EC2-AI Series EtherCAT Slave I/O Modules User Manual

English Ver. 1.0, Dec. 2025

WARRANTY

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

WARNING

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CONTACT US

If you have any questions, please feel free to contact us via email at:

service@icpdas.com, service.icpdas@gmail.com

SUPPORT

EC2-TC16

EC2-RTD16

TABLE OF CONTENTS

1. Introduction

The EC2-AI series are industrial EtherCAT slave remote I/O modules supporting EtherCAT protocol and installed by daisy chain connection which permits the flexibility in devices installation and reduces infrastructure and operation costs. All the modules can be deployed in the network topologies such as star, line or ring. The isolated input and output design protects the EC2-AI series against the harmful interference and environment.

The EC2-AI series has passed and verified by the conformance test tool, therefore eligible EtherCAT Master or configurator can manipulate it simply and implement your various applications easily. Fig 1.1 is shown a typical EtherCAT application.

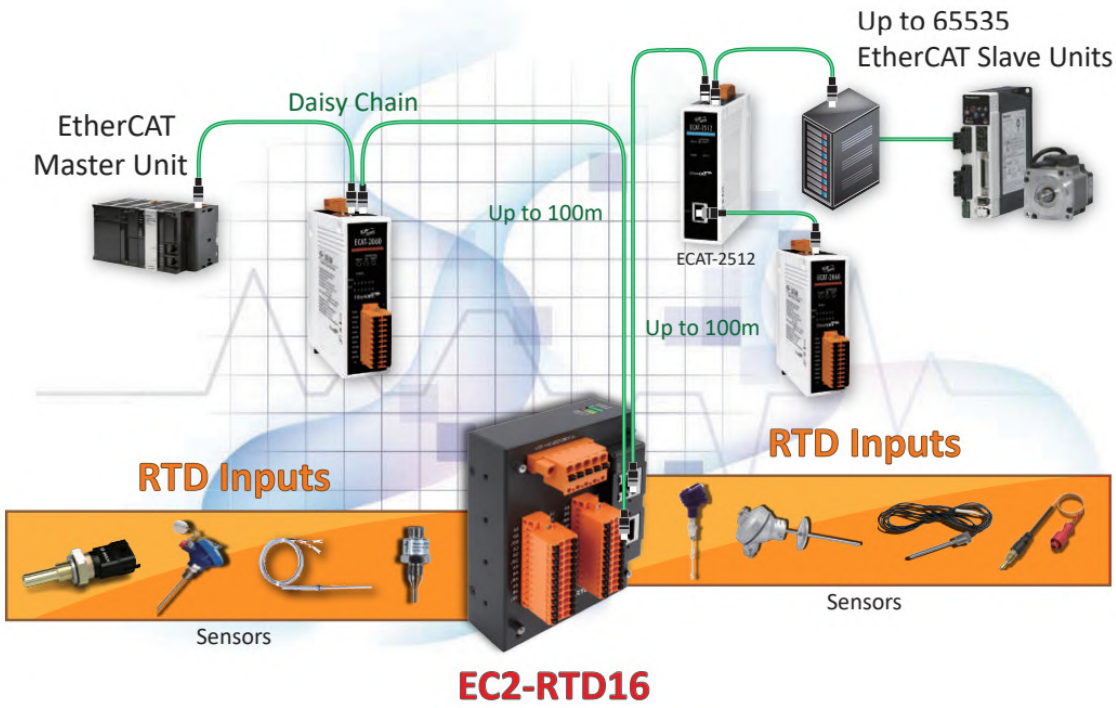


Figure 1.1 Typical Application of EC2-AI Module

1.1 Package List

The shipping package includes the following items:

EC2-AI Series

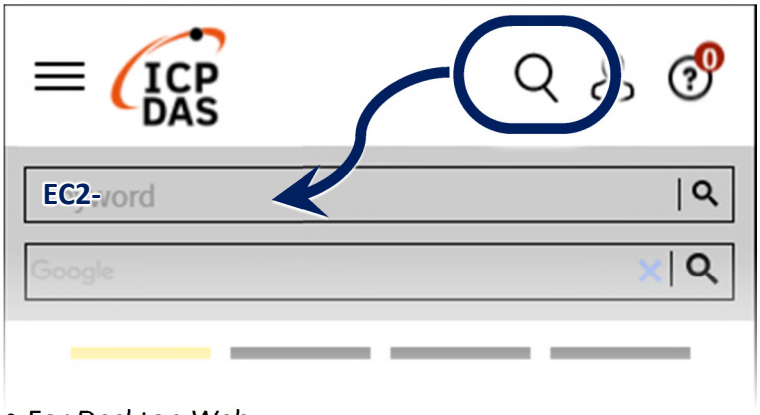
Quick Start

NOTE	If any of these items is missing or damaged, please contact your local distributor for more information. Keep the shipping materials and overall package in case you want to ship the module back in the future.

Resources

How to search for ESI, manuals and spec information on ICP DAS website(www.icpdas.com).

- For Mobile Web



- For Desktop Web

- For more detailed information related to the manual, hardware manual:
https://www.icpdas.com/en/product/guide+Industrial_Communication+EtherCAT+IO

1.2 Product Information

The EC2-AI series of EtherCAT slave modules support a range of AI formats, such as Thermocouple Input and RTD Input, etc. The table below provides a description of each model.

Model	Description
EC2-TC16	16-ch Thermocouple Inputs
EC2-RTD16	16-ch RTD Inputs

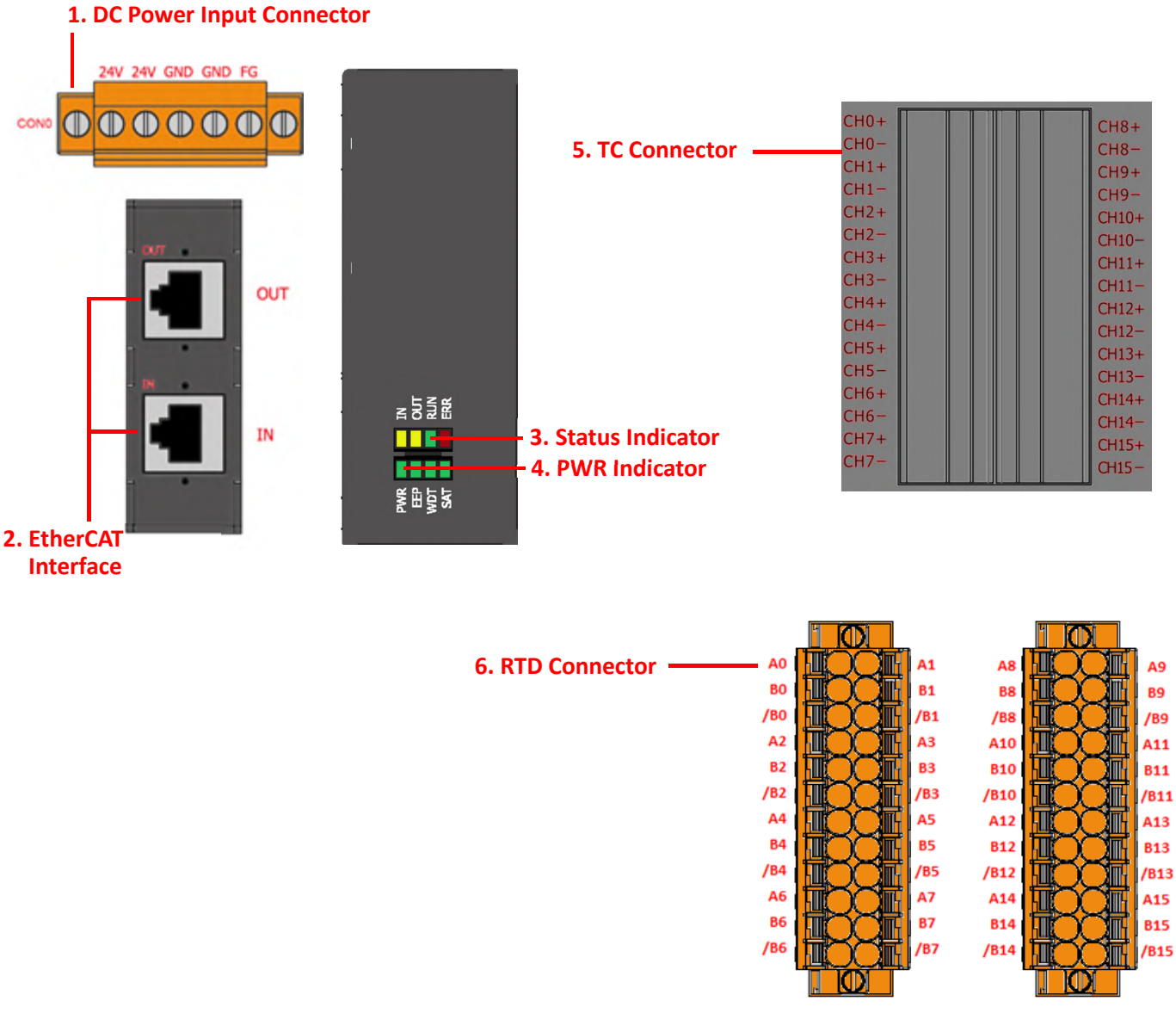
1.3 Selection Guide

Temperature Measurement					
Model	Channel	Resolution	Sampling Rate	Sensor Input	Accuracy
EC2-TC16	16	16-bit	1.5Hz, 100Hz (per channel)	Thermocouple: J, K, T, E, R, S, B, N, C, L, M, LDIN43710	±0.1 % of FSR
EC2-RTD16	16	16-bit	1.5Hz, 90Hz (per channel)	Pt100, Ni120, Cu50, Cu100	±0.1 % of FSR

2. Hardware Information

2.1 Appearance

The front panel and top panel of the EC2-AI series module contain the I/O connector, LEDs, Ethernet Port and power connector.



1. DC Power Input Connector

The **"24V"** and **"GND"** pins are used for the power supply applies to all types of EC2-AI series module. The valid power voltage range is from **+10 to +30 V_{DC}**.

The definition of **"F.G." (Frame Ground)**: Electronic circuits are constantly vulnerable to Electrostatic Discharge (ESD), which becomes worse in a continental climate area. EC2-AI series module feature a new design for the frame ground, which provides a path that bypasses ESD, resulting in an enhanced ESD protection capability and ensuring that the module is more reliable.

2. EtherCAT Interface

EC2-AI series modules are equipped with two RJ-45 EtherCAT Interface ports. **IN** is EtherCAT signal input port that connect EtherCAT Master or EtherCAT signal output of previous EtherCAT slave module，**OUT** is EtherCAT signal output that connect the next EtherCAT signal input of EtherCAT slave module.

3. Status Indicator

Notation	Color	States	Description
RUN	Green	Off	The device is in state INIT
		Blinking	The device is in state PRE-OPERARIONAL
		Single Flash	The device is in state SAFE-OPERARIONAL
		On	The device is in state OPERARIONAL
IN/OUT	Yellow	Off	No link
		Blinking	Link and activity
		On	Link without activity
ERR	Red	Off	PHY configuration is fault
		On	PHY configuration is normally
EEP	Green	Off	SII EEPROM loaded fault
		On	SII EEPROM loaded successfully
WDT	Green	Off	System watchdog event non-activity
		On	System watchdog event activily
SAT	Green	Off	Device configuration in saving mode
		On	Device configuration in protected mode

4. PWR LED Indicator

Once power is supplied to the EC2-AI series module, the system LED indicator will illuminate.

5. TC Connector

For more detailed information regarding the pin assignments for the I/O connector, refer to Section 2.3 “Pin Assignments”.

6. RTD Connector

For more detailed information regarding the pin assignments for the I/O connector, refer to Section 2.3 “Pin Assignments”.

