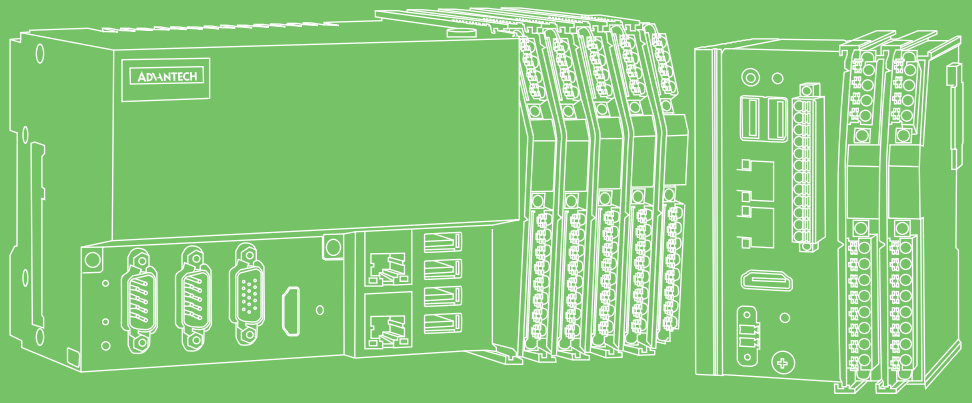
User Manual



AMAX-5000 Series

EtherCAT Slice I/O Modules

ADVANTECH

Enabling an Intelligent Planet

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Product Warranty (2 years)

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Please consult your dealer for more details.

If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain an RMA (return merchandize authorization) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

Part No.2003X50003 Edition 4

Printed in Taiwan February 2023

Declaration of Conformity

CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Advantech. Please contact your local supplier for ordering information.

Test conditions for passing also include the equipment being operated within an industrial enclosure. In order to protect the product from damage caused by electrostatic discharge (ESD) and EMI leakage, we strongly recommend the use of CE-compliant industrial enclosure products.

FCC Class A

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference. In this event, users are required to correct the interference at their own expense.

Technical Support and Assistance

1. Visit the Advantech website at www.advantech.com/support to obtain the latest product information.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Please have the following information ready before you call:
   - Product name and serial number
   - Description of your peripheral attachments
   - Description of your software (operating system, version, application software, etc.)
   - A complete description of the problem
   - The exact wording of any error messages

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

- To avoid electrical shock, always disconnect the power from your PC chassis before you work on it. Don't touch any components on the CPU card or other cards while the PC is on.
- Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.

Safety Instructions

1. Install the system only in area with restricted access.
2. Read these safety instructions carefully.
3. Retain this user manual for future reference.
4. Disconnect the equipment from all power outlets before cleaning. Use only a damp cloth for cleaning. Do not use liquid or spray detergents.
5. For pluggable equipment, the power outlet socket must be located near the equipment and easily accessible.
6. Protect the equipment from humidity.
7. Place the equipment on a reliable surface during installation. Dropping or letting the equipment fall may cause damage.
8. The openings on the enclosure are for air convection. Protect the equipment from overheating. Do not cover the openings.
9. Ensure that the voltage of the power source is correct before connecting the equipment to a power outlet.
10. Position the power cord away from high-traffic areas. Do not place anything over the power cord.
11. All cautions and warnings on the equipment should be noted.
12. If the equipment is not used for a long time, disconnect it from the power source to avoid damage from transient overvoltage.
13. Never pour any liquid into an opening. This may cause fire or electrical shock.
14. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
15. If any of the following occurs, have the equipment checked by service personnel:
    - The power cord or plug is damaged.
    - Liquid has penetrated the equipment.
    - The equipment has been exposed to moisture.
    - The equipment is malfunctioning, or does not operate according to the user manual.
    - The equipment has been dropped and damaged.
    - The equipment shows obvious signs of breakage.
16. Do not leave the equipment in an environment with a storage temperature of below -20 °C (-4 °F) or above 60 °C (140 °F) as this may damage the components. The equipment should be kept in a controlled environment.
17. CAUTION: Batteries are at risk of exploding if incorrectly replaced. Replace only with the same or equivalent type as recommended by the manufacturer. Discard used batteries according to the manufacturer's instructions.
18. In accordance with IEC 704-1:1982 specifications, the sound pressure level at the operator's position does not exceed 70 dB (A).

DISCLAIMER: These instructions are provided according to IEC 704-1 standards. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

Contents

Chapter 1

Introduction

1.1 Introduction to AMAX-5000 Slice I/O Module

This manual will only introduce AMAX-5000 series slice I/O modules. To know more about the AMAX-5580 controller and AMAX-5400 series extension modules, please download AMAX-5580 user manual from our website.

Advantech provides different I/O modules for various applications. The following table outlines Advantech's supported I/O modules.

Table 1.1: AMAX-5000 series extension modules

Module	Name	Specifications
Power Input and Coupler	AMAX-5001	Power Input with 4-ch DI Module
	AMAX-5074	EtherCAT Coupler with ID Switch Module
	AMAX-5079	EtherCAT Extension Module
Analog I/O	AMAX-5015	4-ch RTD Input Module
	AMAX-5017C	6-ch Current Input Module
	AMAX-5017V	6-ch Voltage Input Module
	AMAX-5017H	4-ch High speed Analog Input Module
	AMAX-5018	6-ch Thermocouple Input Module
	AMAX-5024	4-ch Analog Output Module
Digital I/O	AMAX-5051	8-ch Isolated Digital Input Module
	AMAX-5052	16-ch Isolated Digital Input Module
	AMAX-5056	8-ch Isolated Digital Output Module
	AMAX-5056SO	8-ch Source-type Digital Output Module
	AMAX-5057	16-ch Sink-type Digital Output Module
	AMAX-5057SO	16-ch Source-type Digital Output Module
	AMAX-5060	4-ch Relay with 2-ch DI Module
Counter/Encoder	AMAX-5080	2-ch Counter/Encoder Input Module
	AMAX-5081	1-ch TTL/RS-422 Encoder/Counter Module
	AMAX-5082	1-ch SSI Encoder Module
Digital I/O with Timestamp	AMAX-5051T	8-ch Digital Input Module (w/ 2-ch Timestamp)
	AMAX-5056T	2-ch Timestamp Digital Output Module

