Error Counter (0x0300, 0x0302, 0x0304, 0x0306)
- PHY - Physical Layer Error Counter (0x0301, 0x0303, 0x0305, 0x0307)
The 2 counters are generally called as the RX error counter. The change of the RX error counter indicates that the received hardware signal is corrupted, and its carried data will be discarded.



Most likely reasons for signal corruption are:

- External EMC disturbances (usually sporadic counter increment)

- Damaged devices or interconnections (usually fast and systematic counter increment)

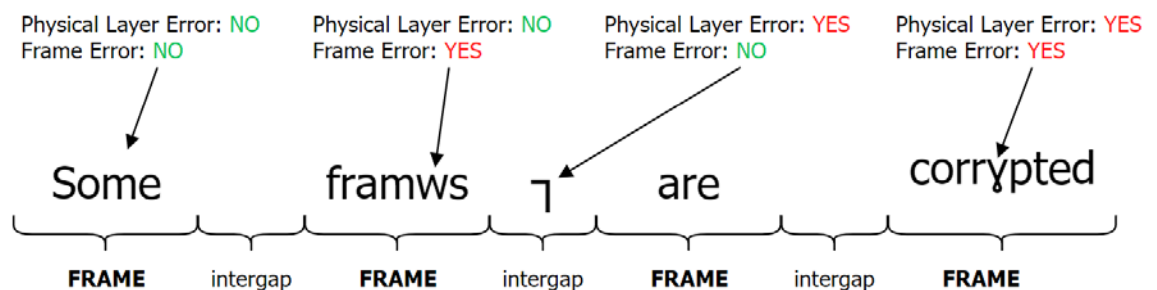
Physical Layer Error:

- Correspond to individual invalid symbols
- Can occur both within and outside frames (when occurring within frames, they represent usually also Frame Errors)

Frame Error:

- Correspond to frames whose overall bit sequence was corrupted
- Can occur only within frames

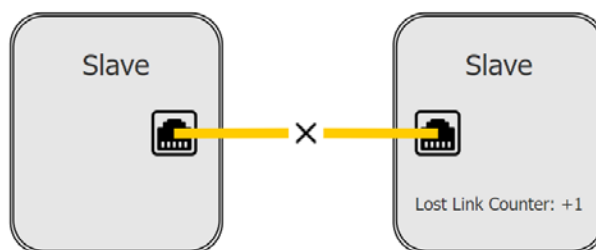
The difference between the two error types can be explained taking a written language as comparison:



- **FWD - Forwarded RX Error Counter (0x0308:0x030D)**
The previous device ESC detected an invalid frame and forwarded to this device.
- **LINK - Lost Link Counter (0x0310:0x0313)**
An increment in a Lost Link Counter indicates an interruption in the hardware communication channel, during link down frames are not send to the neighboring device.

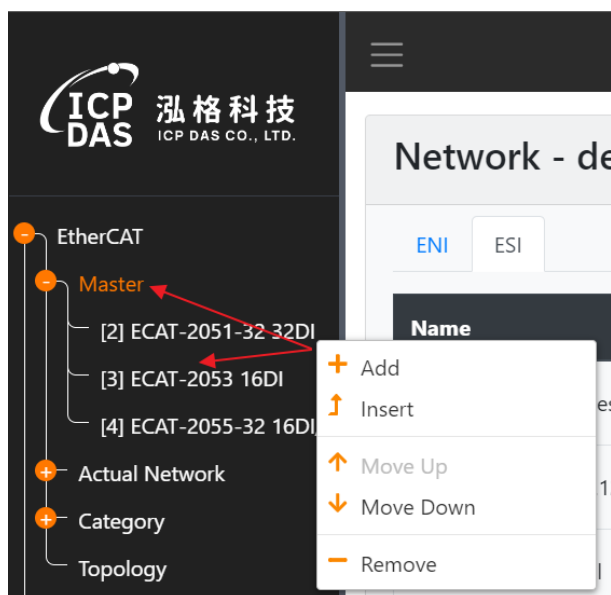
Most likely reasons for link loss are:

- Temporary or permanent device power-supply loss, or device reset
- Damaged cables or connectors or poor/oxidized contacts
- EMC disturbances



3.5. Offline Configuration

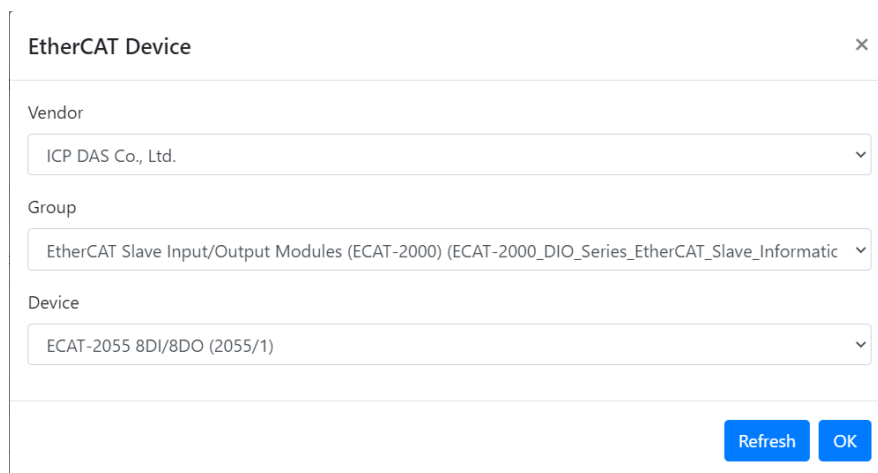
Offline configuration can manually add the slave configuration to the ENI file. First open or create an empty ENI file, and right-click the EtherCAT->Master or EtherCAT->Slave node in the work navigation area (as shown in the figure below). Bring up the right-click menu to perform offline configuration.



The right-click menu functions are as follows:

- + - Adding a new slave configuration. The new configuration will be added under the currently selected slave node.
- ↑ - Inserting a new slave configuration. The new configuration will be added above the currently selected slave node.

After clicking the Add or Insert option, the following dialog box will pop up. According to the supplier and group, select the slave module to be added and click “OK”. It will read all uploaded ESI files and classify them according to vendors, groups, and devices. Therefore, it will take more time to analyze when loading for the first time.



EtherCAT Device [X]

Vendor
ICP DAS Co., Ltd. [v]

Group
EtherCAT Slave Input/Output Modules (ECAT-2000) (ECAT-2000_DIO_Series_EtherCAT_Slave_Informatic [v]

Device
ECAT-2055 8DI/8DO (2055/1) [v]

[Refresh] [OK]

The parameters of the dialog box are as follows:

- Vendor
List of vendors of the slave stations.
- Group
List of device groups under the vendors of the slave stations.
- Device
List of devices under the groups of the vendors in the slave stations.
- Refresh button
Update vendors, groups and devices list. After the dialog box is classified for the first time, these classification results will be kept, and it will be used directly when the dialog box is brought up next time without reading all the contents of the ESI file again, saving the time for reading the classification. But if the ESI file is uploaded again after the first reading of the classification, the user can click this button to read and classify it again.

-  - Moves up the currently selected slave configuration.
-  - Moves down the currently selected slave configuration.
-  - Delete the currently selected slave configuration.

4. EtherCAT Slave

After the ENI file is created, the users can perform configuration of Slave initialization parameters when starting the EtherCAT operation task and the operations of the Slave when performing EtherCAT operation task on this page. The functions of each card is as follow.

4.1. Information

As shown in Figure 4-1, the configuration information of the slave will be displayed, and the function buttons are as follows:

Information	
Name Slave_000 [ECAT-2055 DC Sync 8DI/8DO]	
Vendor ID 4801360	Product Code 2055
Revision No. 100	Serial No. 0
Position 0	AL State
Register Alias	Configuration Alias 1

Figure 4-1

-  - Display online slave information.

The slave station information is as follows:

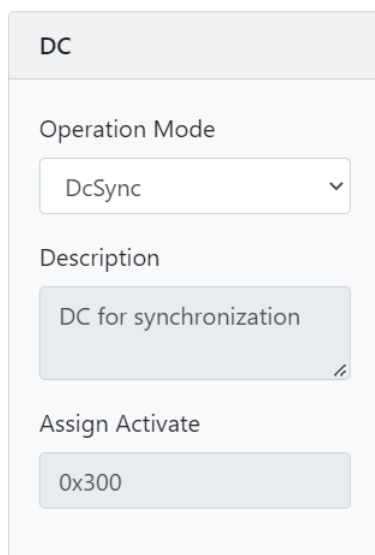
- Name
The name of the slave.
- Vendor ID
The vendor ID of the slave.
- Product Code
Product code of the slave.
- Revision No.

The revision number of the slave.

- Serial No.
The serial number of the slave.
- Position
The configuration position or actual connection position of the slave.
- AL State
AL status of the slave. The states are defined as follows:
Init - Init State
Pre - Pre-Operational State
Boot - Bootstrap State
Safe - Safe-Operational State
OP - Operational State
- Register Alias
Alias address of Slave Register (0x0012:0x0013).
- ID
ENI file configuration ID value.

4.2. DC

As shown in Figure 4-2, the DC parameter can be set to DC or non-DC operation mode. The operation mode is directly read from the ESI file and initialized according to the options set by the user when the EtherCAT operation task is started. Please refer to the manuals of each slave station for detailed information.



The image shows a configuration window titled "DC". It contains three sections: "Operation Mode" with a dropdown menu set to "DcSync"; "Description" with a text box containing "DC for synchronization" and a small edit icon; and "Assign Activate" with a text box containing "0x300".

DC	
Operation Mode	DcSync
Description	DC for synchronization
Assign Activate	0x300

Figure 4-2

4.3. Process Data

The process data (Process Data Objects, PDOs) transferred by an EtherCAT slave during each cycle are user data which the application expects to be updated cyclically or which are sent to the slave. The configuration of process data includes Sync Manager, PDO Assignment, PDO List, Entry List form and Predefined PDO Assignment selection list, CiA402 PDO Assignment, as shown in Figure 4-3, Please refer to the following information:

Process Data

Sync Manager:

Index	Size	Type
0	128	MBoxOut
1	128	MBoxIn
2	18	Outputs
3	18	Inputs

PDO List:

Index	Size	Name	Flags
0x1601	10.0	ENC Control	F
0x1602	2.0	STM Control	MF
0x1603	4.0	STM Position	F
0x1607	2.0	Latch Control	F

PDO Assignment:

Index
☒ 0x1601
☒ 0x1602
☒ 0x1603
☐ 0x1604 (excluded by 0x1603)

Entry List:

Index	Size	Offset	Name	Data Type
---	0.1	0.0	---	---
0x7000:02	0.1	0.1	Set encoder	BOOL
0x7000:03	0.1	0.2	Set position counter	BOOL
0x7000:04	0.1	0.3	Set encoder z latch-clear mode	BOOL

Predefined PDO Assignment:

none

Figure 4-3

4.3.1. Sync Manager

This form lists the configuration of the Sync Manager (SM) as shown in the figure below, if the slave has Mailbox communication, SM0 is used for Mailbox output (MBoxOut) and SM1 is used for Mailbox input (MBoxIn). If the slave has PDO communication, SM2 is used for process data output (Outputs) and SM3 is used for process data input (Inputs). The Size column in the form displays the size of the Sync Manager in bytes. If an item is selected, the corresponding PDO assignment will be displayed in the "PDO Assignment" form.

Index	Size	Type
0	128	MBoxOut
1	128	MBoxIn
2	18	Outputs
3	18	Inputs

4.3.2. PDO Assignment

This form lists all PDO assignments of the selected Sync Manager, as shown in the figure below. If the selected type is Outputs in the Sync Manager form, all RxPDOs will be displayed. If the selected type is Inputs selected in the Sync Manager form, all TxPDOs will be displayed.

Items with a check mark indicates the list of PDOs that will participate in the PDO transmission. These PDO lists will be displayed as variables in the "Process Image" form. The name of the variable is the same as the Name of "PDO List". If the item in the PDO Assignment form cannot be checked and "(excluded by xxxx)" is displayed after the item, it means that the item is excluded and disabled by an item. To enable the check, you must uncheck the item xxxx (during the "excluded by xxxx"). However, if the item is grayed out and checked, it means that this item is a mandatory item and is designed to must-assign item in the slave station.

Index	
☒	0x1601
☐	0x1602
☒	0x1603
☐	0x1604 (excluded by 0x1603)

4.3.3. PDO List

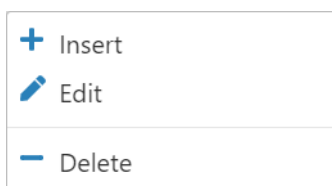
This form lists the details of all PDO assignments for the selected Sync Manager. Each field are as follows:

Index	Size	Name	Flags
0x1601	10.0	ENC Control	F
0x1602	2.0	STM Control	MF
0x1603	4.0	STM Position	F
0x1607	2.0	Latch Control	F

- **Index**
PDO index.
- **Size**
Size of the PDO in bytes.
- **Name**
Name of the PDO.
- **Flags**
F: Fixed content. The content of this PDO is fixed, and the content of PDO Entry cannot be added or changed.

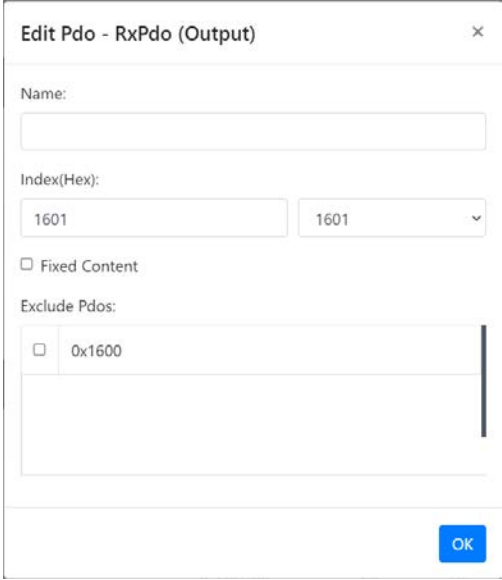
M: Mandatory PDO. This PDO is mandatory, so it must be assigned to the Sync Manager, so you cannot delete this PDO from the PDO assignment form.

As shown in the figure below, you can edit the PDO configuration by right click on the mouse on the form to bring up the right-click menu. The functions to be edited are as follows:



-  - Added new PDO configuration.

-  - Edit the currently selected PDO configuration.
After clicking the Add and Edit options, the following dialog box will pop up. The parameters of the dialog box are as follows:



Dialog box titled "Edit Pdo - RxPdo (Output)".

Fields and options:

- Name: (Text input field)
- Index(Hex): (Text input field containing "1601" and a dropdown menu showing "1601")
- ☐ Fixed Content
- Exclude Pdos: (List box containing "0x1600")
- OK button

- Name
Name of the PDO.
- Index(Hex)
PDO index. You can manually input the hexadecimal index value in the text box or select a PDO index value from the dropdown list to automatically bring the value into the text box.
- Fixed Content
Enable or disable PDO fixed content.
- Exclude Pdos
Set the PDO items that need to be disabled when this PDO is selected.
-  - Delete the currently selected PDO configuration.

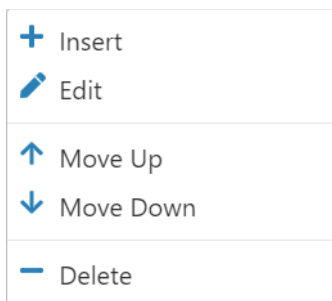
4.3.4. Entry List

This form lists the Entry configuration content of the selected PDO list item. Each field is as follows:

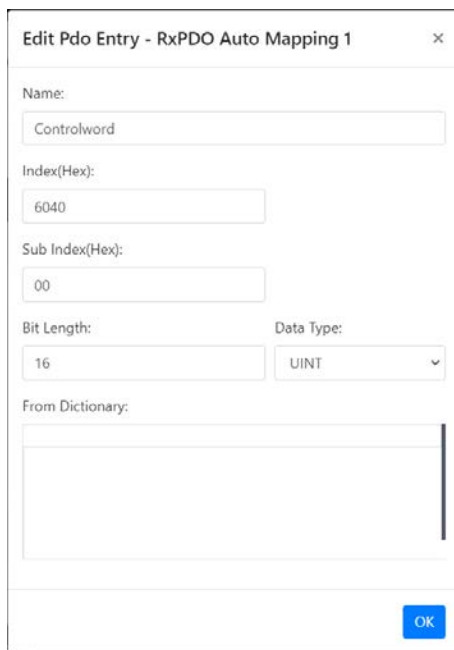
Index	Size	Offset	Name	Data Type
---	0.1	0.0	---	---
0x7000:02	0.1	0.1	Set encoder	BOOL
0x7000:03	0.1	0.2	Set position counter	BOOL
0x7000:04	0.1	0.3	Set encoder z latch-clear mode	BOOL

- **Index**
The Index and SubIndex of the object, presented as "Index: SubIndex".
- **Size**
The size of the object in bytes. "0.1" means a size of one bit.
- **Offset**
The offset of the object in the PDO configuration, in bytes. "0.1" means an offset of one bit.
- **Name**
The name of the object.
- **Data Type**
The data type of the object.

As shown in the figure below, you can edit the Entry configuration by right click on the mouse on the form to bring up the right-click menu. The functions to be edited are as follows:



-  - Add new Entry configuration.
 -  - Edit the currently selected Entry configuration.
- After clicking the Add and Edit options, the following dialog box will pop up. The parameters of the dialog box are as follows:



The dialog box titled "Edit Pdo Entry - RxPDO Auto Mapping 1" contains the following fields and controls:

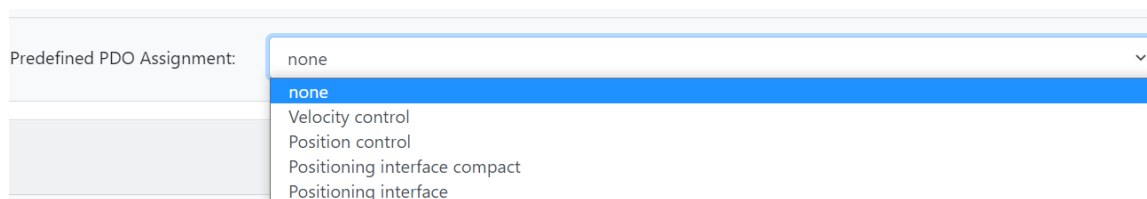
- Name:** A text box containing "Controlword".
- Index(Hex):** A text box containing "6040".
- Sub Index(Hex):** A text box containing "00".
- Bit Length:** A text box containing "16".
- Data Type:** A dropdown menu showing "UINT".
- From Dictionary:** A large empty text area.
- OK:** A blue button at the bottom right.

- **Name**
The name of the object.
- **Index(Hex)**
The index of the object.
- **Sub Index(Hex)**
The SubIndex of the object.
- **Bit Length**
For the size of the object, you can manually input the self-defined size in the text box or select a data type from the dropdown list (Data Type) to automatically bring the size of the data type into the text box (the input of text box will be disabled).
- **Data Type**
The data type of the object.
- **From Dictionary**
Select from object dictionary. This feature has not been implemented yet.

-  - Moves up the currently selected Entry configuration.
-  - Moves down the currently selected Entry configuration.
-  - Delete the currently selected Entry configuration.

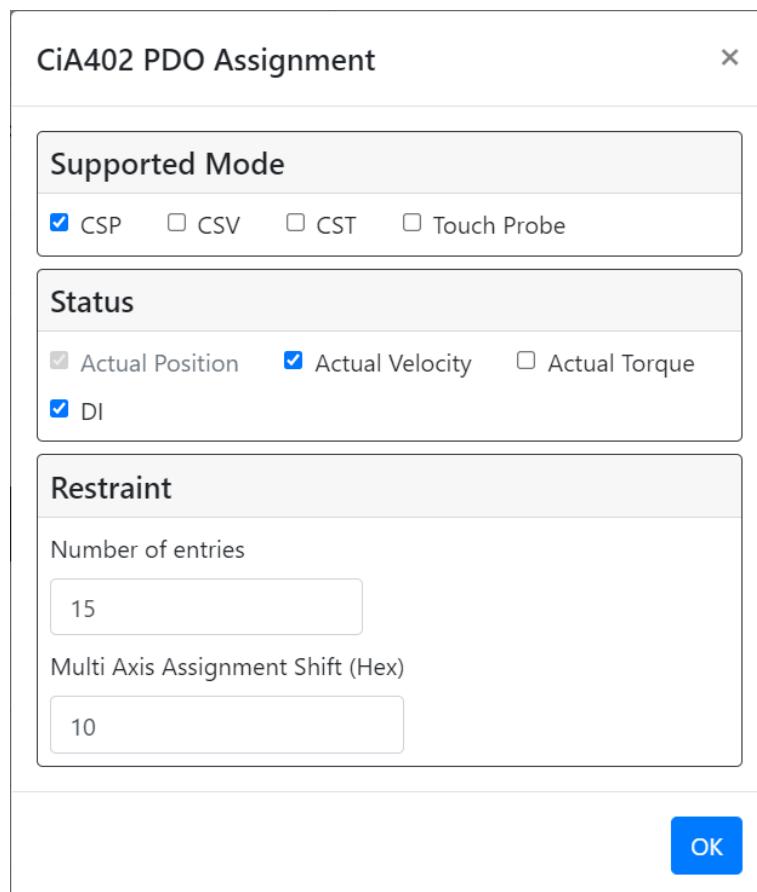
4.3.5. Predefined PDO Assignment

The Predefined PDO Assignment selection list is shown in the figure below, which is a pre-defined PDO Assignment list for the slave station vendors according to its functions of the slave station, this function is used to simplify the PDO assignment process. The user can select the required function from the pre-defined PDO assignment list according to the instructions of the slave station manual, all necessary PDOs will be automatically enabled, and unnecessary PDOs will be disabled. If there is no pre-defined PDO assignment list in the slave ESI file, the selection box will freeze and cannot be selected.



