# ECAT-201x EtherCAT Slave I/O Modules User Manual

English Ver. 1.4, Mar. 2021

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## SUPPORT

ECAT-2011H
ECAT-2012H
ECAT-2016N
ECAT-2016-3

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# 1. Introduction

The ECAT-2000 is equipped with the 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 ECAT-2011H/2012H is built in 8-ch differential inputs or 16-ch single-ended analog inputs by software selectable,ECAT-2016N/2016-3 is built in 1/3-ch strain gauge. It 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.

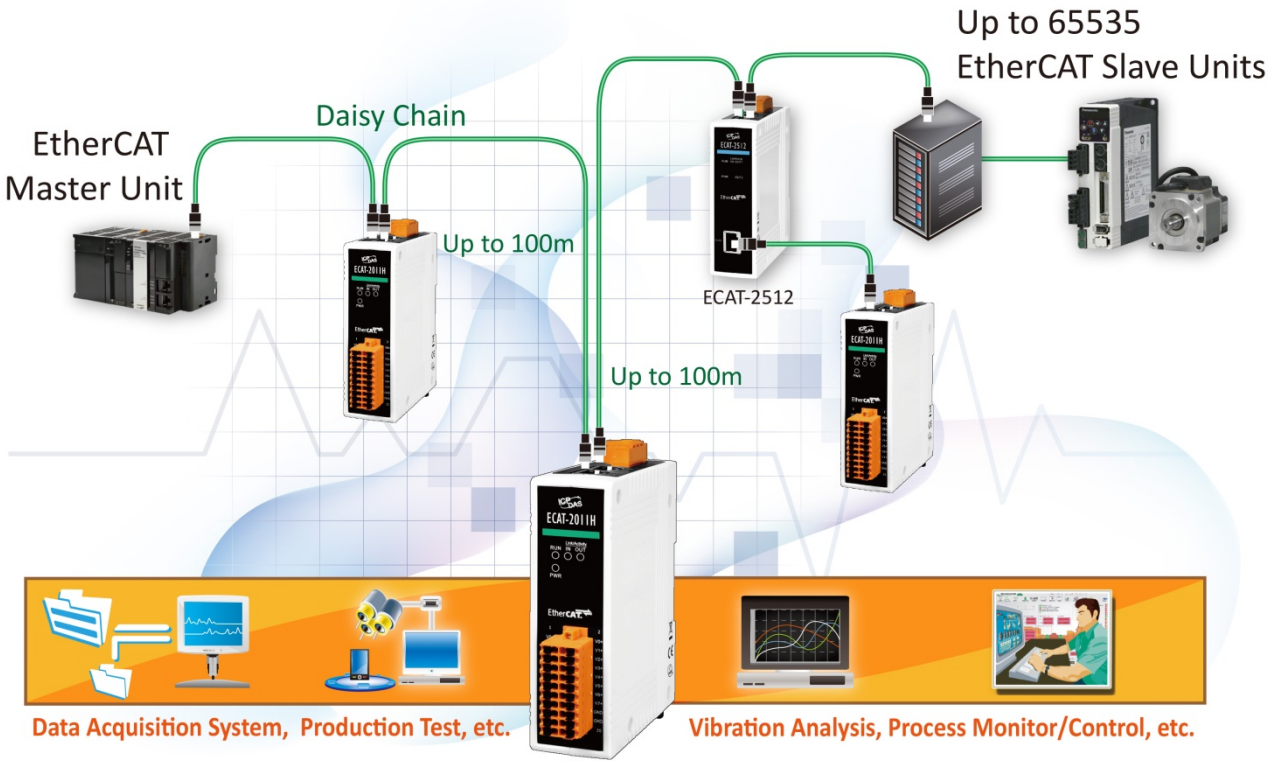


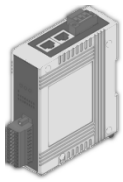

Figure 1.1 Typical Application of ECAT-2000 AI Module

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# 1.1 Package List

The shipping package includes the following items:



ECAT-2011H/
ECAT-2012H/
ECAT-2016N/
ECAT-2016-3



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. |

## More Information

- Manual/QuickStart/Datasheet:

  http://www.icpdas.com/en/download/index.php?model=ECAT-2011H

  http://www.icpdas.com/en/download/index.php?model=ECAT-2012H

  http://www.icpdas.com/en/download/index.php?model=ECAT-2016N

  http://www.icpdas.com/en/download/index.php?model=ECAT-2016-3

- XML Device Description(ESI):

  ECAT-2011 Series

  ECAT-2012 Series

  ECAT-2016 Series

- FAQ:

  http://www.icpdas.com/en/faq/index.php

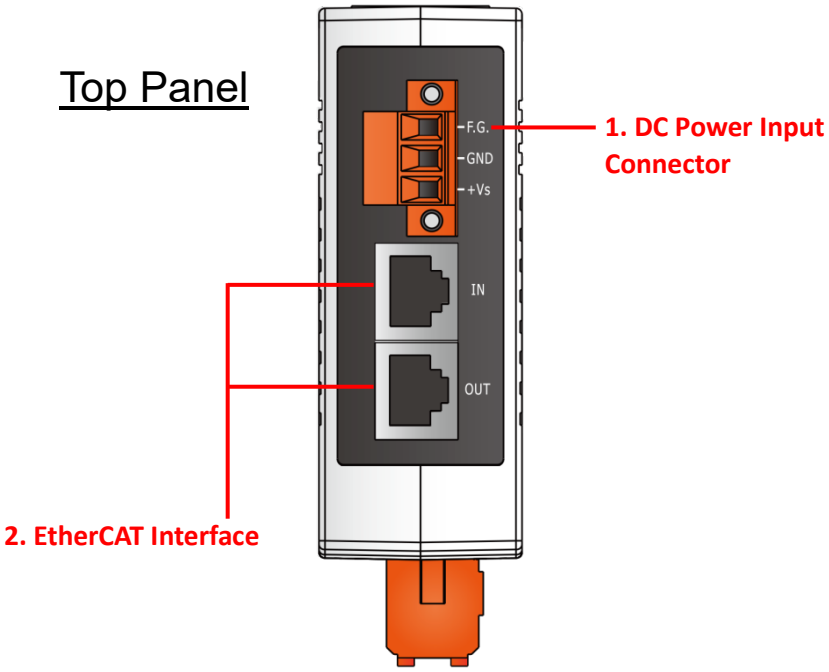
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# 2. Hardware Information

## 2.1 Appearance

The front panel and top panel of the ECAT module contain the I/O connector, LEDs, Ethernet Port and power connector.




### 1. DC Power Input Connector

The **"+Vs"** and **"GND"** pins are used for the power supply applies to all types of ECAT 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. ECAT 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.

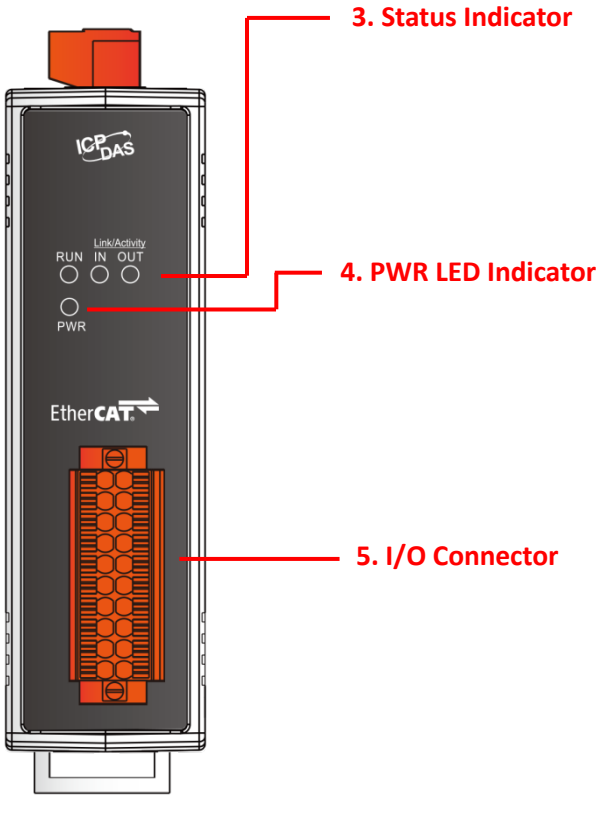
### 2. EtherCAT Interface

ECAT 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.

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## Front Panel




### 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 |
| **Link Activity IN/OUT** | Green | Off | No link |
| | | Blinking | Link and activity |
| | | On | Link without activity |

### 4. PWR LED Indicator

Once power is supplied to the ECAT module, the system LED indicator will illuminate.

### 5. I/O Connector

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

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# 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 |
| **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 | 1KV Class A |
| **Power** | |
| Powered from Terminal Block | +10 ~ +30 $V_{DC}$ |
| Power Consumption | 4 W (Max.) |
| **Mechanical** | |
| Installation | DIN-Rail Mounting |
| Dimensions (L x W x H) | 110 mm x 90 mm x 33 mm |
| **Environment** | |
| Operating Temperature | -25 ~ +75°C |
| Storage Temperature | -30 ~ +80°C |
| Relative Humidity | 10 ~ 90% RH, Non-condensing |

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## 2.2.2 I/O Specification

| Model | ECT-2011H | ECAT-2012H |
|---|---|---|
| **Analog Input** | | |
| Channels | 8/16 | |
| Wire Connection | 8 Differential or 16 Single-ended (Software Selectable) | |
| Type | Voltage, Current | |
| Range | 0~10 V, ±10 V, ±5 V, ±2.5 V,<br>0~ 20 mA, ±20 mA, 4~20mA, ±4~20mA<br>(Software selectable) | |
| Resolution | 12-bit | 16-bit |
| Accuracy | 0.2% of FSR | 0.05% FSR |
| Sampling Rate | 1 kHz per channel | 1 kHz per channel<br>(Max. for 6 channel enable) |
| Distributed clocks | - | |
| Individual Channel Configuration | Yes | |
| Over Voltage Protection | ±35 $V_{DC}$ | |
| Open Wire Detection for +4 ~ +20mA | Yes | |

| Model | ECT-2016N | ECAT-2016-3 |
|---|---|---|
| **Strain Gauge Input** | | |
| Channels | 1 | 3 |
| Sensor | Full-Bridge | |
| Type | Voltage | |
| Range | ±1.25 V, ±600 mV, ±300 mV, ±125 mV, ±80 mV, ±60 mV, ±40 mV, ±30 mV, ±20 mV, ±10 mV<br>(Software selectable) | ±10 V, ±5 V, ±2.5 V, ±1.25 V, ±625 mV, ±312 mV, ±200 mV, ±100 mV, ±50 mV, ±25 mV<br>(Software selectable) |
| Resolution | 16-bit | |
| Accuracy | ±0.1% FSR | |
| Sampling Rate | 1k Hz per channel | |
| Distributed clocks | - | |
| Input Impedance | 20 MΩ | |
| **Excitation Voltage** | | |
| Channel | 1 | 3 |
| Output Voltage | 10 $V_{DC}$ | |
| Max. Load Current | 40 mA | |

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# 2.3 Pin Assignments

## EtherCAT Interface

| Terminal No. | Pin Assignment |
|---|---|
| PWR | F.G. |
| | GND |
| | + Vs |
| IN |  |
| OUT |  |

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## Differentail Input(ECAT-2011H/ECAT-2012H)

| Terminal No. | Pin Assignment | | Pin Assignment | Terminal No. |
|---|---|---|---|---|
| 1 | V0- |  | V0+ | 2 |
| 3 | V1- | | V1+ | 4 |
| 5 | V2- | | V2+ | 6 |
| 7 | V3- | | V3+ | 8 |
| 9 | V4- | | V4+ | 10 |
| 11 | V5- | | V5+ | 12 |
| 13 | V6- | | V6+ | 14 |
| 15 | V7- | | V7+ | 16 |
| 17 | AGND | | AGND | 18 |
| 19 | AGND | | AGND | 20 |

