

Slim67 Analog I/O Module

----EtherCAT System Manual



Preface

1. Scope of this manual:

This manual applies to the ELCO EtherCAT Slim67 analog distributed I/O device. The information in this manual enables you to run the Slim67 analog module on EtherCAT in a distributed I/O device.

2. Basic knowledge requirements

This manual presumes a general knowledge in the field of automation engineering and describes the components based on the data valid at the time of its release. ELCO reserves the right of including a product information for each new component, and for each component of a later version.

3. Guide

This manual describes the hardware of the EtherCAT Slim67 analog distributed I/O device.

Covered topics are:

- Installation and wiring
- Commissioning and diagnostics
- Components
- Article numbers
- Technical specifications

4. Technical support:

This manual describes the characteristics and the usage of a Slim67 analog distributed I/O device.

Please contact your local ELCO representative if you have any questions about the products described in this manual.

Additional information about ELCO products is available:

<http://www.elco-holding.com/>

5. Disclaimer of liability:

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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1. Product overview

1.1 Introduction

The distributed I/O devices Slim67 analog module is an EtherCAT I/O device with IP67 protection level.

1.2 Applications

Slim67 analog distributed I/O device provides a reliable solution for the field bus I/O system which connects controllers and is applied in harsh field environment.

Slim67 analog module based on 32mm wide IP67 housing with standardized installation allows a safe and reliable operation in the harsh working environment where water, dust and vibration may occur. These characteristics make them suitable for many applications, such as material conveying system, automatic assembly system and so on.

Other functions include supporting input and output of multiple signals. Embedded high-brightness LED diagnosis helps maintainers to judge I/O, module and network status more easily.

1.3 Features

- Up to IP67 protection level
- Can be used in compact, narrow installation space
- M8 size power supply and network interface
- Independent bus slave station, which can be directly connected with PLC
- LED status display, channel level protection and diagnosis

1.4 Product type list

No.	Type	Description
1	FEEC-04UA-M12-T	4-Point configurable analog channel Current or voltage input/output signals and thermocouple and resistance signals can be connected as required Short Circuit Protection and Diagnosis