1.2 Object for Internal Settings

1.2.1 Standard Object (0x1000 - 0x1FFF)

Table 1.2: Standard Object (0x1000:00 - 0x10FF:00)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x1000:00	Device type	Device type of the EtherCAT Sub-Device: The Lo-Word contains the COE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UDINT	RO	0x0000 1389 (5001 Dec)
0x1008:00	Device Name	The device name of the EtherCAT SubDevice	STRING	RO	e.g. AMAX-50XX
0x1009:00	Hardware Version	Hardware version of the EtherCAT SubDevice	STRING	RO	e.g. A1
0x100A:00	Software Version	Firmware version of the EtherCAT SubDevice	STRING	RO	e.g. V1.01
Identity					
0x1018:01	Vendor ID	Vendor ID of the EtherCAT Sub-Device, 0x000013FE for Advantech Co., Ltd., assigned by ETG	UDINT	RO	0x0000 13FE
0x1018:02	Product Code	Product code of the EtherCAT SubDevice	UDINT	RO	0x0000 0000
0x1018:03	Revision	The revision number of the EtherCAT SubDevice	UDINT	RO	0x0000 0000
0x1018:04	Serial Number	Serial number of the EtherCAT SubDevice (Reserved)	UDINT	RO	0x0000 0000
Error Setting					
0x10F1:01	Local Error Reaction	Local error reaction (Reserved)	UDINT	RW	0x0000 0001
0x10F1:02	Sync Error Counter Limit	Sync error counter limit	UINT	RW	0x0004

Chapter 2

Hardware Installation

2.1 Install / Remove the Module

AMAX-5000 series is an easy-install design to help you maintain your modules easily.

2.1.1 Attach on the DIN-rail

Follow these steps to secure AMAX-5000 modules on the DIN-rail:

1. Unlock the latches at the bottom of AMAX-5000 module.
2. Plug in each module from the left to the right.
3. Make sure the modules are attached on the DIN-rail.
4. Lock down the latches.

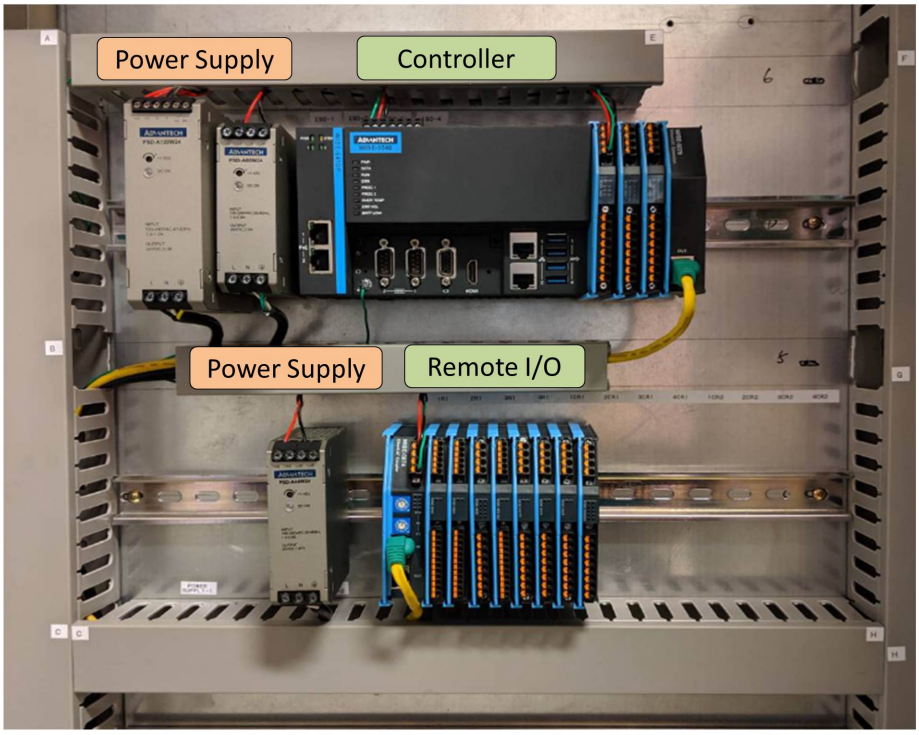


Figure 2.1 AMAX-5000 installed in a control cabinet

2.1.2 Remove from the DIN-rail

You can easily detach the module by releasing the latch at the bottom of the module. Then you can pull out the module without any difficulty.

Figure 2.2 Unlock the latch to remove the module

Figure 2.3 AMAX-5000 module design

2.2 Wiring

AMAX-5000 I/O modules leverage detachable clamp type terminal blocks. Comparing with traditional screw type terminal blocks, clamp type terminal blocks can save wiring time and provide better reliability for shock and vibration. Follow the procedures below for wiring your AMAX-5000 I/O module.

1. Use the screw driver to press the left notch on the terminal.
2. Insert the wire into the terminal.

Note! *Please use # 14 AWG ~ 28 AWG wire for terminal block.*

2.3 Cable Length

According to the structured cabling model defined in the ISO/IEC 11801 specification, cables employed in the connection between two end devices can be distinguished into (as shown in Figure 2.4):

1. Permanent link, which is the main cable span between two end devices, installed either within or outside the cabinet.
2. Patch cords, which are typically short cable sections, used within a cabinet between end devices and intermediate connection points (like bulkhead feed-through connectors)