2.2 Specification

2.2.1 System Specification

Item	Specification
Communication	
Ethernet Port	2 x RJ-45, 100 BASE-TX
Protocol	EtherCAT
Distance between Station	Max. 100 m (100 BASE-TX)
Data Transfer Medium	Ethernet/EtherCAT Cable (Min. CAT 5), Shielded
LED Indicators	
PWR	1
L/A IN (Link/Activity IN)	1
L/A OUT (Link/Activity OUT)	1
RUN	1
Other	ERR/WDT/SAT/EEP
EMS Protection	
ESD (IEC 61000-4-2)	4 KV Contact for Each Channel

EFT (IEC 61000-4-4)	Power: 1 KV Class A; Signal: 1 KV Class A
Surge (IEC 61000-4-5)	1 KV Class A
Hi-Pot	1 KV Class A
Power	
Powered from Terminal Block	+10 ~ +30 V_{DC}
Power Consumption	EC2-TC16: 1.6 W (Max.) EC2-RTD16: 1.6 W (Max.)
Mechanical	
Installation	DIN-Rail Mounting
Dimensions (L x W x D)	EC2-TC16: 122 mm x 83 mm x 65 mm EC2-RTD16: 112 mm x 83 mm x 68 mm
Environment	
Operating Temperature	-25 ~ +75°C
Storage Temperature	-30 ~ +80°C
Relative Humidity	10 ~ 90% RH, Non-condensing

2.2.2 I/O Specification

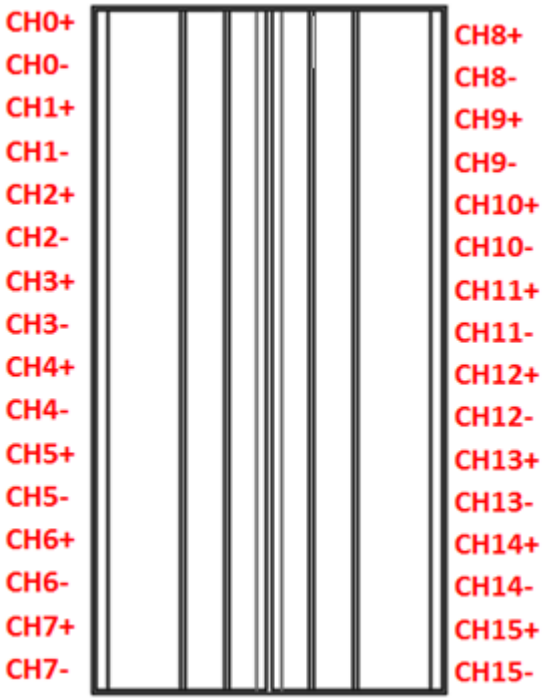
Model		EC2-TC16
Analog Input		
Channels		16
Sensor Type		Thermocouple (J, K, T, E, R, S, B, N, C, L, M, LDIN43710)
Resolution		16-bit
Accuracy		±0.1 % of FSR (25℃)
Sampling Rate	Normal Mode	1.5 Hz (per channel)
	Fast Mode	100 Hz (per channel)
Overvoltage Protection		30 VDC
Individual Channel Configuration		Yes
Open Wire Detection		Yes

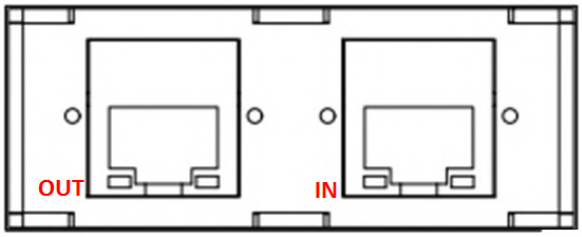
Model		EC2-RTD16
Analog Input		
Channels		16
Sensor Type		Pt100, Ni120, Cu50, Cu100
Resolution		16-bit
Accuracy		±0.1 % of FSR (25℃)
		±0.05 % of FSR (25℃)
Sampling Rate	Normal Mode	1.5 Hz (per channel)
	Fast Mode	90 Hz (per channel)

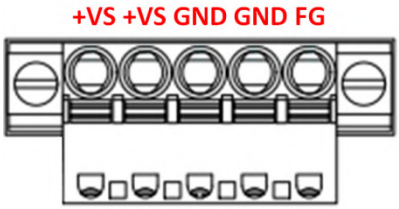
Input Impedance	> 1 MΩ
Overvoltage Protection	30 VDC
Individual Channel Configuration	Yes
3-wire RTD Lead Resistance Elimination	Yes
Open Wire Detection	Yes

2.3 Pin Assignments

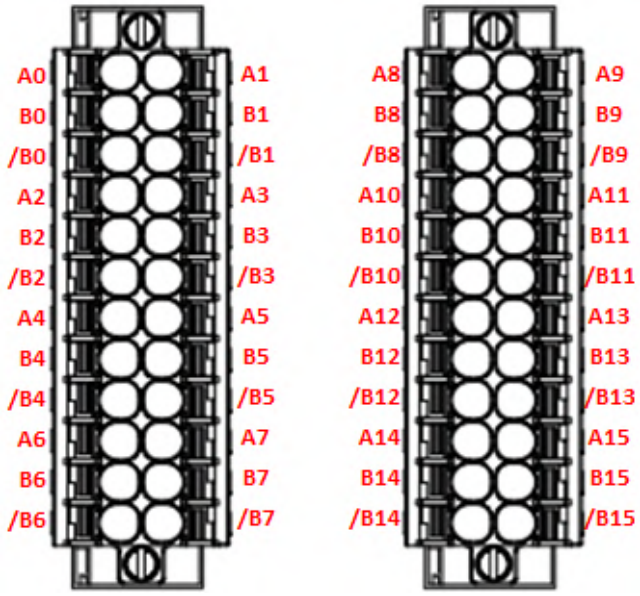
EC2-TC16

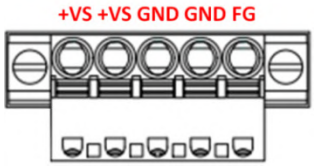


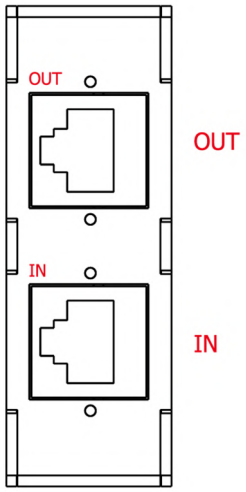




EC2-RTD16

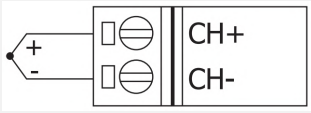




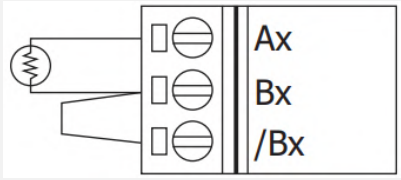


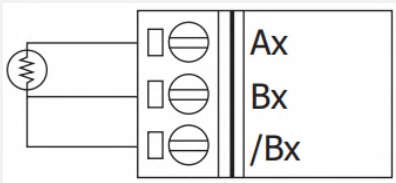
2.4 Wiring Connections

TC Wiring

Model	Thermocouple Inputs
EC2-TC16	

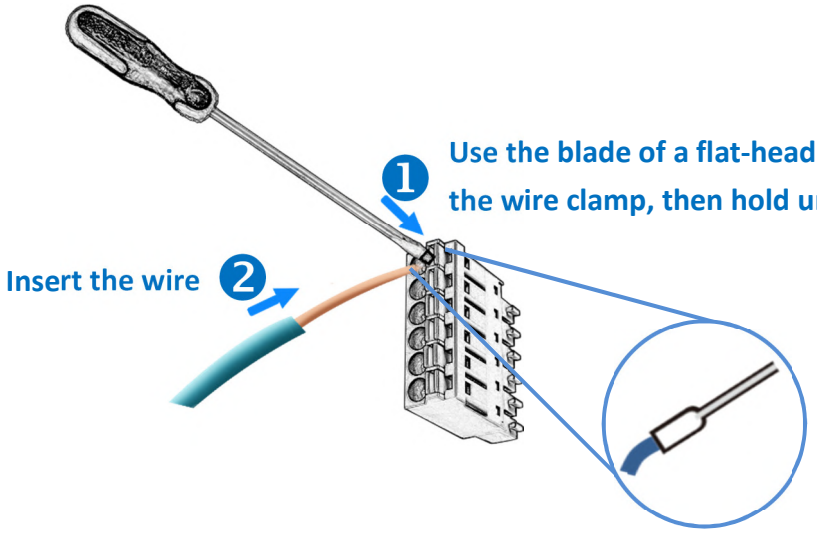
RTD Wiring

Model	2-wire RTD Connection
EC2-RTD16	

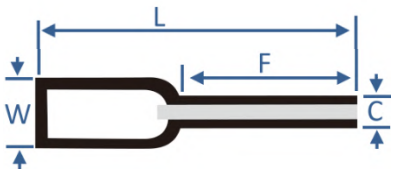
Model	3-wire RTD Connection
EC2-RTD16	

2.5 Wiring to the Connector

A tip for connection the wire to the connector

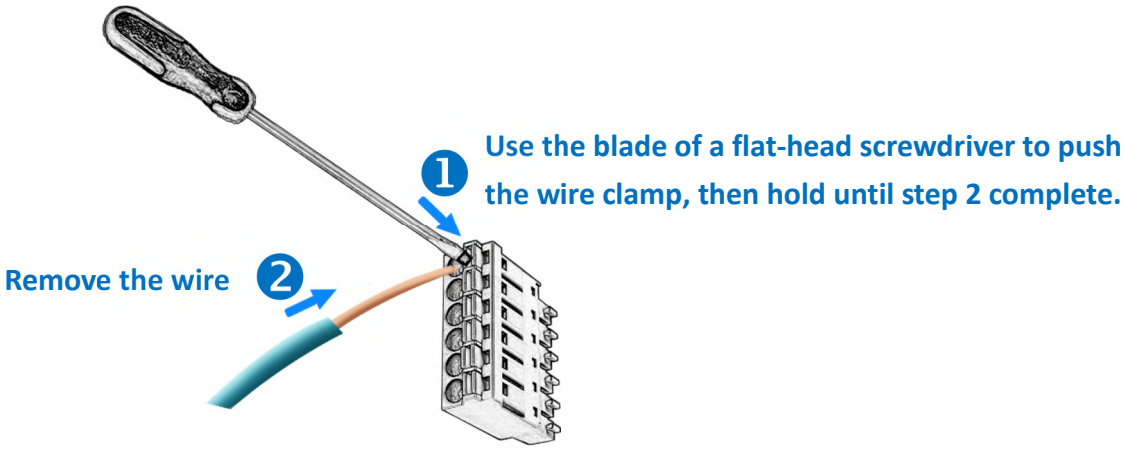


Insulated Terminals Dimensions



Dimensions (Unit: mm)				
Item NO.	F	L	C	W
CE007512	8.0	15.0	1.2	2.8

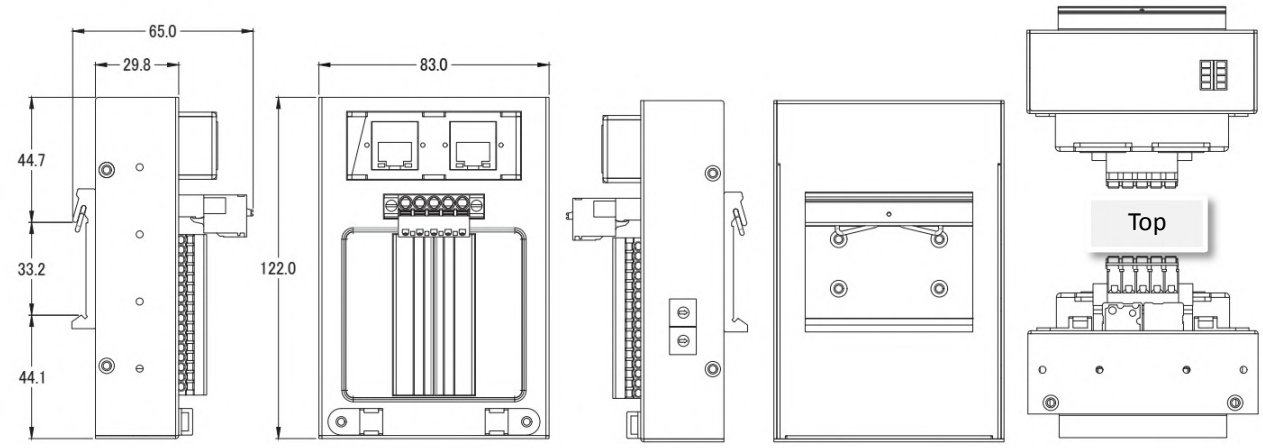
A tip for removing the wire from the connector