## Single-ended Input(ECAT-2011H/ECAT-2012H)

| Terminal No. | Pin Assignment | | Pin Assignment | Terminal No. |
|---|---|---|---|---|
| 1 | V8 |  | V0 | 2 |
| 3 | V9 | | V1 | 4 |
| 5 | V10 | | V2 | 6 |
| 7 | V11 | | V3 | 8 |
| 9 | V12 | | V4 | 10 |
| 11 | V13 | | V5 | 12 |
| 13 | V14 | | V6 | 14 |
| 15 | V15 | | V7 | 16 |
| 17 | AGND | | AGND | 18 |
| 19 | AGND | | AGND | 20 |

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## Strain Gauge Input (ECAT-2016N)

| Terminal No. | Pin Assignment | | Pin Assignment | Terminal No. |
|---|---|---|---|---|
| 1 | EXT.PWR |  | EXT.PWR | 2 |
| 3 | EXT.PWR | | EXT.PWR | 4 |
| 5 | EXT.GND | | EXT.GND | 6 |
| 7 | EXT.GND | | EXT.GND | 8 |
| 9 | Exc+ | | Exc+ | 10 |
| 11 | Vin+ | | Vin+ | 12 |
| 13 | Vin- | | Vin- | 14 |
| 15 | GND | | GND | 16 |
| 17 | N/A | | N/A | 18 |
| 19 | N/A | | N/A | 20 |

## Strain Gauge Input (ECAT-2016-3)

| Terminal No. | Pin Assignment | | Pin Assignment | Terminal No. |
|---|---|---|---|---|
| 1 | EXT.PWR |  | EXT.PWR | 2 |
| 3 | EXT.PWR | | EXT.PWR | 4 |
| 5 | EXT.GND | | EXT.GND | 6 |
| 7 | EXT.GND | | EXT.GND | 8 |
| 9 | GND | | Exc0+ | 10 |
| 11 | Vin1- | | Vin0+ | 12 |
| 13 | GND | | Exc1+ | 14 |
| 15 | Vin1- | | Vin1+ | 16 |
| 17 | GND | | Exc2+ | 18 |
| 19 | Vin2- | | Vin2+ | 20 |

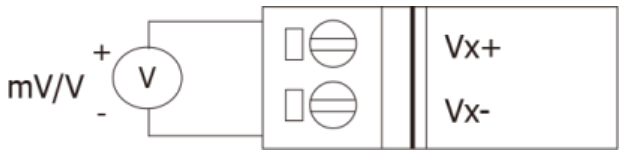
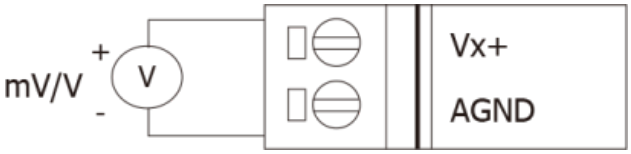
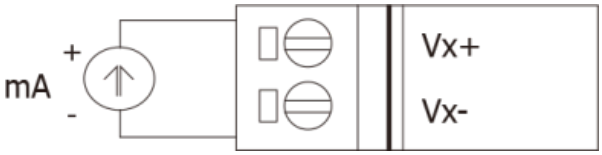
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# 2.4 Wiring Connections

**The factory default settings of ECAT-2011H/2012H is differentail input**. You can refer to Section "AD Input Type Selection" to change the input type. For more details regarding the voltage and current wirings, refer to the table below.

**NOTE:** x = channel unmber

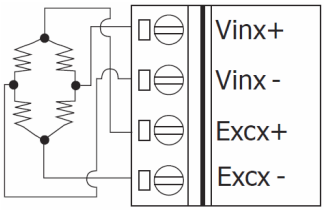
| Voltage Input (Differential) |
|---|
|  (Default Settings) |
| **Voltage Input (Single-ended)** |
|  |
| **Currnet Input** |
|  |







**ECAT-2016N/2016-3 is Strain Guage Input**

| Strain Guage Input |
|---|
|  (Default Settings) |

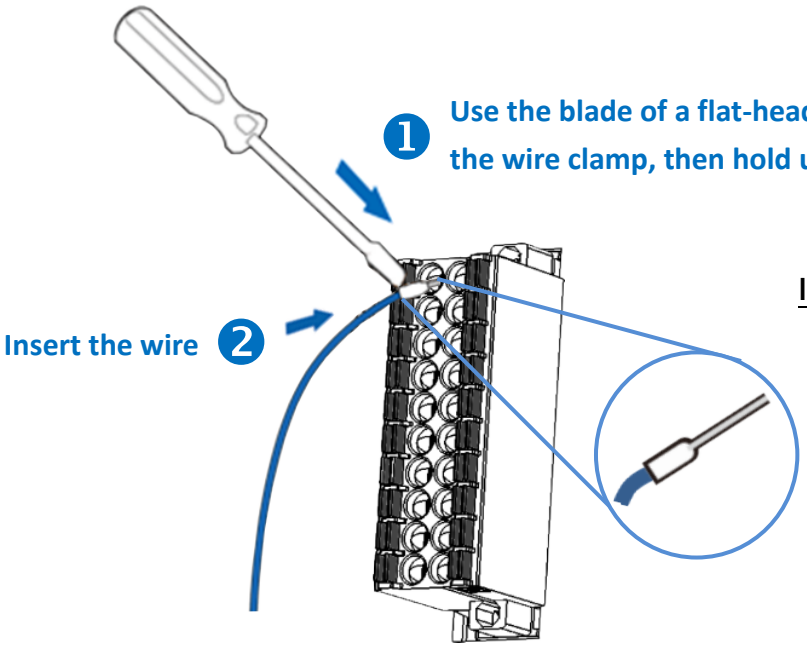


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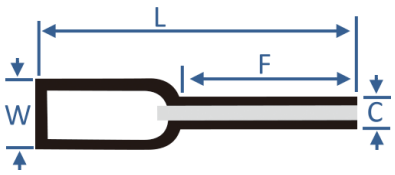
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# 2.5 Wiring to the Connector

## A tip for connection the wire to the connector

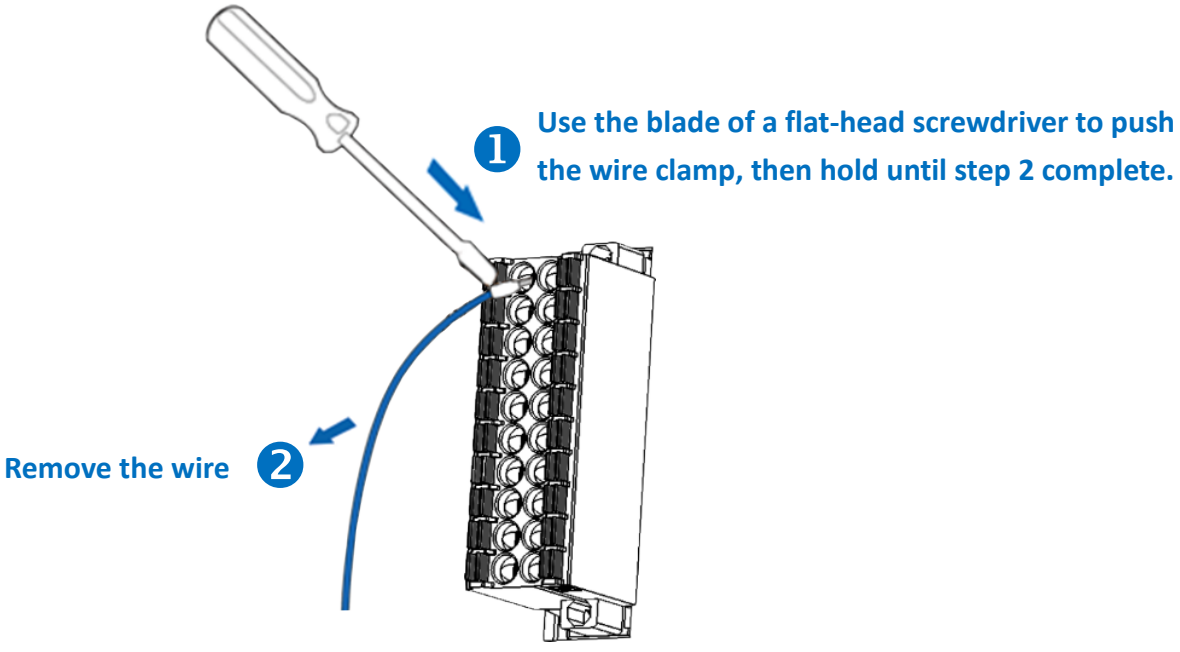



### Insulated Terminals Dimensions




| Dimensions (Unit: mm) | | | | |
|---|---|---|---|---|
| **Item NO.** | F | L | C | W |
| **CE007512** | 12.0 | 18.0 | 1.2 | 2.8 |

## A tip for removing the wire from the connector

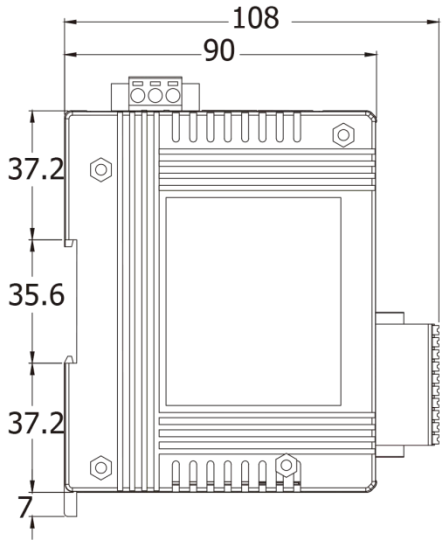



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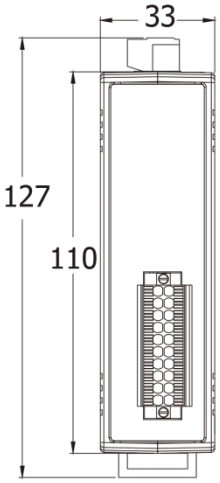
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# 2.6 Dimensions

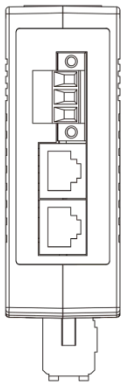
The following diagrams provide the dimensions of the ECAT module and can be used as a reference when defining the specifications for any custom enclosures. All dimensions are in millimeters.



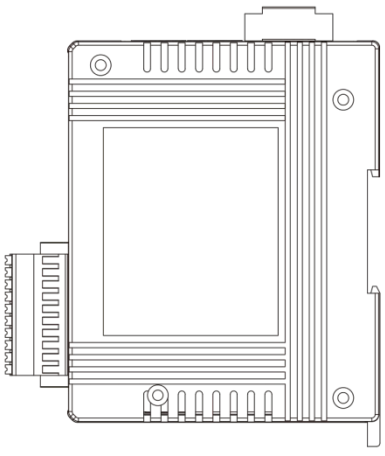

Left Side



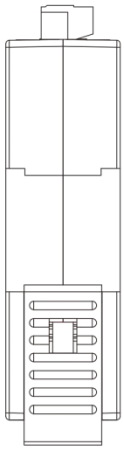

Front



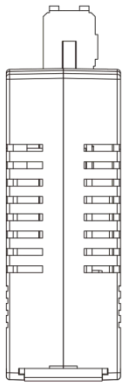
Top



Right Side



Rear



Bottom

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# 3. Getting Started

This chapter provides a basic overview of how to configure and operate your ECAT-2011H module.

## 3.1 Connecting the Power and the Host PC

### Step 1 Connect the IN port on the ECAT module to the RJ-45 Ethernet port on the Host PC.

Ensure that the network settings on the Host PC have been correctly configured and the connection is functioning normally. Ensure that the Windows or 3rd-party firewall or any Anti-virus software 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).

❶ Connect the Host device to the **IN Port** on the ECAT module.
❷ Connect the **+Vs** pin on the ECAT module to the positive terminal on a **+10 ~ +30 $V_{DC}$** power supply, and connect the **GND** pin on the ECAT module to the **negative terminal**.