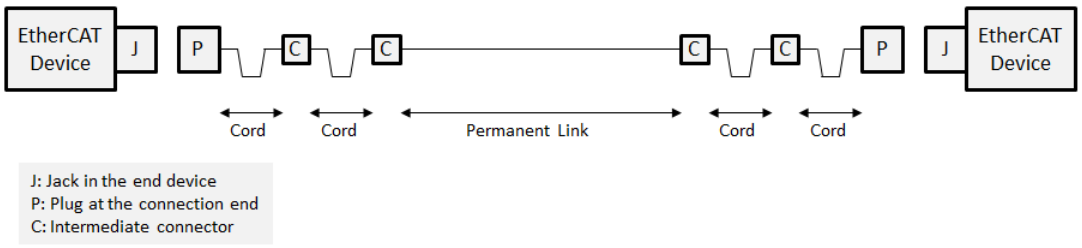


Figure 2.4 Cable mode in ISO/IEC 11801

In terms of planning the EtherCAT networks with use of 100BASE-TX link (copper wire), the following rules can be considered:

1. The total length of the communication channel (including permanent link and all patch cords) should not exceed 100 m.
2. The total length of the patch cords at each end should not exceed 5m, and the length of the permanent link should be reduced accordingly to meet the maximum channel length of 100m as described previously.
3. The maximum number of connections in the channel should be 6 including connectors at each end.
4. In any case, the channel length should be kept as short as possible.

Figure 2.5 shows some possible channel architectures according to these rules.

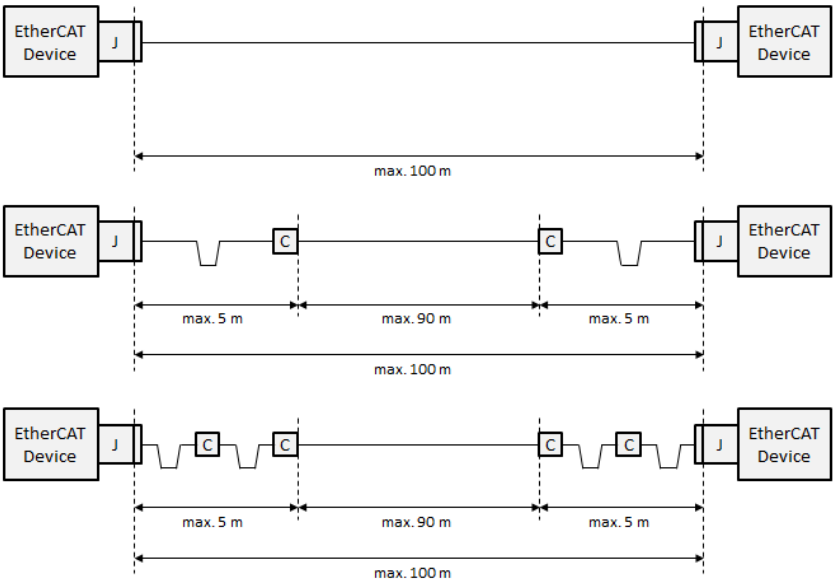


Figure 2.5 Several possible channel architectures

2.4 Cable Selection

The IEC 61784-5-12 profile describes suggested cable types for EtherCAT applications and specifies the worst-case corner values for the cable parameters which should not be exceeded within an EtherCAT channel.

In case of connections between devices moving with respect to each other, flexible cables should be used in order to prevent cable damage. In this case, parameters like maximum permissible bending radius, as well as maximum tolerated tensile and torsional forces, should be carefully verified to be compliant with the application requirements.

Figure 2.6 shows the difference between a fixed cable and a flexible cable in section views, and Table 2.1 lists the recommended parameters for both types of cables to be used for an EtherCAT channel. Parameter values (for example, insertion loss) measured for flexible cables are typically worse than those of fixed cables. The use of flexible cables should therefore be limited to scenarios where it is strictly needed.

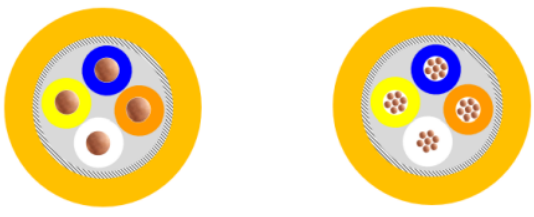


Figure 2.6 Difference between a fixed cable and a flexible cable

Table 2.1: Recommended Cable Parameters.

Item	Fixed Cable	Flexible Cable
Type	AWG22/1	AWG22/7
Shielding	S/FTQ	S/FTQ
Round-Trip Resistance	≤ 115 Ω/km	≤ 115 Ω/km
Insertion Loss at 100 MHz	19.5 dB/100 m	21.3 dB/100 m
Near-End Crosstalk at 100 MHz	50 dB/100 m	50 dB/100 m

EtherCAT recommends the use of at least externally shielded cables, both for the permanent link and for patch cords.

The stranded solution should be preferred for the external cable shielding, as it provides higher mechanical robustness. When using externally foil-shielded cables, particular care should be paid not to damage or to interrupt the shielding itself.

Figure 2.7 shows the recommended and discouraged shielding configurations

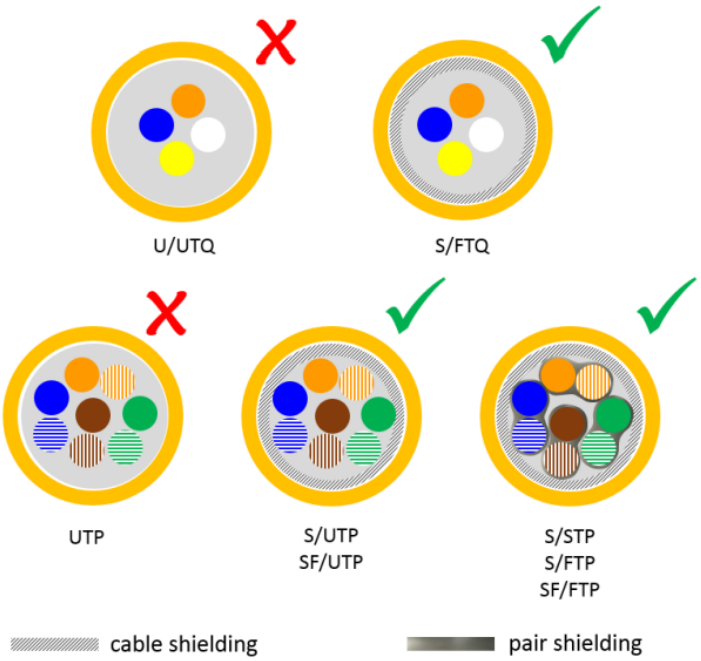


Figure 2.7 Recommended and discouraged shielding configurations

2.5 Registered Jack 45 (RJ45) Selection

A registered jack 45 (RJ45) is a standardized telecommunication network interface for connecting voice and data equipment to a service provided by a local exchange carrier or long distance carrier. The material, configuration, and quality of the RJ45 will affect the communication signal quality as well.