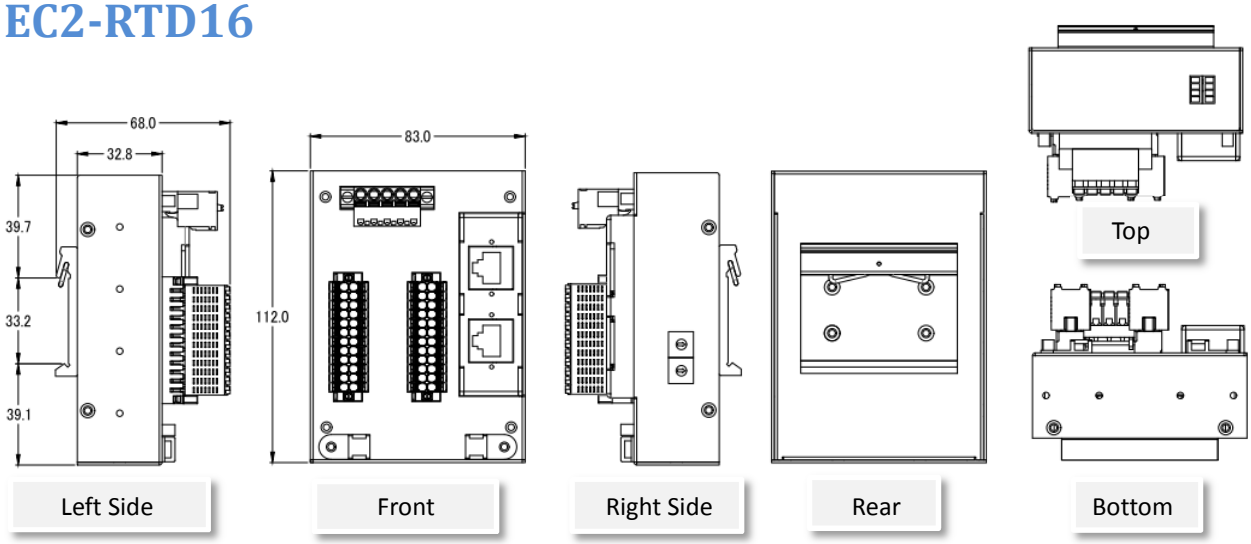
2.6 Dimensions

The following diagrams provide the dimensions of the EC2-AI series module and can be used as a reference when defining the specifications for any custom enclosures. All dimensions are in millimeters.

EC2-TC16



EC2-RTD16



3. Getting Started

This chapter provides a basic overview of how to configure and operate your EC2-AI series module.

3.1 Connecting the Power and the Host PC

Step 1

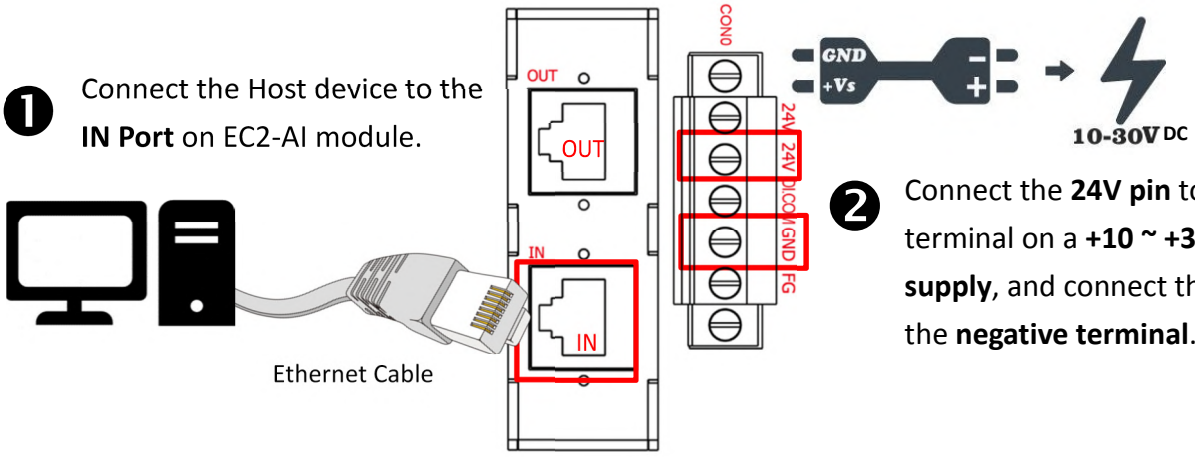
Connect both the IN port of EC2-AI module and RJ-45 Ethernet port of Host PC.

Ensure that the network settings on the Host PC have been correctly configured and are functioning normally. Ensure that the Windows firewall or any Anti-Virus firewall is properly configured to allow incoming connections, or temporarily disable these functions.

NOTE: Attaching an ESC (EtherCAT Slave Controller) directly to an office network will result in network flooding, since the ESC will reflect any frame – especially broadcast frames – back into the network (broadcast storm).

Step 2

Apply power to the EC2-AI module



Step 3

Verify the "PWR" LED indicator on the EC2-AI module is Yellow, "IN" LED indicator is Green.

3.2 Configuration and Operation

Beckhoff TwinCAT 2.X is most commonly used EtherCAT Master software to operate ECAT-2000 module.

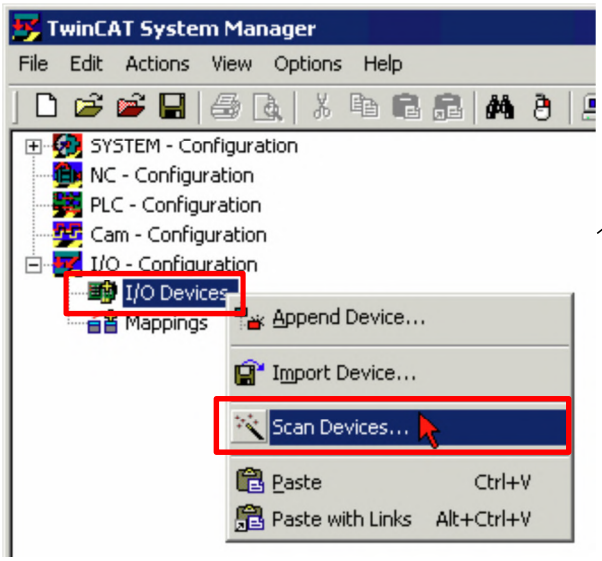
Inserting into the EtherCAT network

NOTE	**Installation of the latest XML device description(ESI)** Please ensure that you have installed the latest XML device description in TwinCAT. This can be downloaded and unzip file from the ICP DAS website ECx-TC (https://www.icpdas.com/en/download/index.php?model=EC2-TC16) ECx-RTD (https://www.icpdas.com/en/download/index.php?model=EC2-RTD16) and installed according to the installation instructions.

Step 1

Automatic Scanning

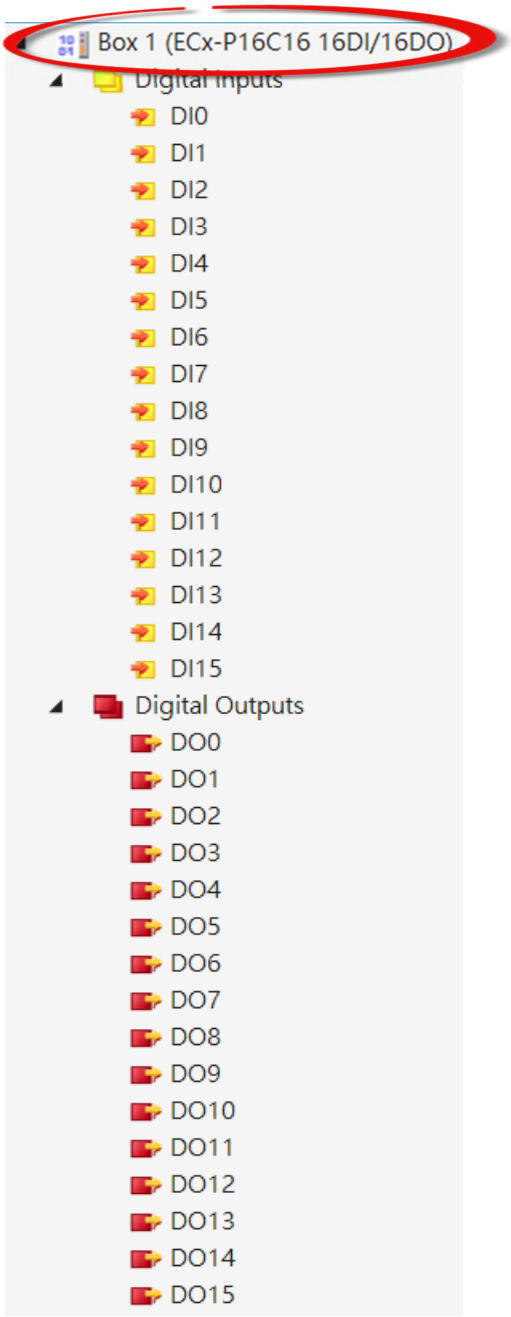
- The EtherCAT system must be in a safe, de-energized state before the module connected to EtherCAT network!
- Switch on the operating voltage, open the TwinCAT System Manager (Config mode), and scan in the devices (below the picture). Acknowledge all dialogs with **"OK"**, so that the configuration is in **"FreeRun"** mode.



Scanning in the configuration
(I/O Devices-> right-click-> Scan Devices...)

Step 2

Configuration via TwinCAT



In the left-hand of the TwinCAT System Manager, click on the branch of the EtherCAT Box you wish to configure (ECx-P16C16 in this example). Click DIx or DOx to get and configure state.

4. Object Description and Parameterization

4.1 Standard Object(0x1000-0x1FFF)

[ALL]Index 1000 Device Type

Index	Name	Meaning	Data type	Flags	Default
1000:00	Device type	Device type of the EtherCAT slave: the Lo-Word contains the CoE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x008F0191 (9372049dec)

[ALL]Index 1001 Device Type

Index	Name	Meaning	Data type	Flags	Default
1001:00	Error Register	Error Register for EtherCAT slave	UINT8	RO	0x00 (0dec)

[ALL]Index 1008 Device Name

Index	Name	Meaning	Data type	Flags	Default
1008:00	Device name	EtherCAT Slave Device Name	String	RO	Refer to following table

Table 4-1: Device Name

Model	Device Name
EC2-TC16	ECx-TC16
EC2-RTD16	ECx-RTD16

[ALL]Index 1009 Hardware Version

Index	Name	Meaning	Data type	Flags	Default
1009:00	Hardware version	Hardware version of the EtherCAT slave	String	RO	1.0.0

[ALL]Index 100A Software Version

Index	Name	Meaning	Data type	Flags	Default
100A:00	Software version	Firmware version for EtherCAT slave	String	RO	1.0.0

[ALL]Index 1018 Identity

Index	Name	Meaning	Data type	Flags	Default
1018:00	Identity	Information for identifying the slave	INT8	RO	0x04(4dec)
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00494350 (4801360dec)
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	Refer to following table
1018:03	Revision	Revision number of the EtherCAT slave;	UINT32	RO	Depend on device
1018:04	Serial number	Serial number of the EtherCAT slave	UINT32	RO	Depend on device

Table 4-2: Product Code

Model	Product Code
EC2-TC16	0xA30010(10682384dec)
EC2-RTD16	0xA40010(10747920dec)

[ALL]Index 10F1 Error Settings

Index	Name	Meaning	Data type	Flags	Default
10F1:00	Error Settings	Error Settings	INT8	RO	0x02(2dec)
10F1:01	Local Error Reaction	Local Error Reaction	UINT32	RO	0x00000001 (1dec)
10F1:02	Sync Error Counter Limit	Sync Error Counter Limit	UINT16	RO	0x0004 (4dec)

[ALL]Index 10F3 Diagnosis History

Index	Name	Meaning	Data type	Flags	Default
10F3:00	Diagnosis History	Diagnosis History	INT8	RW	0x05(5dec)
10F3:01	Maximum Messages	Maximum Messages	UINT8	M RO	0x14 (20dec)
10F3:02	Newset Message	Newset Message	UINT8	M RO	0x00 (0dec)
10F3:03	Newest Acknowledged Message	Newest Acknowledged Message	UINT8	M RW	0x00(0dec)
10F3:04	New Message Available	New Message Available	BOOLEAN	M RO P	FALSE (0dec)
10F3:05	Flags	Flags	UINT16	M RW	0x0000 (0dec)

[ALL]Index 1A0n Analog Inputs Mapping (for 0 ≤ n ≤ F)