4.3.6. CiA402 PDO Assignment

The PDO Automatic Assignment Function of CiA402 Slave Module  is located on the right side of the title of the card, which will automatically assign PDO configuration to the slave module according to its motion control functions. The following dialog box will appear after clicking this button:



The dialog box titled "CiA402 PDO Assignment" contains three sections:

- Supported Mode:** Includes checkboxes for CSP (checked), CSV, CST, and Touch Probe.
- Status:** Includes checkboxes for Actual Position, Actual Velocity (checked), Actual Torque, and DI (checked).
- Restraint:** Includes a "Number of entries" field set to 15 and a "Multi Axis Assignment Shift (Hex)" field set to 10.

An "OK" button is located at the bottom right of the dialog box.

Each parameter is as follows:

- Default - The PDO that will be configured after pressing OK in the dialog box, these are basic configuration that is required for motion control.

RxPdo		TxPdo	
Index	Name	Index	Name
0x6040	Controlword	0x6041	Statusword
0x6060	Modes of Operation	0x6061	Modes of operation display

- CSP - Configure or unconfigure the following PDO, it is required for position control.

RxPdo		TxPdo	
Index	Name	Index	Name
0x607A	Target position	0x6064	Position actual value
		0x606C	Velocity actual value

- CSV - Configure or unconfigure the following PDO, it is required for velocity control.

RxPdo		TxPdo	
Index	Name	Index	Name
0x60FF	Target velocity	0x6064	Position actual value
		0x606C	Velocity actual value

- CST - Configure or unconfigure the following PDO, it is required for torque control.

RxPdo		TxPdo	
Index	Name	Index	Name
0x6071	Target torque	0x6077	Torque actual value

- Touch Probe - It is the configuration required for the Touch Probe function. When this option is checked, the following Touch Probe setting parameters will appear in the dialog box. Touch Probe 1 is basic configuration and is required to be configured, so it cannot be canceled and only operation mode can be selected. Touch Probe 2 can be activated as an option. The configuration of Touch Probe 1,2 is as follows:

Touch Probe

☒ Touch Probe 1
 ☒ Rising
 ☐ Falling

☐ Touch Probe 2
 ☐ Rising
 ☐ Falling

- Touch Probe x - It must be configured when Touch Probe is checked.

RxPdo		TxPdo	
Index	Name	Index	Name
0x60B8	Touch probe function	0x60B9	Touch probe status

- Touch Probe 1 - When Rising is selected, configure the following PDO.

TxPdo	
Index	Name
0x60BA	Touch probe positon1 positive value

- Touch Probe 1 - When Falling is selected, configure the following PDO.

TxPdo	
Index	Name
0x60BB	Touch probe positon1 negative value

- Touch Probe 2 - When Rising is selected, configure the following PDO.

TxPdo	
Index	Name
0x60BC	Touch probe positon2 positive value

- Touch Probe 2 - When Falling is selected, configure the following PDO.

TxPdo	
Index	Name
0x60BD	Touch probe positon2 negative value

- Actual Position - Configure or unconfigure the following PDO. If this option is mandated to be configured, it will be freezed.

TxPdo	
Index	Name
0x6064	Position actual value

- Actual Velocity - Configure or unconfigure the following PDO.

TxPdo	
Index	Name
0x606C	Velocity actual value

- Actual Torque - Configure or unconfigure the following PDO. If this option is mandated to be configured, it will be freezed.

TxPdo	
Index	Name
0x6077	Torque actual value

- DI - Configure or unconfigure the following PDO, it is recommended to configure this option for position control, so that when left or right limit is reached, the internal motion control can take stop action immediately.

TxPdo	
Index	Name
0x60FD	Digital inputs

- Number of entries

When performing automatic assignment, RxPdo will start from 0x1600, while TxPdo starts from 0x1A00. This parameter can limit the maximum Entry to be assigned to 0x1600 or 0x1A00. When exceeds the maximum value, it will be assigned to the next PDO (0x1601, 0x1602..., 0x1A01, 0x1A02...) for configuration.

- Multi Axis Assignment Shift

When the slave is a multi-axis slave module, this parameter can be used to set the RxPdo, TxPdo configuration offset of each axis. As shown in the following figure, when this parameter is set to 0x10, axis 0 is configured from 0x1600, and offset of axis 1 is set to 0x10, configured from 0x1610 and so on. And when the number of Entry configurations per axis (0x1600, 0x1610...) exceeds maximum number of entries, the configuration will be assigned to the next PDO (0x1601, 0x1611...).

Index	Size	Name	Flags
0x1600	11.0	Axis0 RxPDO Auto Mapping 1	
0x1610	11.0	Axis1 RxPDO Auto Mapping 1	
0x1620	11.0	Axis2 RxPDO Auto Mapping 1	
0x1630	11.0	Axis3 RxPDO Auto Mapping 1	

4.4. Process Image

Process Image variable operation is shown in Figure 4-4. When the EtherCAT operation task is started, the user can click on the Inputs/Outputs tabs to read and write the variables on the variable list. The function buttons are as follows:

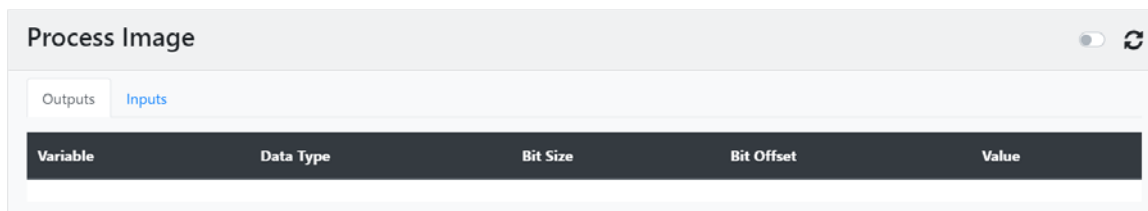


Figure 4-4

-  - Enable/disable automatic update values of all variables.
-  - Manually update values of all variables.

The fields of the Outputs/Inputs variable are as follows:

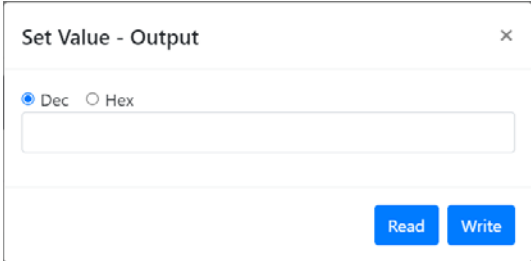
- Variable
The name of the variable.
- Data Type
The data type of the variable.
- Bit Size
The size of the variable in bits.
- Bit Offset
The offset of the variable in the Process Image, in bits.
- Value
The value of the variable.

Process Image variables are as follows:

- Outputs
 - RxPDO Variables - The displayed variable is the assignment result of Process Data Outputs. Please refer to the slave manual of the for information of each variable.
- Inputs
 - TxPDO Variables - The displayed variable is the assignment result of Process Data Inputs. Please refer to the slave manual of the for information of each variable.

- Stauts
 - Error - error status flag.
 - Network - The actual slave does not match the configuration of the ENI file.
 - Communication - Communication error.
 - OP - Error that Slave is not in OP state.
 - Network Position - The current actual network connection position of the slave.
 - AL State - AL state value of the slave.
 - 1: Init State
 - 2: Pre-Operational State
 - 3: Bootstrap State
 - 4: Safe-Operational State
 - 8: Operational State

To write the value of the Outputs variable, click the left mouse button twice on the variable to bring up the following dialog box. Select the input value in decimal (Dec) or hexadecimal (Hex) according to actual requirement, input the value and click the "Write" button to write. You can also click the "Read" button to read. After clicking the "Read" or "Write" buttons, this dialog box will not be closed automatically so that the user can keep on performing read or write operations.



The image shows a dialog box titled "Set Value - Output" with a close button (X) in the top right corner. Inside the dialog, there are two radio buttons: "Dec" (selected) and "Hex". Below the radio buttons is a text input field. At the bottom right of the dialog, there are two buttons: "Read" and "Write".

4.5. SDO

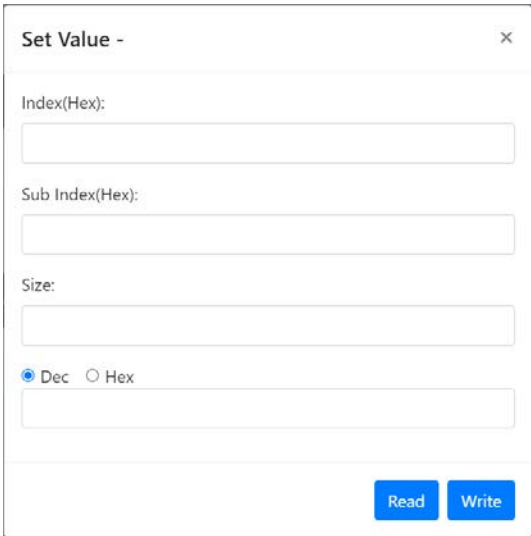
As shown in Figure 4-5, this part is the non-periodic communication operation function of SDO (Service Data Object). If the slave station supports CANopen over EtherCAT (CoE), the handshaking mechanism of SDO Mailbox can be used to access the object of the object dictionary for configurations of the slave station. The function buttons are as follows:



SDO					
Index	Name	Flags	Data Type	Bit Size	Value

Figure 4-5

-  - Manual access to objects.
The following dialog box will be brought up after clicking the button. The user can manually input the Index of the object, the Sub Index of the object, data Size, and then select Dec (decimal) or Hex(hexadecimal) according to actual requirement, and finally click on "Read" or "Write" button to perform read or write operations.



Set Value -

Index(Hex):

Sub Index(Hex):

Size:

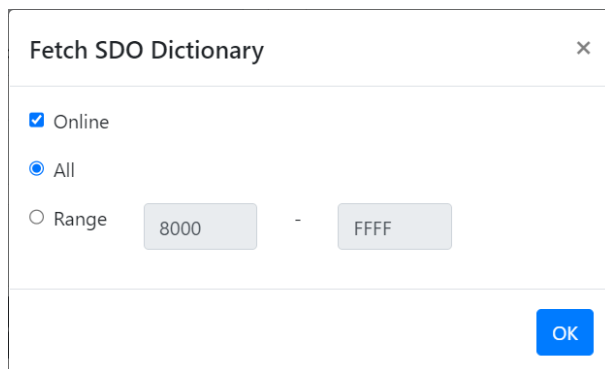
☒ Dec ☐ Hex

Read Write

-  - Fetch Object Dictionary of the Slave.
The following dialog box will be brought up after clicking the button. After selecting the display range of the list, click "OK", the fetch of the content of object dictionary will start. The fetch progress will be displayed, when the progress reaches 100%, the result will be displayed on the form of the object dictionary list.
- Online
If "Online" is checked, it will read the contents of the slave object

dictionary by using "SDO information". If "Online" is not checked, then it will read the contents of the slave object dictionary from the ESI file.

- **All**
Displays all object dictionary contents.
- **Range**
Display part of the object dictionary content according to the input range.



The dialog box titled "Fetch SDO Dictionary" has a close button (X) in the top right corner. It contains three radio button options: "Online" (checked), "All", and "Range". The "Range" option is accompanied by two input fields: the first contains "8000" and the second contains "FFFF", separated by a hyphen. An "OK" button is located at the bottom right.

The fetched content of the object dictionary is shown in the figure below, and the fields are as follows:

Index	Name	Flags	Data Type	Bit Size	Value
0x1000	Device type	r-r-r-	uint32	32	-
0x1001	Error register	r-r-r-	uint8	8	-
0x1008	Device name	r-r-r-	string	136	-
0x1009	Hardware version	r-r-r-	string	24	-
0x100A	Software version	r-r-r-	string	24	-

- **Index**
The Index and SubIndex of the object, presented as "Index:SubIndex".
- **Name**
The name of the object.
- **Flags**
The object's access permission flag. "ABCDEF" flags are as follows:
 A = Read access in Pre-Operational state (r, -).
 B = Write access in Pre-Operational state (w, -).
 C = Read access in Safe-Operational state (r, -).
 D = Write access in Safe-Operational state (w, -).
 E = Read access in Operational state (r, -).
 F = Write access in Operational state (w, -).

The value of each flag are as follows:

"r": Reading is permitted in this state.

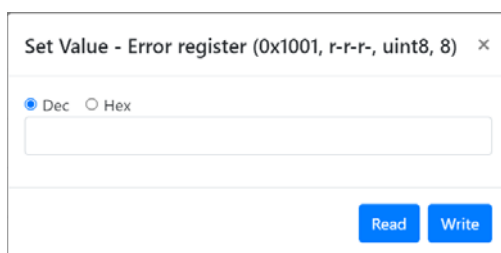
"w": Writing is permitted this state.

"-": Reading and writing are not permitted in this state.

- Data Type
The data type of the object.
- Bit Size
The size of the object, in bits.
- Value
The content value of the object.

-  - Manual update content value of the object.

To access the object, double-click the left mouse button on the object to bring up the following dialog box. Select the input value in decimal (Dec) or hexadecimal (Hex) according to actual requirement, click on "Read" or "Write" button to perform read or write operations.



Set Value - Error register (0x1001, r-r-r-, uint8, 8) ×

☒ Dec ☐ Hex

Read Write

4.6. Diagnostics

The diagnostic function is shown in Figure 4-6, which is mainly used to obtain various error counters of the ESC and the connection status of the 4 ports. The functions are as follows:

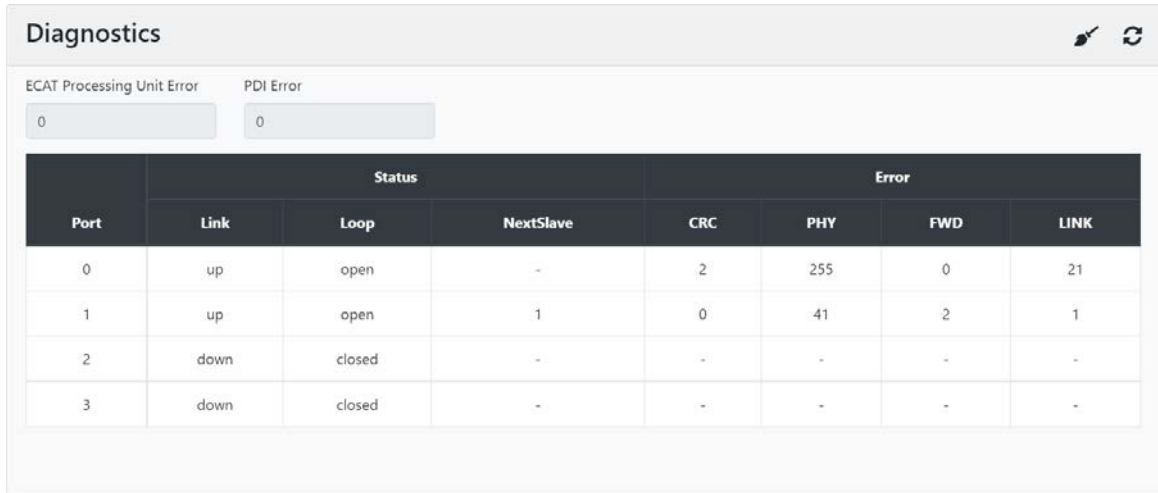


Figure 4-6

-  - Clear counter.
-  - Update diagnostic content.

The parameters are as follows:

- ECAT Processing Unit Error
Invalid frame via EtherCAT processing unit, read from ECAT Processing Unit Error Counter (0x30C) register.
- PDI Error
Physical error detected by PDI, read from PDI Error Counter (0x30D) register.

The 4 port connection and error status are as follows:

- Port
Port number.
- Status
 - Link
Port connection status.
up: Connected.

down: Disconnected.

- Loop

Port Loop status.

open: Indicates that the port can be used to send or receive packets.

closed: Indicates that this port is prohibited from sending or receiving packets, and the packet will be sent to the next port in “open” status.

- NextSlave

The position number of the slave that is connected to the port.

- Error

Please refer to information of the error counter in the section of Master Diagnostics.

5. EtherCAT Actual Slave

This working page is for performing operations of online slave modules. After scanning the connected slave modules, the operations such as SDO, FoE, Diagnostics, etc. can be performed on this page. The function of each card is as follow:

5.1. Scan

As shown in Figure 5-1, right click on the mouse on EtherCAT->Actual Network to bring up the right-click menu and click on “Scan” to scan the currently connected slave modules. After the scan is completed, the scan result will be compared to the configuration of the opened ESI file, and the comparison result will be displayed as shown in Figure 5-2.

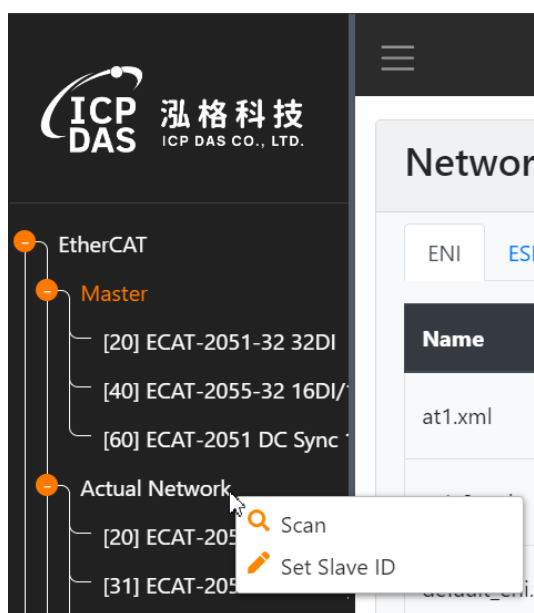


Figure 5-1

ENI Configuration			Comparison	Actual Configuration		
Pos.	ID	Name		Pos.	ID	Name
0	20	[20] ECAT-2051-32 32DI	ID matched	0	20	ECAT-2051-32 32 Ch. Dig. In. Dry/Wet 50V
		---	Newly added	1	31	ECAT-2053 16 Ch. Dig. In. Wet 50V
1	40	[40] ECAT-2055-32 16DI/16DO	ID matched	2	40	ECAT-2055-32 16 Ch. Dig. In. Dry/Wet 50V, 16 Ch. Dig. Out. Sink
2	60	[60] ECAT-2051 DC Sync 16DI	Removed			---

Figure 5-2

The fields in the comparison table are as follows:

Field		Description
ENI Configuration	Pos.	Slave configuration position in ENI file.
	ID	Slave configuration ID in ENI file.
	Name	Slave name in ENI file.
Comparison		The comparison results are defined as follows:
Actual Configuration	Pos.	Actual slave connection position.
	ID	Actual slave ID.
	Name	Actual slave name.

5.2. Set Slave ID

The Set Slave ID function can be used to set the ID of all slaves. as shown in Figure 5-3, user can right-click in EtherCAT->Actual Network, and use the "Set Slave ID" in the right-click menu to open the Set Slave ID dialog box, as shown in Figure 5-4.

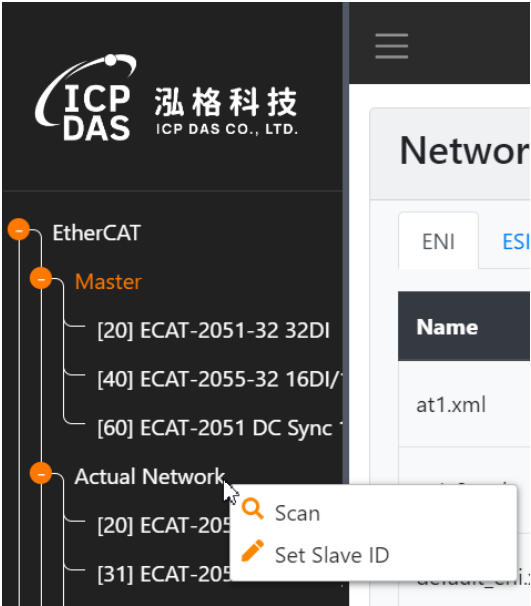


Figure 5-3

Set Slave ID

Pos.	Actual ID	New ID	Name
0	20	20	ECAT-2051-32 32 Ch. Dig. In. Dry/Wet 50V
1	31	31	ECAT-2053 16 Ch. Dig. In. Wet 50V
2	40	40	ECAT-2055-32 16 Ch. Dig. In. Dry/Wet 50V, 16 Ch. Dig. Out. Sink

OK

Figure 5-4

Each parameter is described as follows:

- Pos.
Slave connection position.
- Actual ID
Current slave ID value.
- New ID
New ID value for slave.
- Name
Slave name.
- OK
Set all slave to the New ID value. If the New ID value is zero, no setting action will be performed.