To ensure a good contact between the jack (plug) and the receptacle, the contact plating (as indicated in Figure 2.8) of the jack should be at least 30 µm gold plating.

Note! Do not use gold flash plating.

Figure 2.8 Contact plating of the RJ45.

In addition, use trident pin needles instead of two-fork pin needles for the gold plate tripod as shown in Figure 2.9. This gives more contact area and improves signal integrity in high speed transmissions.

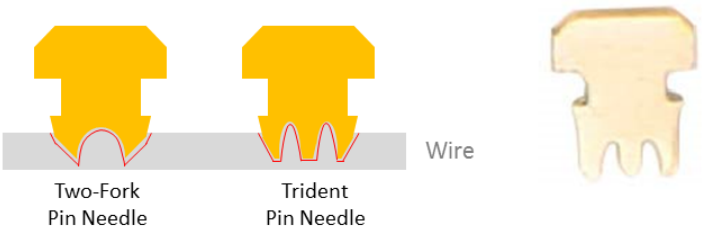


Figure 2.9 Gold plate tripod types.

For better electromagnetic immunity, a shielded RJ45 can be used. An example is shown in Figure 2.10.

Figure 2.10 Shielded RJ45.

It should be noted that the metal shell of the shielded RJ45 must be electrically connected to the drain wire of the shielded cable for the shield to take effect. For example, a shielded RJ45 with tail clip can be used to touch the drain wire, and the drain wire can be wrapped by a copper tape to increase the contact area with the metal shield of the RJ45 as shown in Figure 2.11. The drain wire can even be soldered to the metal shield to ensure stable contact. Failing to do this will result in no shielding effect at all.

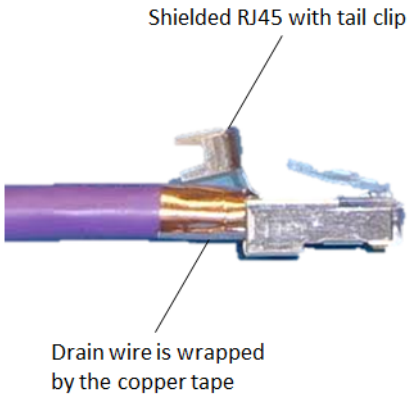


Figure 2.11 Connect metal shield of RJ45 to drain wire

2.6 Electromagnetic Protection

2.6.1 Cable Separation

In order to prevent electromagnetic disturbances to corrupt the signals and therefore affect communication performances, network planning should always guarantee a suitable separation of communication cables from other cable types, and especially from power cables like supply lines or motor connections. This is shown in Figure 2.12

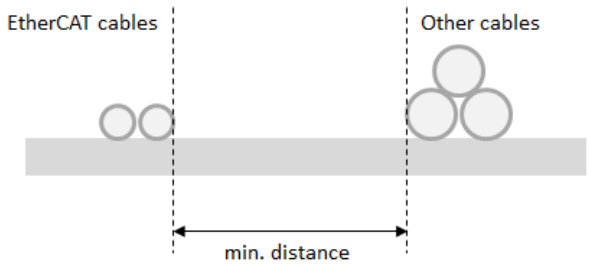


Figure 2.12 Minimum distance between communication and power cables.

In order to improve the immunity to electromagnetic disturbances and to reduce the minimum permissible distance from power lines, EtherCAT cables can be routed through metallic enclosures or conduits as shown in Figure 2-10.

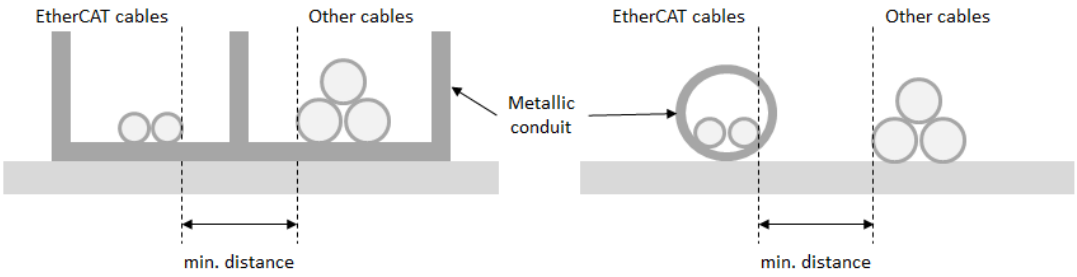


Figure 2.13 Minimum distance with metallic separation conduits.

Table 2.2 lists the recommended minimum distance between communication cables and power cables.

Table 2.2: Recommended Minimum Distance Between Communication and Power Cables

Cable Separation Type	Minimum Distance
Without metallic separation	10 mm
Open metallic cable conduit	8 mm
Perforated metal plate conduit	5 mm
Bulky cable conduit	0 mm

2.6.2 Cable Crossing

In case communication cable must cross power lines, this should always take place at right angle (90 degrees). Do not place them in the same direction (parallel). This is shown in Figure 2.14.