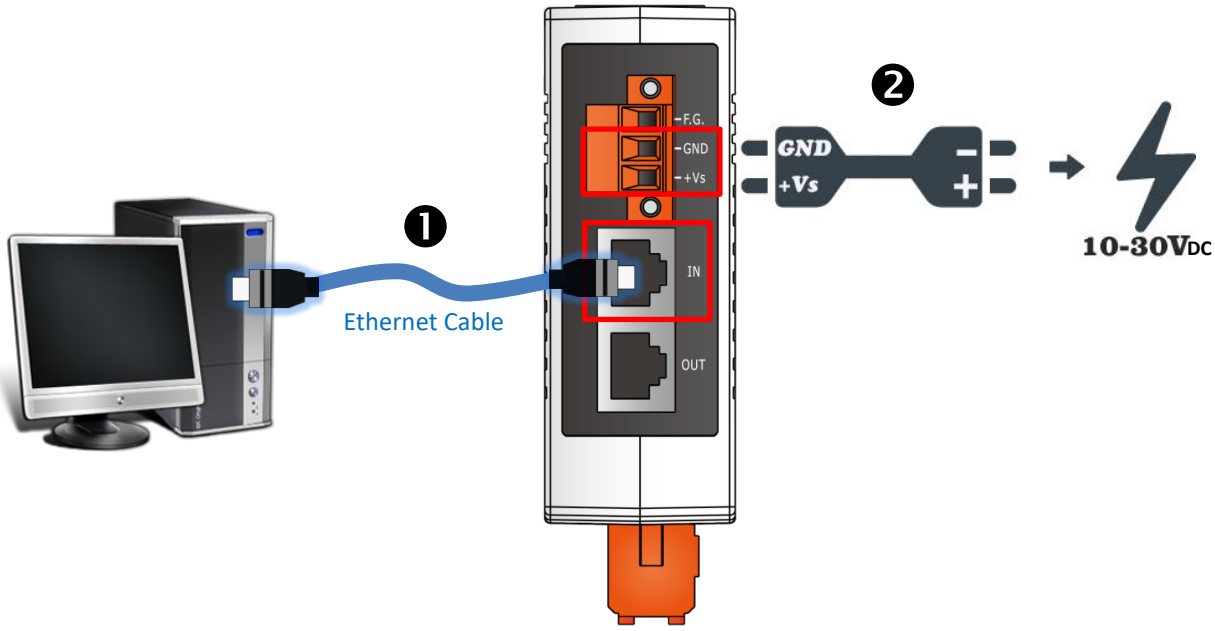



Figure 3-1.1

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## Step 2 Verify that the LEDs indicators on the ECAT module are illuminated as illustrated below:

❶ Once the power is connected, the **"PWR"** LED should be illuminated in red.
❷ Once the Ethernet link is detected, the **"IN"** LED should be flash in green.
❸ Once the ECAT module connected to EtherCAT Master, the **"RUN"** LED should be illuminated in red.

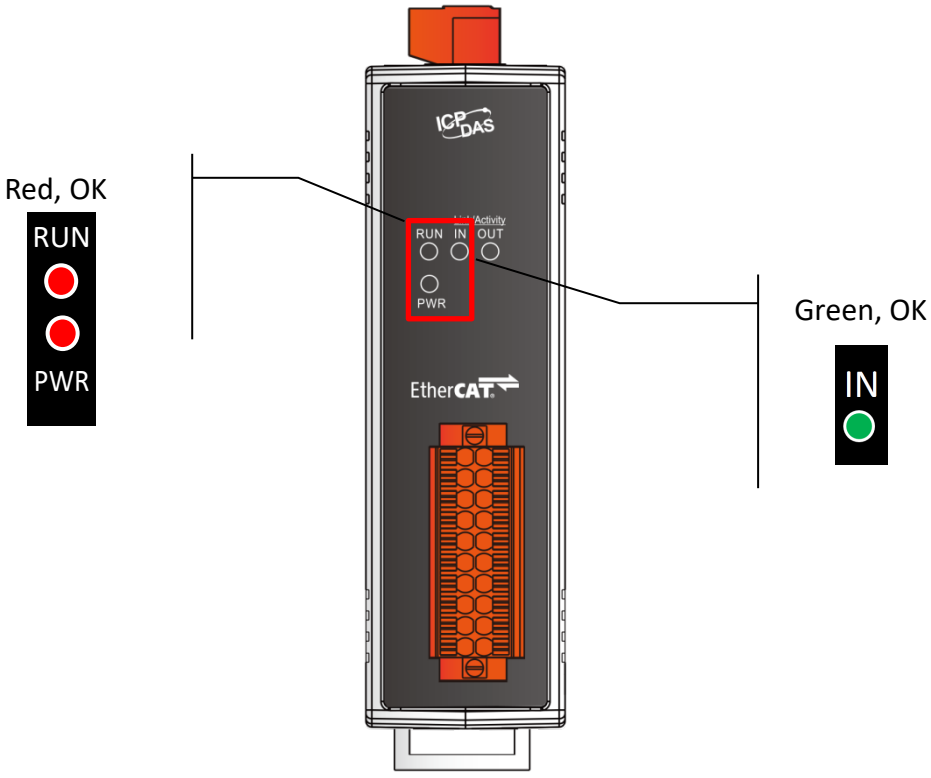



Figure 3-1.2

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# 3.2 Configuration and Operation

Before following the steps below, you must first install the EtherCAT Master software (e.g., Beckhoff TwinCAT, refer to http://infosys.beckhoff.com). In this example, we will use **Beckhoff TwinCAT 2.x** to configuring and operating the ECAT module, and **Beckhoff TwinCAT 2.X** is the most commonly used EtherCAT Master Software.

## Inserting into the EtherCAT network



NOTE

**Installation the latest XML device description(ESI)**

Ensure that the latest XML device description has been installed in the appropriate TwinCAT folder. The ESI file can be downloaded from the ICP DAS web site (http://www.icpdas.com/web/product/download/industrial_communication/ethercat/software/firmware/), and should be installed according to the installation instructions.

### Step 1 Install the ESI file

**ESI Filename**, as indicated in the table below.

| Module | Filename |
|---|---|
| ECAT-2011H | ICPDAS_ECAT-2011.xml |
| ECAT-2012H | ICPDAS_ECAT-2012.xml |
| ECAT-2016N/2016-3 | ICPDAS_ECAT-2016.xml |

Copy the **ESI** file to the **appropriate Master Tools installation folder**, as indicated in the table below.

| Software | Default Path |
|---|---|
| Beckhoff EtherCAT Configuration | C:\EtherCAT Configurator\EtherCAT |
| Beckhoff TwinCAT 3.X | C:\TwinCAT\3.x\Config\Io\EtherCAT |
| Beckhoff TwinCAT 2.X | C:\TwinCAT\Io\EtherCAT |

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## Step 2 Automatic Scanning

**The EtherCAT system must be in a safe, de-energized state before the EtherCAT slave I/O module is connected to the EtherCAT network!**

❶ Switch on the operating power supply, launch the TwinCAT System Manager (Config mode), and scan in the devices, as illustrated in the Figure 3-2.1 below.

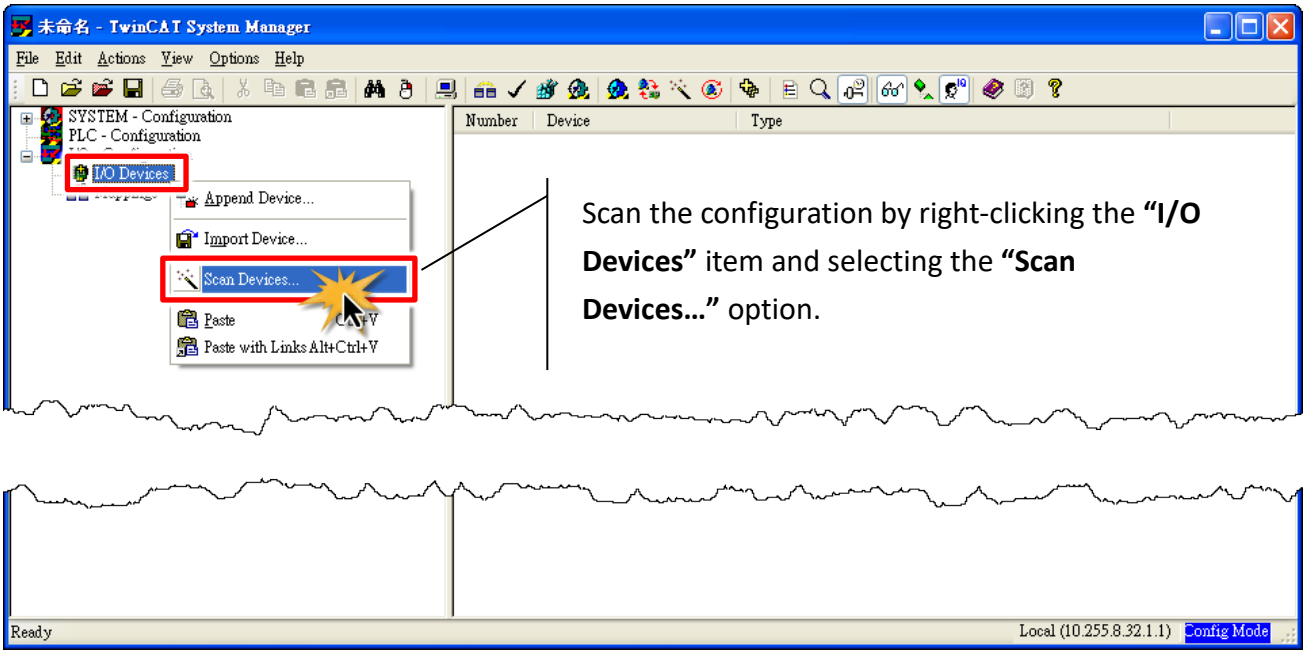



Figure 3-2.1

❷ Click the **"OK"** button for all dialogs when requested, ensuring that the configuration is set to **"FreeRun"** mode.

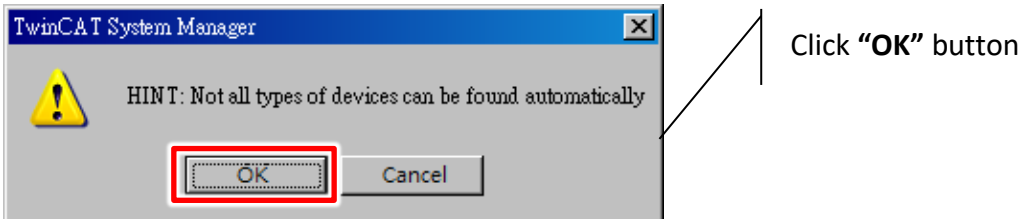
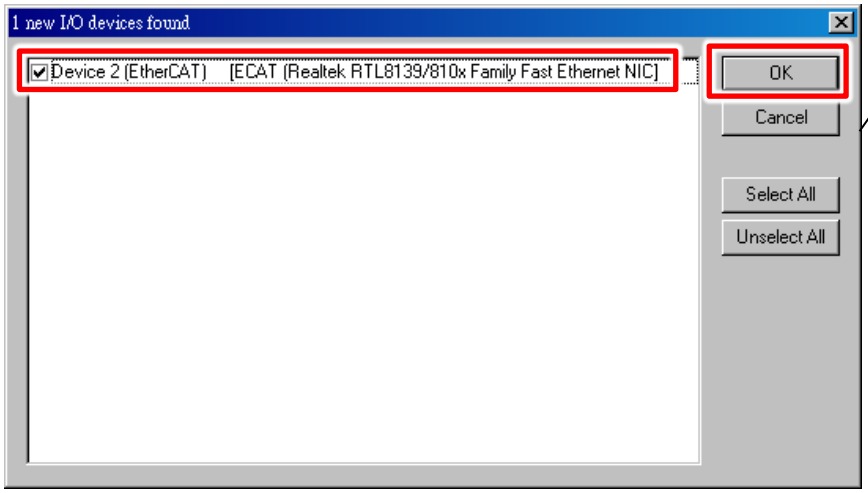



Figure 3-2.2

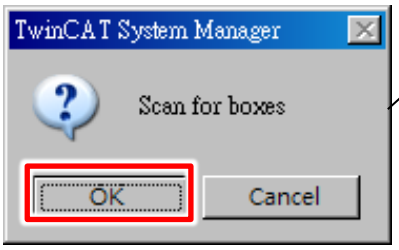
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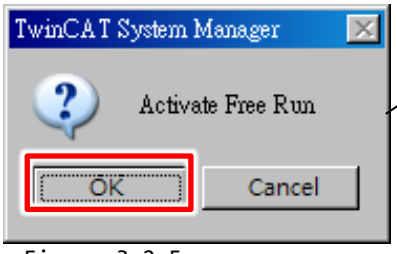

Choose the correct network device which is connected to module and click **"OK"** button

Figure 3-2.3




Click **"OK"** to start scanning

Figure 3-2.4




Click **"OK"** to activate the free run mode

Figure 3-2.5

In the left-hand window, **ECAT** module is now shown in the TwinCAT System Manager.
In the right-hand window, the ECAT module is parameterized via **"Process Data"** and **"CoE-Online"** tabs in the TwinCAT System Manager.