5.3. Information

Please refer to “Information” in the EtherCAT Slave section.

5.4. FoE

The function of FoE (File Access over EtherCAT) is shown in Figure 5-5. FoE is a protocol that can be used to access files in the slave device or write the firmware of the slave into the device. Using FoE, the update of firmware can be performed online at any time without sending technicians to the site to update the firmware, the functions are as follows:

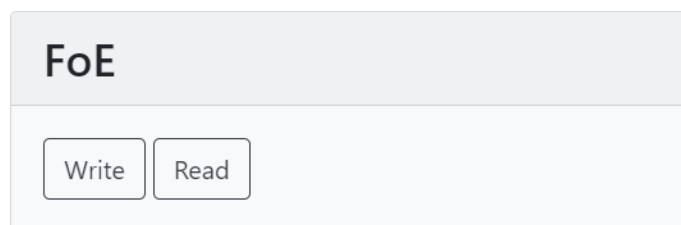
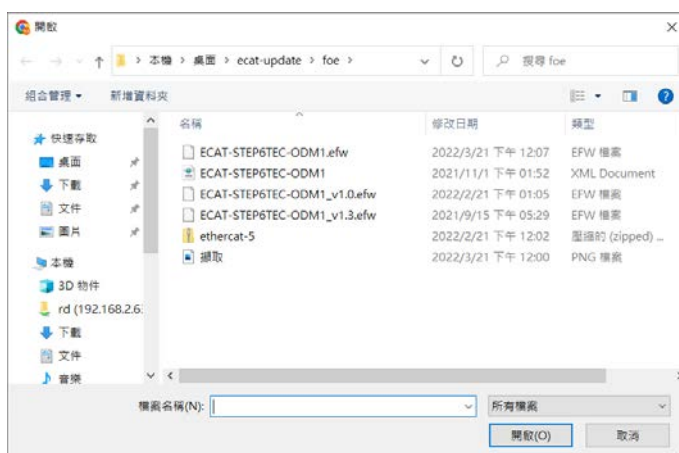


Figure 5-5

- Write - Write file or firmware to slave module.

The process of writing a file or firmware is as follows:

1. After clicking the "Write" button, the Open File dialog box will appear, select a local file or firmware.



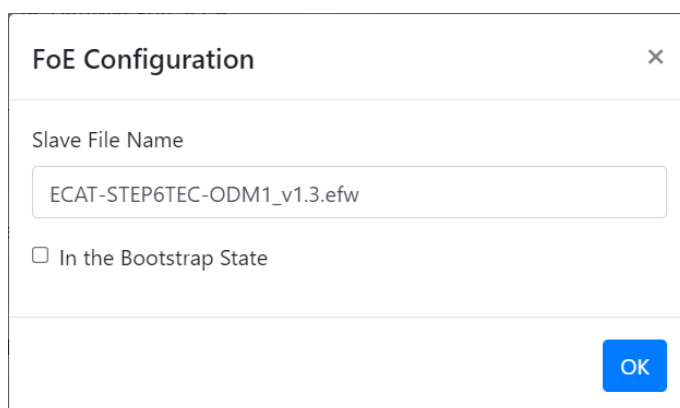
2. Then the FoE setting dialog box will appear. After inputting the setting parameters, click "OK". The parameters are as follows:

Slave File Name

The file name written to the slave device can be different from the selected written file name. The selected written file name will be brought up as the default Slave File Name.

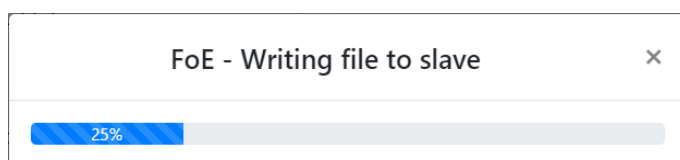
In the Bootstrap State

When checked, the AL state will be switched to the Bootstrap State before performing the FoE process. Generally, it is required to switch the state to the Bootstrap state before updating the firmware of the slave.



The image shows a dialog box titled "FoE Configuration" with a close button (X) in the top right corner. Inside the dialog, there is a label "Slave File Name" above a text input field containing the text "ECAT-STEP6TEC-ODM1_v1.3.efw". Below the input field is a checkbox labeled "In the Bootstrap State", which is currently unchecked. At the bottom right of the dialog is a blue button labeled "OK".

3. When the progress bar of the FoE writing process reaches 100% and no errors occurs, it means that the writing of the file or firmware is successful. When updating the firmware of the slave station, the slave station will restart after the update success, and it is normal the slave station will be disconnected temporarily at this time.



The image shows a progress bar window titled "FoE - Writing file to slave" with a close button (X) in the top right corner. The progress bar is partially filled with blue, and the text "25%" is displayed inside the bar.

- Read - read file from slave device.

The process of reading a file is as follows:

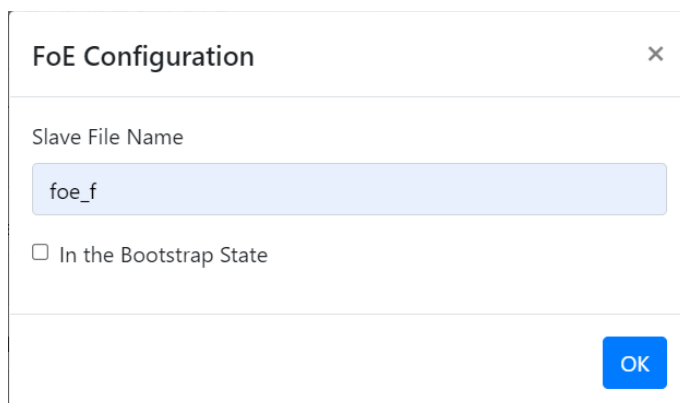
1. After clicking the "Read" button, the FoE setting dialog box will appear. After inputting the setting parameters, click "OK". The parameters are as follows:

Slave File Name

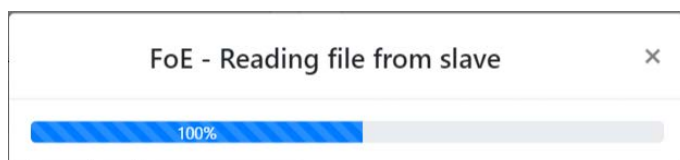
The filename to be read from the slave device.

In the Bootstrap State

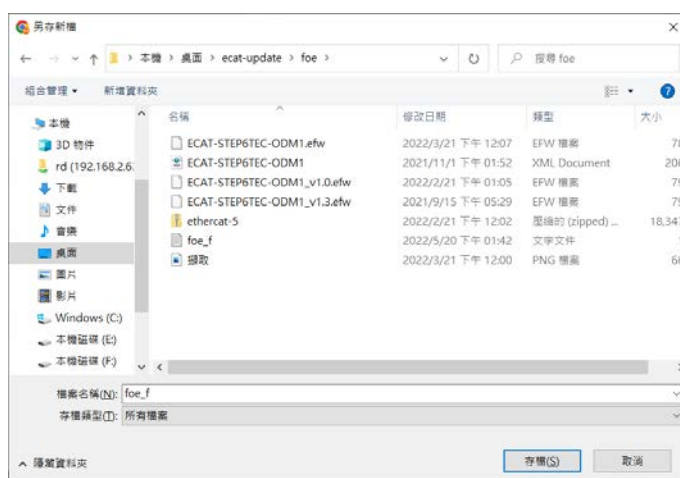
When checked, the AL state will be switched to the Bootstrap State before performing the FoE process. Generally, it is not necessary to switch the state to Bootstrap before reading the file, unless the manual of the slave indicates it is required to switch to Bootstrap state before the reading.



- When the progress bar of the FoE reading process reaches 100% and no errors occur, it means that the file is successfully read.



- After the reading process is successfully completed, the Save New File dialog box will appear, enter the file name to save.



5.5. SDO

Please refer to section EtherCAT Slave for information of the SDO.

5.6. Diagnostics

Please refer to section EtherCAT Slave for information of the Diagnostics.

6. EtherCAT Category

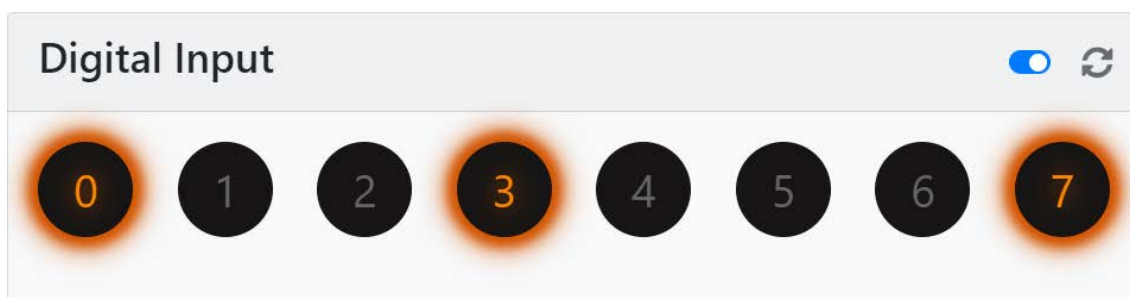
In this section of the user manual, we will provide a detailed overview of EtherCAT slave devices, categorizing them based on their functionalities. The primary classifications include Digital Input/Output (DIO), Analog Input/Output (AIO), and Encoder. Each category is further detailed on separate pages, allowing users to efficiently and effortlessly perform operations related to these functionalities.

6.1. DIO

This page provides a user-friendly interface for reading the status of DI signals and configuring the output states of DO channels.

6.1.1. Digital Input

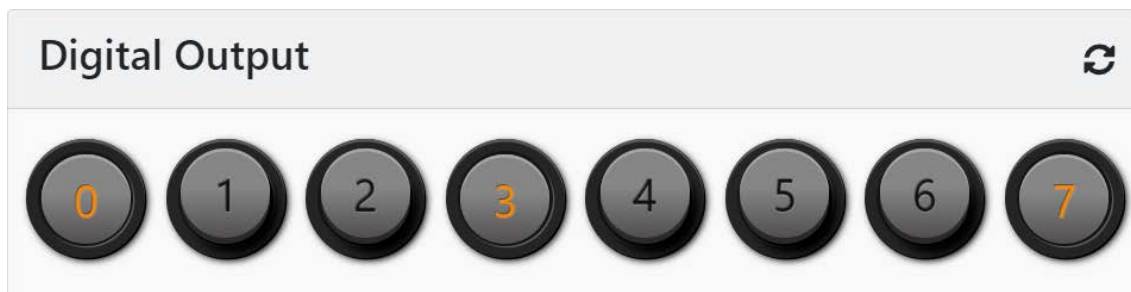
Users can easily monitor the current status of DI through the use of LED indicators.



-  - DI is in the OFF state.
-  - DI is in the ON state
-  - Enables or disables automatic updates of DI status.
-  - Manually update the DI status.

6.1.2. Digital Output

Users can utilize LED buttons to easily toggle and control the output states of DO channels.



-  - DO is in the OFF state.
-  - DO is in the ON state
-  - Manually update the DO status.

6.2. AIO

The AIO page is dedicated to reading Analog Input (AI) values and configuring Analog Output (AO) signals. This section provides functionalities for precise control and monitoring of analog signals.

6.2.1. Analog Input

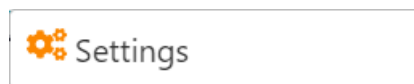
The Analog Input section allows users to read Analog Input (AI) values and provides two distinct display modes: Gauge Mode and Chart Mode. Users can seamlessly switch between these modes using tabs.



-  - Gauge Mode
As shown below, visualize AI values through an intuitive gauge display.



-  - Data channel
The right-click menu functions are as follows:



- Settings - The following dialog box appears when the item is clicked, so you can set the range according to your application.

Set Range

Range

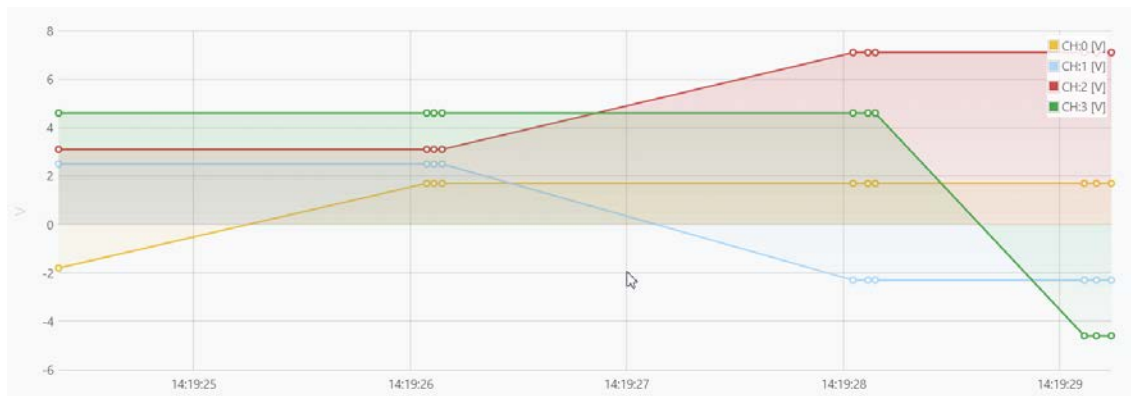
-10 ~ 10 V

OK

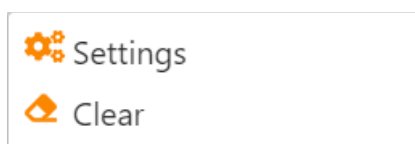
-  - Unit
V: Volts.
mA: Milliampere.

- - Chart Mode

As shown below, view the trend of Analog Input values over time through a graphical representation.



The right-click menu functions are as follows:



- Settings - Chart Settings, when clicked, the following dialog box will appear.

Chart Settings

Plot Channels

0,1,2,3

Opacity

20%

☒ Fill
 ☒ Points
 ☒ Legend

DONE

- Plot Channels
Specify data channels to display on the chart. Comma-separated entries like "0,1,2" determine the specific channels to show.

- **Opacity**
Adjust transparency of the filled area beneath the lines.
20%:



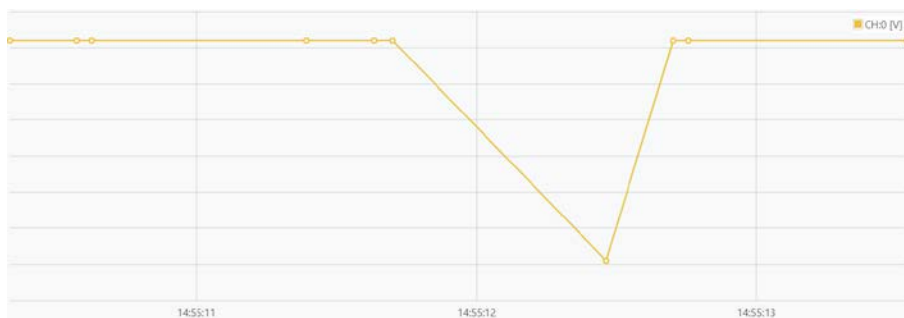
80%:



- **Fill**
Toggle whether the area below the lines is filled.
Check:



Uncheck:



- Points

Control the visibility of endpoints at each data point.

Check:



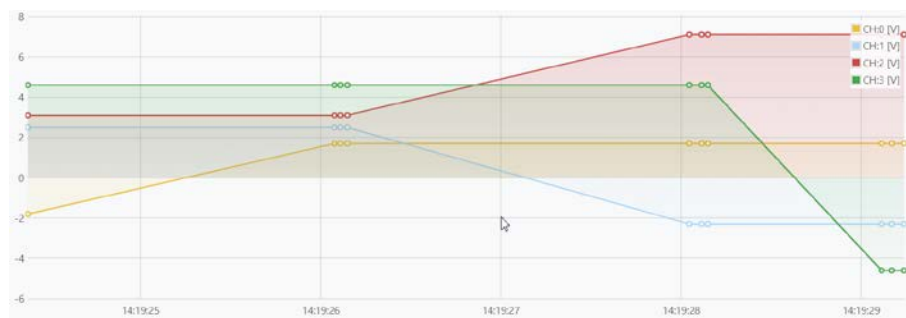
Uncheck:



- Legend

Choose whether to display a legend identifying each channel.

Check:



Uncheck:

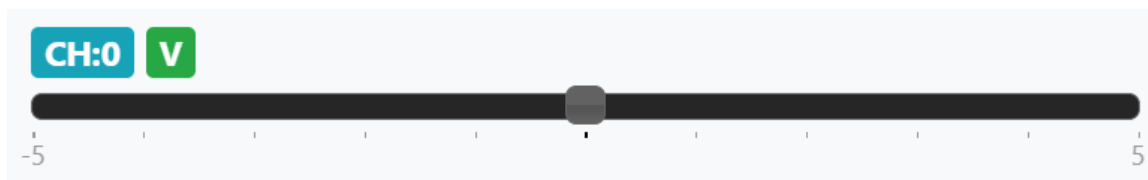


- Clear - Clear chart data.

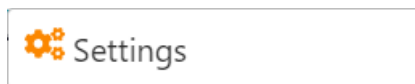
-  - Enables or disables automatic updates of AI status.
-  - Manually update the AI status.

6.2.2. Analog Output

The Analog Output section provides users with a user-friendly interface for controlling Analog Output (AO) values.



- **CH:0** - Data channel
The right-click menu functions are as follows:



- Settings - The following dialog box appears when the item is clicked, so you can set the range according to your application.

A dialog box titled 'Set Range'. Inside, there is a label 'Range' above a dropdown menu. The dropdown menu currently displays '-10 ~ 10 V' with a small downward arrow on the right. At the bottom right of the dialog box is a dark grey button with the text 'OK' in white.

- **V** - Unit
V: Volts.
mA: Milliampere.
-  - Manually update the AO status.

6.3. Encoder

The Encoder page is dedicated to providing users to read and write encoder position, latch encoder position, and configure equidist position compare trigger

6.3.1. Counter

This section can be used to configure the encoder mode and read/write the encoder position..

Counter

CH:0

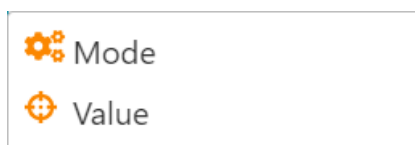
-451

CH:1

626

- CH:0

 - Data channel
 The right-click menu functions are as follows:



- Mode - Set the encoder mode, when clicked, the following dialog box will appear.

Counter Settings

Mode ↺

Quadrant

▼

Set

- Value - Set the encoder position, when clicked, the following dialog box will appear.

Counter Settings

Set Value

0

Set

- 45

 - Encoder position.

6.3.2. Latch

This section can be used to enable the latch encoder position and display the latch position.

Latch

CH:0

✓

💡

CH:1

✓

💡

- CH:0

 - Data channel
- ✓

 - Enable latch encoder position button.
 - ✓

 - Latch encoder position not enabled.
 - ✓

 - Latch encoder position enable.
- 💡

 - Latch encoder position validity.
 - 💡

 - Function not supported.
 - 💡

 - Latch encoder position is invalid.
 - 💡

 - Latch encoder position is valid.
- Latch the value of the encoder position.

6.3.3. Compare Trigger

This section can be used to configure the equidist position compare trigger.

Compare Trigger

CH:0

✓

⚙️

⏪

⏩

CH:1

✓

⚙️

⏪

⏩

Value

1000

Value

0

INCR

500

INCR

0

- **CH:0** - Data channel
- ☒ - Enable position compare trigger button.
 - ☒ - Position compare trigger not enabled.
 - ☒ - Position compare trigger enable.
- ☒ - Position compare trigger setting button, you can use the following input box to set the position compare trigger.

Value

1000

INCR

500

 - Comparison value of the first position.
 - Auto incremental value, the value is automatically incremented by the first comparison position to set the subsequent comparison position.
- ☒ - Negative direction auto increment value setting button.
 - ☒ - The negative direction auto increment value is not active.
 - ☒ - The negative direction auto increment value is active.
- ☒ - Positive direction auto increment value setting button.
 - ☒ - The positive direction auto increment value is not active.
 - ☒ - The positive direction auto increment value is active.

6.4. Rule Configuration

By clicking the "Category" node, users can enter the rule configuration page. This page allows users to define rules for categorizing EtherCAT slave devices into specific functional categories, such as DIO, AIO, and Encoder. Additionally, users can set up corresponding control objects associated with each category.



- 

This toggle enables or disables the rule editing functionality in the right-click menu. When enabled, users can add, edit, or delete rules using the right-click menu.
- 

Click this button to reset all rules to their default values.
- DIO/AIO/Encoder tabs:

These three tabs allow users to switch between different rule tables, each corresponding to the rule configuration for DIO, AIO, and Encoder.

6.4.1. Rule Tables

- DIO Rule Table

Slave	Input	Output
ECAT-2045 16DO (0x494350/0x7FD/---)	0	16
ECAT-2045-32 32DO (0x494350/0x7FD/0x200001)	0	32

- Slave: Comprising Rule Name, Vendor ID, Product Code, Revision No.
- Input: Number of Digital Input Channels.