Index	Name	Meaning	Data type	Flags	Default
1A0n:00	Analog Input Process Data Mapping	PDO Mapping TxPDOn	UINT8	RO	0x0A(10dec)
1A0n:01	SubIndex 001	PDO Mapping entry (object 0x60n0,entry 0x01)	UINT32	RO	0x60n0:01,1
1A0n:02	SubIndex 002	PDO Mapping entry (object 0x60n0,entry 0x02)	UINT32	RO	0x60n0:02,1
1A0n:03	SubIndex 003	PDO Mapping entry (object 0x60n0,entry 0x03)	UINT32	RO	0x60n0:03,2
1A0n:04	SubIndex 004	PDO Mapping entry (object 0x60n0,entry 0x05)	UINT32	RO	0x60n0:05,2
1A0n:05	SubIndex 005	PDO Mapping entry (object 0x60n0,entry 0x07)	UINT32	RO	0x60n0:07,1
1A0n:06	SubIndex 006	PDO Mapping entry (2 bits align)	UINT32	RO	0x60n0:00,1
1A0n:07	SubIndex 007	PDO Mapping entry (6 bits align)	UINT32	RO	0x60n0:00,6
1A0n:08	SubIndex 008	PDO Mapping entry (object 0x60n0,entry 0x0F)	UINT32	RO	0x60n0:0F,1
1A0n:09	SubIndex 009	PDO Mapping entry (object 0x60n0,entry 0x10)	UINT32	RO	0x60n0:10,1
1A0n:0A	SubIndex 010	PDO Mapping entry (object 0x60n0,entry 0x11)	UINT32	RO	0x60n0:11,16

[ALL]Index 1C00 Sync Manager Type

Index	Name	Meaning	Data type	Flags	Default
1C00:00	Sync manager type	Using the sync managers	UINT8	RO	0x04(4dec)
1C00:01	SubIndex 001	Sync-Manager Channel 1:Mailbox write	UINT8	RO	0x01(1dec)
1C00:02	SubIndex 002	Sync-Manager Channel 2:Mailbox read	UINT8	RO	0x02(2dec)
1C00:03	SubIndex 003	Sync-Manager Channel 3:Process data write	UINT8	RO	0x03(3dec)
1C00:04	SubIndex 004	Sync-Manager Channel 4:Process data read	UINT8	RO	0x04(4dec)

[EC2-TC16]Index 1C12 RxPDO Assign

Index	Name	Meaning	Data type	Flags	Default
1C12:00	RxPDO Assign	Sync manager assign outputs	UINT8	RO	0x10(16dec)
1C12:01	SubIndex 001	allocated RxPDO	UINT16	RW	0x1600(5632dec)
1C12:02	SubIndex 002	allocated RxPDO	UINT16	RW	0x1601(5633dec)
1C12:03	SubIndex 003	allocated RxPDO	UINT16	RW	0x1602(5634dec)
1C12:04	SubIndex 004	allocated RxPDO	UINT16	RW	0x1603(5635dec)
1C12:05	SubIndex 005	allocated RxPDO	UINT16	RW	0x1604(5636dec)
1C12:06	SubIndex 006	allocated RxPDO	UINT16	RW	0x1605(5637dec)
1C12:07	SubIndex 007	allocated RxPDO	UINT16	RW	0x1606(5638dec)
1C12:08	SubIndex 008	allocated RxPDO	UINT16	RW	0x1607(5639dec)
1C12:09	SubIndex 009	allocated RxPDO	UINT16	RW	0x1608(5640dec)
1C12:0A	SubIndex 010	allocated RxPDO	UINT16	RW	0x1609(5641dec)
1C12:0B	SubIndex 011	allocated RxPDO	UINT16	RW	0x160A(5642dec)

1C12:0C	SubIndex 012	allocated RxPDO	UINT16	RW	0x160B(5643dec)
1C12:0D	SubIndex 013	allocated RxPDO	UINT16	RW	0x160C(5644dec)
1C12:0E	SubIndex 014	allocated RxPDO	UINT16	RW	0x160D(5645dec)
1C12:0F	SubIndex 015	allocated RxPDO	UINT16	RW	0x160E(5646dec)
1C12:10	SubIndex 016	allocated RxPDO	UINT16	RW	0x160F(5647dec)

[EC2-RTD16]Index 1C12 RxPDO Assign

Index	Name	Meaning	Data type	Flags	Default
1C12:00	RxPDO Assign	PDO Assign Outputs	UINT8	RW	0x00(0dec)

[ALL]Index 1C13 TxPDO Assign

Index	Name	Meaning	Data type	Flags	Default
1C13:00	TxPDO Assign	Sync manager assign outputs	UINT8	RO	0x10(16dec)
1C13:01	SubIndex 001	allocated TxPDO	UINT16	RW	0x1A00(6656dec)
1C13:02	SubIndex 002	allocated TxPDO	UINT16	RW	0x1A01(6657dec)
1C13:03	SubIndex 003	allocated TxPDO	UINT16	RW	0x1A02(6658dec)
1C13:04	SubIndex 004	allocated TxPDO	UINT16	RW	0x1A03(6659dec)
1C13:05	SubIndex 005	allocated TxPDO	UINT16	RW	0x1A04(6660dec)
1C13:06	SubIndex 006	allocated TxPDO	UINT16	RW	0x1A05(6661dec)
1C13:07	SubIndex 007	allocated TxPDO	UINT16	RW	0x1A06(6662dec)
1C13:08	SubIndex 008	allocated TxPDO	UINT16	RW	0x1A07(6663dec)
1C13:09	SubIndex 009	allocated TxPDO	UINT16	RW	0x1A08(6664dec)
1C13:0A	SubIndex 010	allocated TxPDO	UINT16	RW	0x1A09(6665dec)
1C13:0B	SubIndex 011	allocated TxPDO	UINT16	RW	0x1A0A(6666dec)
1C13:0C	SubIndex 012	allocated TxPDO	UINT16	RW	0x1A0B(6667dec)
1C13:0D	SubIndex 013	allocated TxPDO	UINT16	RW	0x1A0C(6668dec)
1C13:0E	SubIndex 014	allocated TxPDO	UINT16	RW	0x1A0D(6669dec)
1C13:0F	SubIndex 015	allocated TxPDO	UINT16	RW	0x1A0E(6670dec)
1C13:10	SubIndex 016	allocated TxPDO	UINT16	RW	0x1A0F(6671dec)

[ALL] Index 1C32 SM Output Parameter

Index	Name	Meaning	Data type	Flags	Default
1C32:00	SM output parameter	Sync manager assign outputs	UINT8	RO	0x20(32dec)
1C32:01	Synchronization type	Current synchronization type: **Bit0 = 0**: Free Run **Bit1 = 1**:Synchron with SM 2 Event	UINT16	RW	0x0000(0dec)

		Bit15 = 0: Standard **Bit15 = 1**: FastOp mode (CoE deactivated)			
1C32:02	Cycle Time	Cycle time (in ns): **Free Run**: Cycle time of the local timer Synchronous with SM 2 event: Master cycle time	UINT32	RO	0x00000000 (0dec)
1C32:04	Synchronization type supported	Supported synchronization modes: **Bit0** = free run is supported **Bit1**= synchronous with SM 2 event is supported (outputs available) **Bit1**= synchronous with SM 3 event is supported (no outputs available) **Bit4-5**= 01: input shift with SYNC 1 event (no outpus available) **Bit14**= 1: dynamic times	UINT16	RO	0x401F (16415dec)
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000186A0 (100000dec)
1C32:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master	UINT32	RO	0x00000000 (0dec)
1C32:08	Get cycle time	With this entry the real required process data provision time can be measured. **0**: Measurement of the local cycle time is stopped **1**: Measurement of the local cycle time is statred	UINT16	RW	0x0000(0dec)
1C32:09	Delay time	Time between SYNC1 event and reading of the inputs	UINT32	RO	0x00000000 (0dec)
1C32:0A	Sync0 cycle time	SYNC0 cycle time (in ns)	UINT32	RW	0x00000000 (0dec)
1C32:0B	SM-event missed	Number of missed SM events in OPERATIONAL	UINT16	RO	0x0000(0dec)
1C32:0C	Cycle Time Too Small	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000(0dec)
1C32:20	Sync error	The synchronization was not correct in the last cycle	BOOLEAN	RO	FALSE(0dec)

[ALL]Index 1C33 SM Input Parameter

Index	Name	Meaning	Data type	Flags	Default
1C33:00	SM output parameter	Sync manager assign outputs	UINT8	RO	0x20(32dec)
1C33:01	Synchronization type	Current synchronization type: **Bit0 = 0**: Free Run **Bit1 = 1**:Synchron with SM 2 Event **Bit15 = 0**: Standard **Bit15 = 1**: FastOp mode (CoE deactivated)	UINT16	RW	0x0000(0dec)
1C33:02	Cycle Time	Cycle time (in ns): **Free Run**: Cycle time of the local timer Synchronous with SM 2 event: Master cycle time	UINT32	RO	0x00000000 (0dec)
1C33:04	Synchronization type supported	Supported synchronization modes: **Bit0** = free run is supported **Bit1**= synchronous with SM 2 event is supported (outputs available) **Bit1**= synchronous with SM 3 event is supported (no outputs available) **Bit4-5**= 01: input shift with SYNC 1 event (no outpus available) **Bit14**= 1: dynamic times	UINT16	RO	0x401F (16415dec)
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000186A0 (100000dec)
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master	UINT32	RO	0x00000000 (0dec)
1C33:08	Get cycle time	With this entry the real required process data provision time can be measured. **0**: Measurement of the local cycle time is stopped **1**: Measurement of the local cycle time is statred	UINT16	RW	0x0000(0dec)
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs	UINT32	RO	0x00000000 (0dec)
1C33:0A	Sync0 cycle time	SYNC0 cycle time (in ns)	UINT32	RW	0x00000000 (0dec)
1C33:0B	SM-event missed	Number of missed SM events in OPERATIONAL	UINT16	RO	0x0000(0dec)
1C33:0C	Cycle Time Too Small	Number of occasions the cycle time was	UINT16	RO	0x0000(0dec)

		exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)			
1C33:20	Sync error	The synchronization was not correct in the last cycle	BOOLEAN	RO	FALSE(0dec)

4.2 Profile Specific Objects(0x6000-0x7FFF)

[ALL]Index 60n0 Analog Inputs (for 0 ≤ n ≤ F)

Index	Name	Meaning	Data type	Flags	Default
60n0:00	TC Inputs RTD Inputs	Maximum subindex	UINT8	RO	0x11(17dec)
60n0:01	Status_Underrange	Value below measuring range	BOOLEAN	RO P	FALSE(0dec)
60n0:02	Status_Overrange	Measuring range exceeded	BOOLEAN	RO P	TRUE(1dec)
60n0:03	Limit 1	Limit value monitoring Limit 1 0: not active 1: Value is smaller than Limit Value1 2: Value is larger than Limit Value1 3: Value is equal to Limit Value1	Bit2	RO P	0x00(0dec)
60n0:05	Limit 2	Limit value monitoring Limit 2 0: not active 1: Value is smaller than Limit Value2 2: Value is larger than Limit Value2 3: Value is equal to Limit Value2	Bit2	RO P	0x00(0dec)
60n0:07	Status_Error	The error bit is set if the data is invalid (over-rang, un-der-range)	BOOLEAN	RO P	TRUE(1dec)
60n0:0F	Status_TxPDO State	Validity of the data of the associated TxPDO (0=valid, 1=invalid)	BOOLEAN	RO P	FALSE(0dec)
60n0:10	Status_TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO P	FALSE(0dec)
60n0:11	Value	Analog input data	BOOLEAN	RO P	0x0104(259dec)

[EC2-TC16]Index 70n0 TC Outputs (for 0 ≤ n ≤ F)

Index	Name	Meaning	Data type	Flags	Default
70n0:00	TC Outputs		UINT8	RO	0x11(17dec)
70n0:11	CJCompensation		INT16	RW P	0x0000(0dec)

4.3 Profile Specific Objects(0x8000-0x8FFF)

[EC2-TC16]Index 80n0 TC Settings (for 0<=n<=F)