- **Process Data:** The process data-specific settings.
- **CoE-Online:** Settings parameter, refer to Chapter 4 "Object Description and Parameterization" for details.

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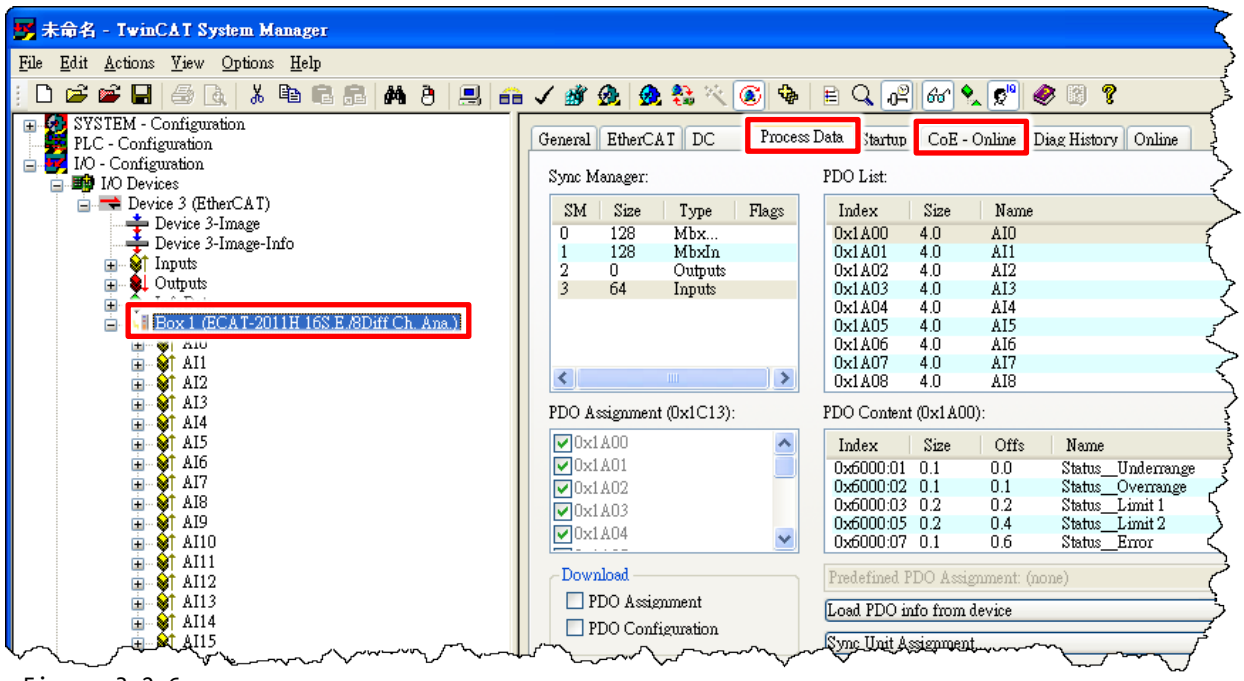
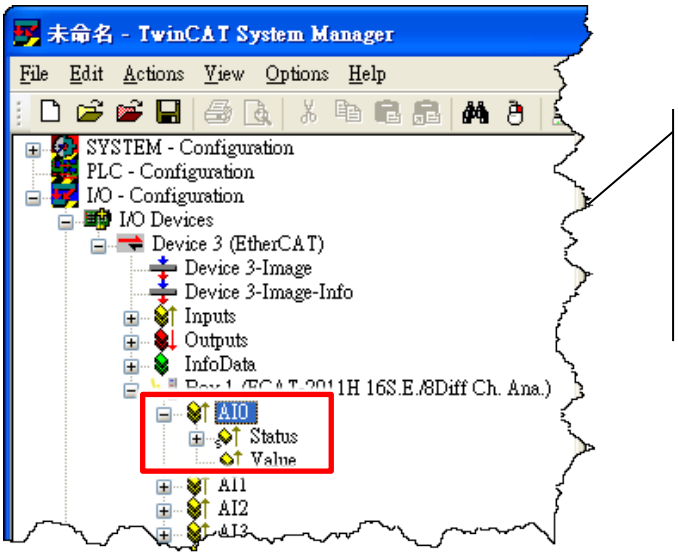



Figure 3-2.6

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The moduel offer two different process data per analog channel for transmission: the analog value **Value (16-bit)** and status information **Status (16-bit)**

Figure 3-2.7

In the left-hand window, clicking on the **"Status"** variable in the configuration tree (A), the structure can be opened for linking (B). In order to be able to read the bit meanings in plain text in the online display (C), click the Analog Input channel (e.g, AI0) and then click the **"Show Sub Variables"** button to display all subvariables and the structure contents of the status word, refer to table 3-2-1 below for more details.

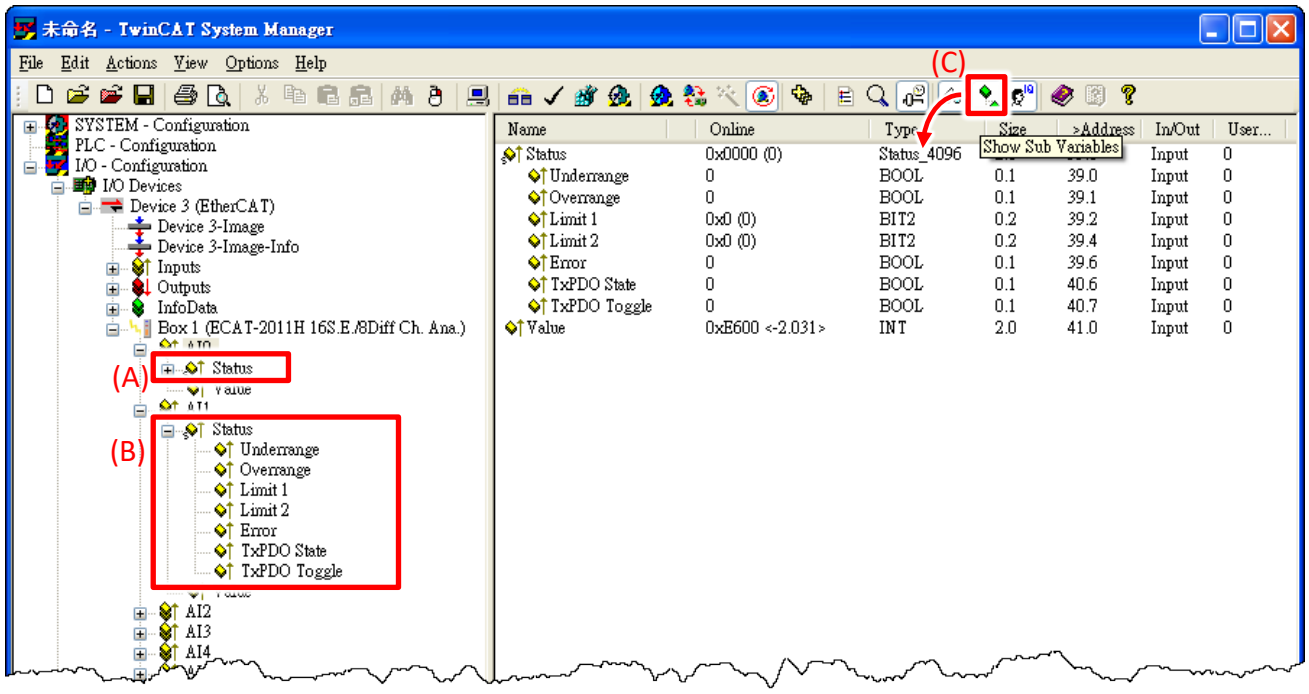



Figure 3-2.8

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Table 3-2-1: Status Word (SW) are defined as:

| Bit | Name | Description |
|---|---|---|
| SW.15 | TxPDO Toggle | Toggles with each new analog process value, refer Index 0x60n0:10 for details. |
| SW.14 | TxPDO State | TRUE in the case of an internal error, refer Index 0x60n0:0F for details. |
| SW.13 | - | - |
| SW.12 | - | - |
| SW.11 | - | - |
| SW.10 | - | - |
| SW.9 | - | - |
| SW.8 | - | - |
| SW.7 | - | - |
| SW.6 | EEROR | General error bit, is set together with overrange and underrange, refer Index 0x60n0:07 for details. |
| SW.5 | Limit 2 | If the value exceeds or falls below these values, which can be entered in the Index 0x80n0:14, then the bits in the Index 0x60n0:05 is set accordingly.<br>The Index 08n0:08 respectively serve to activate the limit value monitoring.<br><br>Output Limit 2 (2-bit):<br>**0:** not active<br>**1:** Value is smaller than Limit Value2<br>**2:** Value is larger than Limit Value2<br>**3:** Value is equal to Limit Value2 |
| SW.4 | | |
| SW.3 | Limit 1 | If the value exceeds or falls below these values, which can be entered in the Index 0x80n0:13, then the bits in the Index 0x60n0:03 is set accordingly.<br>The Index 08n0:07 respectively serve to activate the limit value monitoring.<br><br>Output Limit 1 (2-bit):<br>**0:** not active<br>**1:** Value is smaller than Limit Value1<br>**2:** Value is larger than Limit Value1<br>**3:** Value is equal to Limit Value1 |
| SW.2 | | |
| SW.1 | Overrange | Analog input signal lies above the upper permissible threshold for this terminal, refer Index 0x60n0:02 for details. |
| SW.0 | Underrange | Analog Input signal lies under the lower permissible threshold for this terminal, refer Index 0x60n0:01 for details. |

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# 3.3 Self-Test

This chapter can give you the detail steps about self-test. In this way, user can confirm that ECAT-2011H/2012H well or not. Before the self-test, you must prepare a stable signal source (e.g., dry battery) is available, and than follow the steps described below:

❶ Wire the **stable signal source (e.g., dry battery) to AI channel 0**.
❷ ECAT-2011H/2012H connect the **V0- (Pin01)** to **signal positive(-)**, ECAT-2016N connect the **VIn- (Pin14)** to **signal positive(-).**
❸ ECAT-2011H/2012H connect the **V0+ (Pin02)** to **signal positive(+)**,ECAT-2016N connect the **VIn+ (Pin11)** to **signal positive(+).**