2. Technical characteristics

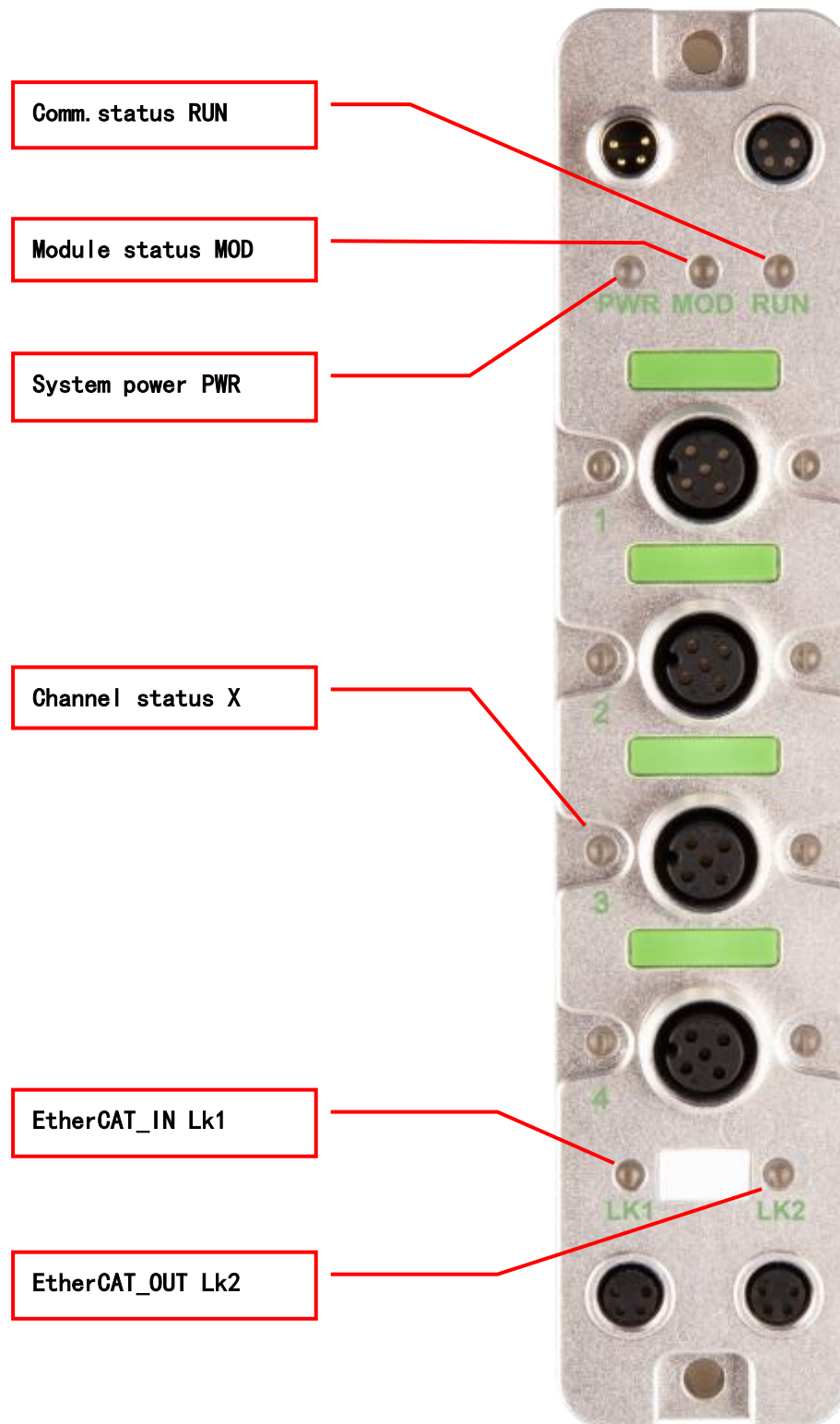
2.1 Hardware parameters

Ordering data	
Product type	FEEC-04UA-M12-T
Description	Slim IP67 analog module
Communication	
Protocol	EtherCAT
Operating mode	Auto-negotiation, Auto-MDI/MDI-X
Transfer rate	10/100 Mbps
Addressing	System automatic allocation
Power supply	
工作电压	24 VDC (18...30 VDC)
Current consumption	Max. 200mA
System&Signal supply	Us, Max. 4A
Auxiliary supply	Ua, Max. 4A
Electrical isolation	Us and Ua: 24V separated, 0V connected
Connections	
Power supply	2 x M8 4pin, Male+Female
Fieldbus	2 x M8 4pin, Female
Signals	4 x M12 A-code 5pin, Female
Electrical parameter	
Operating mode	Current, voltage, thermocouple, thermal resistancesignal type and in/out can be set
Input channels	Max. 4
Input supply current	Max. 200mA per channel
Input type	Current: 0...20mA, 4...20mA Voltage: 0...10V Thermocouple: Type J, K, T, N, E Thermal resistance: PT100, PT1000
Internal impedance	Current: 250Ω Voltage: 1MΩ
Resolution	16 Bit

Switching time	Current & Voltage: 12 ms Thermocouple: 50 ms
Measurement accuracy	± 0.3%
Output channels	Max. 4
Output type	Current: 0...20mA, 4...20mA Voltage: 0...10V
Internal impedance	Current: <450Ω Voltage: >1kΩ
Resolution	16 Bit
Switching time	12 ms
Measurement accuracy	± 0.3%
Diagnostics	
Communication indication	LED indication, Communication message
Voltage detection	Support, Low voltage alarm
Short-circuit & Overload	Support, LED indication
General data	
Protection	IP67
Temperature	Operating -25...+70 °C, Storage -40...+85 °C
Dimensions (W*H*D)	32x155x34 mm

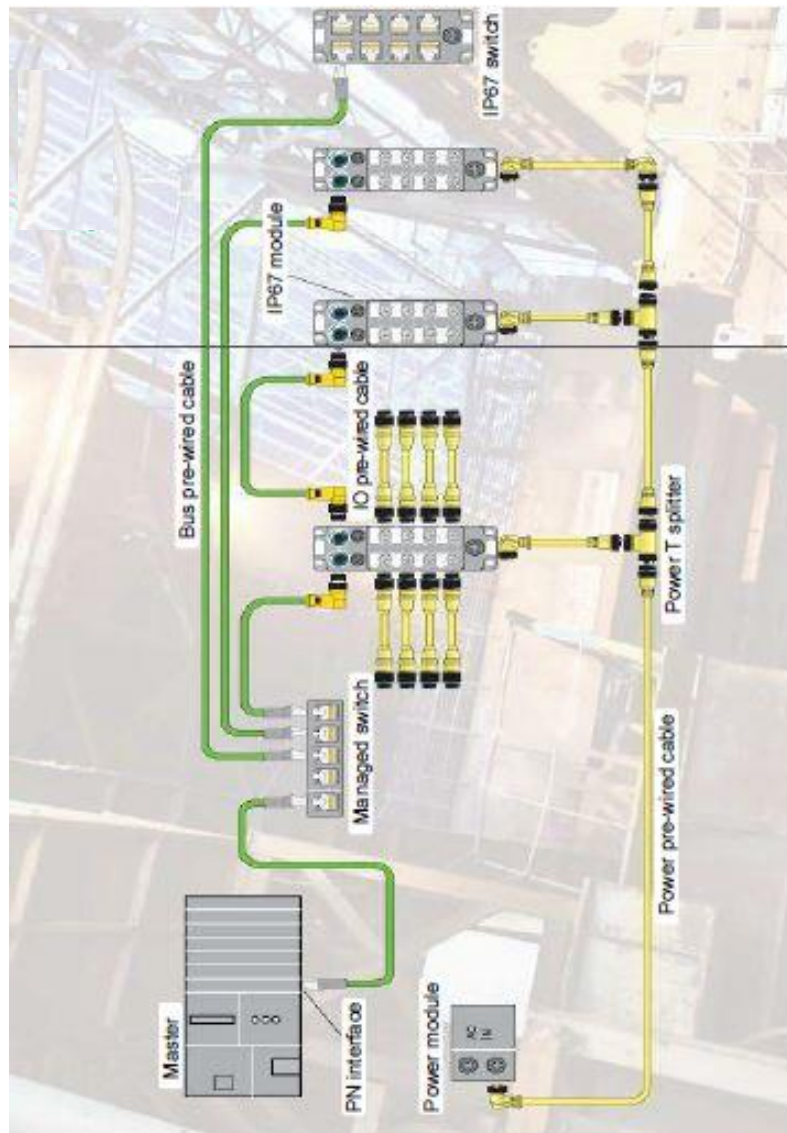
2.2 LED Indication

The operating status of the module can be clearly displayed by the LED indicator.