Index	Name	Meaning	Data type	Flags	Default
80n0:00	TC Settings		UINT8	RO	0x1B(27dec)
80n0:01	Enable user scale	**User scale is active**	BOOLEAN	RW	FALSE(0dec)
80n0:02	Presentation	**0:** Signed **1:** Absolute MSB sign **2:** High resolution	Bit3	RW	Signed(0)
80n0:05	Enable TC Channel	Enable TC Channel	BOOLEAN	RW	TRUE(1dec)
80n0:06	Enable filter	**0:** FALSE **1:** TRUE	BOOLEAN	RW	TRUE(1dec)
80n0:07	Enable limit 1	**Limit 1 enable**	BOOLEAN	RW	FALSE(0dec)
80n0:08	Enable limit 2	**Limit 2 enable**	BOOLEAN	RW	FALSE(0dec)
80n0:0A	Enable user calibration	**Enabling of the user calibration**	BOOLEAN	RW	FALSE(0dec)
80n0:0B	Enable vendor calibration	**Enabling of the vendor calibration**	BOOLEAN	RW	TRUE(1dec)
80n0:0C	Coldjunction compensation	**0:** Intern **1**: No **2**: Extern processdata(1/10℃)	UINT8	RW	Intern(0dec)
80n0:0E	Disable wire break detection	**0:** FALSE **1:** TRUE	BOOLEAN	RW	FALSE(0dec)
80n0:0F	SubIndex 015		INT8	RO	0x00(0dec)
80n0:11	User scale offset	User scaling offset	INT16	RW	0x00(0dec)
80n0:12	User scale gain	User scaling gain. The value 1 corresponds to 65535 dec (0x00010000) and is limited to ±0x7FFFF.	INT32	RW	0x00010000 (65536dec)
80n0:13	Limit 1	First limit value for setting the status bits	INT16	RW	0x8000(-32768)
80n0:14	Limit 2	Second limit value for setting the status bits	INT16	RW	0x7FFF(32767)
80n0:15	Filter settings	1.5 Hz, 100 Hz	Enum	RW	100 Hz(1)
80n0:17	User calibration offset	User offset compensation	INT32	RW	0
80n0:18	User calibration gain	User calibration gain	INT32	RW	0x01000000(16777216)
80n0:19	TC element	J, K, T, E, R, S, B, N, C, L, M, LDIN43710	UINT16	RW	K(-270 ~ 1372 ℃)(1)
80n0:1A	MC filter	Inactive, IIR 1 ~ IIR 8	UINT16	RW	Inactive (0)
80n0:1B	FactoryCMD	Factory Command	UINT32	RW	0x00000000 (0)

[ECx-RTD16]Index 80n0 RTD Settings (for 0<=n<=F)

Index	Name	Meaning	Data type	Flags	Default
80n0:00	RTD Settings		UINT8	RO	0x1B(27dec)
80n0:01	Enable user scale	**User scale is active**	BOOLEAN	RW	FALSE(0dec)
80n0:02	Presentation	**0:** Signed **1:** Absolute MSB sign **2:** High resolution	Bit3	RW	Signed(0)
80n0:05	Enable RTD Channel	Enable RTD Channel	BOOLEAN	RW	TRUE(1dec)
80n0:06	Enable filter	**0:** FALSE **1:** TRUE	BOOLEAN	RW	TRUE(1dec)
80n0:07	Enable limit 1	Limit 1 enable	BOOLEAN	RW	FALSE(0dec)
80n0:08	Enable limit 2	Limit 2 enable	BOOLEAN	RW	FALSE(0dec)
80n0:09	SubIndex 009		BOOLEAN	RO	FALSE(0dec)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	FALSE(0dec)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	TRUE(1dec)
80n0:11	User scale offset	User scaling offset	INT16	RW	0x00(0dec)
80n0:12	User scale gain	User scaling gain. The value 1 corresponds to 65535 dec (0x00010000) and is limited to ±0x7FFFF.	INT32	RW	0x00010000 (65536dec)
80n0:13	Limit 1	First limit value for setting the status bits	INT16	RW	0x8000(-32768)
80n0:14	Limit 2	Second limit value for setting the status bits	INT16	RW	0x7FFF(32767)
80n0:15	Filter settings	1.5 Hz, 90 Hz	Enum	RW	1.5 Hz(0)
80n0:17	User calibration offset	User offset compensation	INT32	RW	0
80n0:18	User calibration gain	User calibration gain	INT32	RW	0x01000000(16 777216)
80n0:19	RTD element	0: Pt 100, α = 0.00385 (-200 ~ 600°C) 1: Pt 100, α = 0.003916 (-200 ~ 600°C) 2: Ni 100 (-60 ~ 180°C) 3: Ni 120 (-80 ~ 150°C) 4: Cu 50 (-50 ~ 150°C) 5: Cu 100, α = 0.00421 (-20 ~ 150°C) 6: Cu 100, α = 0.00427 (0 ~ 200°C) 7: Cu 100, α = 0.00428 (0 ~ 150°C) 8: Resistance (0 ~ 655Ω)	UINT16	RW	Pt 100, α = 0.00385 (-200 ~ 600°C)
80n0:1A	MC filter	Inactive, IIR 1 ~ IIR 8	UINT16	RW	Inactive (0)
80n0:1B	Wire calibration	Wire calibration 0x8000 ~ 0x7FFF	INT16	RW	0x0000(0dec)
80n0:1C	FactoryCMD	Factory Command	UINT32	RW	0x00000000 (0)

[EC2-TC16]Index 80nE TC Internal data (for 0<=n<=F)

Index	Name	Meaning	Data type	Flags	Default
80nE:00	TC Internal Data		UINT8	RO	0x3(3dec)
80nE:01	ADC raw value TC	ADC raw value	UINT32	RO	
80nE:02	Calibrated ADC raw value TC	Calibrated ADC raw value TC	UINT32	RO	
80nE:03	CJ temperature	CJ data	INT16	RO	

[ECx-RTD16]Index 80nE RTD Internal data (for 0<=n<=F)

Index	Name	Meaning	Data type	Flags	Default
80nE:00	RTD Internal Data		UINT8	RO	0x3(3dec)
80nE:01	ADC raw value RTD	ADC raw value	UINT32	RO	
80nE:02	Calibrated ADC raw value RTD	Calibrated ADC raw value RTD	UINT32	RO	
80nE:03	Resistance	Resistance data	UINT16	RO	

[EC2-TC16]Index 80nF TC Vendor data (for 0<=n<=F)

Index	Name	Meaning	Data type	Flags	Default
80nF:00	TC Vendor Data		UINT8	RO	0x3(3dec)
80nF:01	Calibration offset TC	Offset TC(vendor calibration)	INT32	RW	
80nF:02	Calibration gain TC	Gain TC(vendor calibration)	UINT32	RW	
80nF:03	CJ offset	Offset CJ(vendor calibration)	INT32	RW	0x0(0dec)

[ECx- RTD16]Index 80nF RTD Vendor data (for 0<=n<=F)

Index	Name	Meaning	Data type	Flags	Default
80nF:00	RTD Vendor Data		UINT8	RO	0x3(3dec)
80nF:01	Calibration offset RTD	Offset RTD(vendor calibration)	UINT32	RW	
80nF:02	Calibration gain RTD	Gain RTD(vendor calibration)	UINT32	RW	

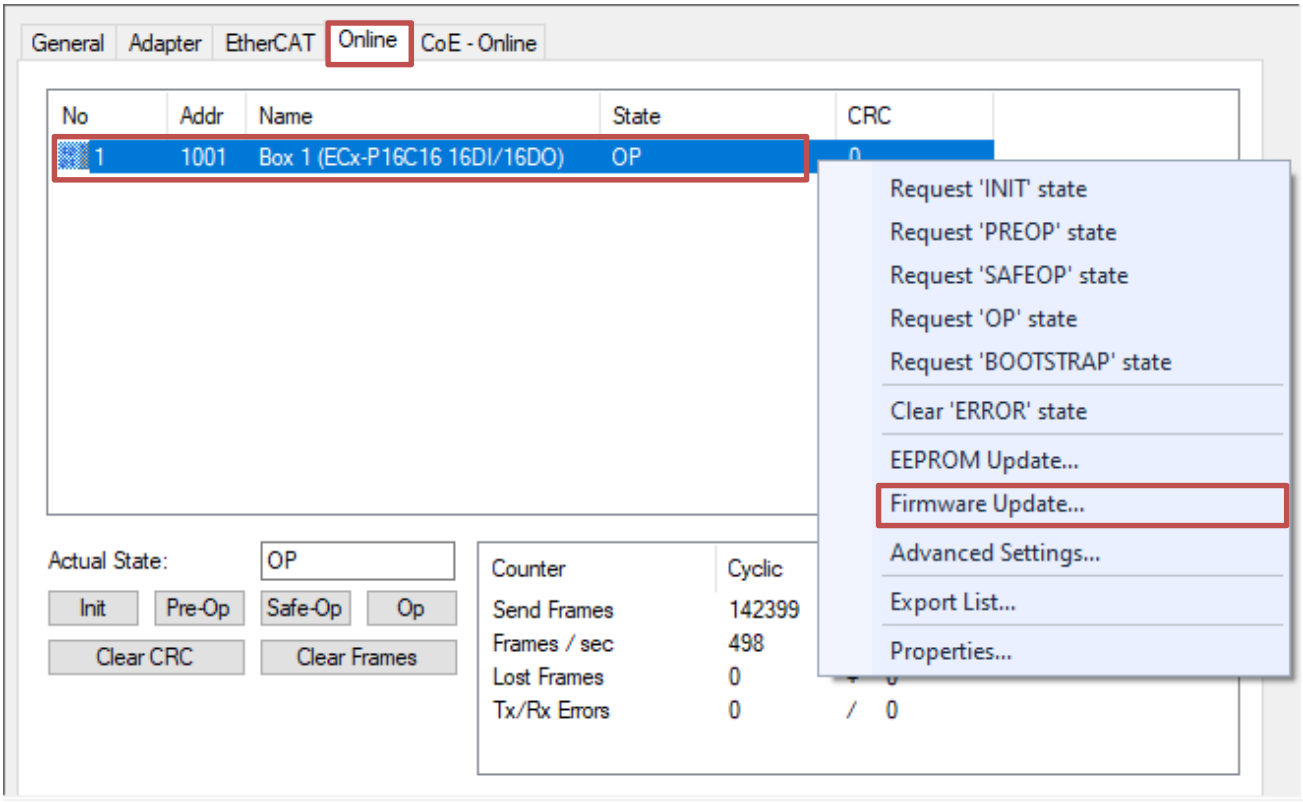
5. Firmware upgrade through EtherCAT FoE

This section describes the device update for ICP DAS EtherCAT slaves from the EC1, EC2 and EC8 series.

Demonstrate how to update firmware using Beckhoff TwinCAT 3 EtherCAT master.

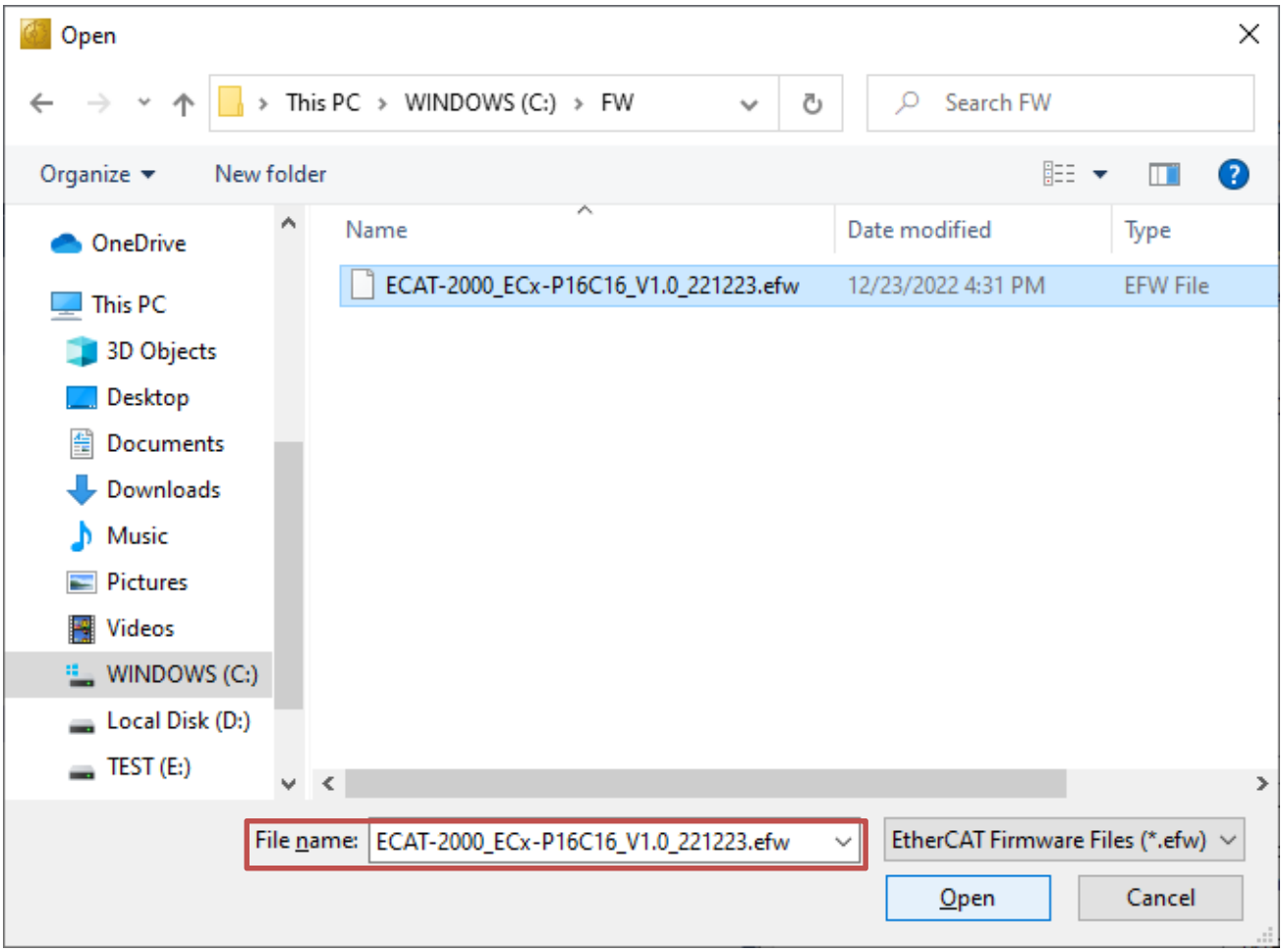
Step 1

Right-click the ECx-DIO Module, click "**Firmware Update…**".