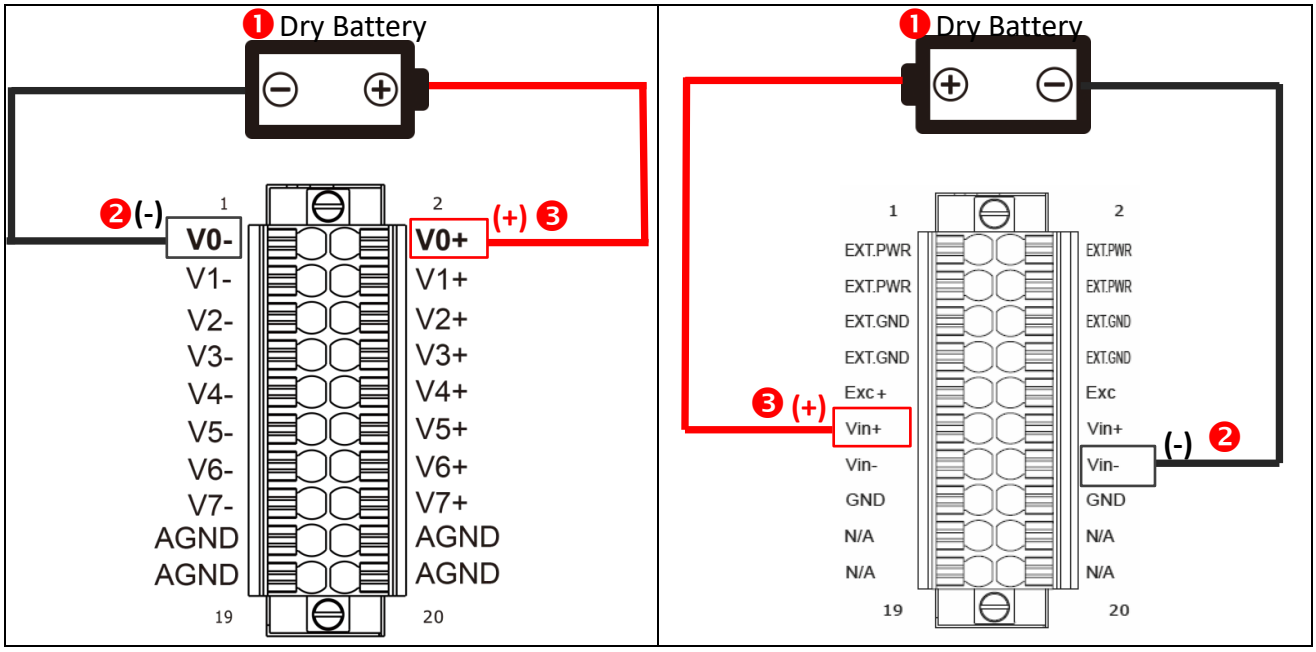



Figure 3-3.1

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❹ In the left-hand window, click **“AI0”** to get and configure state.

❺ In the right-hand window, check the voltage vaule in the **“Value”** item.

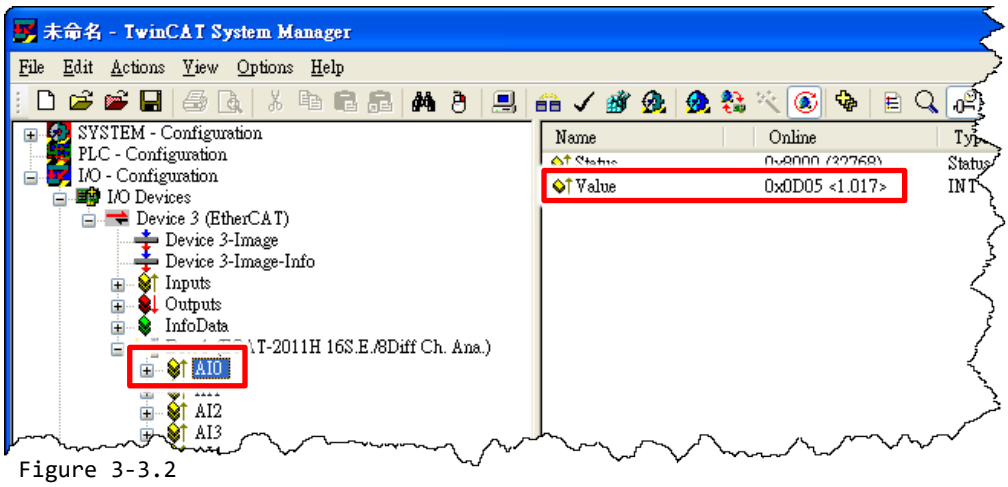



Figure 3-3.2

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# AD Input Type Selection(ECAT-2011H/2012H)

The ECAT-2011H/2012H provides 8-channel of differential inputs or 16-channel single-ended inputs. **The factory default settings is differentail input**. Refer to the following instructions for details of how to change the Analog Input type.

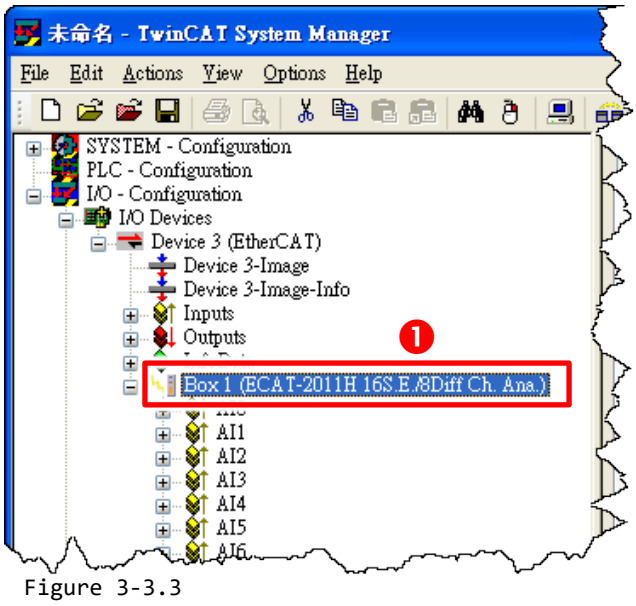



Figure 3-3.3

❶ In the left-hand window, click the **"Box 1 (ECAT-201xH 16S.E./8Diff Ch. Ana.)"** itme.

❷ In the right-hand window, click the **"CoE – Online"** tab.

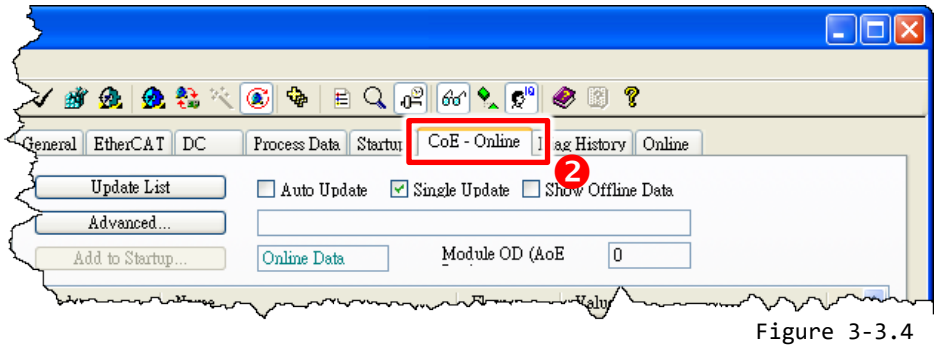



Figure 3-3.4

❸ **Double-click** the **"Index 8000:09 (Analog input type)"** to open the **"Set Value Dialog"** box.

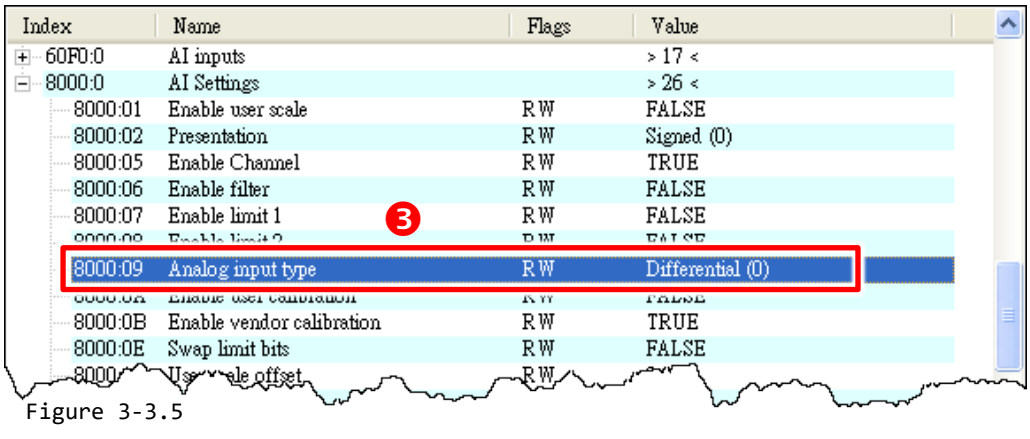



Figure 3-3.5

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❹ Select the **"Single-ended"** option from the **"Enum"** drop down options and then click the **"OK"** button. **Note that all AI channels will be changed to single-ended input.**

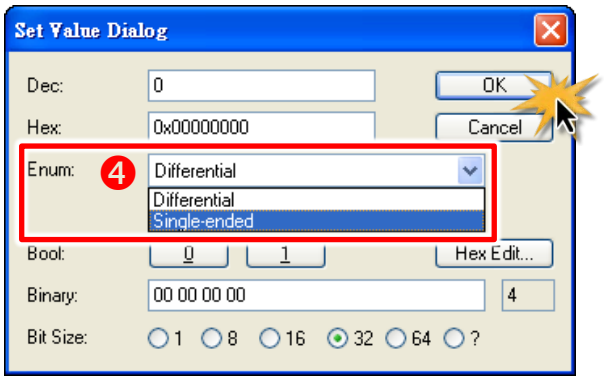



Figure 3-3.6

❺ **Double-click** the **"Index 80n0:05 (n = 8 to F, Enable Channel)"** to enable AI channel. Here, the AI8 (Index 8080:05) is used as an example.

❻ Type the **"1"** in the **"Dec:"** field and then the **"OK"** button.
**Note that AI Channels 8 to 15 (0xF) defaults setting is FALSE (0x00). If the input type is single-ended, you must manually enable AI Channels 8 to 15 (0xF).**

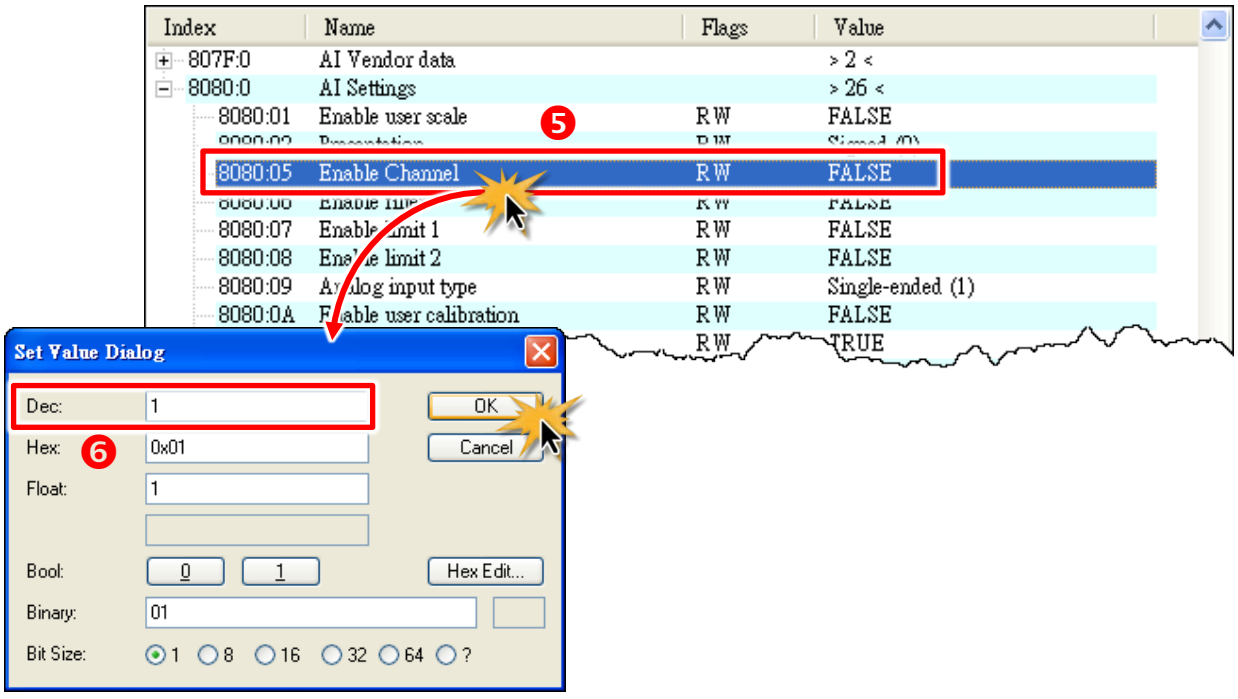



Figure 3-3.7

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# AD Range Selection

The ECAT-2011H provides Analog Input voltage range of ±10 V, ±5 V, ±2.5 V, 0 ~ +10 V and Analog Input currnet range of ±20 mA, 0 ~ +20 mA, +4 ~ +20 mA. **The factory default a setting is ± 10 V.**

ECAT-2016N provides Strain Guage Input range of ±1.25 V、±600 mV、±300 mV、±125 mV、±80 mV、±60 mV、±40 mV、±30 mV、±20 mV、±15 mV and ±10 mV. **The factory default a setting is ±1.25 V.**

ECAT-2016-3 provides Strain Guage Input range of 10 V, ±5 V, ±2.5 V±1.25 V、±625 mV、±312 mV、±200 mV、±100 mV、±50 mV、±25 mV. **The factory default a setting is ±10 V.**

Refer to the following instructions for details of how to change the AD range.