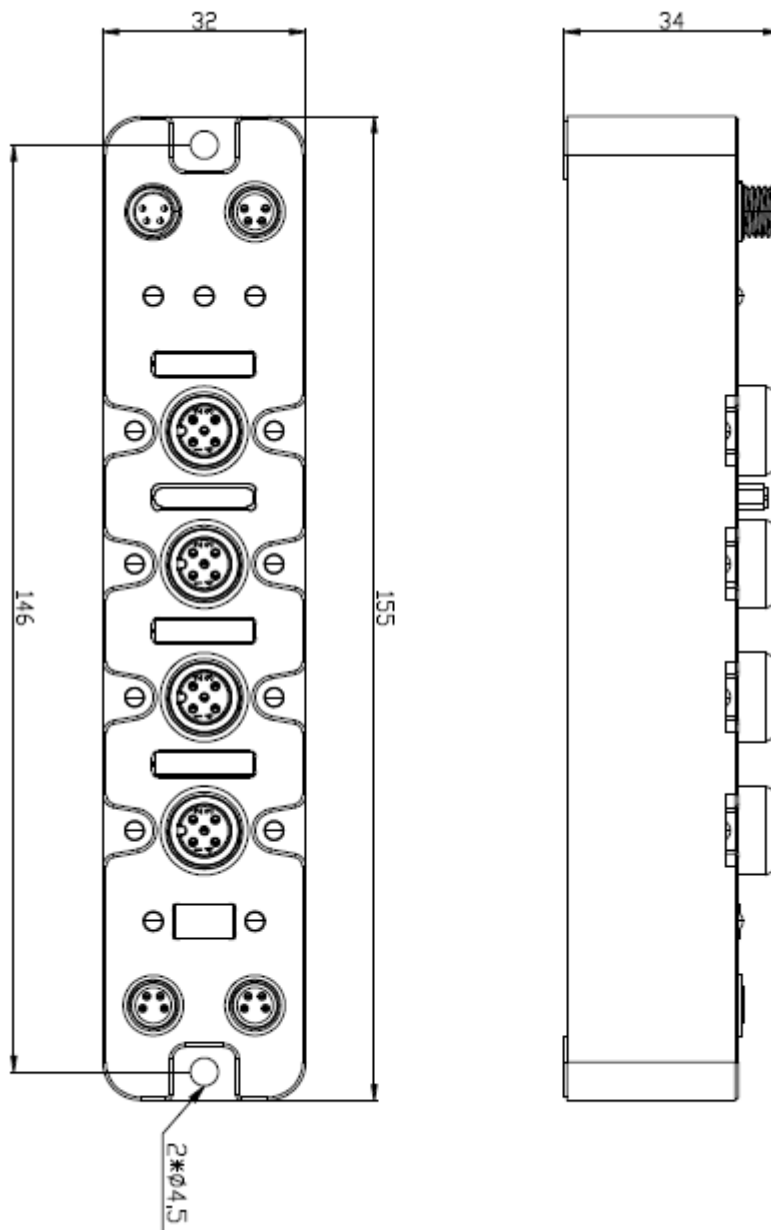
2.3 General system layout

The following figure shows an example of a conventional EtherCAT system module connection, which is powered by 24VDC power supply to three modules. EtherCAT network connects modules through switches or cascades. The further modules can also use more switches to expand the connection distance.



3. Installing

3.1 Mounting dimensions



3.2 Mounting position, mounting dimensions

Slim67 analog module can be mounted in any position because of IP67's high protection level and excellent anti-vibration and anti-interference capability.

Slim67 analog module adopts a uniform shape size. The following table shows the dimensions of the module:

	Dimensions
Mounting width	32 mm
Mounting height	155 mm
Mounting depth	34 mm (without connector)

3.3 Wiring Slim67 analog module

Please connect according to the basic electrical specifications. For personal and equipment safety, we recommend disconnecting the power supply during wiring operation.

3.3.1 Connecting Slim67 analog module to protective earth (PE)

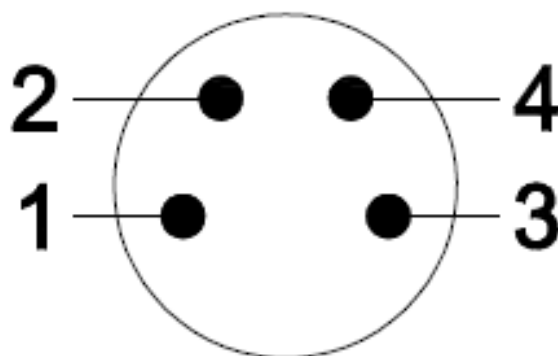
- Always connect the Slim67 analog module to protective earth.
- The module also requires this connection to protective earth in order to discharge any interference currents to ground, and for EMC compatibility.
- Always make sure you have a low-impedance connection to protective earth.

3.3.2 Slim67 analog module power supply

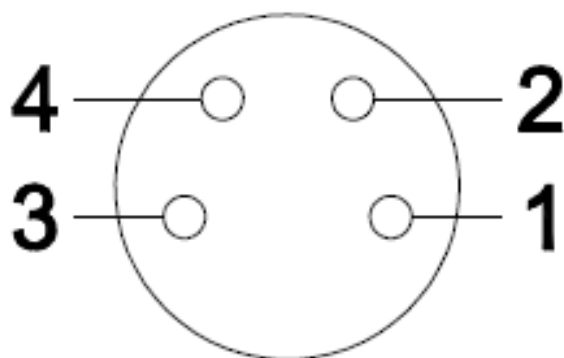
Slim67 analog module adopt 24VDC power supply, voltage range 18~30VDC, standard M8-4pin connector.

Two parts for power supply: module and input signal power supply U_i (1L+、1M), output signal power supply (2L+、2M). Electrical isolation between 1L+ and 2L+, internally connected between common point 1M and 2M.