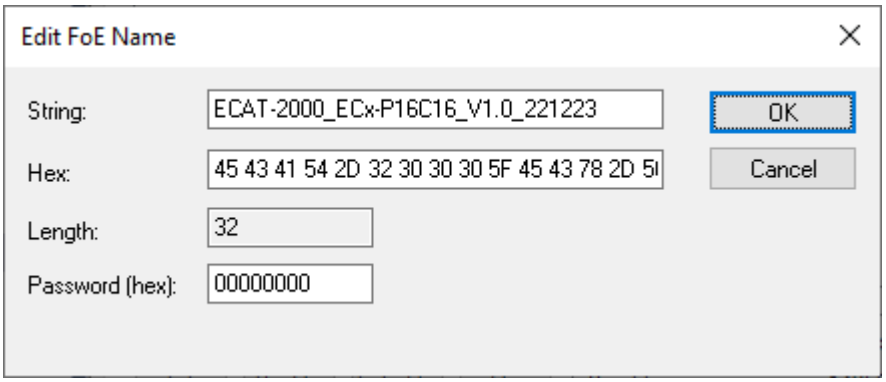
Step 2

Select the firmware file(*.efw).



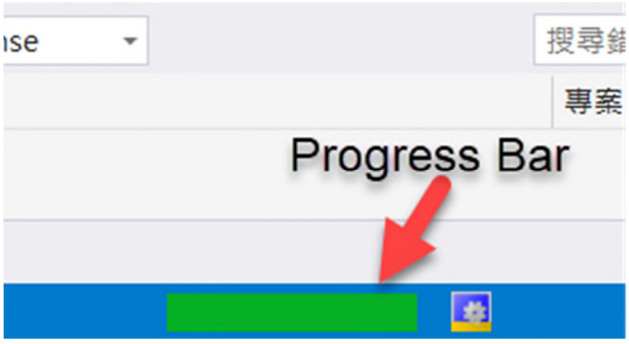
Step 3

Click ok button to start upgrade firmware.



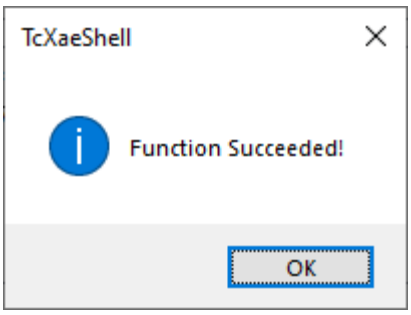
Step 4

Check out the progress bar and wait for it finish.

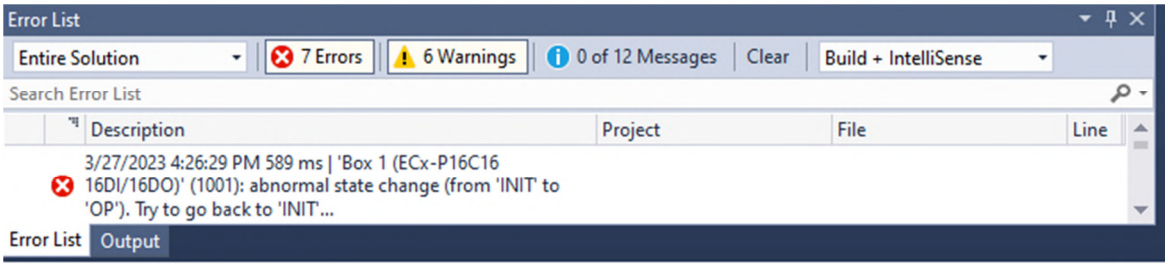


Step 5

TwinCAT master will notice user the function successes, just click “OK”.



NOTE: Due to the ECx-IO will restart the system after firmware upgrading so that TwinCAT will indicate the slave not in the expected state. Don’t worry, this is a normal situation. TwinCAT will try to switch the slave to original state (ex: OP or BOOTSTRAP).

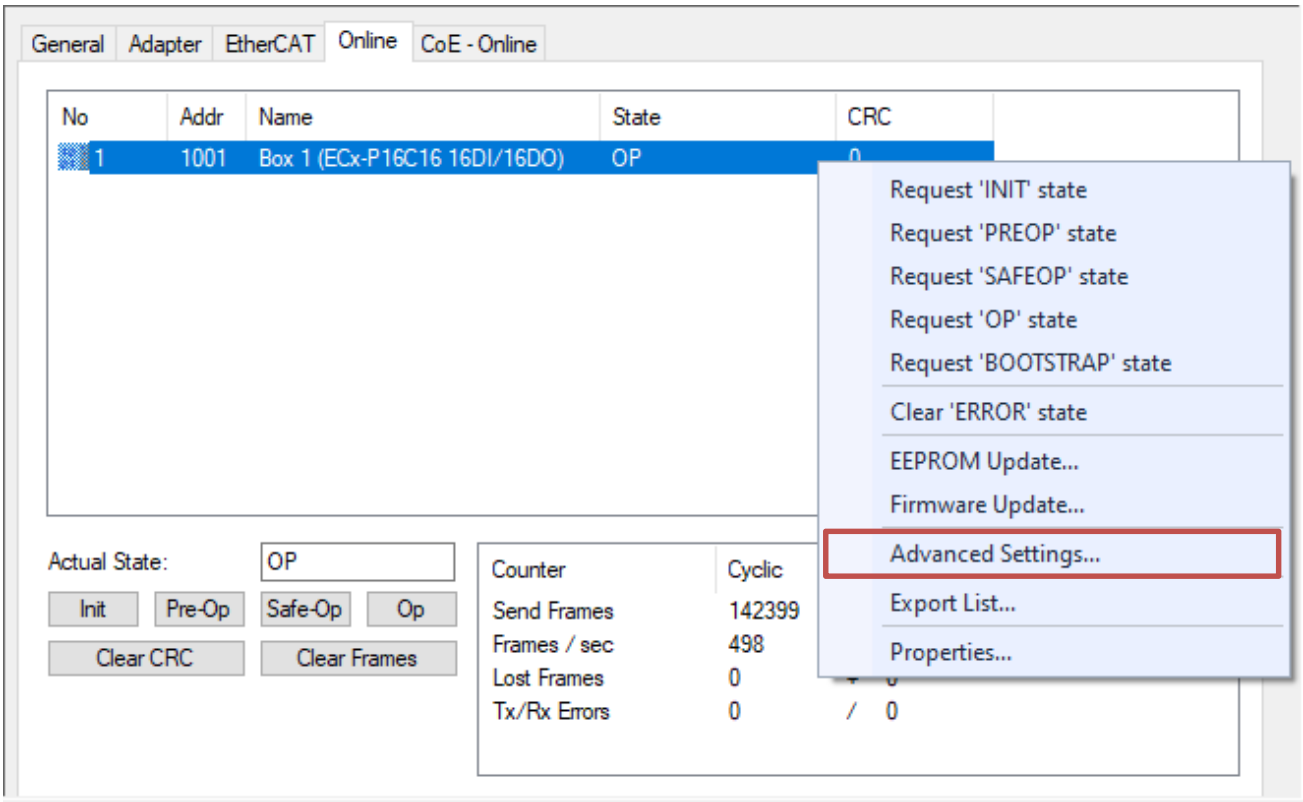


6. Explicit Device ID

Explicit Device ID is used for met identification function of TwinCAT master.
User can specify an ID at EtherCAT slave side and setup identification at TwinCAT master side.
TwinCAT master will check if the ID of the slave matched with the expected identification value during startup the slave.

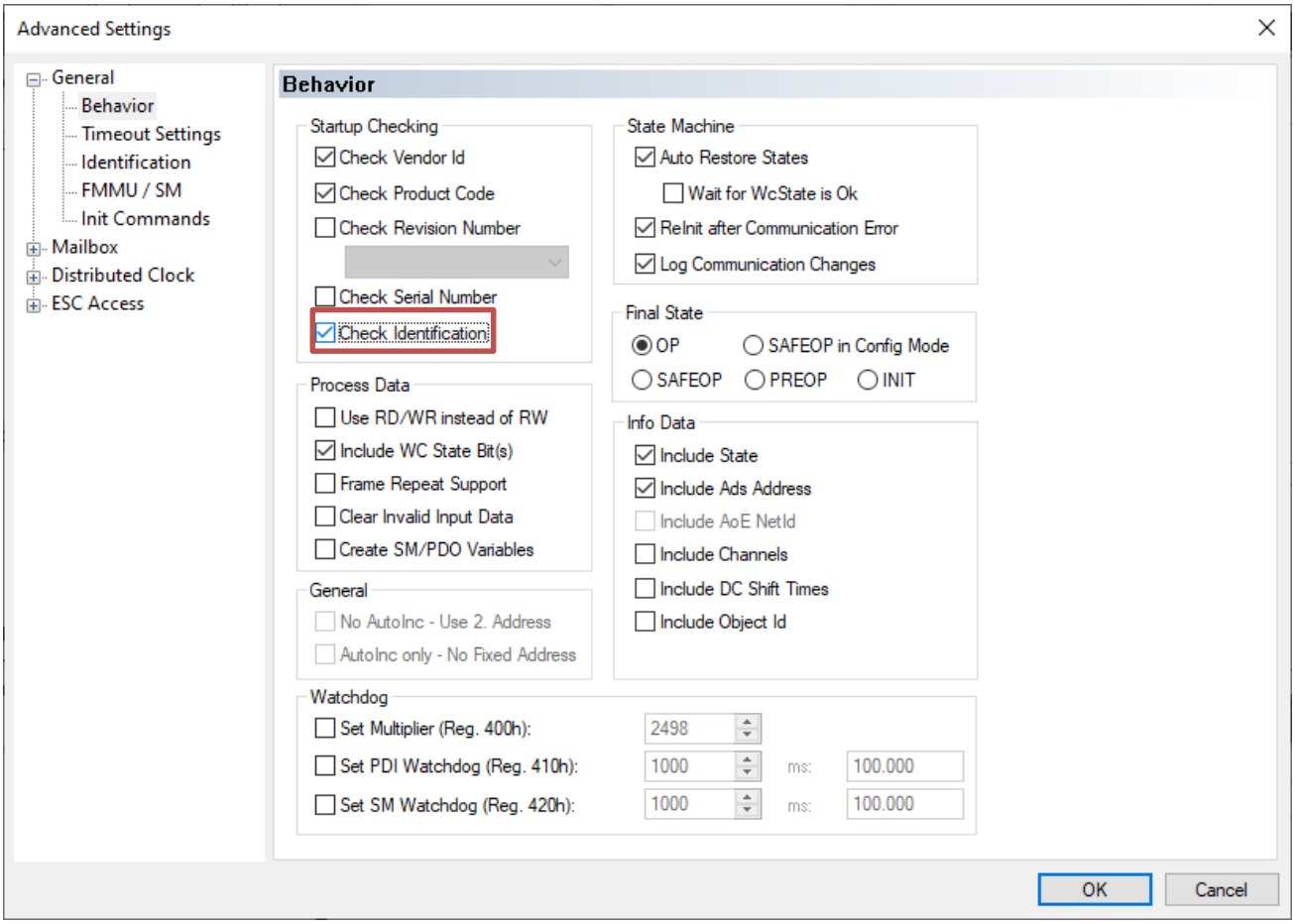
Step 1

This setting will let TwinCAT master turn on the identification function for the slave.
Select the slave, right-click and select "**Advanced Settings…**".