❶ In the left-hand window, click the **"Box 1 (ECAT-201xH 16S.E./8Diff Ch. Ana.)"** itme. (See Figure 3-3.3)

❷ In the right-hand window, click the **"CoE – Online"** tab. (See Figure 3-3.4)

❸ **Double-click** the **"Index 8000:19 (AI Range)"** to open the **"Set Value Dialog"** box.

❹ Select the **AI range value (e.g., ±5 V)** from the **"Enum"** drop down options and then click the **"OK"** button.

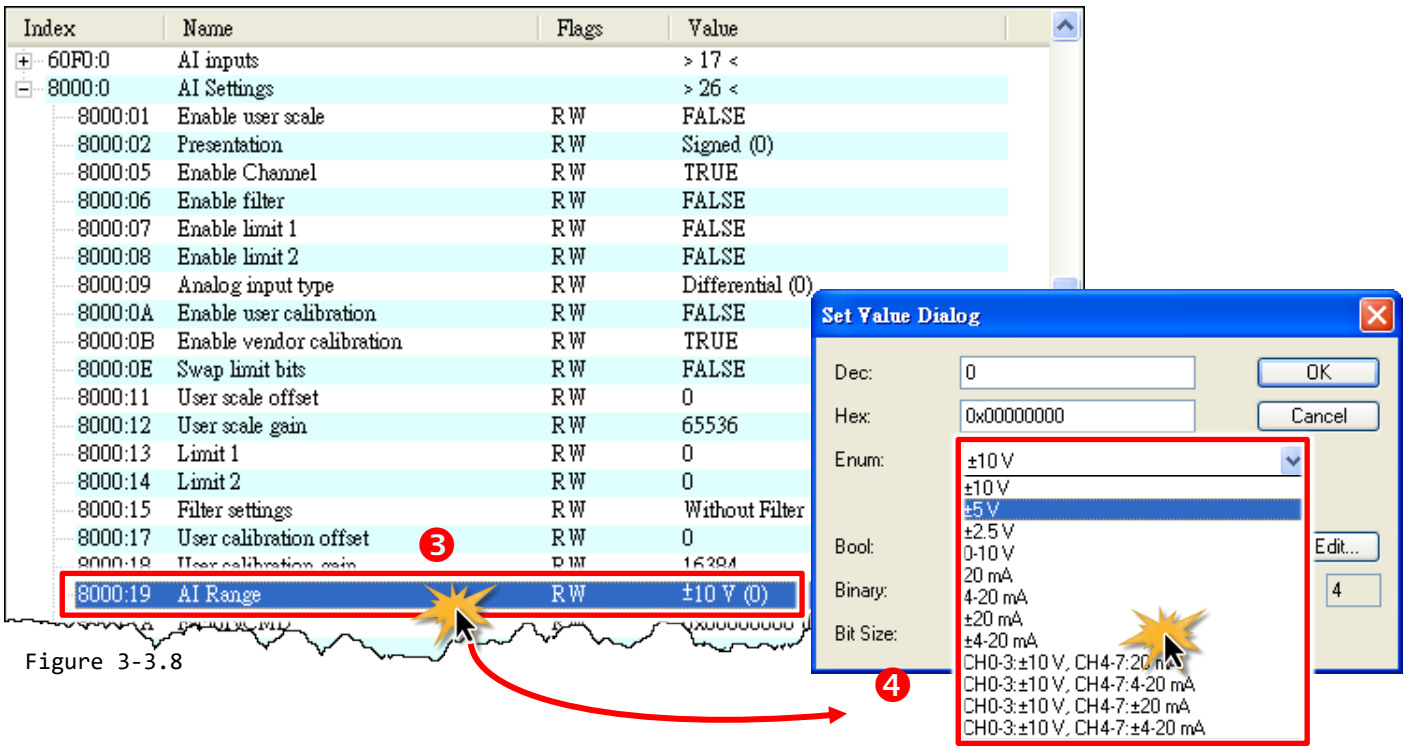


Figure 3-3.8

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# 4. Object Description and Parameterization

The CoE interface is used for parameter management of EtherCAT devices. The display matches that of the CoE objects from the XML device description **(ESI file)**. Once the ECAT connected to EtherCAT Master, you can configure the parameters via **"CoE – Online"** tab (double-click on the respective object). In general, the changes to the online CoE directory are immediately effective.

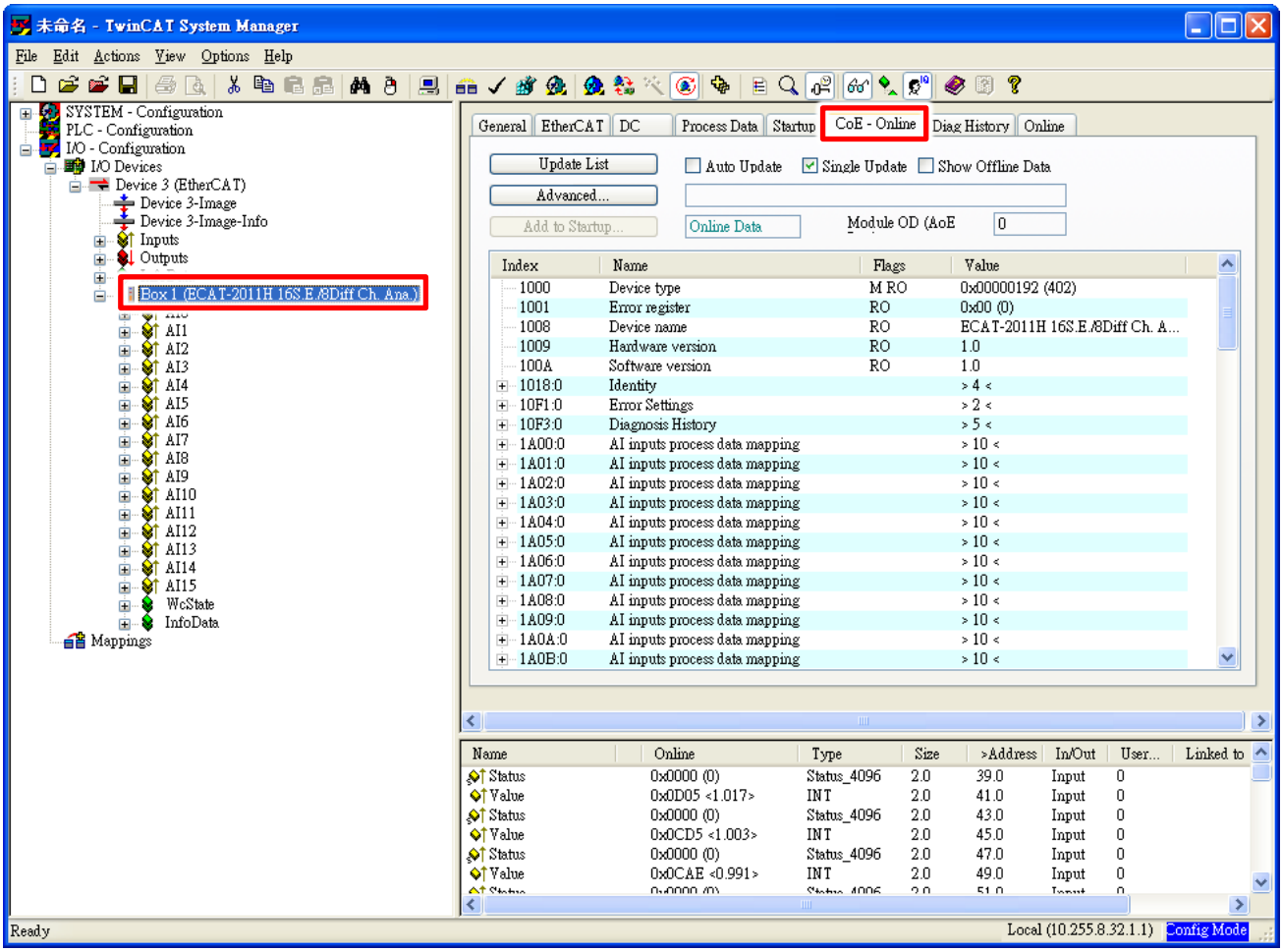



Figure 4-1.1

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The following section first describes the standard objects required, followed by a complete overview of profile specific objects.

# 4.1 Standard Object(0x1000-0x1FFF)

### 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 | 0x00000192 (402dec) |

### Index 1001 Device Type

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

### Index 1008 Device Name(For ECAT-2011H)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **1008:00** | Device name | EtherCAT Slave Device Name | String | RO | Depend on device |

### 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 |

### Index 100A Software Version

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **100A:00** | Software version | Firmware version for EtherCAT slave | String | RO | 1.0 |

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## 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 | Depend on device |
| **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 |

## Index 10F1 Error Settings

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

## 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 | UIN16 | M RW | 0x0000(0dec) |

## Index 1A0n AI Input Process Data Mapping (for 0 ≤ n ≤ F)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **1A0n:00** | AI Input Process Data Mapping | PDO Mapping TxPDOn | UINT8 | RO | 0x0A(10dec) |
| **1A0n01** | 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 | 0x0000:00,1 |
| **1A0n:07** | SubIndex 007 | PDO Mapping entry (6 bits align) | UINT32 | RO | 0x0000:00,6 |
| **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 |

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## 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) |

## Index 1C12 RxPDO Assignment

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

## Index 1C13 TxPDO Assignment(For ECAT-2011H/2012H)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| 1C13:00 | TxPDO Assignment | PDO Assign Inputs | UINT8 | RW | 0x010(16dec) |
| 1C13:01 | SubIndex 001 | 1st allocated TxPDO | UINT16 | RW | 0x1A00(6656dec) |
| 1C13:02 | SubIndex 002 | 2nd allocated TxPDO | UINT16 | RW | 0x1A01(6657dec) |
| 1C13:03 | SubIndex 003 | 3rd allocated TxPDO | UINT16 | RW | 0x1A02(6658dec) |
| 1C13:04 | SubIndex 004 | 4th allocated TxPDO | UINT16 | RW | 0x1A03(6659dec) |
| 1C13:05 | SubIndex 005 | 5th allocated TxPDO | UINT16 | RW | 0x1A04(6660dec) |
| 1C13:06 | SubIndex 006 | 6th allocated TxPDO | UINT16 | RW | 0x1A05(6661dec) |
| 1C13:07 | SubIndex 007 | 7th allocated TxPDO | UINT16 | RW | 0x1A06(6662dec) |
| 1C13:08 | SubIndex 008 | 8th allocated TxPDO | UINT16 | RW | 0x1A07(6663dec) |
| 1C13:09 | SubIndex 009 | 9th allocated TxPDO | UINT16 | RW | 0x1A08(6664dec) |
| 1C13:0A | SubIndex 010 | 10th allocated TxPDO | UINT16 | RW | 0x1A09(6665dec) |
| 1C13:0B | SubIndex 011 | 11th allocated TxPDO | UINT16 | RW | 0x1A0A(6666dec) |
| 1C13:0C | SubIndex 012 | 12th allocated TxPDO | UINT16 | RW | 0x1A0B(6667dec) |
| 1C13:0D | SubIndex 013 | 13th allocated TxPDO | UINT16 | RW | 0x1A0C(6668dec) |
| 1C13:0E | SubIndex 014 | 14th allocated TxPDO | UINT16 | RW | 0x1A0D(6669dec) |
| 1C13:0F | SubIndex 015 | 15th allocated TxPDO | UINT16 | RW | 0x1A0E(6670dec) |
| 1C13:10 | SubIndex 016 | 16th allocated TxPDO | UINT16 | RW | 0x1A0F(6671dec) |