- Output: Number of Digital Output Channels.
- AIO Rule Table

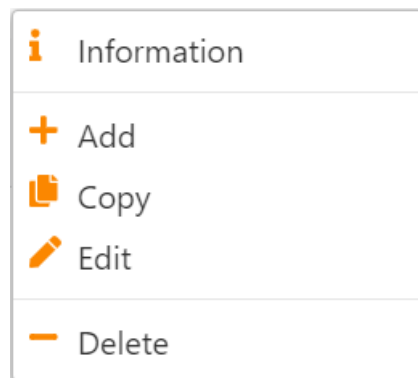
Slave	Input	Output
ECAT-2012H (0x494350/0x7DC/---)	8	0
ECAT-2016N (0x494350/0x7E0/---)	1	0

- Slave: Comprising Rule Name, Vendor ID, Product Code, Revision No.
- Input: Number of Analog Input Channels.
- Output: Number of Analog Output Channels.
- Encoder Rule Table

Slave	Channel
ECAT-2092T (0x494350/0x209254/---)	2
ECAT-2093 (0x494350/0x82D/---)	3

- Slave: Comprising Rule Name, Vendor ID, Product Code, Revision No.
- Channel: Number of Encoder Channels.

Each rule form has the same right-click menu functionality.



- Information: Display detailed information about the selected rule.
- Add: Add a new rule to the table.
- Copy: Duplicate the content of the selected rule, creating a similar new rule.
- Edit: Modify the content of the selected rule.
- Delete: Delete the selected rule.

6.4.2. Rule Editing Dialog

When selecting "Information", "Add", "Copy" or "Edit" from the right-click menu in the rule table, the Rule Editing Dialog will open. This dialog is divided into two sections, as illustrated in the diagram below:

Edit Rule

Vendor ID: 4801360 Product Code: 2045 Revision No.: -1

1 Name: ECAT-2045 16DO

DI ☒ DO

2 Channel: 0 Offset: 0

Gap: 0

Edit

1. **Basic Settings:** This section is used to identify the slave device, ensuring it is correctly classified into the corresponding category.
 - **Vendor ID**
The vendor ID of the slave.
 - **Product Code**
Product code of the slave.
 - **Revision No.**
The revision number of the slave. Set to -1 to allow any revision number to be classified into the category.
 - **Name**
Rule name.
2. **Control Settings:** This section is used to configure the number of channels and set control objects for PDO (Process Data Object) and SDO (Service Data Object) for the respective category.
 - (1) DIO

DI DO	
Channel	Offset
0	0
Gap	
0	

- **Channel**
Number of channels.
- **Offset**
Offset in bits before each channel in the PDO data.
- **Gap**
Gap in bits after each channel in the PDO data.

(2) AIO

AI AO	
☐ Multiplex	
Channel	Presentation
4	Signed
Value	Range
70n0:01	80n0:09:1
Range Dictionary	
<pre>{"0":3,"1":2,"2":1,"3":0}</pre>	

- **Multiplex**
Indicates whether it is a multiplexed channel. If multiplexed, the range settings for all channels will be consistent.
- **Channel**
Number of channels.
- **Presentation**
Method of representation of the measured value.
- **Value**
PDO object for AI/AO value.

- **Range**
SDO object for AI/AO range.
 - **Range Dictionary**
Dictionary for AI/AO range, as each slave may have different range settings. Establish a dictionary for range queries.
-  - Create Range Dictionary button. When clicked, the following dialog box appears.

Range Dictionary

Reset Object Value 

Object Value	Key

Setup

Process to Create Range Dictionary:

- (1) Enter all the setting values of the AI/AO range SDO object in the "Reset Object Value" input box. For example, for ECAT-2024, if SDO object 80n0:09 has values "0,1,2,3", input "0,1,2,3" and click  to reset dictionary parameters.

Value	Description
0	Unipolar 5V (0-5V)
1	Bipolar 5V ($\pm 5V$)
2	Unipolar 10V (0-10V)
3	Bipolar 10V ($\pm 10V$)

- (2) After resetting dictionary parameters, the table will display the range corresponding to SDO object values. Use the dropdown menu to set the range for each value and click the "Setup" button to complete the range dictionary configuration.

Object Value	Key
0	0 ~ 5 V ▾ 
1	-5 ~ 5 V ▾
2	0 ~ 10 V ▾
3	-10 ~ 10 V ▾

(3) Encoder

(3.1) Counter

Counter
Latch
Compare

Channel
Value

2
60n0:11

Set Counter
Set Value

70n0:04
70n0:09

Mode

80n0:09:1

Mode Dictionary 

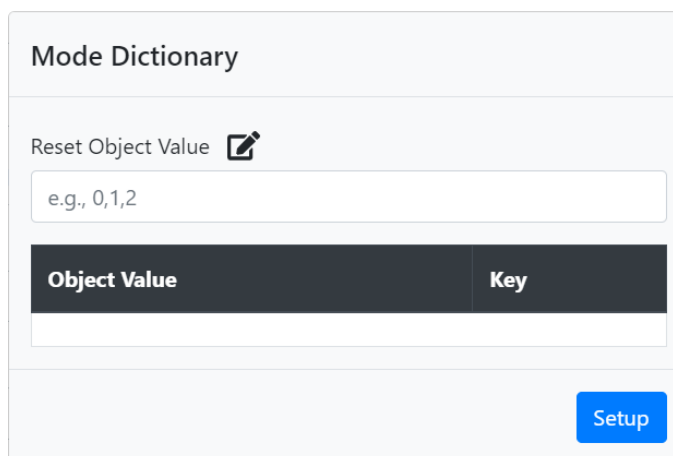
{"1":0,"2":1,"3":2}

- Chnanel
Number of channels.
- Value
PDO object for encoder value¹.
- Set Counter
PDO object for activating encoder value setting¹.
- Set Value
PDO object to set the encoder value¹.
- Mode
SDO object for set the encoder mode².

- **Mode Dictionary**

Dictionary for encoder mode, as each slave may have different mode settings. Establish a dictionary for mode queries.

-  - Create Encoder Mode button. When clicked, the following dialog box appears.



The dialog box is titled "Mode Dictionary". It contains a "Reset Object Value" section with a text input field containing "e.g., 0,1,2" and a pencil icon. Below this is a table with two columns: "Object Value" and "Key". The table is currently empty. At the bottom right of the dialog is a blue "Setup" button.

Process to Create Encoder Mode Dictionary:

- (1) Enter all the setting values of the encoder mode SDO object in the "Reset Object Value" input box. For example, for ECAT-2092T, if SDO object 80n0:09 has values "0,1,2", input "0,1,2" and click  to reset dictionary parameters.

Value	Description
0	CW/CCW
1	Pulse/Direction
2	Quadrant

- (2) After resetting dictionary parameters, the table will display the mode corresponding to SDO object values. Use the dropdown menu to set the mode for each value and click the "Setup" button to complete the mode dictionary configuration.

Object Value	Key
1	CW/CCW ▾ 
2	Pulse/Dir. ▾
3	Quadrant ▾

(3.2) Latch

Counter	Latch	Compare
Value		Enable
60n1:01		70n1:01
Valid		

- Value
PDO object for encoder latch position¹.
- Enable
PDO object to enable encoder latch¹.
- Valid
PDO object indicating whether the latched encoder position is valid¹.

(3.3) Compare

Counter	Latch	Compare
Value		Increment
70n2:07		70n2:08
Enable		Direction
70n2:01		70n2:02

- Value
PDO object for the first position compare value¹.

- Increment
PDO object for auto increment compare value¹.
- Enable
PDO object to enable equidistant position compare trigger ¹.
- Direction
PDO object for the direction of auto increment compare value¹.

Note:

- ¹ For PDO object, use a colon to separate Index and Subindex values (e.g., 70n0:01, where n is the channel index).
- ² For SDO object, use a colon to separate Index, Subindex, and Size (Byte) values (e.g., 80n0:09:1, where n is the channel index).

7. Motion Control Axis

When the motion control function is enabled in the EtherCAT operation task, the initialization parameters for single-axis motion control can be configured in this page. The following section will introduce how to enable single-axis motion control functions and how to configure the parameters in each card of this work page.

7.1. Enable single-axis motion control

As shown in Figure 7-1, right click on the mouse on Motion Control->Axes or Motion Control->Axes->Axis to bring up the right-click menu and click on “Add” to add the number of axes and then set up the initialized parameters to start the motion control function of the EtherCAT operation task.

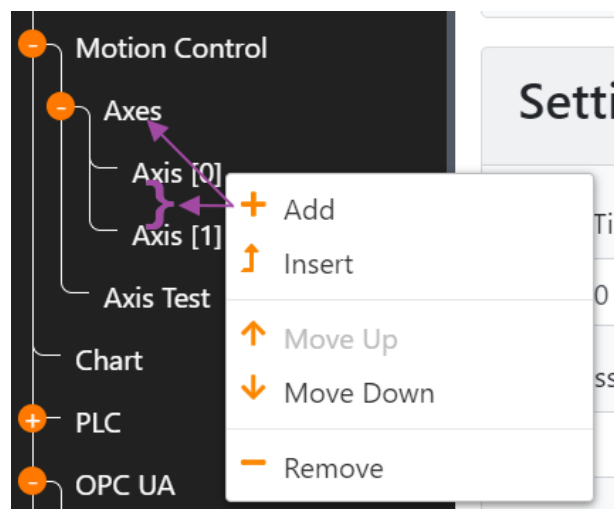


Figure 7-1

The right-click menu functions are as follows:

-  - Adding a new single axis. The new single axis will be added below the currently selected single axis node.
-  - Inserting a new single axis. The new single axis will be added above the currently selected single axis node.
-  - Moves up the position of the currently selected single axis.
-  - Moves down the position of the currently selected single axis.
-  - Delete the currently selected single axis.

7.2. Basic Settings

As shown in Figure 7-2, this part is the basic settings for single axis, which is used to determine the type of axis and the slave module to be controlled by the axis. The parameters are as follows:

Basic Settings

Axis Number: 0 Axis Type: Encoder Control Slave:

Control Variable

Name	Process Data	Data Type	Bit Size
Outputs	-	-	-
Set counter	None	BOOL	1
Set counter value	None	DINT	32
Inputs	-	-	-
Set counter done	None	BOOL	1
Error	None	BOOL	1
Counter value	None	DINT	32

Figure 7-2

- **Axis Number**
The number of the axis.
- **Axis Type**
The type of axis.
 - **Virtual Servo**
Set the axis as a virtual axis. If the axis is set as a virtual axis, single-axis motion control can be simulated without setting the slave station to be controlled.
 - **Servo (CiA402)**
Set the axis as a CiA402 servo axis. The slave module to be controlled is required to be set.
 - **Generic Drive**
Set the axis as a generic drive axis. It is necessary to set the slave module to be controlled and the PDO variables to be controlled. Currently this feature is still in beta testing.
 - **Encoder**
Set the axis as an encoder. It is necessary to set the slave module to be controlled and the PDO variables to be controlled.

- Control Slave

The slave module to be controlled by the axis. After clicking the input box below the text label, a dialog box as shown below will appear, select the number of the slave module to be controlled, the selected row will be grayed out and then click "OK" or click twice on the row to complete the selection.

Name	Multi Axis	Profile No.
Slave_000 [MADLN05BE]	---	402
Slave_001 [MADLN05BE]	---	402

- Control Variable

PDO variable for axis control. The following will introduce the PDO variables that need to be set for the control of different types of axes.

- Virtual Servo

No need to set control variables.

- Servo (CiA402)

No need to set control variables, it is based on CiA402 standard, it only need to take PDO automatic assignment function of the CiA402 slave module to perform the control.

- Generic Drive

The PDO variables controlled by the Generic Drive are shown in the figure below. The variable are as follows:

Name	Process Data	Data Type	Bit Size
Outputs	-	-	-
Enable	None	BOOL	1
Reset	None	BOOL	1
Target Position	None	DINT	32
Inputs	-	-	-
Ready	None	BOOL	1
Error	None	BOOL	1
Actual Position	None	DINT	32
Actual Velocity	None	DINT	32

Enable

Set this variable to “true”, the axis will be “Power ON (Servo ON)”.

Set this variable to “false”, the axis will be “Power OFF (Servo OFF)”.

Reset

During the clearing error process of the axis, it will set this variable to “true”, after clearing the error, the value will be set to “false” again.

Target Position

When the axis is performing the motion control, the position of the calculation result will be written to this variable.

Ready

This variable is used to judge the axis Power ON/OFF (Servo ON/OFF) status.

Error

This variable is used to judge whether there is an error happens to the axis.

Actual Position

This variable is used to read the actual position of the axis.

Actual Velocity

This variable is used to read the actual velocity of the axis.

- Encoder**

When the axis type is encoder, the PDO variables to be controlled are shown as the figure below, the variables are as follows:

Name	Process Data	Data Type	Bit Size
Outputs	-	-	-
Set counter	None	BOOL	1
Set counter value	None	DINT	32
Inputs	-	-	-
Set counter done	None	BOOL	1
Error	None	BOOL	1
Counter value	None	DINT	32

Set counter

Set value to the counter of the encoder.

Set counter value

The value to be set as the encoder counter value

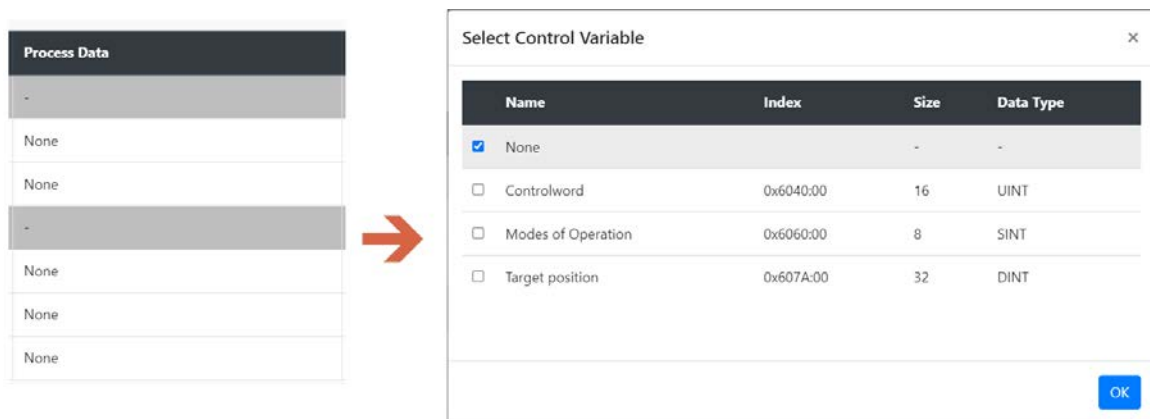
Set counter done

It is used to judge whether the setting of the encoder counter to the set value is completed.

Counter value

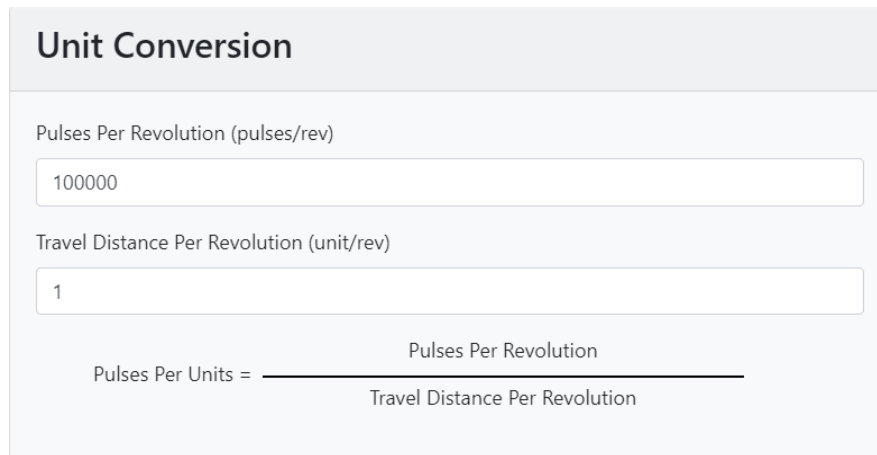
The variable is used to read the encoder counter value.

As shown in the figure below, the dialog box to select the variable will be brought up after clicking twice on the “Process Data” field of each variable. The user can select the PDO variable to be controlled according to the requirements of the application.



7.3. Unit Conversion

The setting of unit conversion is shown in Figure 7-3. The unit conversion can be used to convert the units to user's units according to different requirements. The parameters are as follows:



The figure shows a 'Unit Conversion' settings window. It contains two input fields: 'Pulses Per Revolution (pulses/rev)' with the value '100000' and 'Travel Distance Per Revolution (unit/rev)' with the value '1'. Below these fields is a formula for 'Pulses Per Units'.

Unit Conversion

Pulses Per Revolution (pulses/rev)
100000

Travel Distance Per Revolution (unit/rev)
1

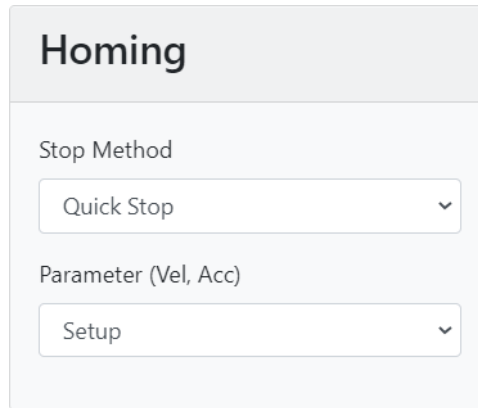
Pulses Per Units = $\frac{\text{Pulses Per Revolution}}{\text{Travel Distance Per Revolution}}$

Figure 7-3

- **Pulses Per Revolution (pulses/rev)**
The number of pulses per revolution.
- **Travel Distance Per Revolution (unit/rev)**
The travel distance of the mechanism per revolution.
- **Pulses Per Units**
The number of pulses per unit. Pulses per Unit = Pulses per Revolution / Travel Distance per Revolution.

7.4. Homing

As shown in Figure 7-4, the Homing parameter provides the choice of actions of the CiA402 slave module during the homing process. For some CiA402 slave modules do not fully implement the CiA402 specification, at this time, these parameters can be used to determine the actions. The parameters are as follows:



Homing

Stop Method

Quick Stop

Parameter (Vel, Acc)

Setup

Figure 7-4

- **Stop Method**
How to stop during homing.
 - Quick Stop**
Use the Quick Stop command of the CiA402 to stop the operation.
 - Halt**
Use the Halt command of the CiA402 to stop the operation.
- **Parameter (Vel, Acc)**
Whether to set the velocity or acceleration parameters or not during the homing.
 - Ignore**
During the homing process, there is no need to use the SDO to set parameters (such as speed or acceleration parameters).
 - Setup**
During the homing process, use the SDO to set parameters (such as speed or acceleration parameters).

7.5. Parameter

The advanced motion parameter setting is shown in Figure 7-5, which can be used to set limits in motion control. The parameters are as follows:

Parameter
Maximum Velocity
100000
Maximum Acceleration
100000

Figure 7-5

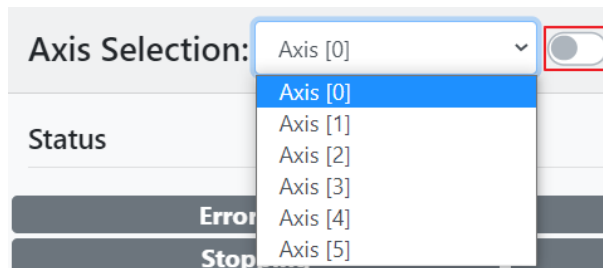
- Maximum Velocity
Limit of maximum speed.
- Maximum Acceleration
Limit of maximum acceleration.

8. Motion Control Axis Test

When the motion control function is enabled in the EtherCAT operation task, the user can perform a simple motion control test on this page. The following are the functions of this test page.

8.1. Enable Axis Test

As shown in the figure below, select the axis to perform the test from the drop-down list, and click the enable button on the right to enable the test of the specified axis number.



8.2. Axis Status

The axis status includes three parts: PLCopen status, axis flags, motion control status. The following section will give detailed information of these three parts.

8.2.1. PLCopen Status

The PLCopen status is shown in the figure below, which is the state machine defined by the PLCopen specification (PLCopen Part 1) for single-axis motion control. Each state is as follows:

ErrorStop	Disabled
Stopping	Homing
Standstill	Discrete
Continuous	Synchronized

- **Disabled**
The disabled state is the initial state of the axis, the power state is off and there are no errors on the axis.
- **Standstill**
The standstill state is the state the power is on, there is no error on the axis, and the axis is not executing any motion commands.
- **ErrorStop**
The ErrorStop state is the state to be held on when an axis error occurs.

- **Homing**
The Homing state is the state to be switched to when the axis performs Homing.
- **Stopping**
The Stopping state is the state to be switched to when the axis receives a stop command.
- **Discrete**
The Discrete motion state is the state to be switched to when the axis receives motion commands such as absolute position, relative position, or additional position.
- **Continuous**
The Continuous motion state is the state to be switched to when the axis receives a velocity motion command.
- **Synchronized**
The Synchronized motion state is the state to be switched to when the axis receives a gear motion command.