Step 2

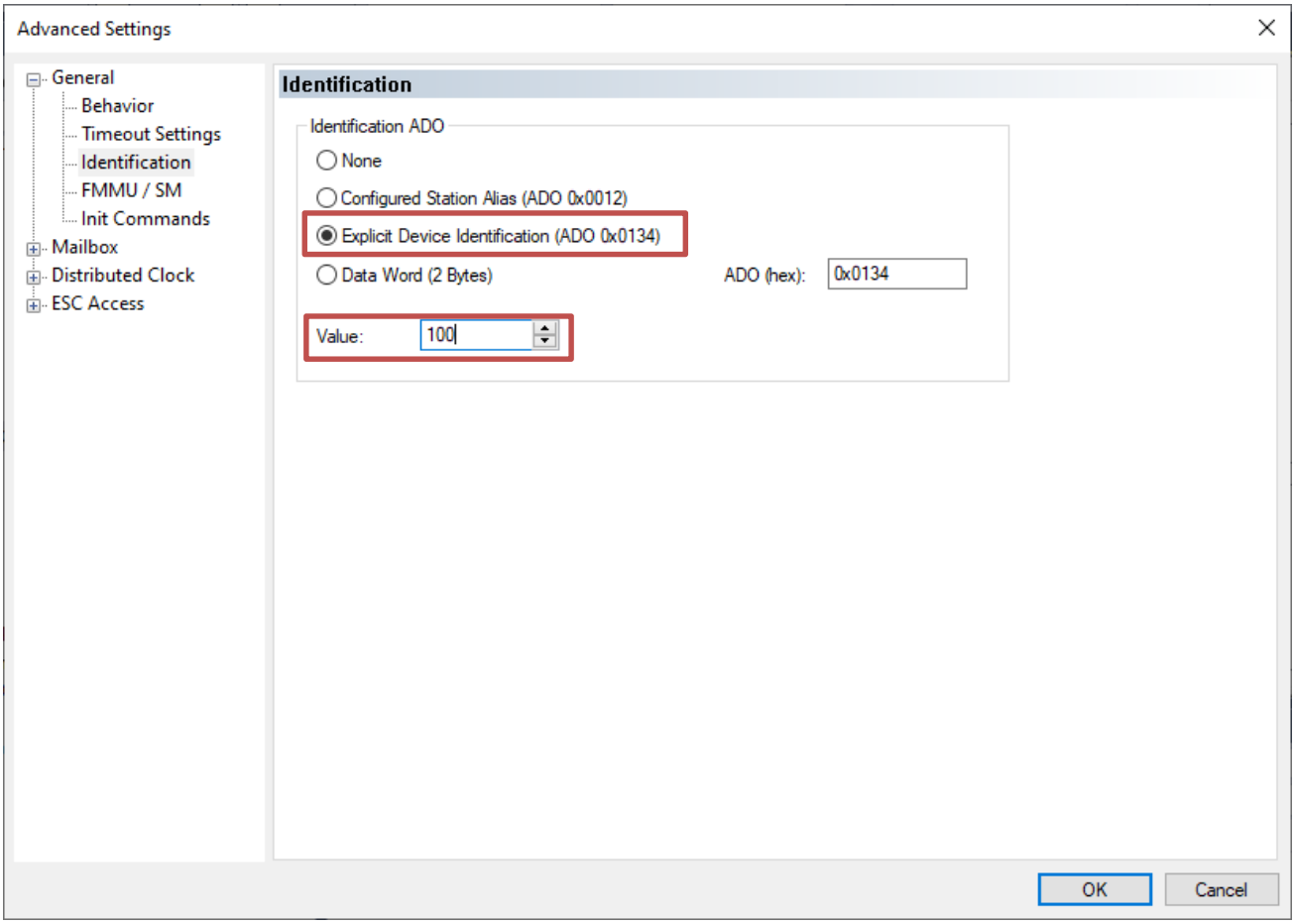
Go to **“General -> Behavior”** and turn on the “Check Identification”.



Step 3

Confirm current identification ADO (Address Offset) is "**(ADO 0x0134)**".

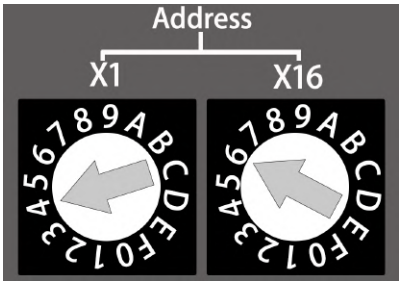
Don't forget to assign the value in decimal. The value "**100**" is just an example here.



Step 4

User should also setup the same value on moduel like following:

The digit format "Rotary Switch" is hex so that we should set it to "**0x64**".

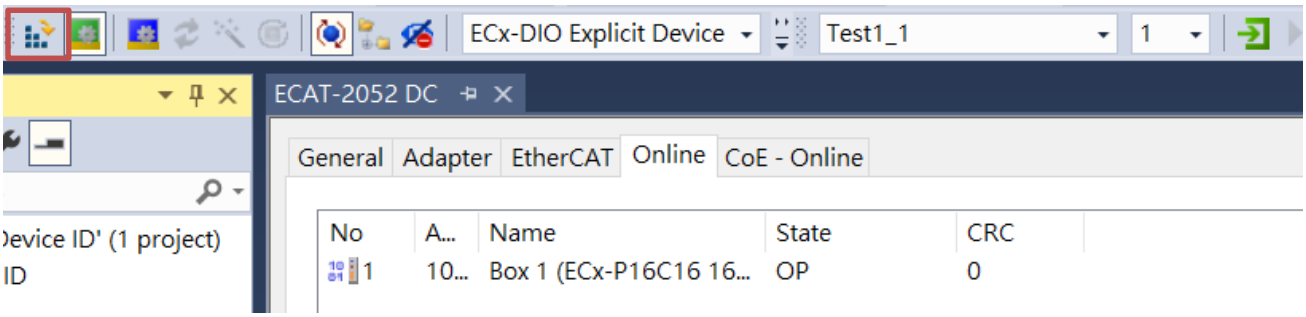


Step 5

Please disconnect the power connect to **reboot** the module

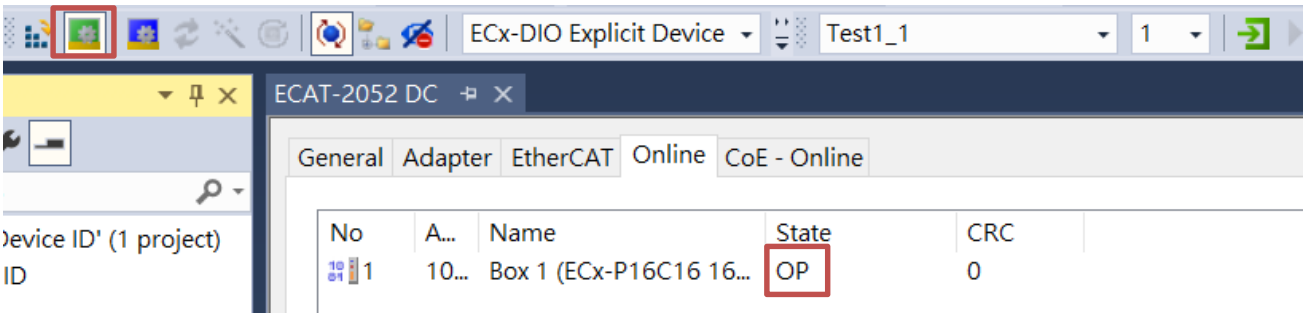
Step 6

Re-activate the TwinCAT master.



Step 7

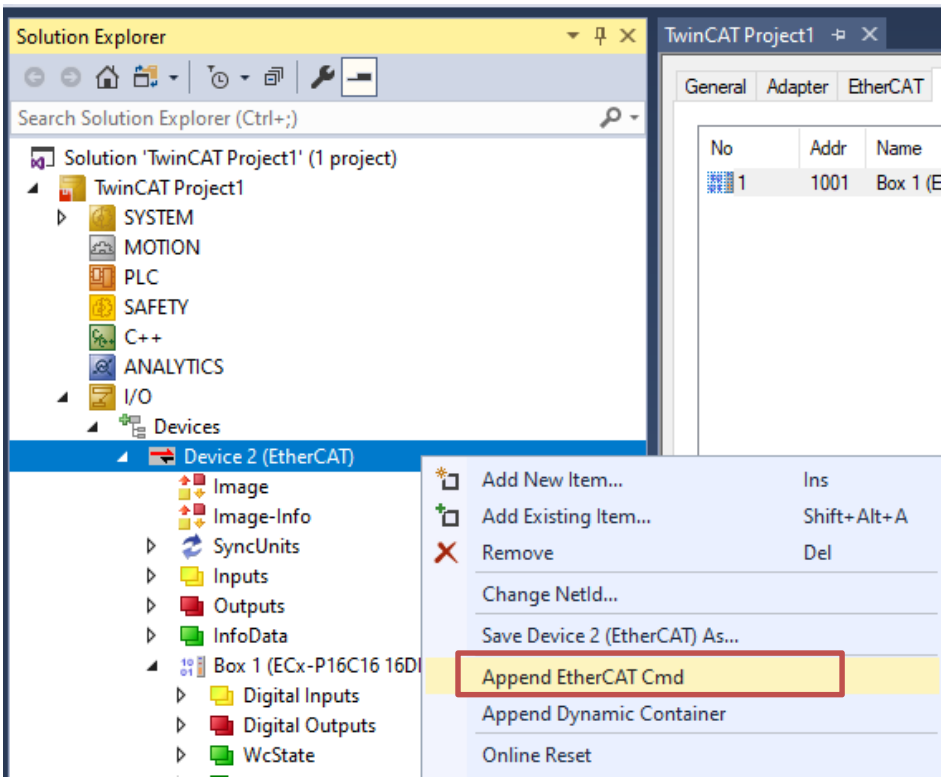
If user see the below screen, that means that TwinCAT master already enter running mode successfully and the slave also passed the identification checking so that it can enter OP state.



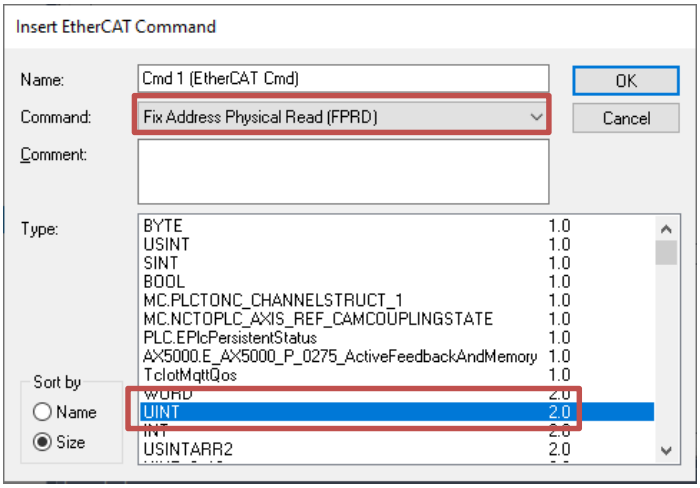
Step 8

The slave will also accept frames from TwinCAT master with 2 kinds of address (1001 or 100) at the same time.But it needs to turn on second address function in ESC register. However, we arrange command for observe this behavior first.

You can append an EtherCAT command to TwinCAT master for confirm the second address.
Click "**Device N (EtherCAT) -> Append EtherCAT Cmd**".