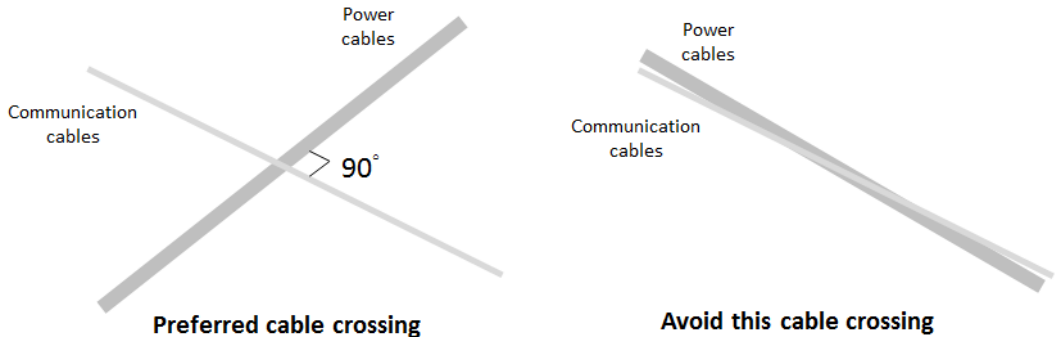


Figure 2.14 Communication cable and power cable crossing

2.6.3 Avoid Cable Loop

Coils in the communication cables should be avoided, as they represent large areas where electromagnetic disturbances can be introduced into the network and severely affect the communication performances as shown in Figure 2.15.

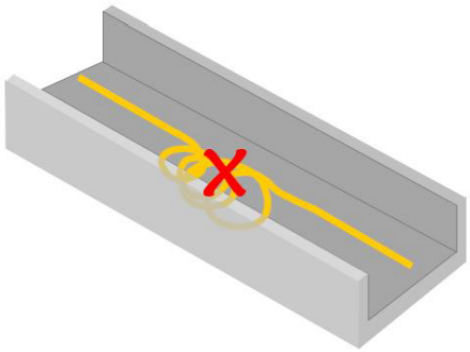
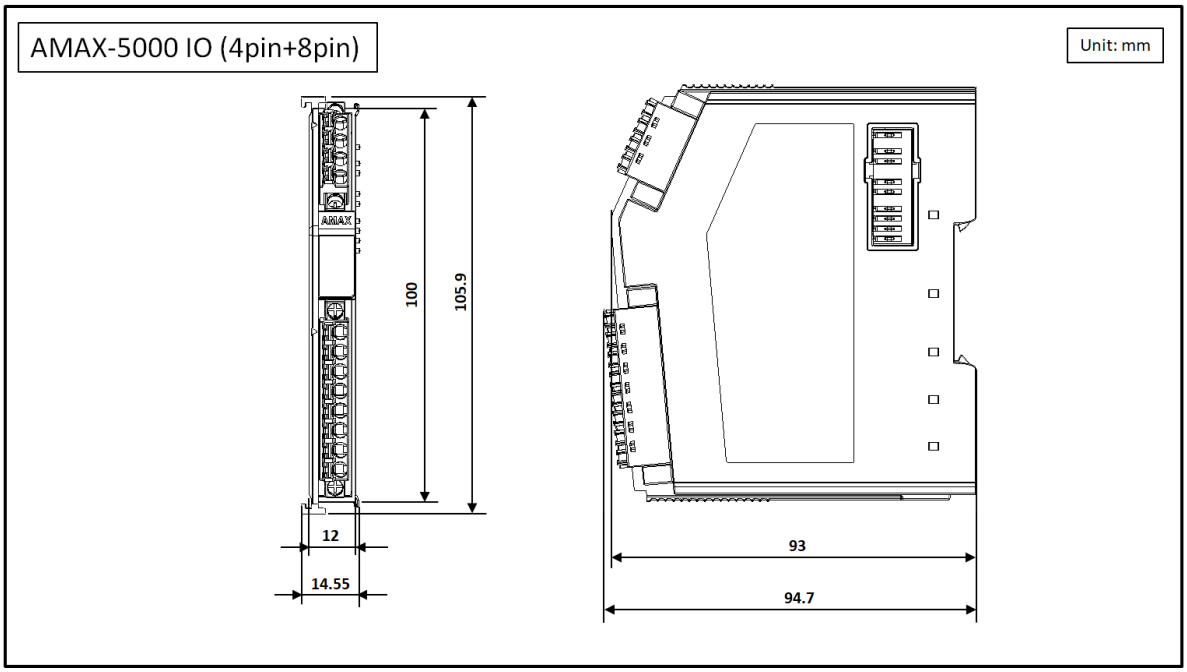
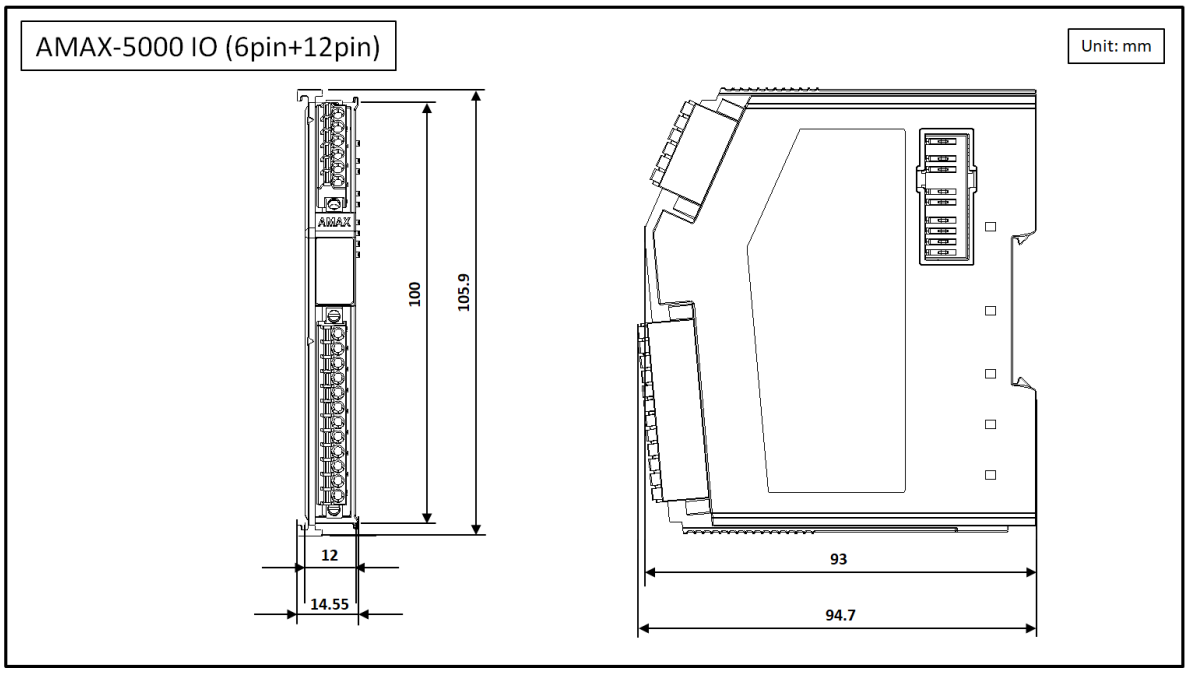