1) Power in connector view (Male)



2) Power out connector view (Female)



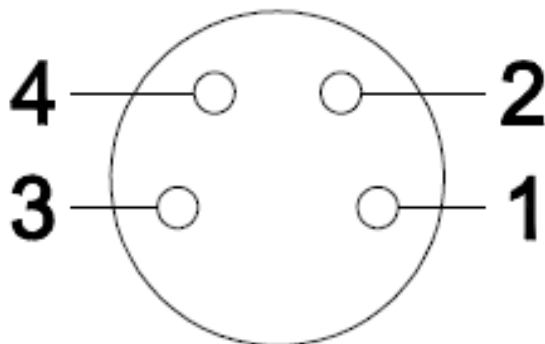
3) Power definition

Terminal	Function	Power supply
1	Module and input signal 1L+	24V
2	Output signal 2L+	24V
3	Module and input signal 1M	0V
4	Output signal 2M	0V

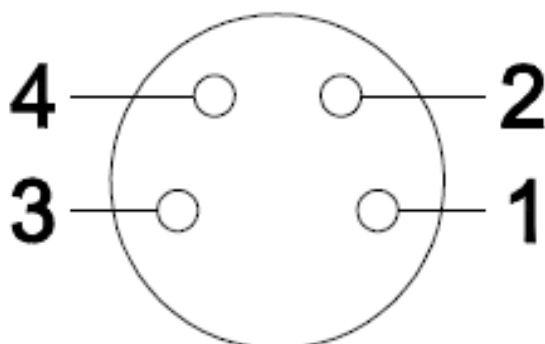
3.3.3 Slim67 analog module BUS connection

Slim67 analog module, supporting EtherCAT protocol, transmits signals by a shielded cable, M8-4pin connector.

1) BUS-In connector view (Female)



2) BUS-Out connector view (Female)



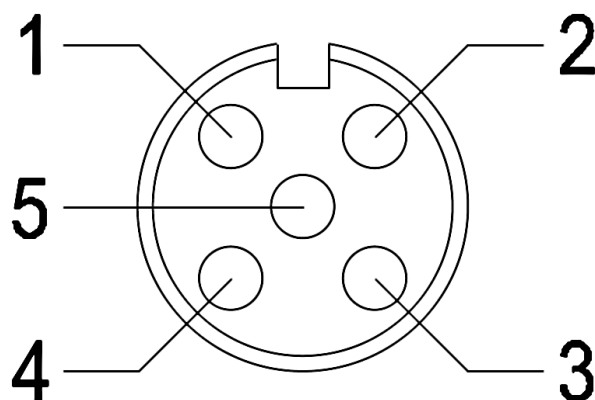
3) Bus definition

Terminal	Function	Cable color
1	Transmit Data(TD+)	Yellow
2	Receive Data(RD+)	White
3	Receive Data(RD-)	Blue
4	Transmit Data(TD-)	Orange

3.3.4 Slim67 analog module signal connection

I/O signals of Slim67 analog module are connected by standard M12 A-Code 5-pin connectors, and each port can connect up to one signal (input or output).

1) Signal connector view (Female)

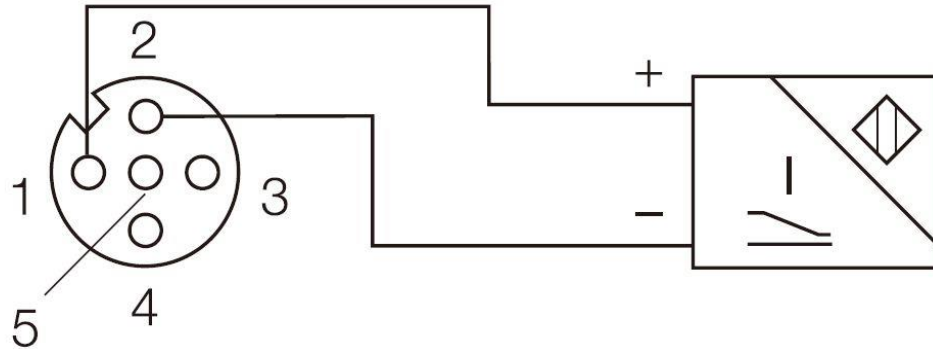


2) Digital signal interface definition

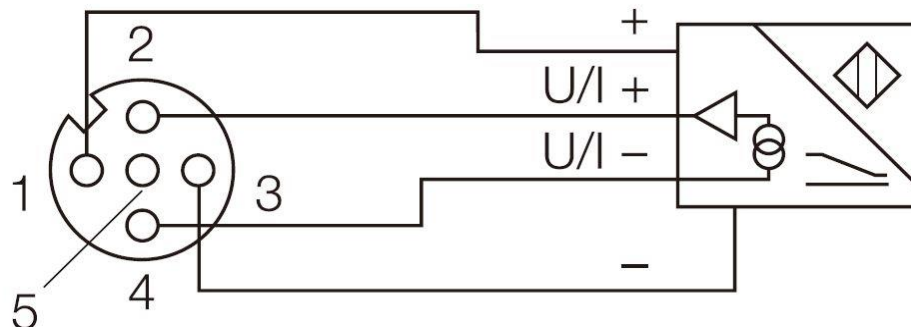
Terminal	M12 connector	
1	Power supply 24V+	
2	Signal in/out A	AI/AO +
3	Power supply GND	
4	Signal in/out B	AI/AO -
5	Protective earth PE	

3) Analog signal interface definition

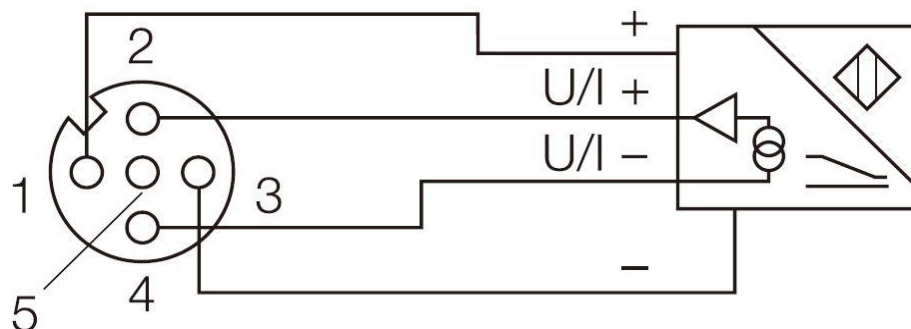
- a) Two-wire input --- 1 connector connects 1 two-wire input, FEEC-04UA-M12-T supports this connection.