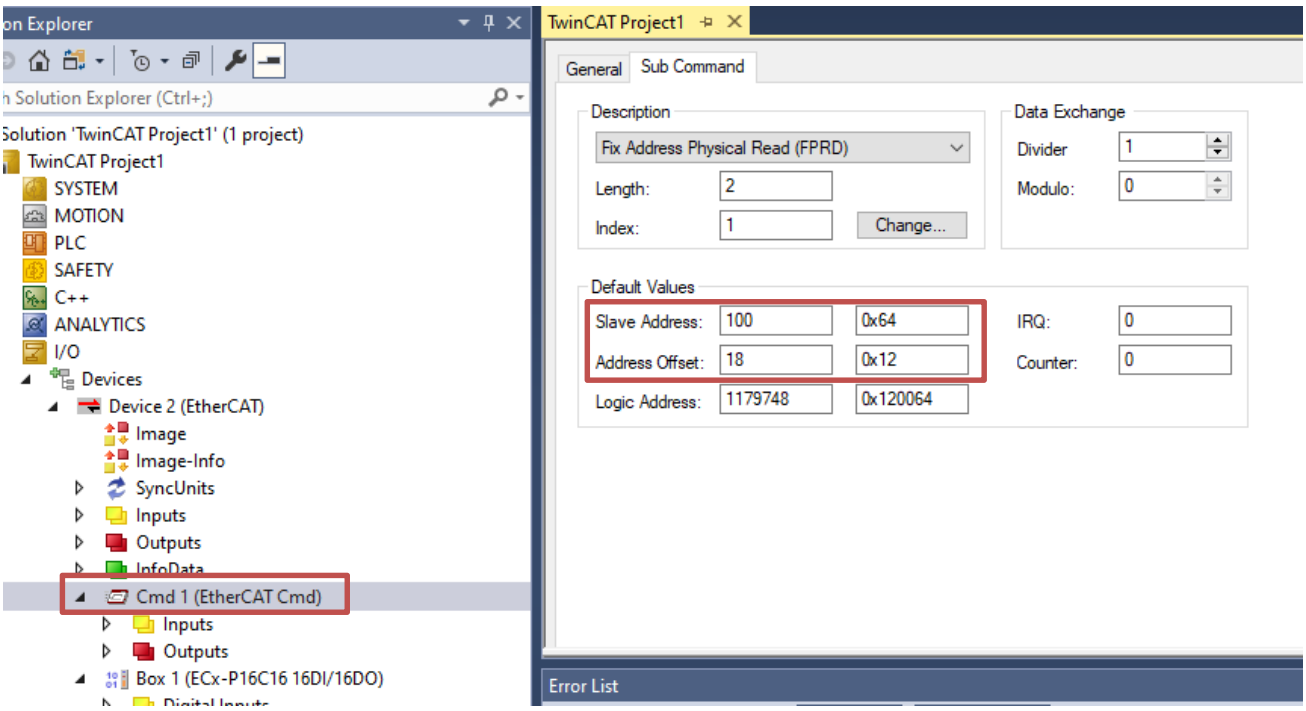
Please assign "**Command**" and "**Type**".
I demonstrate "**FPRD**" and "**UINT**" in this example.



Step 9

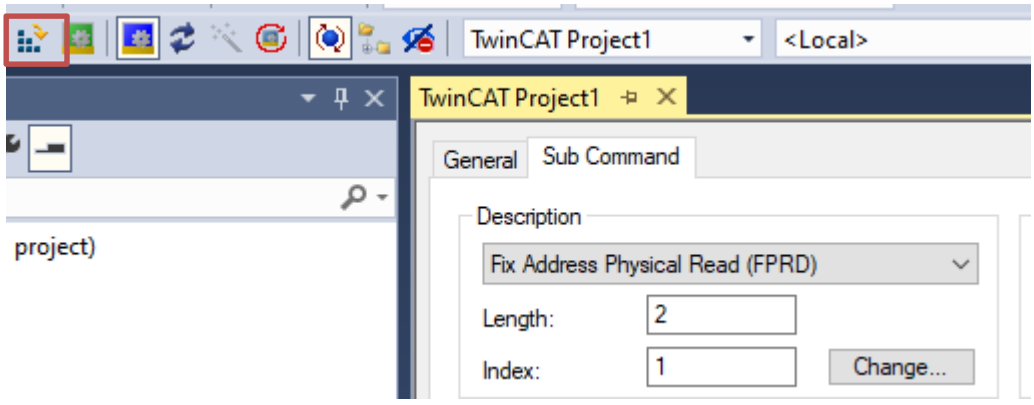
Double-click “**Cmd 1**” and setup “**Slave Address**” and “**Address Offset**”.

I setup slave address = **0x64** and address offset = **0x12** in this example.



Step 10

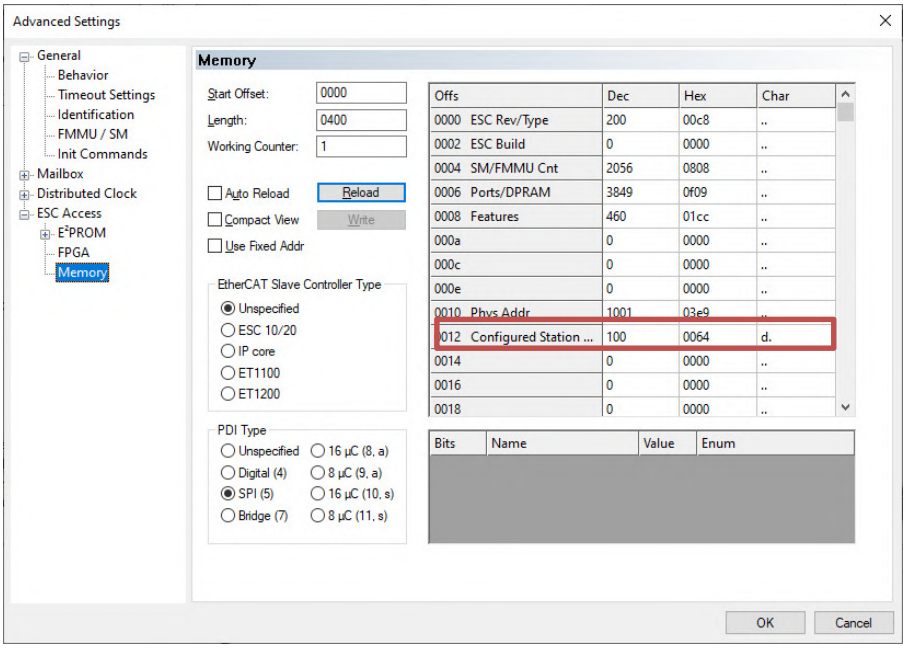
Re-activate the TwinCAT master again.



Step 11

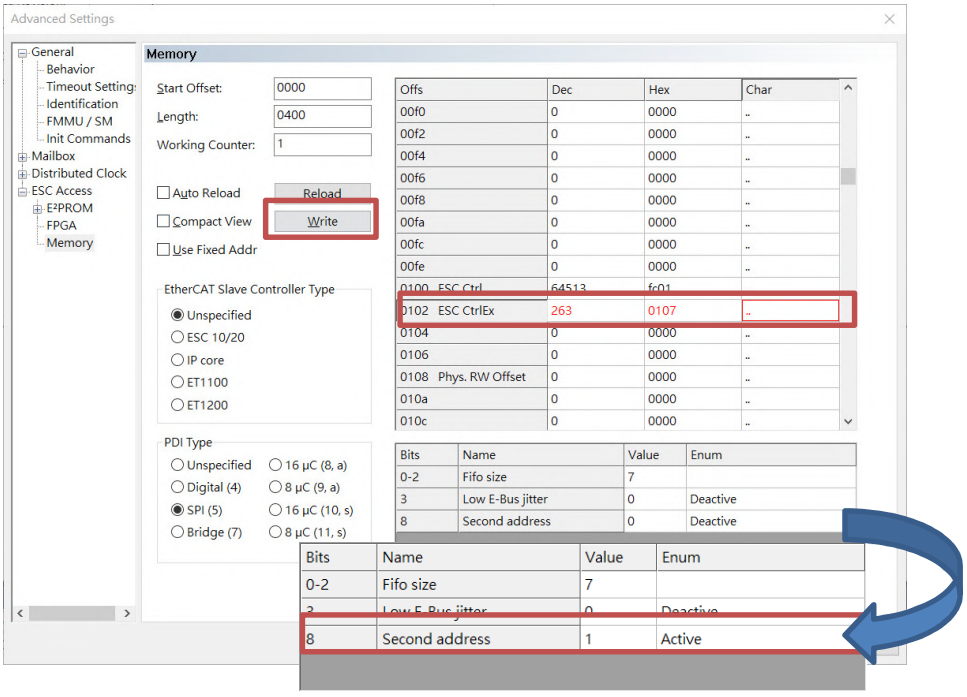
Go to “**ESC Access** -> **Memory**” in “Advanced Settings” and check out the address 0x0012.

The firmware will write the user specified Switch ID value into ESC register 0x0012 (the register named Configured Station Alias).



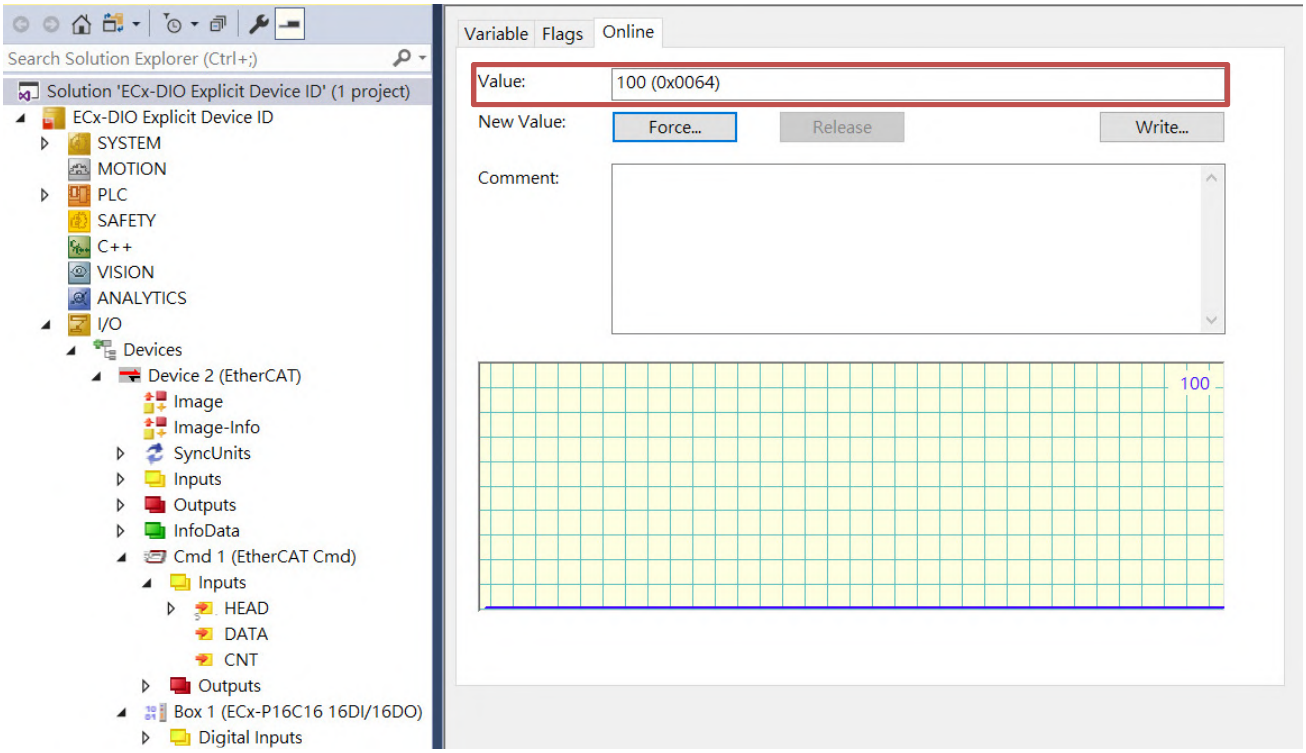
Step 12

If user expect that the slave can also use this Switch ID value as second slave address. user just turn on “Seconds address” bit (bit8 = 1) in ESC register 0x0102 (Need click “**Write**” button).



Step 13

Click “Device N (EtherCAT) -> Cmd 1 -> DATA”, you will see the command get the value of ESC register 0x0012 back successfully. It is correct, the “0x0064” in UINT data type.



Appendix: Revision History

This chapter provides revision history information to this document.

The table below shows the revision history.

Revision	Date	Description
1.0	2023.Mar	Initial issue
1.1	2025.Oct	Add EC2-TC16 & EC2-RTD16