Figure 2.15 Avoid loops in communication cables

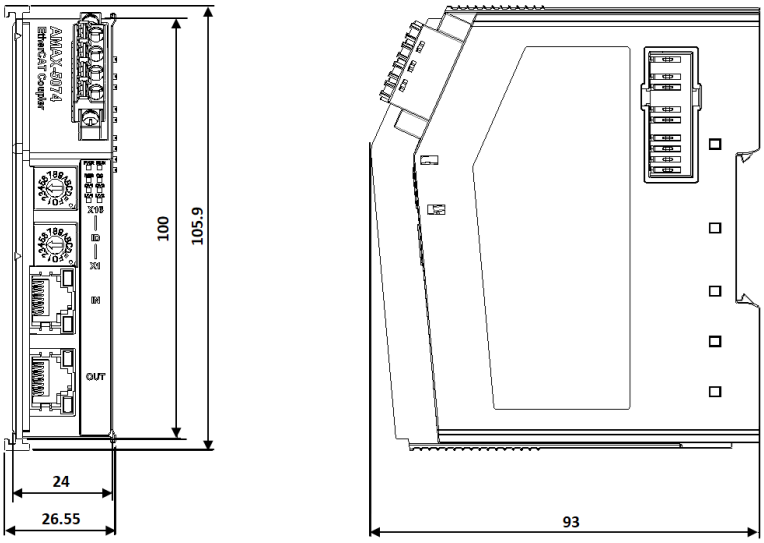
2.7 Dimensions





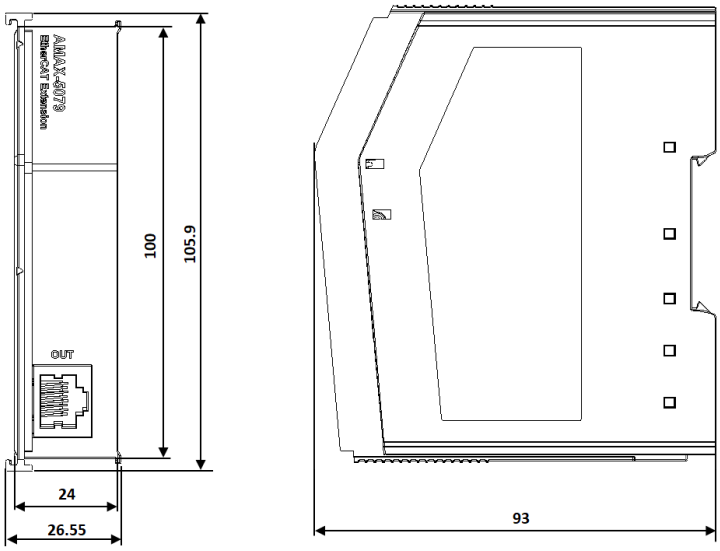
AMAX-5074

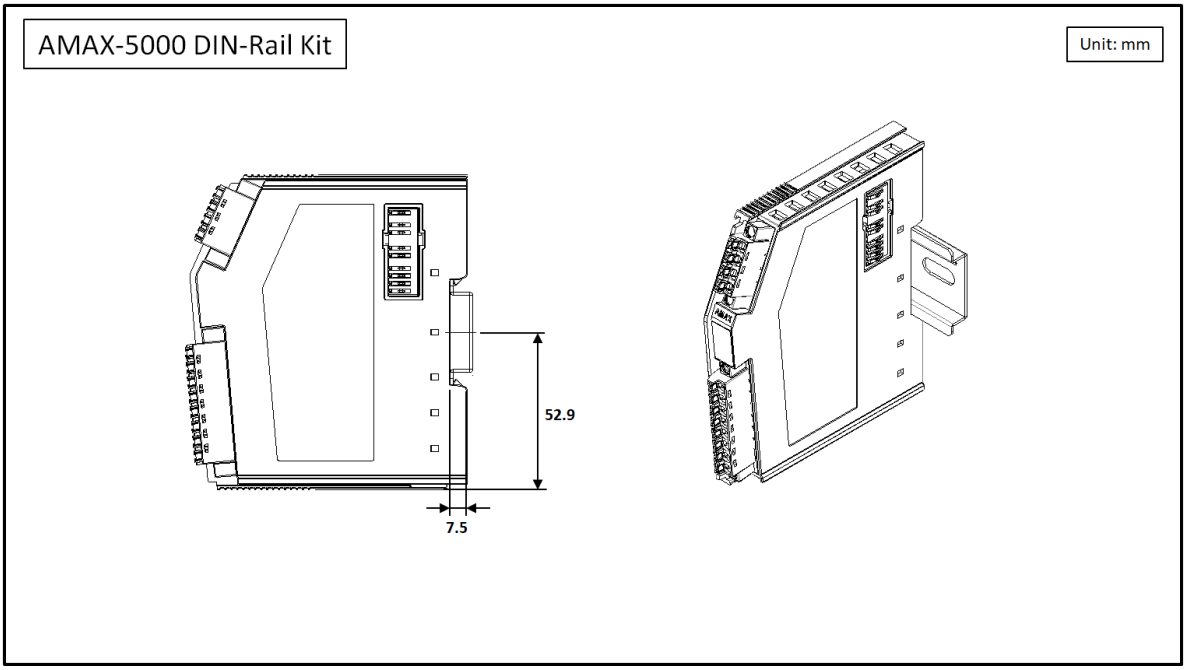
Unit: mm



AMAX-5079

Unit: mm




AMAX-5000 DIN-Rail Kit
Unit: mm
52.9
7.5

Chapter 3

Power Input and Coupler Modules

3.1 AMAX-5001 Smart Power Input with 4-ch Digital Input Module

AMAX-5001 is a smart power input module. It supports dual power - external 24V_{DC} power input, and a maximum 2A current to the EtherCAT bus to power the IO modules on the right side. Moreover, AMAX-5001 provides 4-ch wet contact for digital input, and a smart diagnostic function which identifies power errors from external power supply or internal bus. The module status will be shown on the front LED indicator.