## Index 1C13 TxPDO Assignment(For ECAT-2016N)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| 1C13:00 | TxPDO Assignment | PDO Assign Inputs | UINT8 | RW | 0x01(16dec) |

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## Index 1C32 TxPDO Assignment

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **1C32:00** | SM output parameter | Synchronization parameters for the outputs | UINT8 | RO | 0x20(32dec) |
| **1C32:01** | Synchronization type | Current synchronization type:<br>Bit0 = 0: Free Run<br>Bit1 = 1:Synchron with SM 2 Event<br>Bit15 = 0: Standard<br>Bit15 = 1: FastOp mode (CoE deactivated) | UINT16 | RW | 0x0000(0dec) |
| **1C32:02** | Cycle | Cycle time (in ns):<br>**Free Run:** Cycle time of the local timer<br>Synchronous with SM 2 event: Master cycle time | UINT32 | RO | 0x00000000 (0dec) |
| **1C32:04** | Synchronization type supported | Supported synchronization modes:<br>**Bit0** = free run is supported<br>**Bit1**= synchronous with SM 2 event is supported (outputs available)<br>**Bit1**= synchronous with SM 3 event is supported (no outputs available)<br>**Bit4-5**= 01: input shift with SYNC 1 event (no outpus available)<br>**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 | 0x000061A8 (2500dec) |
| **1C32:08** | Get cycle time | With this entry the real required process data provision time can be measured.<br>**0:** Measurement of the local cycle time is stopped<br>**1:** Measurement of the local cycle time is statred | UINT16 | RW | 0x0001(1dec) |
| **1C32:09** | Delay time | Time between SYNC1 event and reading of the inputs | UINT32 | RO | 0x000009C4 (2500dec) |
| **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** | Sync Error | 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) |

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### Index 1C33 SM Input Parameter

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **1C33:00** | SM input parameter | Synchronization parameters for the inputs | UINT8 | RO | 0x20(32dec) |
| **1C33:01** | Synchronization Type | Current synchronization type:<br>**Bit0** = **0**: Free Run<br>**Bit1** = **1**:Synchron with SM 2 Event<br>**Bit15** = **0**: Standard<br>**Bit15** = **1**: FastOp mode (CoE deactivated) | UINT16 | RW | 0x0000(0dec) (Only support Free Run Mode) |
| **1C33:02** | Cycle time | Cycle time (in ns):<br>**Free Run:** Cycle time of the local timer<br>Synchronous with SM 2 event: Master cycle time | UINT32 | RO | 0x00000000 (0dec) |
| **1C33:04** | Synchronization Type supported | Supported synchronization modes:<br>**Bit0** = free run is supported<br>**Bit1**= synchronous with SM 2 event is supported (outputs available)<br>**Bit1**= synchronous with SM 3 event is supported (no outputs available)<br>**Bit4-5**= 01: input shift with SYNC 1 event (no outpus available)<br>**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 | 0x000061A8 (2500dec) |
| **1C33:08** | Get cycle time | With this entry the real required process data provision time can be measured.<br>**0:** Measurement of the local cycle time is stopped<br>**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 | 0x000009C4 (2500dec) |
| **1C33:0B** | SM event missed counter | Number of missed SM events in OPERATIONAL | UINT16 | RO | 0x0000(0dec) |
| **1C33:0C** | Cycle time to 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) |
| **1C33:20** | Sync error | The synchronization was not correct in the last cycle | BOOLEAN | RO | FALSE(0dec) |

## 4.2 Profile Specific Objects(0x6000-0xFFFF)

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# Index 60n0 AI Inputs (for 0 ≤ n ≤ F)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **60n0:00** | AI Inputs | Maximum subindex | UINT16 | RO P | 0x11(17dec) |
| **60n0:01** | Underrange | Value below measuring range | BOOLEAN | RO P | FALSE(0dec) |
| **60n0:02** | Overrange | Measuring range exceeded | BOOLEAN | RO P | FALSE(0dec) |
| **60n0:03** | Limit 1 | Limit value monitoring Limit 1<br>**0:** not active<br>**1:** Value is smaller than Limit Value1<br>**2:** Value is larger than Limit Value1<br>**3:** Value is equal to Limit Value1 | Bit2 | RO P | |
| **60n0:05** | Limit 2 | Limit value monitoring Limit 2<br>**0:** not active<br>**1:** Value is smaller than Limit Value2<br>**2:** Value is larger than Limit Value2<br>**3:** Value is equal to Limit Value2 | Bit2 | RO P | |
| **60n0:07** | Error | The error bit is set if the data is invalid (over-rang, un-der-range) | BOOLEAN | RO P | FALSE(0dec) |
| **60n0:0F** | TxPDO State | Validity of the data of the associated TxPDO (0=valid, 1=invalid) | BOOLEAN | RO P | FALSE(0dec) |
| **60n0:10** | TxPDO Toggle | The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated. | BOOLEAN | RO P | TRUE(1dec) |
| **60n0:11** | Value | Analgo input data | INT16 | RO P | 0x000B(11dec) |

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# Index 80n0 AI Settings (for 0 ≤ n ≤ F ,for ECAT-2011H/2012H)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **80n0:00** | AI Settings | Maximum subindex | UINT8 | RW | 0x1A(26dec) |
| **80n0:01** | Enalbe user scale | User scale is active | BOOLEAN | RW | FALSE(0dec) |
| **80n0:02** | Presentation | Change the method of representation of the measured value.<br>**0:** Signed presentation<br>(Refer to Table 4-2-1 below)<br>**1:** Unsigned presentation<br>(Refer to Table 4-2-2 below)<br>**2:** Absolute value with MSB as sign Signed amount representation<br>(Refer to Table 4-2-3 below) | Bit3 | RW | Signed(0dec) |
| **80n0:05** | Enable Channel | Enable Channel | BOOLEAN | RW | TRUE(1dec) |
| **80n0:06** | Enalbe filter | Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary | BOOLEAN | RW | FALSE(0dec) |
| **80n0:07** | Enable limit 1 | Limit 1 enable | BOOLEAN | RW | FALSE(0dec) |
| **80n0:08** | Enalbe limit 2 | Limit 2 enable | BOOLEAN | RW | FALSE(0dec) |
| **80n0:09** | Analog input type | **0:** Differential input<br>**1:** Single-ended input | NIT32 | RW | Differential (0dec) |
| **80n0:0A** | Enalbe user calibration | Enabling of the user calibration | BOOLEAN | RO | FALSE(0dec) |
| **80n0:0B** | Enalbe vendor calibration | Enabling of the vendor calibration | BOOLEAN | RW | TRUE(1dec) |
| **80n0:0E** | Swap limit bits | Swap limit bits<br>**FALSE:**<br>0: not active<br>1: value < limit value<br>2: value > limit value<br>3: value is equal to the limit value<br>**TRUE:**<br>0: not active<br>1: value < limit value<br>2: value > limit value<br>3: value is equal to the limit value | BOOLEAN | RW | FALSE(0dec) |

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| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **80n0:11** | User scale offset | User scaling offset | INT16 | RW | 0x00(0dec) |
| **80n0:12** | User scale gain | User scaling gain.<br>The value 1 corresponds to 65535 dec (0x00010000) and is limited to ±0x7FFFF. | INT32 | RW | 0x0x0001000 (65535dec) |
| **80n0:13** | Limit 1 | First limit value for setting the status bits | INT16 | RW | 0x00(0dec) |
| **80n0:14** | Limit 2 | Second limit value for setting the status bits | INT16 | RW | 0x00(0dec) |
| **80n0:15** | Filter settings | This object determines the digital filter settings, if it is active via Enable filter (Index 0x80n0:06).<br>The possible settings are sequentially numbered.<br>**0:** Without Filter<br>**1:** N/A<br>**2:** IIR 1 (168 Hz)<br>**3:** IIR 2 (88 Hz)<br>**4:** IIR 3 (43 Hz)<br>**5:** IIR4 (21 Hz)<br>**6:** IIR5 (10.5 Hz)<br>**7:** IIR 6 (5.2 Hz)<br>**8:** IIR 7 (2.5 Hz)<br>**9:** IIR 8 (1.2 Hz) | UINT16 | RW | Without Filter (0dec) |
| **80n0:17** | User calibration offset | User offset compensation | INT16 | RW | 0x0000(0dec) |
| **80n0:18** | User calibration gain | User calibration gain | INT16 | RW | 0x4000(16384dec) |
| **80n0:19** | AI Range | **0:** ±10V<br>**1:** ±5V<br>**2:** ±2.5V<br>**3:** 0~10V<br>**4:** 20 mA<br>**5:** 4~20 mA<br>**6:** ±20 mA<br>**7:** ±4~20mA<br>**8:** CH0-3: ±10V, CH4-7: 20mA<br>**9:** CH0-3: ±10V, CH4-7: 4~20mA<br>**10(A):** CH0-3: ±10V, CH4-7: ±20mA<br>**11(B):** CH0-3: ±10V, CH4-7: ±4~20mA | UINT32 | RW | ±10V (0dec) |
| **80n0:1A** | FactoryCMD | Factory Command | UINT32 | RW | 0x00000000(0dec) |

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# Index 80n0 AI Settings (for 0 ≤ n ≤ F ,for ECAT-2016 Series)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **80n0:00** | AI Settings | Maximum subindex | UINT8 | RW | 0x1A(26dec) |
| **80n0:01** | Enalbe user scale | User scale is active | BOOLEAN | RW | FALSE(0dec) |
| **80n0:02** | Presentation | Change the method of representation of the measured value.<br>**0:** Signed presentation<br>(Refer to Table 4-2-1 below)<br>**1:** Unsigned presentation<br>(Refer to Table 4-2-2 below)<br>**2:** Absolute value with MSB as sign<br>Signed amount representation<br>(Refer to Table 4-2-3 below) | Bit3 | RW | Signed(0dec) |
| **80n0:05** | Enable Channel | Enable Channel | BOOLEAN | RW | TRUE(1dec) |
| **80n0:06** | Enalbe filter Type | 0:Enable Sinc3<br>1:Enable Sinc1+Sin5 | BOOLEAN | RW | Sinc3(0dec) |
| **80n0:07** | Enable limit 1 | Limit 1 enable | BOOLEAN | RW | FALSE(0dec) |
| **80n0:08** | Enalbe limit 2 | Limit 2 enable | BOOLEAN | RW | FALSE(0dec) |
| **80n0:09** | Analog input type | **0:** Differential input | NIT32 | RW | Differential (0dec) |
| **80n0:0A** | Enalbe user calibration | Enabling of the user calibration | BOOLEAN | RO | FALSE(0dec) |
| **80n0:0B** | Enalbe vendor calibration | Enabling of the vendor calibration | BOOLEAN | RW | TRUE(1dec) |
| **80n0:0E** | Swap limit bits | Swap limit bits<br>**FALSE:**<br>0: not active<br>1: value < limit value<br>2: value > limit value<br>3: value is equal to the limit value<br>**TRUE:**<br>0: not active<br>1: value < limit value<br>2: value > limit value<br>3: value is equal to the limit value | BOOLEAN | RW | FALSE(0dec) |