8.2.2. Axis Flags

Axis flags are shown in the figure below, showing information of axis such as Ready, Active, Fault, limit switches, etc., and the descriptions are as follows.

Ready	Fault	Reset
Active	Error	Homed
Home Switch	POT	NOT

- **Ready**
Ready flag shows if the axis is ready to operate.
- **Active**
Active flag shows if the axis is receiving an Active or Power ON command.
- **Fault**
Fault flag shows if the axis hardware is damaged or an error has occurred.
- **Error**
Error flag shows whether there is any error happens to the software or hardware of the axis.
- **Reset**
Reset flag shows if the axis is in the process of resetting.

- **Homed**
Homed flag shows whether the axis has completed the Homing or not.
- **Home Switch**
Home switch flag shows the logic state of the axis home switch.
- **POT**
Positive limit switch flag, showing the logical state of the positive limit switch of the axis.
- **NOT**
Negative limit switch flag, showing the logic state of the negative limit switch of the axis.

8.2.3. Motion Control Status

The motion control status is shown in the figure below, displaying information such as axis position, speed, error code, etc. The information is as follows.

Actual Position	Actual Velocity	Error ID
-0.00001	0.0019	0
Command Position	Command Velocity	
-0.00001	0	

- **Actual Position**
The actual position of the axis.
- **Command Position**
The command position of the axis.
- **Actual Velocity**
The actual velocity of the axis.
- **Command Velocity**
The command velocity of the axis.
- **Error ID**
The error code when an axis error occurs.

8.3. Axis Control

Axis control consists of general control, absolute and relative position control, loop motion control, homing, parameter setting, etc. The description of each part is as follows.

8.3.1. General Control

The general control is shown as the figure below, general control includes controls of: Enable, Disable, Reset and Stop the axis. The control buttons are as follows:



- **Enable**
Enable the control axis or Power ON (Servo ON).
- **Disable**
Disable the control axis or Power OFF (Servo OFF).
- **Reset**
Reset the control axis due to error.
- **Stop**
Stop the axis in motion.

8.3.2. Absolute Position Control

As shown in the figure below, the absolute position control interface can be displayed by clicking the "Absolute" tab. The parameters and buttons are as follows:

- **Aborting**
Aborting mode. When this mode is selected, if the axis was executing a motion command, it will abort the executing of the original motion command and execute the new motion command. If no motion command is being executed, it will execute the new motion command directly.
- **Buffered**
Buffered mode. When this mode is selected, if the axis was executing a motion command, it will not stop the executing of motion command. The new motion command will enter the internal buffer, wait for the execution of the motion command to be completed, and then continue the new motion. If no motion command is being executed, it will execute the new motion command directly.
- **Position**
Absolute position (user unit).
- **Velocity**
Velocity (user unit/s).
- **Acceleration**
Acceleration (user unit/s²).
-  Start absolute position movement.

8.3.3. Relative Position Control

As shown in the figure below, the relative position control interface can be displayed by clicking the "Relative" tab. The parameters and buttons are as follows:

The screenshot shows a web-based control interface for a motor system. At the top, there are five tabs: 'Absolute', 'Relative', 'Loop', 'Homing', and 'Parameter'. The 'Relative' tab is currently selected, indicated by a purple arrow. Below the tabs, there are two radio buttons: 'Aborting' (unselected) and 'Buffered' (selected). Underneath, there are three input fields labeled 'Position', 'Velocity', and 'Acceleration'. The 'Position' field contains the value '5', 'Velocity' contains '2', and 'Acceleration' contains '20'. To the right of these input fields are two large, dark circular buttons with white arrows pointing left and right, respectively.

- **Aborting**
Aborting mode. When this mode is selected, if the axis was executing a motion command, it will abort the executing of the original motion command and execute the new motion command. If no motion command is being executed, it will execute the new motion command directly.
- **Buffered**
Buffered mode. When this mode is selected, if the axis was executing a motion command, it will not stop the executing of motion command. The new motion command will enter the internal buffer, wait for the execution of the motion command to be completed, and then continue the new motion. If no motion command is being executed, it will execute the new motion command directly.
- **Position**
Relative distance (user unit).
- **Velocity**
Velocity (user unit/s).
- **Acceleration**
Acceleration (user unit/s²).
- 
Start moving relative distance in positive direction.



- Start moving relative distance in negative direction. That is, the relative distance is automatically multiplied by a negative number.

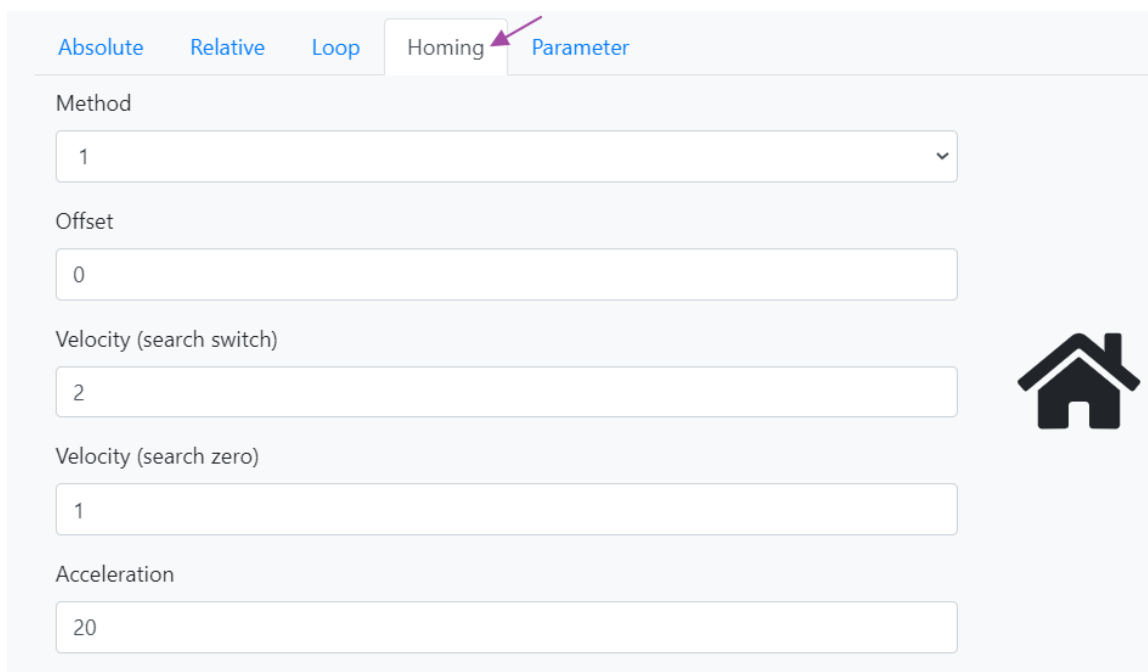
8.3.4. Loop Motion Control

As shown in the figure below, this function allows the user to enter two positions for convenient loop motion control. Click the “Loop” tab to display the loop motion control interface. The parameters and buttons are as follows:

- **Number of loop**
The number of loop, up to 50 times.
- **Position 1**
Position 1 of the loop (absolute position).
- **Position 2**
Position 2 of the loop (absolute position).
- **Velocity**
Velocity (user unit/s).
- **Acceleration**
Acceleration (user unit/s²).
- 
Jog moves in the positive direction. The Jog will keep moving after the button is pressed, and will not stop until the user releases the button.
- 
Jog moves in the negative direction. The Jog will keep moving after the button is pressed, and will not stop until the user releases the button.
- 
Start moving the controls in loop.

8.3.5. Homing

As shown in the figure below, the homing interface can be displayed by clicking the "Homing" tab. The parameters and buttons are as follows:



The screenshot shows the 'Homing' configuration interface. It features five tabs: 'Absolute', 'Relative', 'Loop', 'Homing' (selected), and 'Parameter'. A purple arrow points to the 'Homing' tab. Below the tabs, there are five input fields: 'Method' (a dropdown menu with '1' selected), 'Offset' (an input field with '0'), 'Velocity (search switch)' (an input field with '2'), 'Velocity (search zero)' (an input field with '1'), and 'Acceleration' (an input field with '20'). A house icon is positioned to the right of the 'Velocity (search switch)' and 'Velocity (search zero)' fields.

- **Method**
Homing method. Please refer to the description of the SDO object (0x6098) in the Slave Manual for detailed information.
- **Offset**
Position offset after homing is completed (user unit). Please refer to the description of the SDO object (0x607C) in the Slave Manual for detailed information.
- **Velocity (search switch)**
Homing velocity (user unit/s) is the velocity to search the switch. Please refer to the description of the SDO object (0x6099:01) in the Slave Manual for detailed information.
- **Velocity (search zero)**
Homing velocity (user unit/s) is the velocity to search the origin. Please refer to the description of the SDO object (0x6099:02) in the Slave Manual for detailed information.
- **Acceleration**
Homing acceleration (user unit/s²). Please refer to the description of the SDO object (0x609A) in the Slave Module Manual for detailed information.



Start Homing.

8.3.6. Parameter Settings

As shown in the figure below, the parameter settings interface can be displayed by clicking the "Parameter" tab. The parameters and buttons are as follows:

- **Parameter**
Parameter settings of the axis. The parameters to be set from the drop-down list are as follows:

 Max Velocity
Maximum velocity limit.

 Max Acceleration
Maximum acceleration limit.

 Velocity Factor
Velocity scaling factor (0 to 1).
- **Set Position**
Set the axis position.

 Absolute
In absolute mode, the axis position is set to be absolute position.

 Relative
In relative mode, the axis position is set to the sum of the current position + the distance value to be entered.

 Hardware
Set the encoder hardware counter value, this option is only available when the axis type is encoder.
- **Value**
Read and write parameter values.



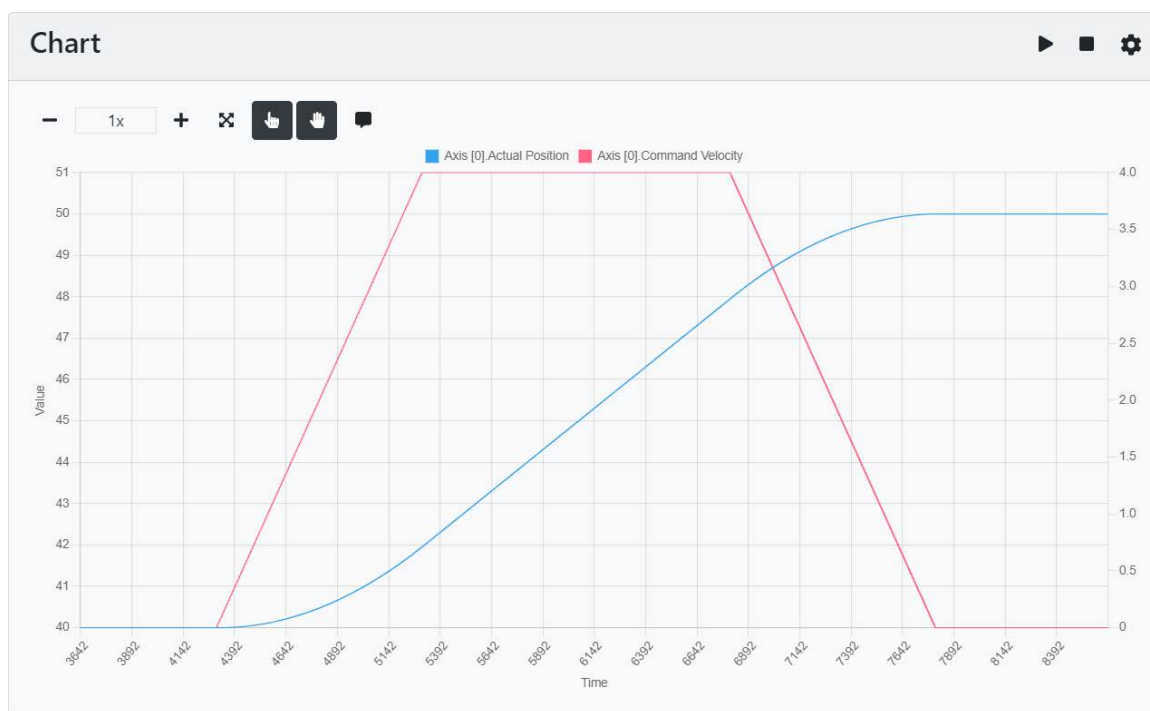
Read parameter value.



Override parameter values.

9. Chart

The chart function is shown in the figure below, which allows users to draw a trend chart to identify changes of variables over time when the EtherCAT operation task is started. These variables can be PDO variables or motion control variables. A total of 2 sets of data sets can be recorded. The following will explain how to set the chart, start the chart drawing and use the chart tools.



9.1. Setting the Chart

As shown in the figure below, click the function button  on the right side of the tab to bring up the chart setting dialog box. The contents and parameters of each tab are as follows.

Chart Settings

X Axis

Y Axis

Dataset 1

Dataset 2

Title

Time

Ticks Step

1

Ticks Limit

20

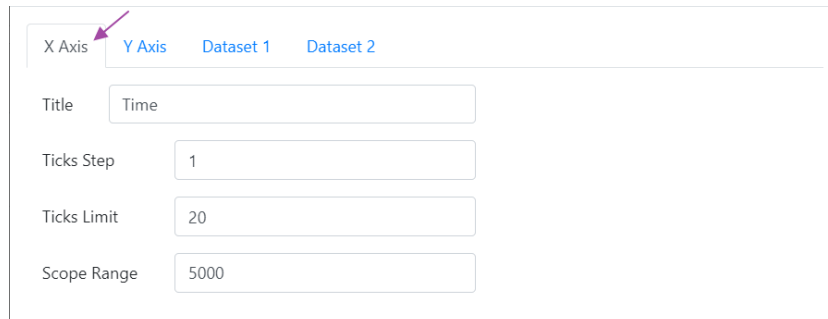
Scope Range

5000

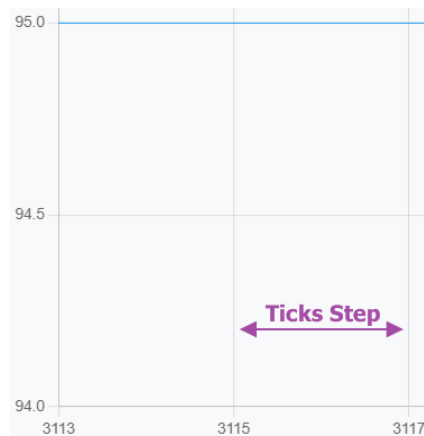
OK

9.1.1. X Axis

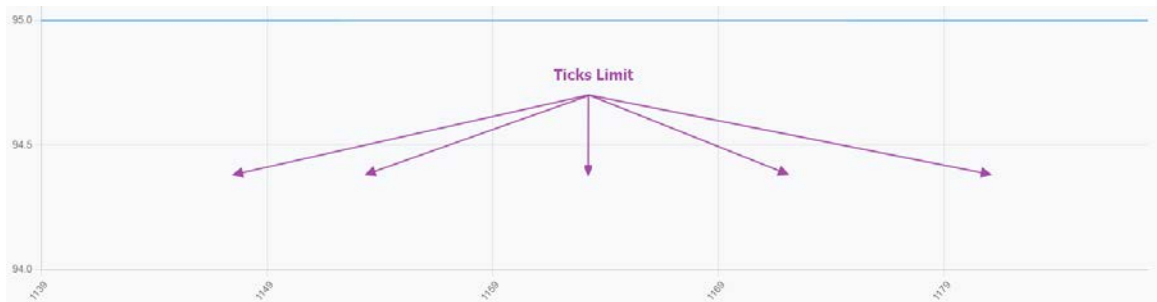
As shown in the figure below, the X-axis parameter setting page can be switched by clicking the "X Axis" tab. The parameters are as follows.



- **Title**
The title of the X-axis. The text will appear below the graph.
- **Ticks Step**
The size of each tick on the X-axis. The chart will automatically adjust to an appropriate value according to the number of strokes drawn or the actual value changes.



- **Ticks Limit**
Maximum total number of X-axis ticks. The chart will automatically adjust to an appropriate value according to the number of strokes drawn or the actual value changes.

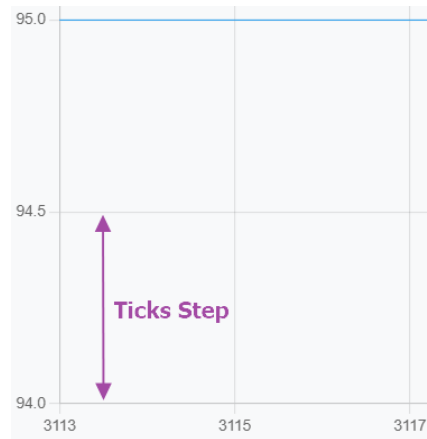


- Scope Range**
 The total number of X-axis records. The time unit of each X-axis data is determined according to the communication cycle of the EtherCAT operation task. When the total number of records exceeds this set value, the data recorded earlier will be deleted to record the new data. If the number of record strokes is too large, the drawing performance will be reduced, and the drawing screen may pause temporarily.

9.1.2. Y Axis

As shown in the figure below, the Y-axis parameter setting page can be switched by clicking the "Y Axis" tab. The parameters are as follows.

- Title**
 The title of the Y-axis. The text will appear to the left of the graph.
- Ticks Step**
 The size of each tick on the Y-axis. The chart will automatically adjust to an appropriate value according to the number of strokes drawn or the actual value changes.

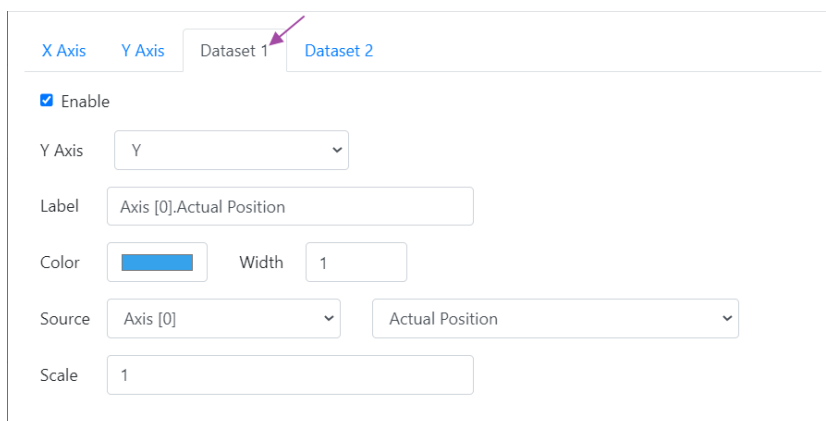


- Ticks Limit**
 Maximum total number of Y-axis ticks. The chart will automatically adjust to an appropriate value according to the number of strokes drawn or the actual value changes.



9.1.3. Dataset 1

As shown in the figure below, the parameter setting of Dataset 1 can be switched by clicking the "Dataset 1" tab. The parameters are as follows.



- **Enable**
Whether to enable this dataset or not.
- **Y Axis**
The Y axis on which the dataset is drawn.

Y
Left Y-axis, use the left scale range.

Y1
Right Y-axis, use the right scale range.
- **Label**
Dataset label. The text will appear above the graph.
- **Color**
The line color on the chart of the dataset.
- **Width**
The width of the lines on the chart of the dataset.
- **Source**
Source of dataset variable.

Drop down list 1
Select slave number or axis number.

Drop down list 2

Select slave PDO variable or motion control variable.

Slave PDO Variable

Axis Variable

- Scale

Scale factor. The source variable will be multiplied by this scale and plotted on the graph.

9.1.4. Dataset 2

As shown in the figure below, the parameter setting of Dataset 2 can be switched by clicking the "Dataset 2" tab. Please refer to Section "Dataset 1" for detailed information of the parameters.

9.2. Start/Stop Chart Drawing

The drawing of the chart can be started or stopped by using the function buttons on the right side of the title, as shown below:

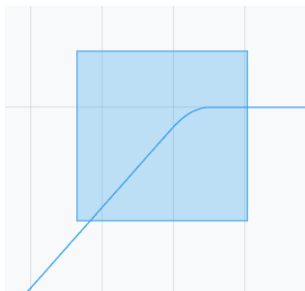
-  Start drawing the chart.
-  Stop drawing the chart.

9.3. Chart Tools

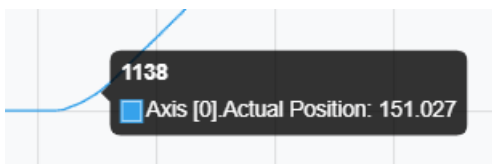
As shown in the figure below, the chart tools are located above the chart. When the drawing of the chart is completed and stopped, you can use these tools to analyze the chart. The function buttons are as follows.



-  Zoom out the chart.
-  The current zoom ratio.
-  Zoom in the chart.
-  Reset the zoom ratio, it will automatically zoom to the appropriate ratio.
-  Enable the drag-to-zoom function. As shown in the figure below, when this function is enabled, click on the left mouse button and drag to zoom in the chart.