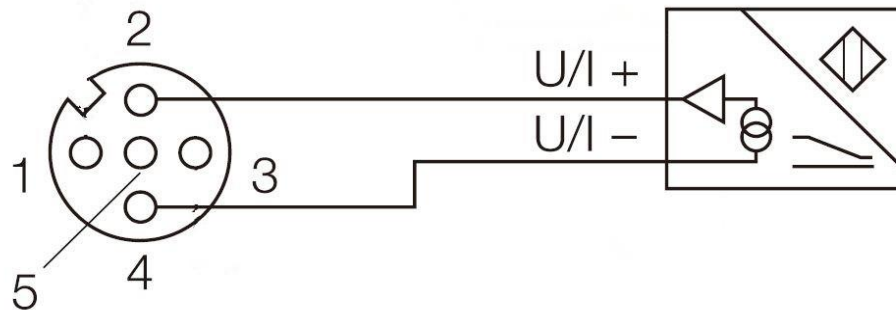
- b) Four-wire input --- 1 connector connects 1 four-wire input, FEEC-04UA-M12-T supports this connection.



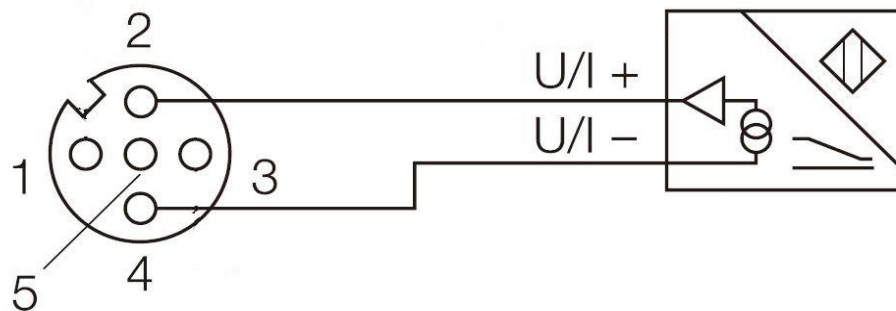
- c) Voltage input- 1 connector connects 1 voltage input, FEEC-04UA-M12-T supports this connection.



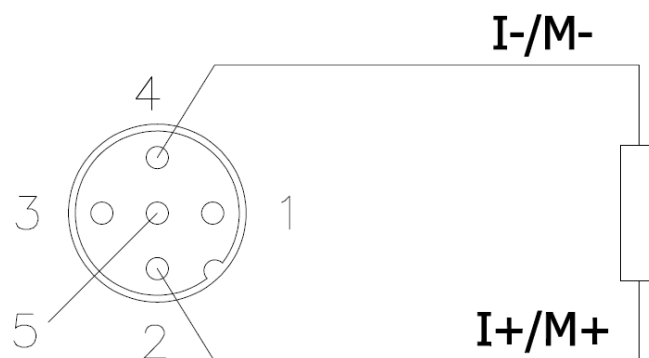
- d) Current output- 1 connector connects 1 current output, FEEC-04UA-M12-T supports this connection.



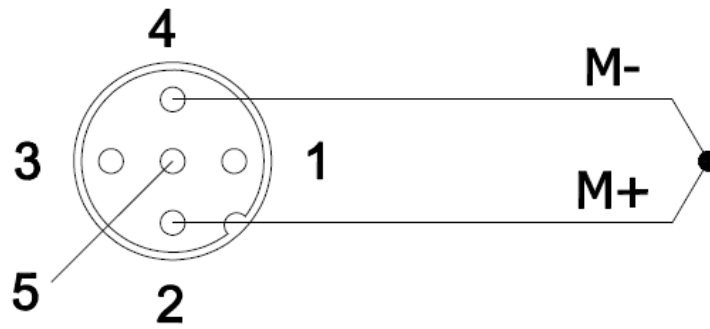
- e) Voltage output- 1 connector connects 1 voltage output, FEEC-04UA-M12-T supports this connection.



- f) Two-wire thermal resistance signal — 1 connector connects 1 two-wire thermal resistance signal, FEEC-04UA-M12-T supports this connection.



- g) Thermocouple signal —1 connector connects 1 thermocouple signal, FEEC-04UA-M12-T supports this connection.



4. Configuration Commissioning

4.1 Installation of configuration files

Configuration of Slim67 analog distributed I/O device via ESI file (XML format) and the standard EtherCAT IO ESI file for the Slim67 analog module will be integrated into user's system. You can visit the ELCO website to get the latest GSD file or call the hotline to contact technical personnel.

How to integrate the ESI file into the system depends on the user's configuration software:

1. Beckhoff system

Take Beckhoff TwinCAT programming software used in EtherCAT system as an example, add ESI files according to the following steps:

Install TwinCAT, then copy the XML file of Slim67 analog module to the following installation directory, for example:

TwinCAT2-----C:\TwinCAT\Io\EtherCAT\

TwinCAT3-----C:\TwinCAT\3.1\Config\Io\EtherCAT\

2. Omron system

Take Omron Sysmac Studio software used in EtherCAT system as an example, add ESI files according to the following steps:

Install TwinCAT, then copy the XML file of Slim67 analog module to the following installation directory, for example:

C:\OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles

4.2 Signal address assignment

Each Slim67 analog module has four connectors (Port1~Port4) for connecting signals, and each connector has five pins (Pin1~Pin5) for connection. The following model list shows the corresponding relationship between the signal status of each connector and the bytes transmitted by the EtherCAT bus.