Figure 3.1 AMAX-5001 Module

3.1.1 AMAX-5001 Application

AMAX-5000 controller doesn't provide power for the right side I/O modules of the controller. This design will avoid damaging the entire system when a huge voltage/ current flows into the controller or modules.

AMAX-5001 must be the first module on the right side of AMAX-5000 series controller. It provides maximum of 2A to the other modules on EtherCAT bus. But it does'nt provide power for the left side of the AMAX-5001 module, only for the right side modules. For more about the EtherCAT bus application and design please refer to the below figure.

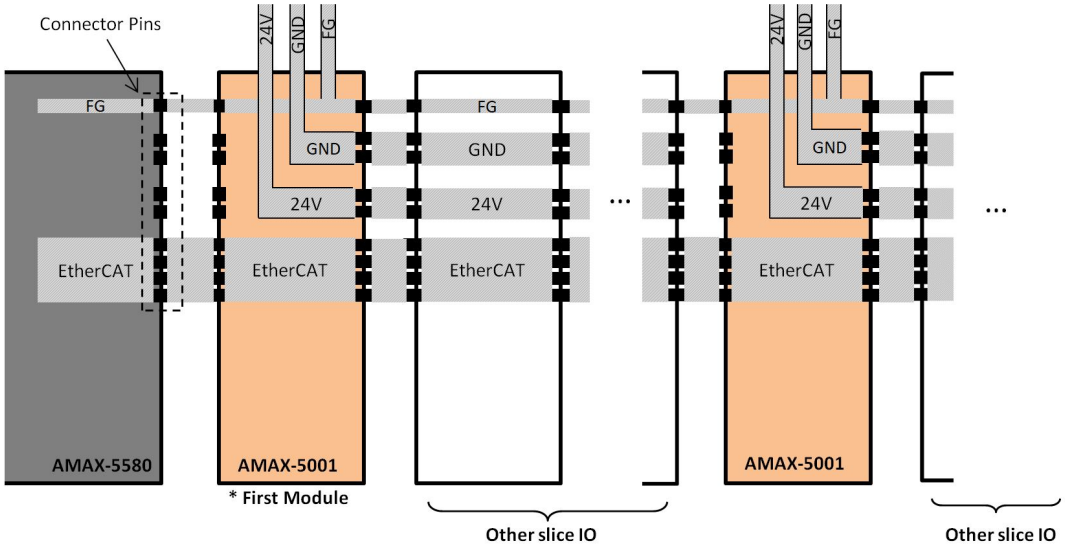


Figure 3.2 AMAX-5001 Application

3.1.2 AMAX-5001 Specification

3.1.2.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, Power diagnosis LED
- **Weight:** Approx. 80g

3.1.2.2 Power Input

- **Rated Voltage:** $24V_{DC}$ (±20%)
- **Dual Power Input:** Supported
- **Max Current on Bus:** 2A
- **Diagnosis Function:**
  - Over/under voltage for input 1&2
  - Over current output on bus

3.1.2.3 Digital Input

- **Channels:** 4
- **Digital Input:**
  - Wet contact:
    Rated voltage: $24V_{DC}$
    Logic level 1: 10~30 V_{DC} and -10~-$30V_{DC}$
    Logic level 0: -3~$3V_{DC}$
- **Input Delay:**
  - From logic level 0 to 1: 4ms (including 3 ms DI filter)
  - From logic level 1 to 0: 4ms (including 3 ms DI filter)
- **Digital Filter:** 3ms
- **Typical Input Current:** Logic level 1: 1.3mA~4mA (10V~30V)

3.1.2.4 Protection

Isolation Voltage: 2,000V_{DC}

3.1.2.5 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

3.1.3 LED Indicator

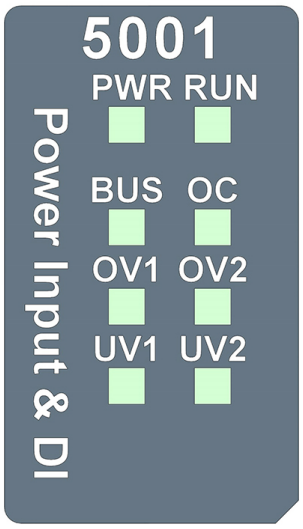


Figure 3.3 AMAX-5001 Module LED Indicator

Table 3.1: AMAX-5001 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating Module
Run	Green	ON	EtherCAT Connected
		Blink	EtherCAT Connecting
BUS	Green	ON	BUS Power On
OC	RED	ON	BUS Over Current (2A)
OV1	RED	ON	V1 Over-voltage (30V)
OV2	RED	ON	V2 Over-voltage (30V)
UV1	RED	ON	V1 Under-voltage (10.7V)
UV2	RED	ON	V2 Under-voltage (10.7V)