-  Enable the panning chart function. When this function is enabled, click on the left mouse button and drag to pan the chart.
-  Enable the tooltip function. As shown in the figure below, when this function is enabled, when the mouse cursor passes over the line segment of the chart, the detailed information of the point will appear.



10. PLC Task

As shown in Figure 10-1, this part allows users to obtain the information of each PLC task and perform PLC task control without using Win-GRAF Workbench.

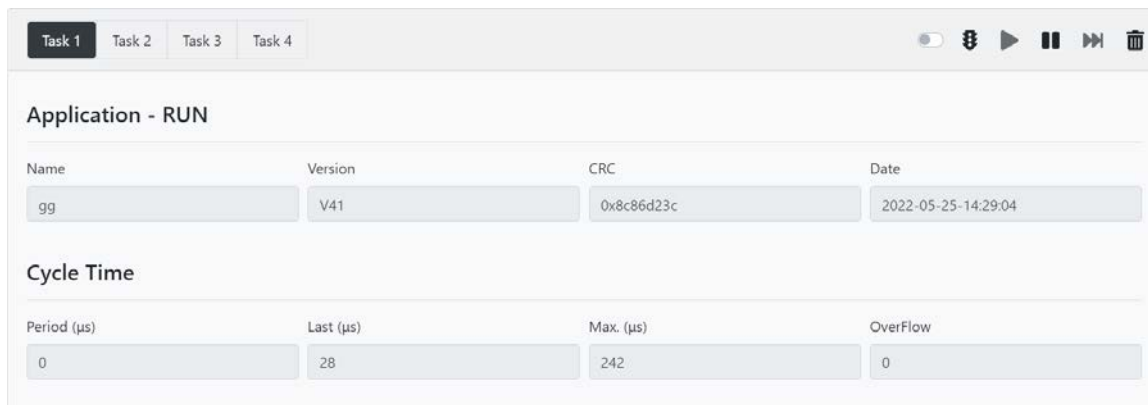
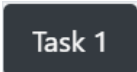
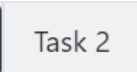
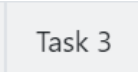
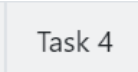


Figure 10-1

The function buttons are as follows:

-    

Switch to the task by clicking on specific task tab. The information of the task will be displayed below, and the user can perform control of the task by the function buttons on the right hand side.
- 

Automatically update information of task cycle time.
- 

Start or stop the task.
- 

Pause cycle to cycle mode.
- 

Resume cycle to cycle mode. Can only be used when the cycle to cycle mode is paused.
- 

Execute a single cycle. Can only be used when the cycle to cycle mode is paused.

-  Delete the code file of the task.

The task information is as follows:

- Application - "xxx"
"xxx" is the running status of the task, the status are as follows:

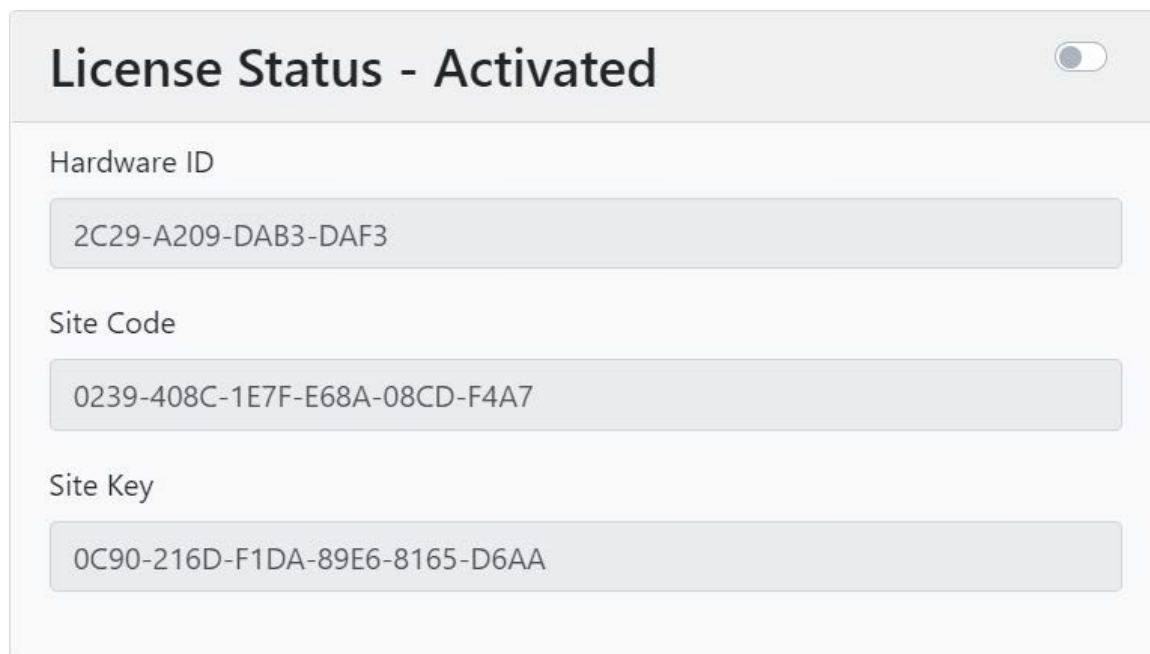
IDLE: Stop task execution.

RUN: The task is being executed.

STOP: The task is paused.
 - Name
Task or project name
 - Version
Program version
 - CRC
CRC check code of the program
 - Date
Program creation time
- Cycle Time
Task cycle time information.
 - Period (μ s)
The task period, in microseconds.
 - Last (μ s)
The task execution time, taking the latest cycle as the last cycle time, in microseconds.
 - Max. (μ s)
The maximum execution time of the task, in microseconds.
 - OverFlow
The count times when the task execution time exceeds the cycle time.

11. PLC License

As shown in Figure 11-1, the authorization status of PLC Runtime is displayed, and the parameters and function buttons are as follows:



The screenshot shows a window titled "License Status - Activated" with a toggle switch in the top right corner. The window contains three sections: "Hardware ID" with the value "2C29-A209-DAB3-DAF3", "Site Code" with the value "0239-408C-1E7F-E68A-08CD-F4A7", and "Site Key" with the value "0C90-216D-F1DA-89E6-8165-D6AA".

Figure 11-1

- License Status - "xxx"
"xxx" is the authorization status, the status are as follows:

Activated: Activated.

Deactivated: Not activated.
- Hardware ID
Hardware ID of the controller
- Site Code
The Site Code of the authorization code
- Site Key
The Site Key of the authorization code

-  Edit the authorization code. The "Activate" button will appear after enabling the button, please input the Site Code and Site Key of the authorization code. Then press the "Activate" button to activate the authorization. Whether the authorization is successful can be shown by the License Status - "xxx".

12. OPC UA

OPC UA (Open Platform Communications Unified Architecture) is an open standard communication protocol designed for facilitating data exchange and communication between different devices and systems. Its primary goal is to provide interoperability across platforms, networks, and vendors while ensuring high scalability and security.

12.1. Server Certificate

The contents of this page are used to manage the certificate files of the Win-GRAF Runtime OPC UA Server to ensure the security of communications. The following is a detailed description of the contents of each tab:

- Own

This tab displays existing server certificates and allows the creation of new self-signed certificates. Detailed information about server certificates can be accessed through the General/Subject/SAN tabs. The following details are explained:

- General: General information.

General Subject SAN		+	↓	↑	🗑️
Issuer	Thumbprint				
UaServer:EMP-OPCUA	7832CFF1D5512CE8815C1A440524F55522F0DA13				
Valid From	Valid To				
Mon Jan 08 2024 13:06:25 GMT+0800 (台北標準時間)	Tue Jan 07 2025 13:06:25 GMT+0800 (台北標準時間)				

- Issuer: Issuer name.
- Thumbprint: This is commonly called a “fingerprint”.
- Valid From: Start date of certificate.
- Valid To: Expiry date of a certificate.

- Subject: Subject field.

The screenshot shows a configuration window with three tabs: 'General', 'Subject' (selected), and 'SAN'. In the top right corner of the window are icons for adding (+), downloading, uploading, and deleting. The 'Subject' tab contains six text input fields arranged in a 3x2 grid. The first row contains 'Common Name' (with the value 'UaServer:EMP-OPCUA') and 'Organization' (with the value 'Organization'). The second row contains 'Organization Unit' (with the value 'Unit') and 'Locality' (empty). The third row contains 'State' (empty) and 'Country' (empty).

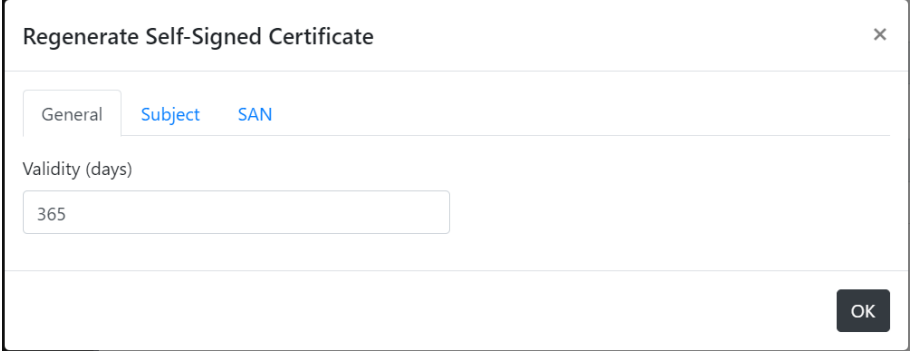
- SAN: Subject Alternative Name.

The screenshot shows the same configuration window with the 'SAN' tab selected. It contains three text input fields. The first field is labeled 'URI' and contains the value 'urn:Company:Product:UA_Serverurn:Company:Product:UA_Server2'. The second field is labeled 'DNS' and contains the value 'EMP-OPCUA,EMP-OPCUA2'. The third field is labeled 'IP' and contains the value '192.168.2.82,192.168.2.83'.

- URI: Uniform Resource Identifier.
- DNS: Domain Name System. Use commas to separate multiple entries.
- IP: IP Address. Use commas to separate multiple entries.

Buttons on the right:

-  Create Self-Signed Certificate. After clicking the button, the following dialog box will appear, and each parameter is described as follows:



The dialog box titled "Regenerate Self-Signed Certificate" has a close button (X) in the top right corner. It contains three tabs: "General", "Subject", and "SAN". The "General" tab is selected. Below the tabs, there is a label "Validity (days)" and a text input field containing the value "365". An "OK" button is located in the bottom right corner.

- General: General Settings.
 - Validity (days): Certificate validity period, unit days.
- Subject: Please refer to the Subject SubjectSubjectdescription in the Own server certificate information.
- SAN: Please refer to the SAN SubjectSubjectdescription in the Own server certificate information.

-  Download the server certificate.

-  Upload the server certificate. After clicking the button, the following dialog box appears, select public key or private key to upload server certificate.



The dialog box titled "Upload Own Certificates" has a close button (X) in the top right corner. It contains two sections: "Public key" and "Private key". Each section has a text input field with the placeholder "Choose file" and a "Browse" button. An "OK" button is located in the bottom right corner.

-  Delete the server certificate.

- Trusted

Used to manage server trust and rejected certificates. You can also trust or reject specific certificates.

Own	Trusted	Issuers
Certificates		
MyCA2 [4310F510486C708D57B01F8323939C5690CFA787].der		
UaExpert@DESKTOP-Q36M1JG [76EF881F3033B2C1DD33600913225EDCDDC8F8D5].der		
Rejected		
UaExpert@DESKTOP-FSVMGHH [785DD568D4A6C30EF14AB5365CAE80B83CD1CA64].der		
Certificate Revocation Lists		
MyCA2 [4310F510486C708D57B01F8323939C5690CFA787].crl		

- Certificates: List of trusted certificates.
- Rejected: List of rejected certificates.
- Certificate Revocation Lists: Certificate Revocation Lists of trusted certificates.

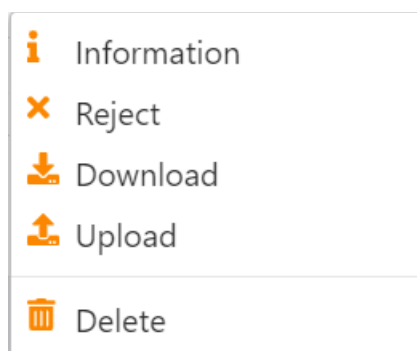
- Issuers

Manage issuer certificates. An issuer certificate is used to verify the legality and authenticity of other certificates. It establishes a trust chain to ensure that it comes from a trusted source.

Own	Trusted	Issuers
Certificates		
RootCA [D1FE74C48BABAFA0DB26B2CB2CBD85C7ACC234D2C].der		
MyCA1 [DE551C4BA4C24FED4288B7754F34A4BCE2361A7A].der		
Certificate Revocation Lists		
MyCA1 [DE551C4BA4C24FED4288B7754F34A4BCE2361A7A].crl		

- Certificates: List of issuer certificates.
- Certificate Revocation Lists: Certificate Revocation Lists of issuer certificates.

The right-click menu of the Certificates/Rejected/Certificate Revocation Lists file list is as follows:



- Information: Display detailed information for certificates or certificate revocation lists. The instructions are as follows:

- Certificate Information

Please refer to the description of the Own server certificate information.

Certificate Information
×

General
Subject
SAN

Issuer	Thumbprint
MyCA1	4310F510486C708D57B01F8323939C5690CFA787
Valid From	Valid To
Wed Oct 04 2023 10:30:46 GMT+0800 (台北標準時間)	Sat Sep 28 2024 10:30:46 GMT+0800 (台北標準時間)

- Certificate Revocation Lists (CRL) Information

Certificate Information
×

General
Subject
SAN

CRL Number	Issuer
03	ICPDAS Root CA
Last Update	Next Update
Fri Nov 10 2023 10:15:42 GMT+0800 (台北標準時間)	Sun Dec 10 2023 10:15:42 GMT+0800 (台北標準時間)
Thumbprint	
3C1685F48676E49AC0E57C964004759DC7F6E986	

- General: General information.
 - Subject: Please refer to the Subject description in the Own server certificate information.
 - SAN: Please refer to the SAN SubjectSubjectdescription in the Own server certificate information.
-
- Download: Download certificate or certificate revocation lists file.
 - Upload: Upload certificate or certificate revocation lists file.
 - Delete: Delete certificate or certificate revocation lists file.
 - Reject: Move the certificate to the rejected certificate list. (This option is available only in the trusted certificate list.)
 - Trust: Move the certificate to the trusted certificate list. (This option is available only in the rejected certificate list.)

13. System General

The system general page is for parameter settings such as host name, network setting, date & time, software update, etc. The following are the functions.

13.1. Hostname

The name of the host controller is set as shown in Figure 13-1. The parameters and function buttons are as follows:

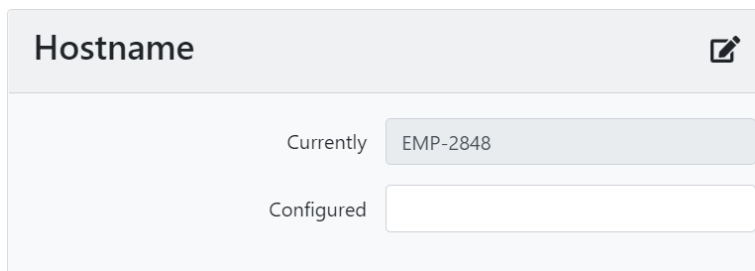


Figure 13-1

- **Currently**
The current hostname.
- **Configured**
The newly set hostname.
- 
Write the newly set hostname to the controller.

13.2. Date & Time

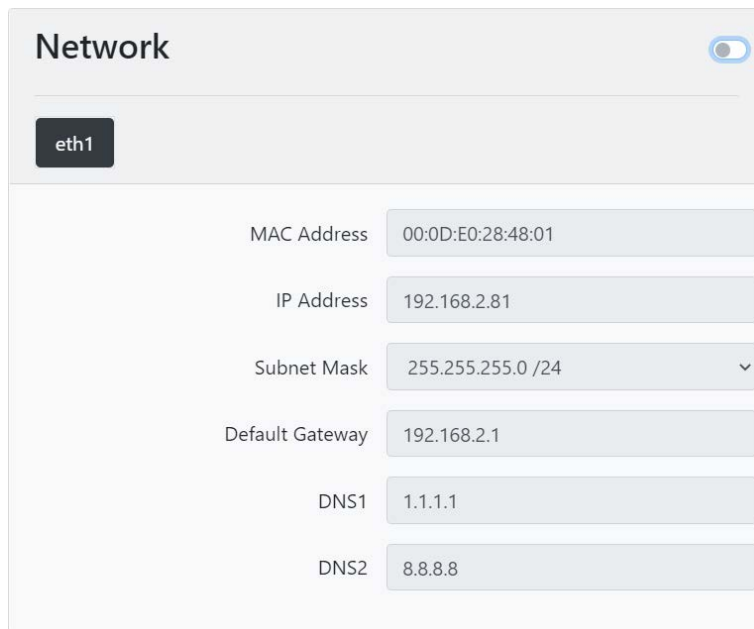
The date and time settings of the controller are shown in Figure 13-2. The parameters and function buttons are as follows:

Figure 13-2

-  The switch on the right side of the title is used to enable or disable the date and time setting function. When it is disabled, it will only display the current date and time. If it is enabled, a  write button will appear.
- NTP sync
Enable or disable NTP synchronization. The NTP network time protocol will synchronize the system time of the controller to the system time on the network.
- Time zone
Time zone.
- Time
Time. Can only be set when NTP sync is disabled.
- Date
Date. Can only be set when NTP sync is disabled.
-  Write new Settings to the controller, which only appears if the settings function is enabled.

13.3. Network

The network settings of the controller are shown in Figure 13-3, and the descriptions of the parameters and function buttons are as follows:



The screenshot shows a web interface for configuring the network settings of the 'eth1' interface. At the top, there is a 'Network' title and a toggle switch. Below the toggle, the interface name 'eth1' is shown. The configuration fields are as follows:

Parameter	Value
MAC Address	00:0D:E0:28:48:01
IP Address	192.168.2.81
Subnet Mask	255.255.255.0 /24
Default Gateway	192.168.2.1
DNS1	1.1.1.1
DNS2	8.8.8.8

Figure 13-3

-  The switch is used to enable or disable the network settings. When it is disabled, it will only display the current network interface and network configuration. If it is enabled, a  write button will appear.
- MAC Address
MAC address.
- IP Address
IP Address.
- Subnet Mask
Subnet mask.
- Default Gateway
Default gateway.
- DNS1
DNS server 1.

- DNS2
DNS server 2.
- Connection Type
Connection Type will only appear when the setting is enabled.

Static IP: Static IP address.

DHCP: Request an IP address by using DHCP.
-  Write new Settings to the controller, which only appears if the settings function is enabled.

13.4. Maintenance

The maintenance function of the controller is shown in Figure 13-4, which can be used to update the software, display the software version, etc. The function buttons are as follows:

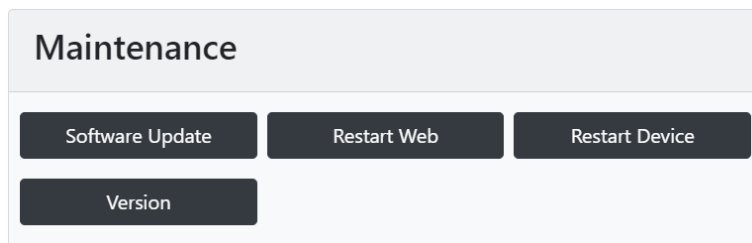
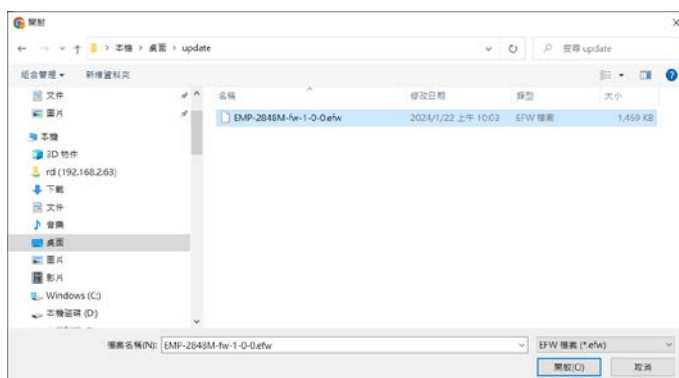


Figure 13-4

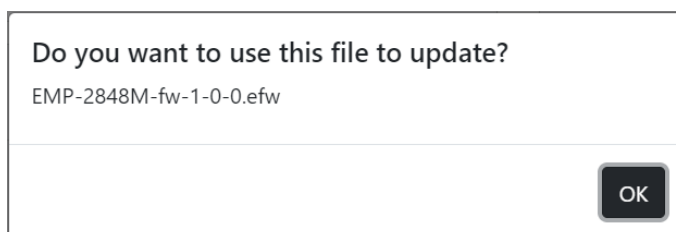
- Software Update

The software update button is used to update the relevant software inside the system. The update steps are as follows:

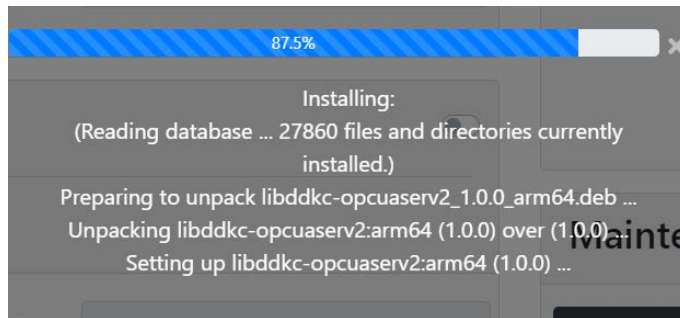
1. After clicking the “Software Update” button, the open file dialog box will appear, select the local firmware update file(.efw).