FEEC-04UA-M12-T takes 12 bytes Input and 8 bytes Output.

Byte	Byte	Channel	e.g
Input/Output Byte 0~7	Byte 0 Byte 1	Port1	IW 0 QW 0
	Byte 2 Byte 3	Port2	IW 2 QW 2
	Byte 4 Byte 5	Port3	IW 4 QW 4
	Byte 6 Byte 7	Port4	IW 6 QW 6
Input Byte 8~11	Byte 8 Byte 9 Byte 10 Byte 11	Diagnosis	IB 8 IB 9 IB 10 IB 11

4.3 Instruction of Analog Value

PLC controller processes analog values in a binary system; the analog input module transfers analog process signals into digital signals; the analog output module transfers the digital output value into an analog signal.

Digital analog values are suitable to the same rated input and output value; each analog signal occupies 1 word PLC address, i. e. each analog signal corresponds to 16 bit. The symbol of analog is set on bit15: 0 represents '+'; 1 represents '1'. For the analog module with resolution less than 16 bits, the analog value is saved in the format of left justifying; the idle least significant bit is padded with '0'.

Example: analog value 18035 can be expressed in binary system as follows:

Resolution	Analog Value															
Bit No.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16bit	0	1	0	0	0	1	1	0	0	1	1	1	0	0	1	1
14bit	0	1	0	0	0	1	1	0	0	1	1	1	0	0	0	0

Analog signal types can be divided into the following types: current unipolarity value is 0~20mA and 4~20mA, voltage unipolarity value is 0~10V, thermal resistance supports PT100/PT1000, and thermocouple supports multiple TC types (Type J, K, T, N, E).

Note: Analog output only supports rated analog value; overshoot range only represents input module.

- Analog value within unipolar current input/output range:

System Value			Input/Output Range		
	Decimalism	hexadecimal	0~20mA	4~20mA	
104.999%	32767	7FFF	$\geq 23.7 \text{ mA}$	$\geq 22.96 \text{ mA}$	Overflow, lock the maximum
	31208	79E8			Overshoot range
100%	31207	79E7	20 mA	20 mA	Rated range
75%	23405	5B6D	15 mA	16 mA	
0.0032%	1	1			
0%	0	0	0 mA	4 mA	
	-1	FFFF			
-75%	-23405	A493	0 mA	0 mA	Underflow, lock the least value
-100%	-31207	8619			
	-31208	8618			
-104.999%	-32768	8000	0 mA	0 mA	

- Analog value within unipolar voltage input/output range:

System Value			Input/Output Range		
	Decimalism	hexadecimal	0~5 V	0~10 V	
104.999%	32767	7FFF	$\geq 5.926 \text{ V}$	$\geq 11.85 \text{ V}$	Overflow, lock the maximum
	31208	79E8			Overshoot range
100%	31207	79E7	5 V	10 V	Rated range
75%	23405	5B6D	3.75 V	7.5 V	
0.0032%	1	1			
0%	0	0	0 V	0 V	
	-1	FFFF			
-75%	-23405	A493	0 V	0 V	Underflow, lock the least value
-100%	-31207	8619			
	-31208	8618			
-104.999%	-32768	8000	0 V	0 V	

- Analog value within PT x00 thermal resistance:

System Value			Input/Output Range	
	Decimalism	hexadecimal	-200~+850 °C	
	32767	7FFF	≥ 850.1 °C	Overflow, lock the maximum
	8500	2134	850 °C	Rated range
	6375	18E7	637.5 °C	
	10	A	1 °C	
	0	0	0 °C	
	-10	FFF6	-1 °C	
	-1500	FA24	-150 °C	
	-2000	F830	-200 °C	
	-32768	8000	≤ -200.1 °C	Underflow, lock the least value

- Analog value within thermocouple:

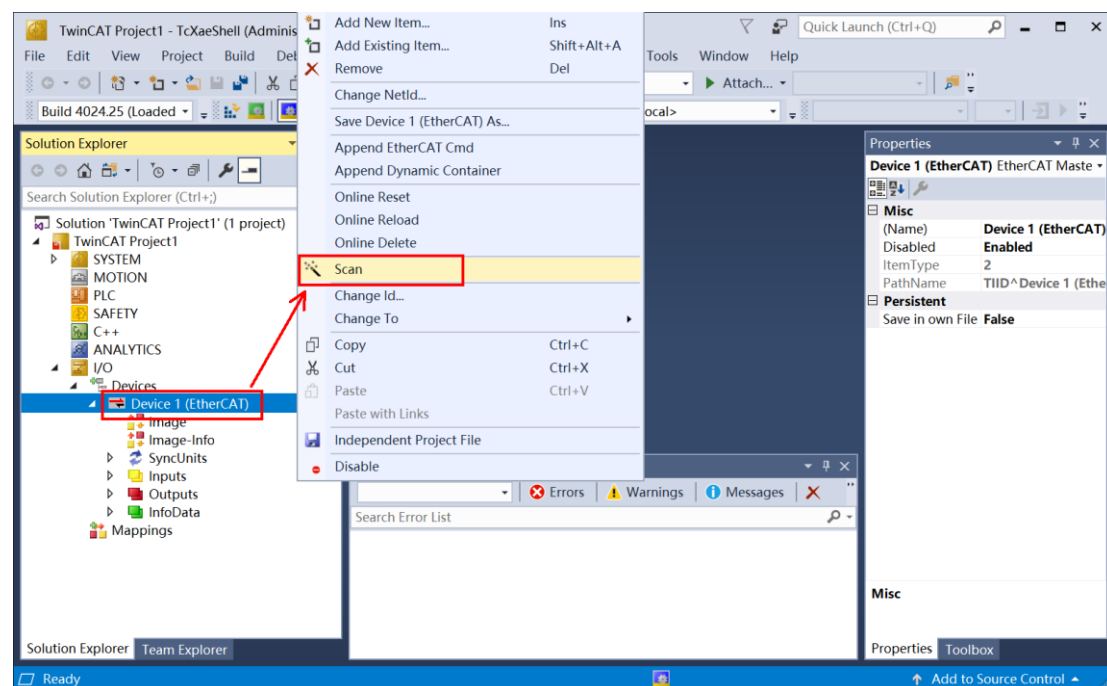
Type J, K, T, N, E thermocouple determines the rated input and output range according to the temperature range of the scale. Dividing the decimal value of the system by 10, the current temperature can be obtained. The resolution is 0.1 C, and the maximum or minimum value can be locked out beyond the limit.