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| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **80n0:11** | User scale offset | User scaling offset | INT16 | RW | 0x00(0dec) |
| **80n0:12** | User scale gain | User scaling gain.<br>The value 1 corresponds to 65535 dec (0x00010000) and is limited to ±0x7FFFF. | INT32 | RW | 0x0x0001000 (65535dec) |
| **80n0:13** | Limit 1 | First limit value for setting the status bits | INT16 | RW | 0x00(0dec) |
| **80n0:14** | Limit 2 | Second limit value for setting the status bits | INT16 | RW | 0x00(0dec) |
| **80n0:15** | Filter settings | The possible settings are sequentially numbered.<br>**0:** 125 kSPS **1:** IIR0 (125 kSPS)<br>**2:** IIR 1 (62.5 kSPS)<br>**3:** IIR 2 (62.5 kSPS)<br>**4:** IIR 3 (31.25 kSPS)<br>**5:** IIR4 (25 kSPS)<br>**6:** IIR5 (15.625 kSPS)<br>**7:** IIR 6 (10.390 kSPS)<br>**8:** IIR 7 (5.0 kSPS) **9:** IIR 8 (2.5 kSPS)<br>**10:** IIR 9 (1 kSPS)<br>**11:** IIR 10 (500 SPS)<br>**12:** IIR 11 (400 SPS)<br>**13:** IIR 12 (200 SPS)<br>**14:** IIR 13(100.2 SPS)<br>**15:** IIR 14(59.87 SPS)<br>**16:** IIR 15(49.92 SPS)<br>**17:** IIR 16(20 SPS)<br>**18:** IIR 17(16.7 SPS)<br>**19:** IIR 18(10 SPS) **20:** IIR 19(5 SPS) | UINT16 | RW | 125 kSPS (0dec) |
| **80n0:17** | User calibration offset | User offset compensation | INT16 | RW | 0x0000(0dec) |
| **80n0:18** | User calibration gain | User calibration gain | INT16 | RW | 0x4000(16384dec) |
| **80n0:19** | AI Range | **ECAT-2016N:**<br>**0:** ±1.25V **1:** ±600mV **2:** ±300mV<br>**3:** ±125mV **4:** ±80mV **5:** ±60mV<br>**6:** ±40mV **7:** ±30mV **8:** ±20mV<br>**9:** ±15mV **10(A):** ±10mV<br>**ECAT-2016-3:**<br>**0:** ±10V **1:** ±5V **2:** ±2.5V<br>**3:** ±1.25V **4:** ±625mV **5:** ±312mV<br>**6:** ±200mV **7:** ±100mV **8:** ±50mV<br>**9:** ±25mV | UINT32 | RW | ECAT-2016N: ±1.25V (0dec)<br>ECAT-2016-3: ±10V (0dec) |
| **80n0:1A** | FactoryCMD | Factory Command | UINT32 | RW | 0x00000000(0dec) |

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➢ **Table 4-2-1: Signed Integer representation as follows:**

The negative output value is represented in two's complement (negated + 1).

Maximum representation range for 16 bits = -32768 to +32767dec

| Input signal | | | | | | | Value | |
|---|---|---|---|---|---|---|---|---|
| ±10 (V) | ±5 (V) | ±2.5 (V) | 0-10 (V) | 20 (mA) | 4-20 (mA) | ±4 – 20 (mA) | Decimal | Hexadecimal |
| 10 | 5 | 2.5 | 10 | 20 | 20 | 20 | 32767 | 0x7FFF |
| 5 | 2.5 | 1.25 | 5 | 10 | 12 | 12 | 16383 | 0x3FFF |
| | | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 4 | ±4 | 0 | 0x0000 |
| | | | | | | | | 0xFFFF |
| -5 | - 2.5 | -1.25 | | | | -12 | -16383 | 0xC001 |
| -10 | -5 | -2.5 | | | | -20 | -32768 | 0x8000 |

| Input signal | | | | | | | | | | | Value | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ±1.25 (V) | ±600 (mV) | ±300 (mV) | ±125 (mV) | ±80 (mV) | ±60 (mV) | ±40 (mV) | ±30 (mV) | ±20 (mV) | ±15 (mV) | ±10 (mV) | Decimal | Hexadecimal |
| 1.25 | 600 | 300 | 125 | 80 | 60 | 40 | 30 | 20 | 15 | 10 | 32767 | 0x7FFF |
| 0.75 | 300 | 150 | 72.5 | 40 | 30 | 20 | 15 | 10 | 7.5 | 5 | 16383 | 0x3FFF |
| | | | | | | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x0000 |
| | | | | | | | | | | | | 0xFFFF |
| -0.75 | -300 | -150 | -72.5 | -40 | -30 | -20 | -15 | -10 | -7.5 | -5 | -16383 | 0xC001 |
| -1.25 | -600 | -300 | 125 | -80 | -60 | -40 | -30 | -20 | 15 | -10 | -32768 | 0x8000 |

| Input signal | | | | | | Value | |
|---|---|---|---|---|---|---|---|
| ±625 (mV) | ±312 (mV) | ±200 (mV) | ±100 (mV) | ±50 (mV) | ±25 (mV) | Decimal | Hexadecimal |
| 625 | 312 | 200 | 100 | 50 | 25 | 32767 | 0x7FFF |
| 312.5 | 156 | 100 | 50 | 25 | 12.5 | 16383 | 0x3FFF |
| | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x0000 |
| | | | | | | | 0xFFFF |
| -312.5 | -156 | -100 | -50 | -25 | -12.5 | -16383 | 0xC001 |
| -625 | -312 | -200 | -100 | -50 | -25 | -32768 | 0x8000 |

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➢ **Table 4-2-2: Unsigned Integer representation as follows:**

The output value is represented with 15-bit resolution without sign, therefore polarity detection is no longer possible. Maximum representation range for 16 bits = 0 to +32767dec

| Input signal | | | | | | | Value | |
|---|---|---|---|---|---|---|---|---|
| ±10 (V) | ±5 (V) | ±2.5 (V) | 0-10 (V) | 20 (mA) | 4-20 (mA) | ±4 – 20 (mA) | Decimal | Hexadecimal |
| 10 | 5 | 2.5 | 10 | 20 | 20 | 20 | 32767 | 0x7FFF |
| 5 | 2.5 | 1.25 | 5 | 10 | 12 | 12 | 16383 | 0x3FFF |
| | | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 4 | ±4 | 0 | 0x0000 |
| | | | | | | | | 0xFFFF |
| -5 | - 2.5 | -1.25 | | | | -12 | -16383 | 0xC001 |
| -10 | -5 | -2.5 | | | | -20 | -32768 | 0x8000 |

| Input signal | | | | | | | | | | | Value | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ±1.25 (V) | ±600 (mV) | ±300 (mV) | ±125 (mV) | ±80 (mV) | ±60 (mV) | ±40 (mV) | ±30 (mV) | ±20 (mV) | ±15 (mV) | ±10 (mV) | Decimal | Hexadecimal |
| 1.25 | 600 | 300 | 125 | 80 | 60 | 40 | 30 | 20 | 15 | 10 | 32767 | 0x7FFF |
| 0.75 | 300 | 150 | 72.5 | 40 | 30 | 20 | 15 | 10 | 7.5 | 5 | 16383 | 0x3FFF |
| | | | | | | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x0000 |
| | | | | | | | | | | | | 0xFFFF |
| -0.75 | -300 | -150 | -72.5 | -40 | -30 | -20 | -15 | -10 | -7.5 | -5 | -16383 | 0xC001 |
| -1.25 | -600 | -300 | 125 | -80 | -60 | -40 | -30 | -20 | 15 | -10 | -32768 | 0x8000 |

| Input signal | | | | | | Value | |
|---|---|---|---|---|---|---|---|
| ±625 (mV) | ±312 (mV) | ±200 (mV) | ±100 (mV) | ±50 (mV) | ±25 (mV) | Decimal | Hexadecimal |
| 625 | 312 | 200 | 100 | 50 | 25 | 32767 | 0x7FFF |
| 312.5 | 156 | 100 | 50 | 25 | 12.5 | 16383 | 0x3FFF |
| | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x0000 |
| | | | | | | | 0xFFFF |
| -312.5 | -156 | -100 | -50 | -25 | -12.5 | -16383 | 0xC001 |
| -625 | -312 | -200 | -100 | -50 | -25 | -32768 | 0x8000 |

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➢ **Table 4-2-3: Absolute value with MSB as sign - representation as follows:**

The output value is displayed in magnitude-sign format: MSB=1 (highest bit) in the case of negative values. Maximum representation range for 16 bits = -32767 to +32767dec

| Input signal | | | | | | | Value | |
|---|---|---|---|---|---|---|---|---|
| ±10 (V) | ±5 (V) | ±2.5 (V) | 0-10 (V) | 20 (mA) | 4-20 (mA) | ±4 – 20 (mA) | Decimal | Hexadecimal |
| 10 | 5 | 2.5 | 10 | 20 | 20 | 20 | 32767 | 0x7FFF |
| 5 | 2.5 | 1.25 | 5 | 10 | 12 | 12 | 16383 | 0x3FFF |
| | | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 4 | ±4 | 0 | 0x0000 |
| | | | | | | | | 0x8001 |
| -5 | - 2.5 | -1.25 | | | | -12 | [-16383] | 0xBFFF |
| -10 | -5 | -2.5 | | | | -20 | [-32768] | 0xFFFF |

| Input signal | | | | | | | | | | | Value | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ±1.25 (V) | ±600 (mV) | ±300 (mV) | ±125 (mV) | ±80 (mV) | ±60 (mV) | ±40 (mV) | ±30 (mV) | ±20 (mV) | ±15 (mV) | ±10 (mV) | Decimal | Hexadecimal |
| 1.25 | 600 | 300 | 125 | 80 | 60 | 40 | 30 | 20 | 15 | 10 | 32767 | 0x7FFF |
| 0.75 | 300 | 150 | 72.5 | 40 | 30 | 20 | 15 | 10 | 7.5 | 5 | 16383 | 0x3FFF |
| | | | | | | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x0000 |
| | | | | | | | | | | | | 0x8001 |
| -0.75 | -300 | -150 | -72.5 | -40 | -30 | -20 | -15 | -10 | -7.5 | -5 | [-16383] | 0xBFFF |
| -1.25 | -600 | -300 | 125 | -80 | -60 | -40 | -30 | -20 | 15 | -10 | [-32768] | 0xFFFF |

| Input signal | | | | | | Value | |
|---|---|---|---|---|---|---|---|
| ±625 (mV) | ±312 (mV) | ±200 (mV) | ±100 (mV) | ±50 (mV) | ±25 (mV) | Decimal | Hexadecimal |
| 625 | 312 | 200 | 100 | 50 | 25 | 32767 | 0x7FFF |
| 312.5 | 156 | 100 | 50 | 25 | 12.5 | 16383 | 0x3FFF |
| | | | | | | | 0x0001 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x0000 |
| | | | | | | | 0xFFFF |
| -312.5 | -156 | -100 | -50 | -25 | -12.5 | -16383 | 0xC001 |
| -625 | -312 | -200 | -100 | -50 | -25 | -32768 | 0x8000 |

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## Index 80nE AI Internal Data (for 0<=n<=F)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **80nE:00** | AI Internal data | Maximum subindex | UINT8 | RO | 0x1(1dec) |
| **80nE:01** | ADC raw value | ADC raw value | UINT16 | RO | 0x0008(8dec) |

## Index 80nF AI Vendor Data (for 0<=n<=F)

| Index | Name | Meaning | Data type | Flags | Default |
|---|---|---|---|---|---|
| **80nF:00** | AI Vendor data | Maximum subindex | UINT8 | RW | 0x2(2dec) |
| **80nF:01** | Calibration offset | Offset (vendor calibration) | UINT16 | RW | 0xFFED(-19dec) |
| **80nF:02** | Calibration gaing | Gain (vendor calibration) | UINT16 | RW | 0x40AD (16557dec) |

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# Appendix: Revision History

This chapter provides revision history information to this document.

The table below shows the revision history.

| Revision | Date | Description |
|---|---|---|
| 1.0 | Oct. 08 2018 | Initial issue |
| 1.1 | Dec. 2018 | Add the unit conversion table about Signed Integer, Unsigned Integer and Most Significant Bit (MSB). |
| 1.2 | Dec. 2019 | Add ECAT-2012H and ECAT-2016N information |
| 1.3 | Jan. 2021 | Add ECAT-2016-3 information |
| **1.4** | Mar. 2021 | Fix ESI file web link |

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