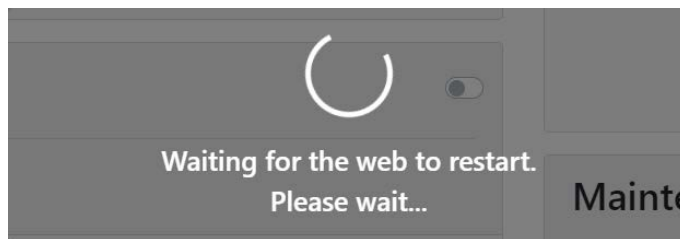
2. Then a file confirmation dialog box will appear. Click “OK” button to confirm the update.



3. Start the software update process, wait until the progress bar reaches 100% without any error, it means the software update is successful.



4. If the software update package includes a web software update, the web server will be restarted and wait for the restart to complete.



After the web server restart is complete, perform a hard refresh in your browser to clear the cache. Below are common browser shortcut keys:

- Chrome
 - Windows/Linux:
 1. Hold down Ctrl and click the Reload button.
 2. Ctrl + F5.
 3. Ctrl + Shift + R.
 - MacOS:
 1. Hold Shift and click the Reload button.
 2. Command + Shift + R.
- Firefox
 - Windows/Linux:
 1. Hold down Ctrl and click the Reload button.
 2. Ctrl + F5.
 3. Ctrl + Shift + R.
 - MacOS:
 1. Hold Shift and click the Reload button.
 2. Command + Shift + R.

- Edge
Windows/Linux:
 1. Hold down Ctrl and click the Reload button.
 2. Ctrl + F5.
 3. Ctrl + Shift + R.MacOS:
 1. Hold Shift and click the Reload butto.
 2. Command + Shift + R.
- Safari
1. Option + Command + E.
- Reboot Web
Reboot web server.
- Reboot Device
Reboot controller.
- Version
Show software version information. The following version information dialog box will appear after clicking this button.

Version				×
Name	Version	Architecture	Description	
ecat-mod	1.0.0	arm64	EtherCAT Master Modules	
ecat-dev-rt	1.0.0	arm64	EtherCAT device runtime	
libecat-dev	1.0.0	arm64	EtherCAT device library	
ecat-web	1.0.0	arm64	ICPDAS EtherCAT Web server	
t5mt-rt	1.0.0	arm64	PLC T5 multitask runtime	
libt5bdll-ecat	1.0.0	arm64	PLC(T5MT) EtherCAT FBs library	
libt5bdll-mc	1.0.0	arm64	PLC(T5MT) PLCopen FBs library	
libt5busecat	1.0.0	arm64	PLC(T5MT) Bus EtherCAT DDKC library	
libt5bussockipc	1.0.0	arm64	PLC(T5MT) Bus Socket IPC DDKC library	
libt5cp5	1.0.0	arm64	PLC(T5MT) CPS library	

14. System Service

This working page can be used to view the status of the controller service program and view the related logs of the controller. The functions are as follow.

14.1. Service

As shown in Figure 14-1, this part shows the status of the controller service program. The action buttons allow users to manually start, stop, restart, etc. Each column of the system service program are as follows:

Service		
Name	Status	Actions
EtherCAT module	active	  
EtherCAT device runtime	active	  
PLC(T5) runtime	active	  

Figure 14-1

- Name

Name of the service.

EtherCAT module: EtherCAT kernel modules service.

EtherCAT device runtime: EtherCAT Runtime service.

PLC(T5) runtime: PLC Runtime service

- Status

Status of the service.

active: service or daemon is running.

inactive: service is not running.

- Actions

action button.



: Start the service.

 : Stop the service.

 : Restart the service.

14.2. Log

The controller log function is shown in Figure 14-2, which records the errors, warnings and other prompt messages generated by the internal program of the controller. These messages allow developers to understand the operation status of the program and the cause of the error.

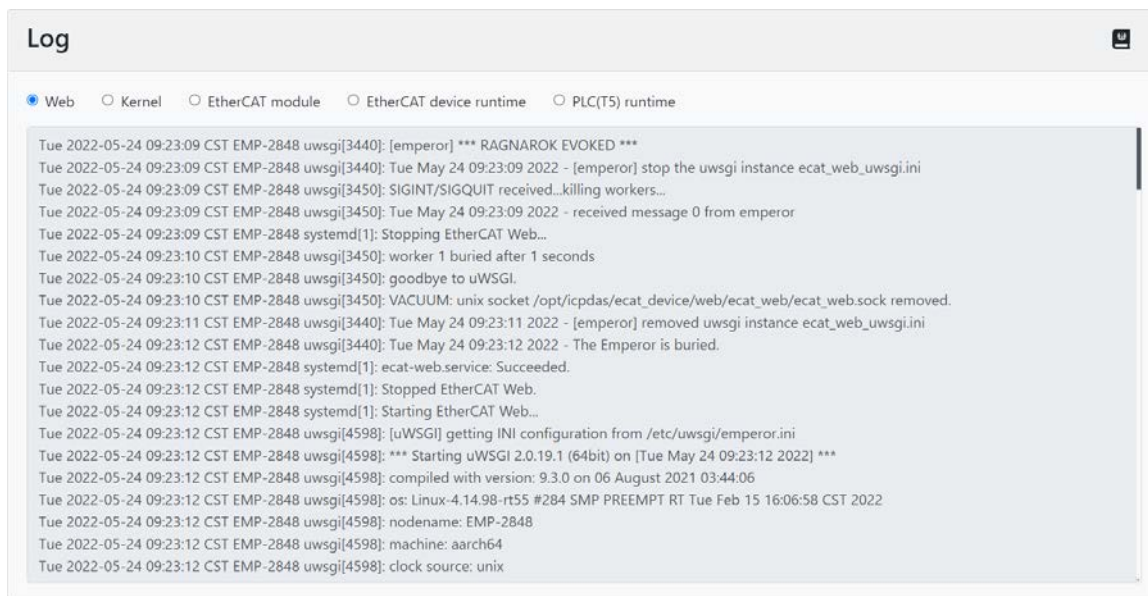


Figure 14-2

The types of logs to be displayed are as follows:

- Web
Logs of web interface.
- Kernel
Logs of controller kernel.
- EtherCAT module
Logs of EtherCAT kernel modules service.
- EtherCAT device runtime
Logs of EtherCAT Runtime service.
- PLC(T5) runtime
Logs of PLC Runtime service.



The button is used to access the content of the selected log. After clicking the button, the following Log Filter dialog box will appear, and the records within the range of the log time will be filtered according to the filter items.

Log Filter (Max. 200) ×

☒ Today ☐ Yesterday ☐ All

☐ Since

Until

☐ lines ☐ First ☒ Last

OK

Filter items are as below:

- Today
Filter logs within today.
- Yesterday
Filter logs within yesterday.
- All
All logs.
- Since - Until
Filter logs within the specified time range.

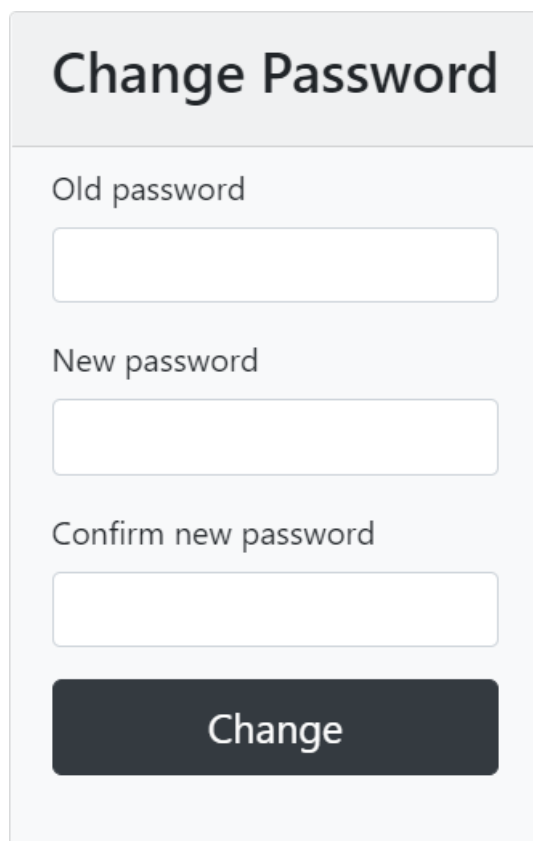
The display restriction items are as follows:

- lines
Limit the number of lines displayed in the log. By default, no matter what filter item is selected, the maximum number of displayed lines is 200 lines. The parameter can be set to limit the number of lines to less than 200 lines.

- First
Based on the filter range, the logs that are order in time will be displayed.
- Last
Based on the filter range, the logs that are later in time will be displayed.

15. Account Settings

This page can be used to modify the user account password on the web interface. After the user logs in the web interface for the first time (using the factory default account/password), please change the password as soon as possible. The password change is shown as Figure 15-1.

A web form titled "Change Password" with a light gray background. It contains three input fields: "Old password", "New password", and "Confirm new password". Each field is a simple white rectangle with a thin gray border. Below the input fields is a dark gray button with the word "Change" in white text.

Change Password

Old password

New password

Confirm new password

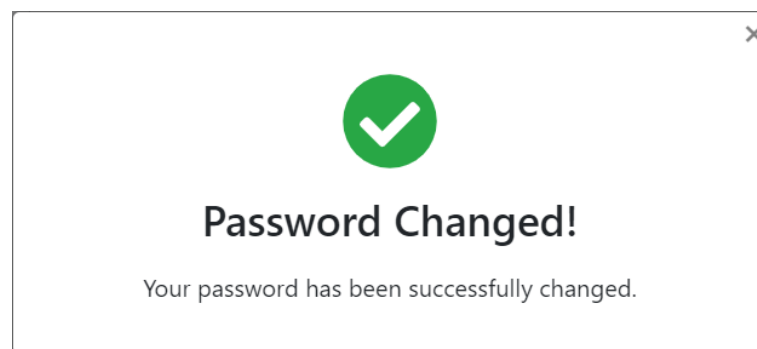
Change

Figure 15-1

The modification steps are as follows:

1. Enter the old password in the "Old password" input box.
2. Enter a new password in the "New password" input box.
3. Enter the new password again in the "Confirm new password" input box to confirm the password accuracy.
4. Click the "Change" button. After the password is successfully changed, the following dialog box will appear. When you log in to the web interface next time, please log in with the new password. The new password features the following verification restrictions:

- Which checks the similarity between the password and a set of attributes of the user.
- Which checks whether the password meets a minimum length, the default is 8 characters.
- Which checks whether the password occurs in a list of common passwords. By default, it compares to an included list of 20,000 common passwords.
- Which checks whether the password isn't entirely numeric.



5. If there is an error in changing the password, an error message will be displayed below each input box, as shown in the figure below.

Change Password

Old password

- Your old password was entered incorrectly. Please enter it again.

New password

Confirm new password

- The two password fields didn't match.

Change

16. Quick Start

This chapter will give a quick introduction of how to create an ENI file required for EtherCAT Runtime on the web interface, use this ENI file to start the EtherCAT operation task, and then control the slave module through the web interface.

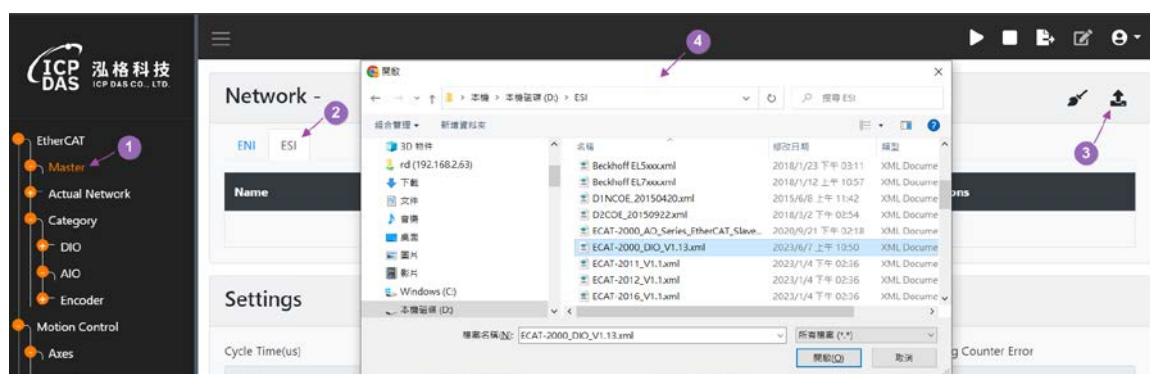
16.1. Slave Free-Run/DC Setting and Control Steps

This section will introduce how to create, configure and control the slave modules by connecting the slave modules ECAT-2055 (DI/DO), ECAT-2028 (AO), ECAT-2012H (AI) as an example.

[Steps]

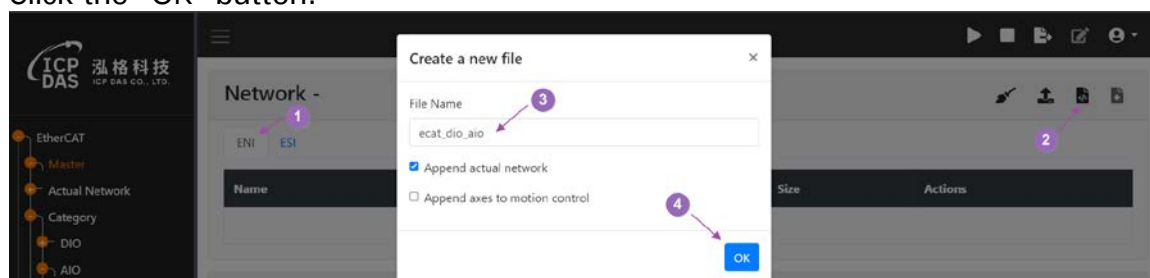
A. Upload the ESI file.

- (1) Click on the EtherCAT->Master node.
- (2) Click the "ESI" tab.
- (3) Click the Upload button.
- (4) The file selection dialog box appears, select the ESI file of the slave module, if there are multiple ESI files, please upload each file one by one and wait for the upload to complete.

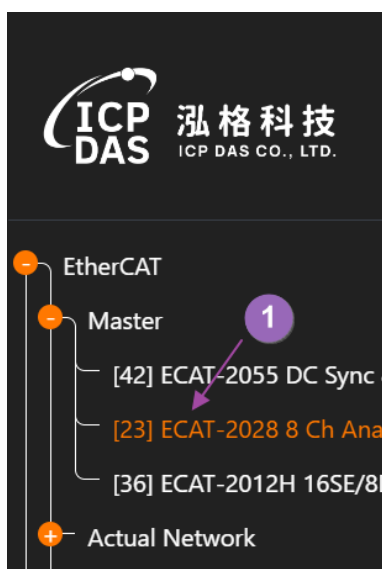


B. Create an ENI file.

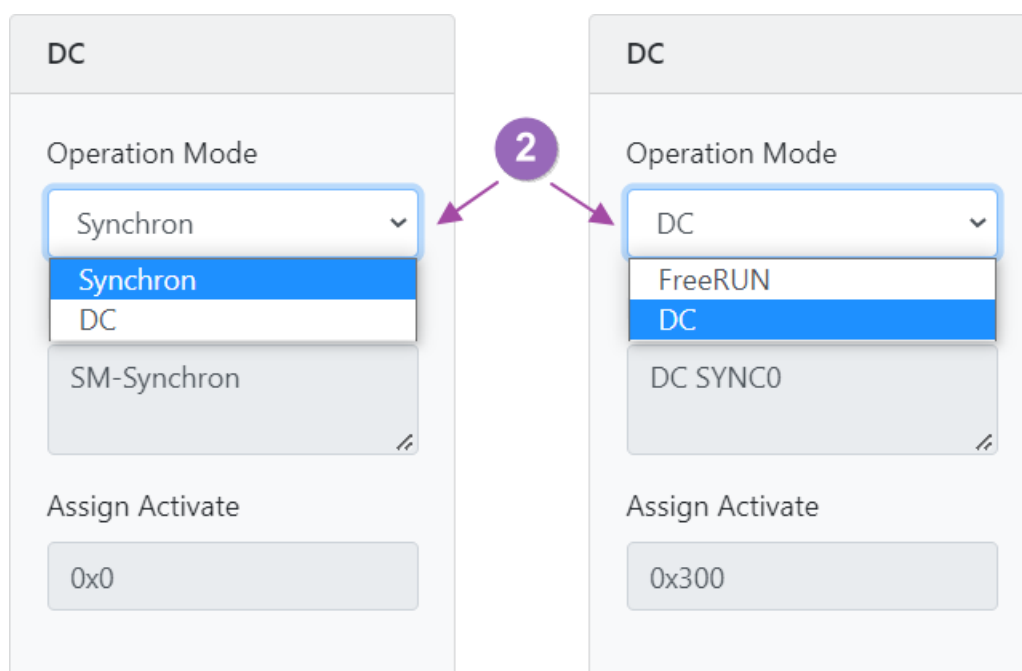
- (1) Click on the "ENI" tab.
- (2) Click the New ENI button.
- (3) A new file dialog box will appear, enter the file name.
- (4) Click the "OK" button.



- C. Set the operation mode of the slave to SM-Synchron, Free-Run, DC.
 (1) Click on the node of EtherCAT->Slave node.



- (2) Select the operation mode option from the "Operation Mode" drop-down list of the DC function.



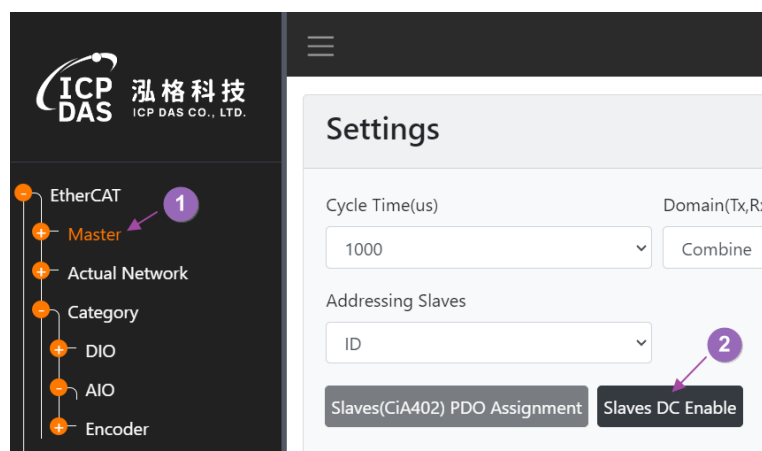
- (3) Click the save settings button on the toolbar to save.



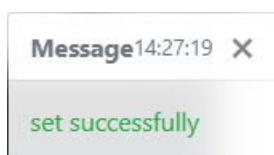
Follow the steps below to quickly set all slave to DC mode

(1) Click on the node of EtherCAT->Master.

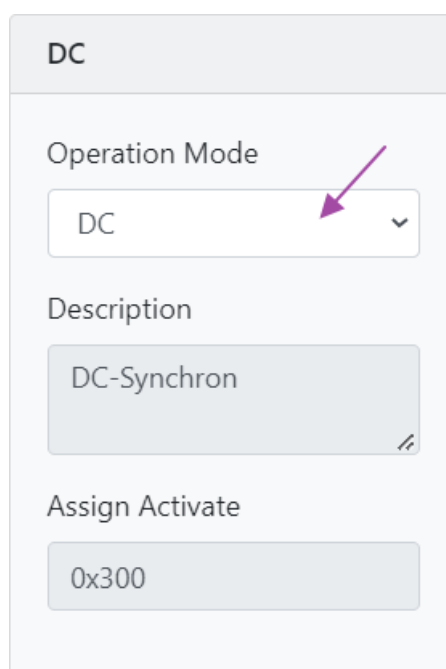
(2) Click the "Slaves DC Enable" button.



(3) A "set successfully" message box will appear in the lower right corner.