4.4 Module configuration example (Beckhoff)

This section, through a case of connection configuration in actual operation process, makes the users fully understand how to use the Slim67 analog distributed I/O system. In this case, using the ELCO Slim67 analog module as EtherCAT slave station to connect the Beckhoff EtherCAT controller CX1020 under the condition that all power and bus connection have been completed.

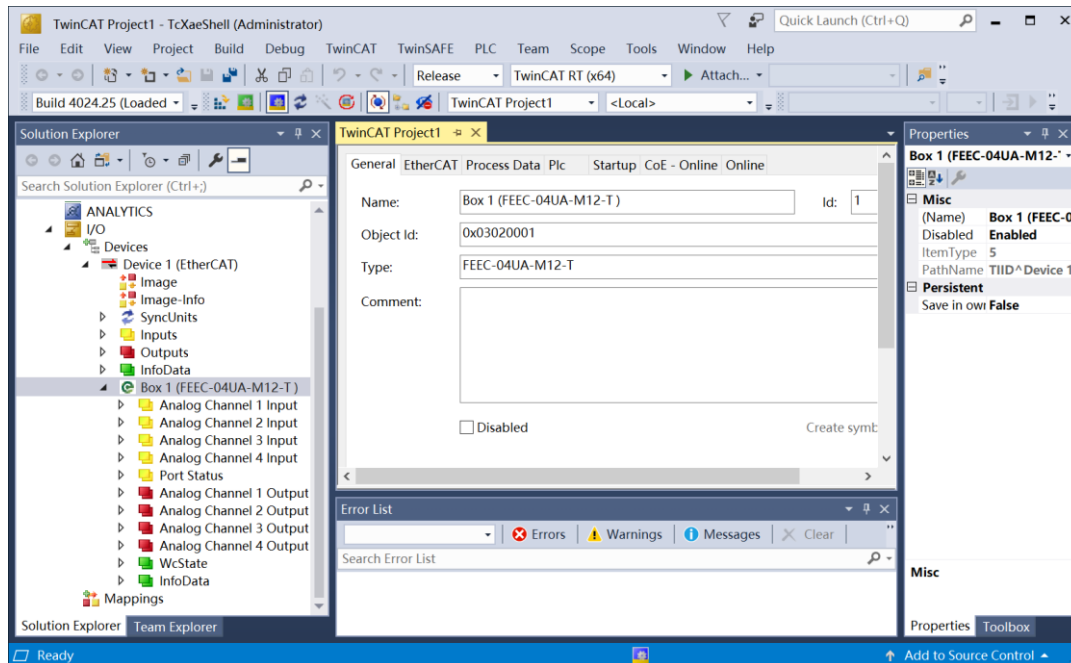
The following will show the specific process of software configuration and debugging.

1) Start a new TwinCAT project, and connect to the PLC controller, switch to Config Mode. Then search the slave station: right-click at the arrow marker in the following figure>Scan Boxes...