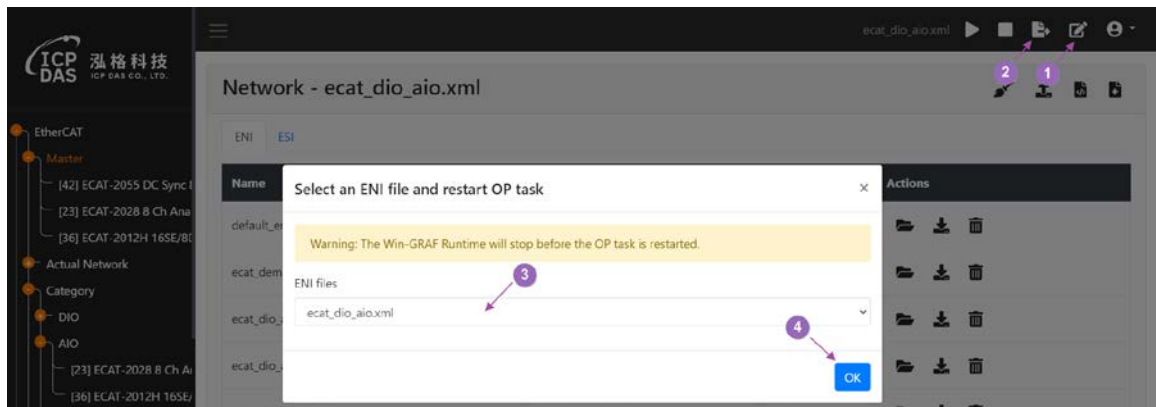


(4) Make sure that the 'Operation Mode' of each slave page is set to DC. If there is no setting, it means that the slave station does not support DC mode, please check if there is DC option in the "Operation Mode" dropdown list.



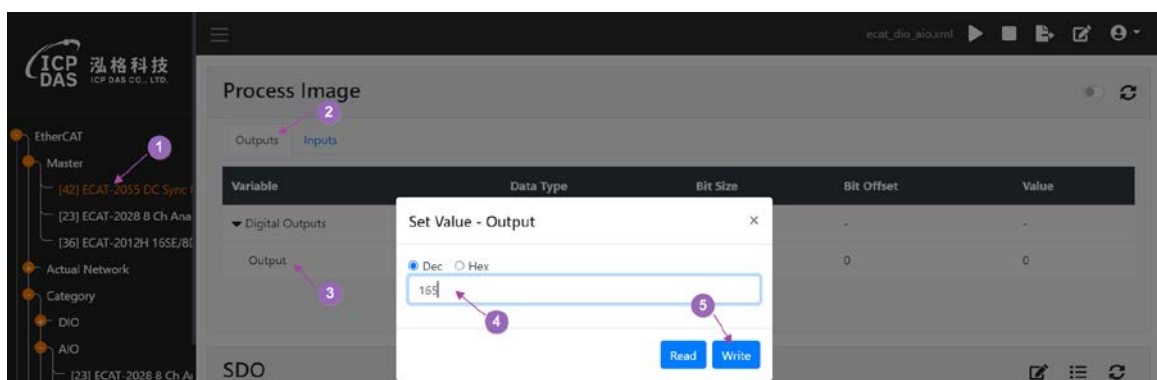
D. EtherCAT Runtime reloads the ENI file.

- (1) Click the save settings button on the toolbar to save.
- (2) Click select ENI file and restart EtherCAT operation task button on the toolbar.
- (3) Select the ENI file to be reloaded in the dialog box.
- (4) Click the "OK" button.

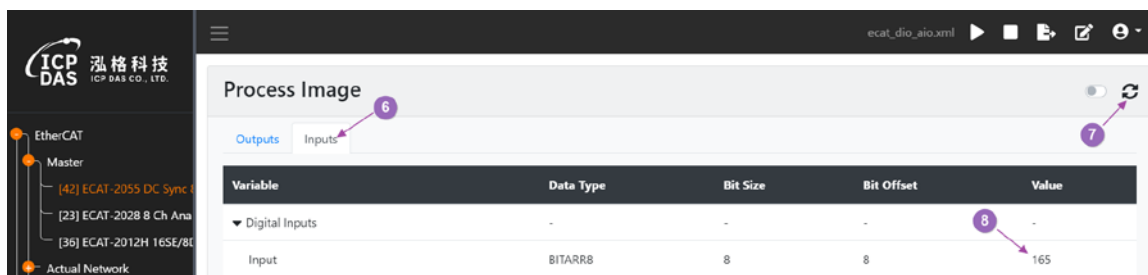


E. Enter the slave station page and use PDO to control the slave station module.

- I. Read and write control of DI/DO module on slave station, it will connect ECAT-2055 (DI/DO) pin DIx to DOx on slave station.
 - (1) Click on the EtherCAT->Slave (ECAT-2055, DI/DO) node.
 - (2) Click on the Process Image->Outputs tab.
 - (3) Double click on the Digital Outputs->Output variable, and a read and write dialog box will appear.
 - (4) Input 165 value and output DO.
 - (5) Click the "Write" button.

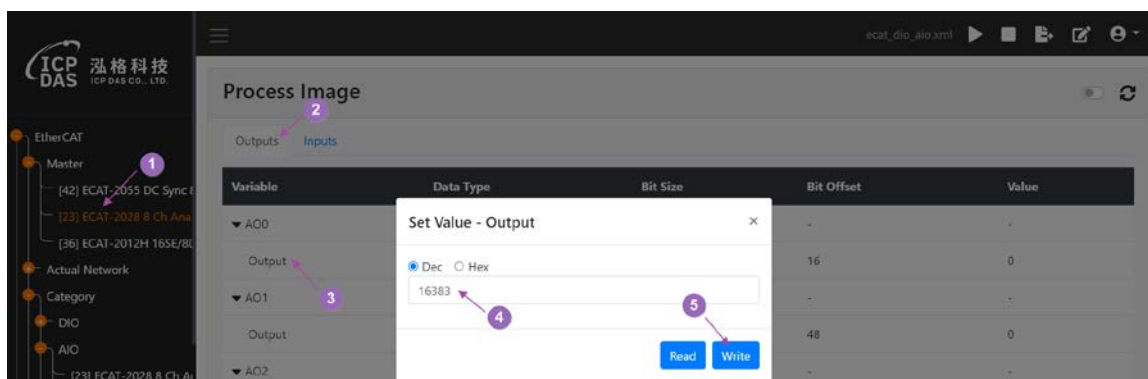


- (6) Click on the Process Image->Inputs tab.
- (7) Click the refresh button.
- (8) Check if Digital Inputs->Input is 165.



II. Connect channel 0 of AO (ECAT-2028) and AI (ECAT-2012H) for AI/AO control.

- (1) Click on the EtherCAT->Slave (ECAT-2028, AO) node.
- (2) Click on the Process Image->Outputs tab.
- (3) Double click on the AO0->Output variable, and a read and write dialog box will appear.
- (4) Input the value of 16383. When the AO range is $\pm 10V$, the output AO is about +5V.
- (5) Click the "Write" button.



- (6) Click on the EtherCAT->Slave (ECAT-2012H, AI) node.
- (7) Click on the Process Image->Inputs tab.
- (8) Click the refresh button.
- (9) Read the AIO->Value variable, and check whether the value is close to the value written in AO.

The screenshot shows the ICP DAS software interface. On the left, a tree view under 'EtherCAT' shows 'Slave (ECAT-2012H, AI)' selected. The main window displays the 'Process Image' configuration for this slave. The 'Inputs' tab is active, showing a table of variables. The 'Value' variable is highlighted with a red circle and a red arrow pointing to its value, 16371.

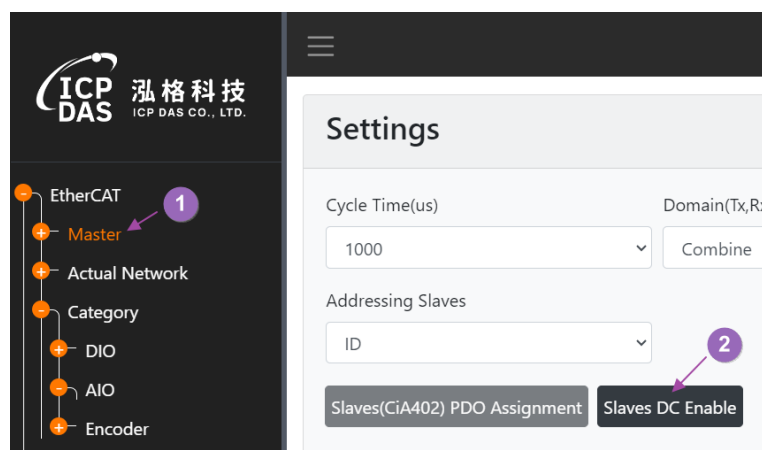
Variable	Data Type	Bit Size	Bit Offset	Value
▼ AIO	-	-	-	-
▼ Status	UINT	16	272	0
Underrange	BOOL	1	272	0
Overrange	BOOL	1	273	0
Limit 1	BIT2	2	274	0
Limit 2	BIT2	2	276	0
Error	BOOL	1	278	0
TxPDO State	BOOL	1	286	0
TxPDO Toggle	BOOL	1	287	0
Value	INT	16	288	16371

16.2. Motion Control Setting and Control Steps

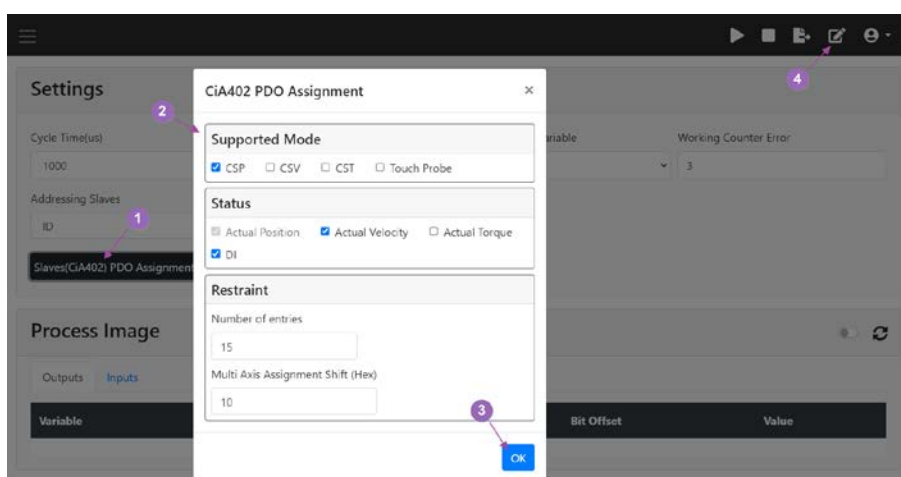
This section will connect the CiA402 servo drive slave module to introduce how to start and set the motion control function, and use the web interface to perform a simple move test.

[Steps]

- A. Configure the EtherCAT network deployment according to steps A to B in section 16.1.
- B. Set all slave stations to DC mode.
 - (1) Click on EtherCAT->Master node.
 - (2) Click the "Slaves DC Enable" button.

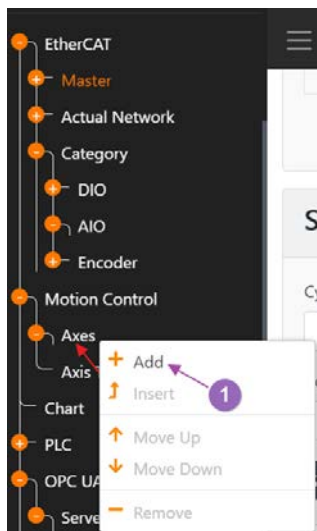


- C. Automatically configure CiA402 PDO Mapping.
 - (1) Click the "Slaves(CiA402) PDO Assignment" button.
 - (2) The PDO Auto Assignment dialog box appears, use default selection.
 - (3) Click the "OK" button.
 - (4) Click the Save button.



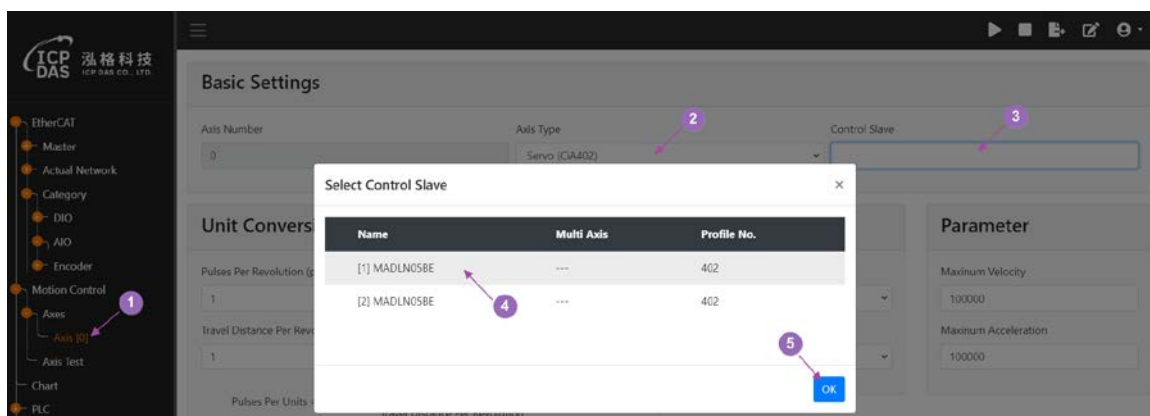
D. Enable the motion control function.

- (1) Right click on the node of Motion Control->Axes or Motion Control->Axes->Axis in the navigation area, click on the "Add" option in the right-click menu to increase the number of axes.



E. Parameter settings of motion control axis.

- (1) Click the Motion Control->Axes->Axis[n] node.
- (2) Select the axis type as "Servo (CiA402)".
- (3) Click on the "Control Slave" button, a dialog box for selecting the slave module will appear.
- (4) Select the number of the slave to be controlled.
- (5) Click the "OK" button.



- (6) Set the PPU according to actual requirements.
- (7) Click the Save button.

Basic Settings

Axis Number: 0 Axis Type: Servo (CiA402) Control Slave: [0] - [1] MADLN05BE

Unit Conversion

Pulses Per Revolution (pulses/rev): 100000 (marked with 6)

Travel Distance Per Revolution (unit/rev): 1

Pulses Per Units = $\frac{\text{Pulses Per Revolution}}{\text{Travel Distance Per Revolution}}$

Homing

Stop Method: Quick Stop

Parameter (Vel, Acc): Setup

Parameter

Maximum Velocity: 100000

Maximum Acceleration: 100000

F. EtherCAT Runtime reloads the ENI file.

- (1) Click the save settings button on the toolbar to save.
- (2) Click the Start EtherCAT Operation Task button on the toolbar.
- (3) A dialog box for starting the EtherCAT operation task appears, select the "Override Default" option.
- (4) Click the "OK" button.

Network - mc.xml

ENI: ESI

Dialog Box: Select an ENI file and restart OP task

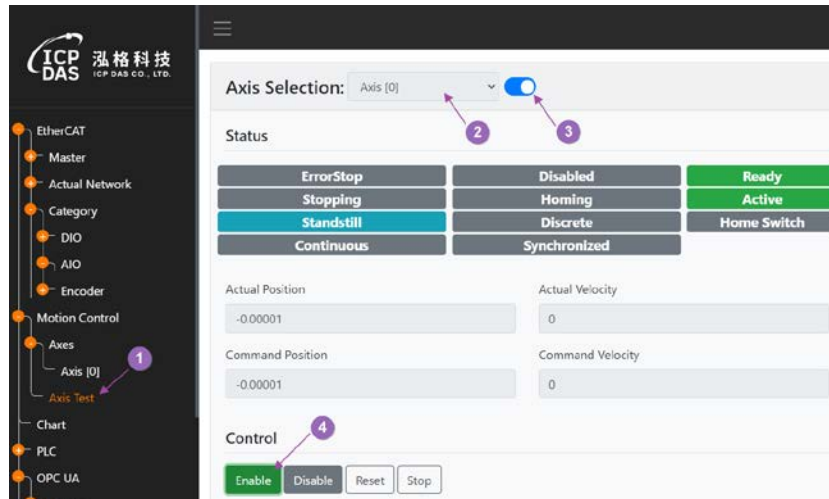
Warning: The Win-GRAP Runtime will stop before the OP task is restarted.

ENI files: mc.xml (marked with 3)

OK (marked with 4)

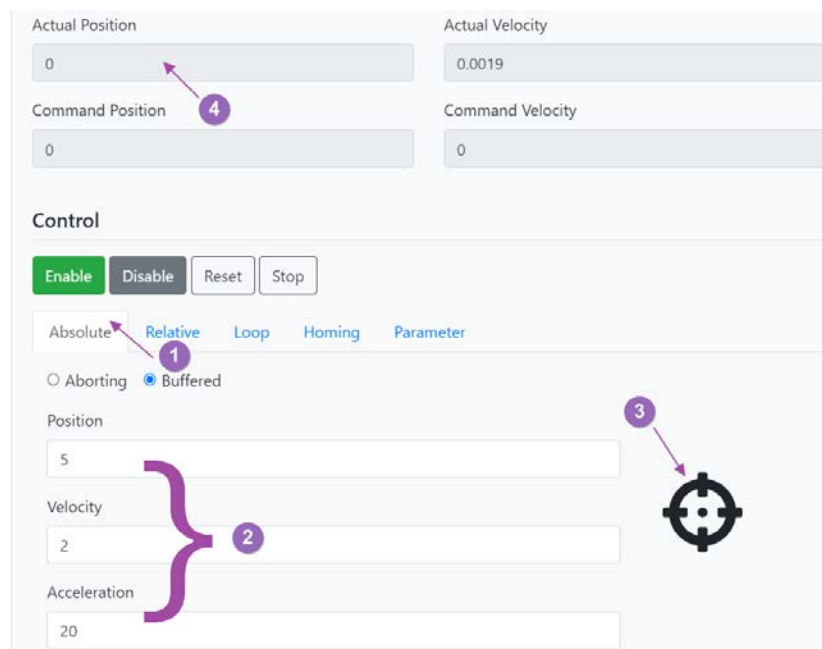
G. Enter the motion control test page.

- (1) Click on the Motion Control->Axis Test node.
- (2) Select the axis number.
- (3) Click the "Activate" button to activate the axis number.
- (4) Click the "Enable" button to control the axis Power ON (Servo ON).



H. Perform absolute position movement control.

- (1) Click the Control->Absolute tab.
- (2) Input position, velocity, acceleration parameters.
- (3) Click the move button for motion control.
- (4) Make sure that the final stop position is consistent.



I. Perform relative position movement control.

- (1) Click the Control->Relative tab.
- (2) Click the Control->Relative tab.
- (3) Click the positive or negative movement buttons for motion control.
- (4) Make sure the final stop position is consistent.

The screenshot displays the control interface for the EMP-2848M system. It includes fields for Actual Position (0), Actual Velocity (-0.0019), Command Position (0), and Command Velocity (0). The Control section features buttons for Enable, Disable, Reset, and Stop. Below these are tabs for Absolute, Relative, Loop, Homing, and Parameter. The Relative tab is selected, and the Buffered option is chosen. The Position field is set to 5, Velocity to 2, and Acceleration to 20. To the right of these fields are two large circular buttons with left and right arrows, labeled with a circled 3. A circled 4 points to the Command Position field, and a circled 1 points to the Buffered radio button. A bracket labeled with a circled 2 groups the Velocity and Acceleration fields.

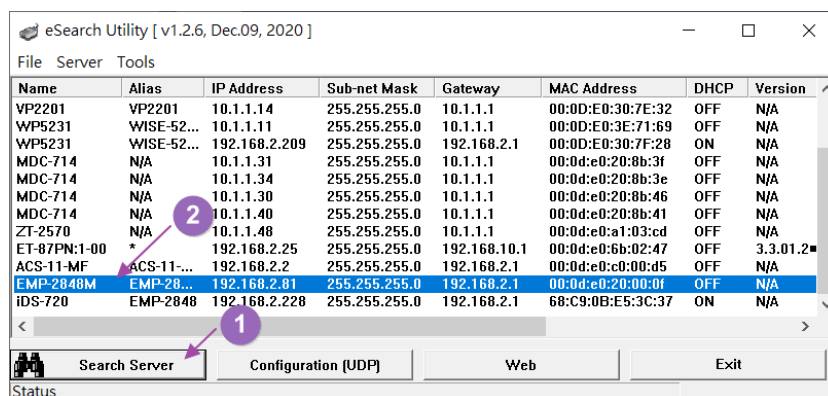
Appendix A. eSearch Tool Software

eSearch Utility is a set of easy-to-use portable software, which can be used to search and configure ICP DAS network communication devices on the Ethernet network. For software usage, please follow the steps below:

[Steps]

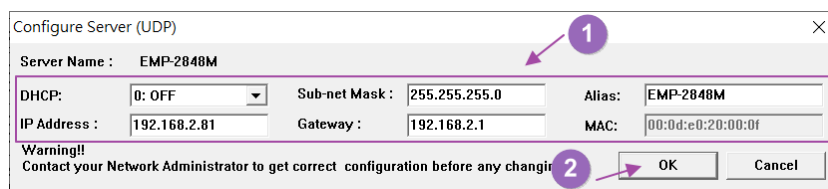
A. Search for EMP-2848M devices on the Ethernet network.

- (1) Click the "Search Server" button to start searching for devices.
- (2) The EMP-2848M device will appear in the search list.



B. Modify network settings.

- (1) Double click on the search found EMP-2848M device, and a setting dialog box will appear. Change information such as the IP address, subnet mask, default gateway, alias and others according to actual requirements.
- (2) Click the "OK" button.



C. Open the device web interface.

- (1) Click on the searched device.
- (2) Click the "Web" button to automatically open the default browser of the system.