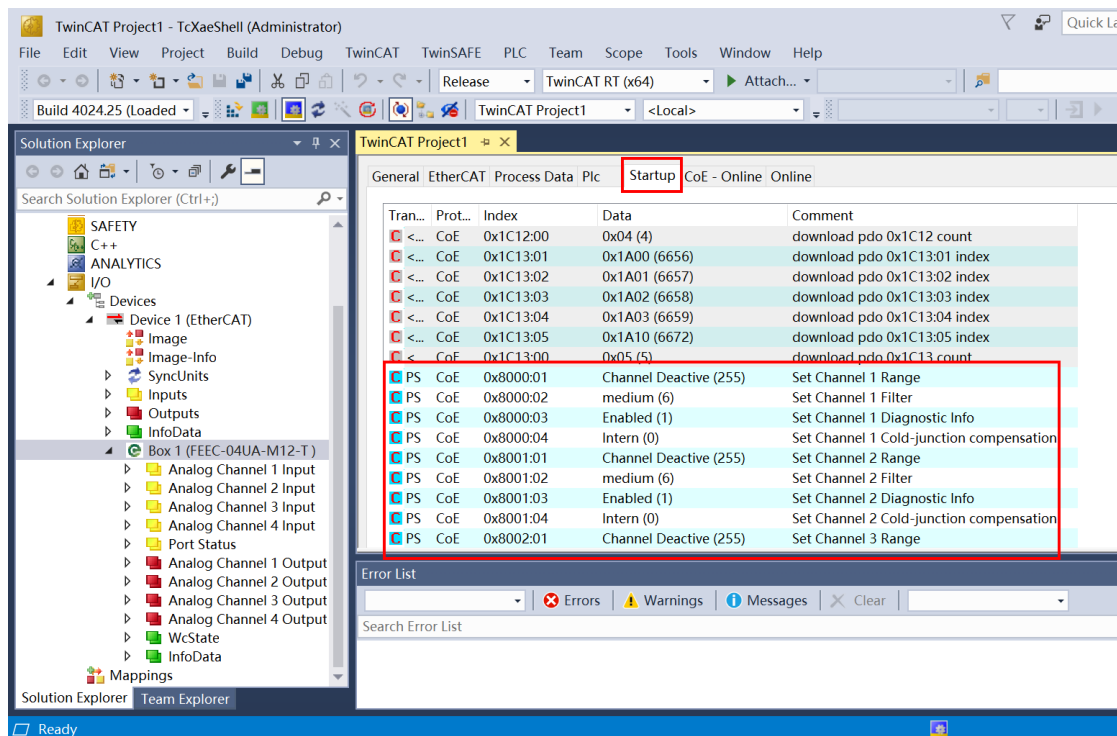


2) If the gateway is connected to PLC properly, the system can automatically search the Slim67 analog module and see the specific module connection.

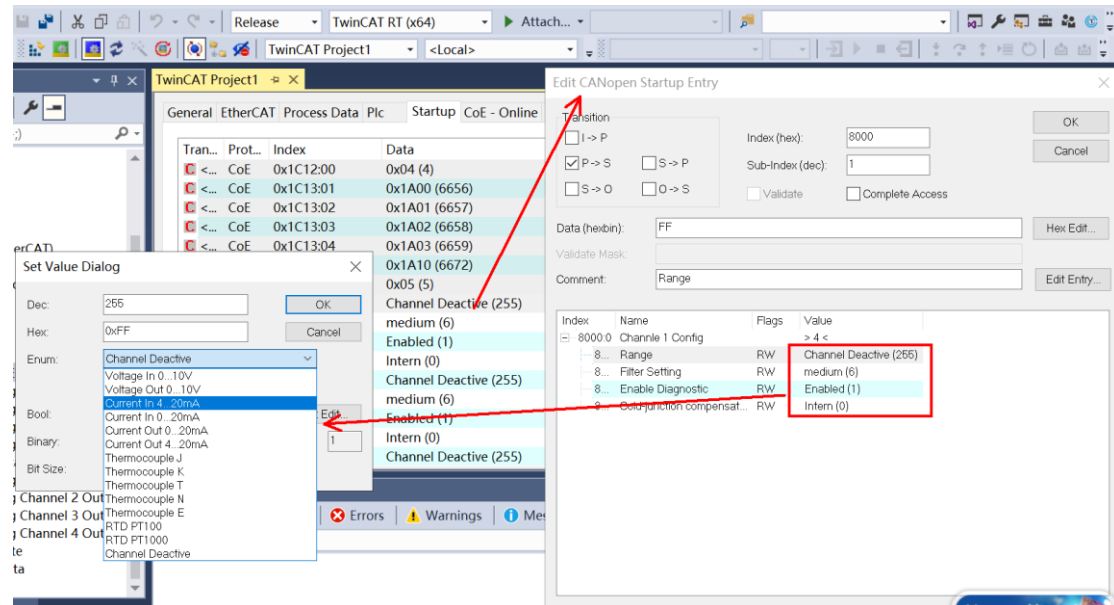
As follows:



3) To configure the input/output type and specific range of the module, double-click to enter the “Startup” tab, and double-click the corresponding channel to open the attribute setting window.



4) In the new pop-up window, set the input and output attributes of this channel.



5) After all the settings are completed, click on the "Reload I/O Devices" button and download all the information to the PLC. At this time, the module should be in the connection state and the RUN indicator light should be in the evergreen state.

5. Alarm diagnosis

5.1 LED fault indicator

With the LED indicator on the Slim67 analog module, users can easily and quickly determine the current working status of the module. (For the appearance of the indicator, please refer to Section 2.2 "LED Indication")

FEEC-04UA-M12-T indicator

Name	Status	Meaning	Fault cause
Power supply Indicator PWR	Green	Supply voltage normal	–
	Red	Supply voltage abnormal	1. Overvoltage or undervoltage 2. Port is short circuited
	Off	No power supply	1. Power supply cable failure 2. Module is damaged
Fault status Indicator MOD	Green	Work normally	–
	Red	Working abnormally	1. Power supply is abnormal 2. Channel abnormal (short circuit, overload, etc.)
BUS status Indicator RUN	Green	Communication normal OP Mode	–
	Green fast flash	Pre-OP Mode	
	Green slow flash	Safe-OP Mode	
	Off	Communication abnormal	1. Network cable failure 2. Check the configuration 3. Module is damaged
EtherCAT network status Indicator LK	Green flash	Connected to the network	–
	Orange	Not connected to the network	1. Network cable failure 2. Module is damaged
Signal Indicator X	Green	Work normally	–
	Red	Working abnormally	1. Overvoltage or undervoltage 2. The module is damaged

5.2 Process image area of Slim67 analog module

Each Slim67 analog module occupies the address area in the PLC process image area, which is used to transmit the gateway's communication and power supply abnormal status, as follows:

IN=4 bytes, OUT=0 byte

IN	Byte	Bit_7	Bit_6	Bit_5	Bit_4	Bit_3	Bit_2	Bit_1	Bit_0
Status	0	-	-	-	-	Port4 Low range	Port3 Low range	Port2 Low range	Port1 Low range
	1	-	-	-	-	Port4 Overrange	Port3 Overrange	Port2 Overrange	Port1 Overrange
	2	-	-	-	-	Port4 Error	Port3 Error	Port2 Error	Port1 Error
	3	-	-	24V Overvoltage	24V Undervoltage	Port4 Short circuit	Port3 Short circuit	Port2 Short circuit	Port1 Short circuit