3.1.4 Pin Definition

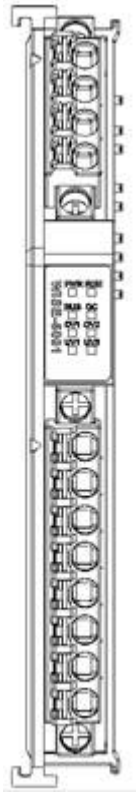


Figure 3.4 AMAX-5001 Module Front View

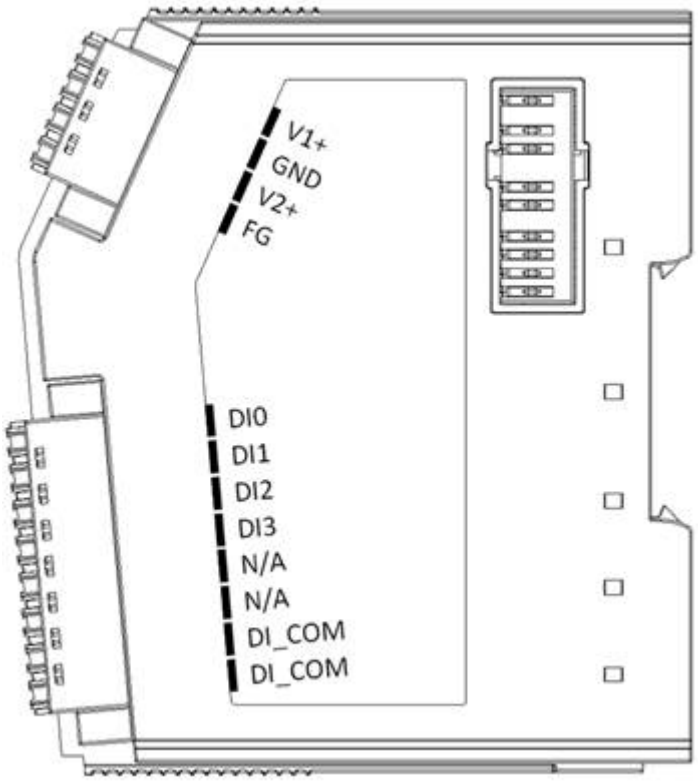


Figure 3.5 AMAX-5001 Module Side View

Table 3.2: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	V1+
2	GND
3	V2+
4	FG

Table 3.3: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI0
2	DI1
3	DI2
4	DI3
5	N/A
6	N/A
7	DI_COM
8	DI_COM

3.1.5 Application Wiring

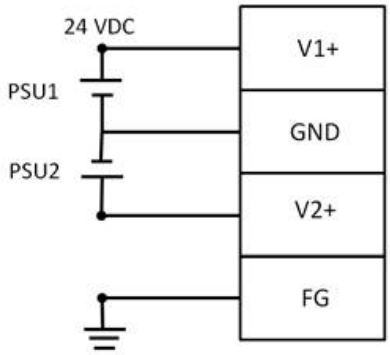


Figure 3.6 Wiring for AMAX-5001 Upper Connector Power Input

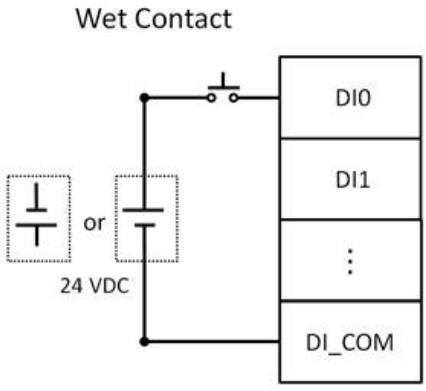


Figure 3.7 Wiring for AMAX-5001 Lower Connector Digital Input

3.1.6 AMAX-5001 Object Dictionary

3.1.6.1 Input Data

Table 3.4: Input Data (0x6000:01 - 0x6000:11)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x6000:01	Over_Voltage_1	Voltage 1 > 28.8V (24V*1.2)	UINT	RO	0x0000
0x6000:02	Under_Voltage_1	Voltage 1 < 19.2V (24V*0.8)	UINT	RO	0x0000
0x6000:03	Over_Voltage_2	Voltage 2 > 28.8V (24V*1.2)	UINT	RO	0x0000
0x6000:04	Under_Voltage_2	Voltage 2 < 19.2V (24V*0.8)	UINT	RO	0x0000
0x6000:05	Over_Current	Bus current > 2A	UINT	RO	0x0000
0x6000:06	DI0	Digital input channel 0	UINT	RO	0x0000
0x6000:07	DI1	Digital input channel 1	UINT	RO	0x0000
0x6000:08	DI2	Digital input channel 2	UINT	RO	0x0000
0x6000:09	DI3	Digital input channel 3	UINT	RO	0x0000
0x6000:11	Voltage_1	Input voltage 1	REAL	RO	Dec 0
0x6000:12	Voltage_2	Input voltage 2	REAL	RO	Dec 0
0x6000:13	Current	Input current	REAL	RO	Dec 0

3.1.6.2 Module Configuration

Table 3.5: Module Configuration (0xF600:01 - 0xF600:10)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	Locate Module	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00
0xF600:10	LED_Trigger	For RMA centre testing	BOOL	RW	0x00

3.2 AMAX-5074 EtherCAT Coupler with ID Switch

The AMAX-5074 is an EtherCAT coupler that connects remote EtherCAT SubDevice IO modules to the EtherCAT through RJ-45 LAN port, it supports three main topologies: Ring, line, and star. AMAX-5074 provide 24VDC dual input and maximum 2A current for other connected modules.

Figure 3.8 AMAX-5074 Module

3.2.1 AMAX-5074 Specification

3.2.1.1 General

- **Certification:** CE, FCC class A
- **Connector':** Pluggable 4P push-in terminal (#24~16 AWG) and 2x RJ45
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2.5W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, Power Diagnosis LED
- **Weight:** Approx. 97g

3.2.1.2 Power Input

- **Rated Voltage:** 24VDC (±20%)
- **Dual Power Input:** Supported
- **Max Current on Bus:** 2A
- **Diagnosis Function:**
  - Over/under voltage for input 1&2
  - Over current output on bus

3.2.1.3 EtherCAT Coupler

- **Function:** Coupling EtherCAT IO modules to 100BASETX EtherCAT network
- **Cable:** Ethernet/EtherCAT cable (min. Cat. 5), shielded
- **Distance between stations:** Max. 100 m (100BASETX)
- **Number of configurable IDs:** 256 (2 x 16-bit ID switch)
- **Bus Interface:** 2 x RJ45 (1 x Input, 1 x Output)

3.2.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

3.2.2 LED Indicator

Figure 3.9 AMAX-5074 Module LED Indicator

Table 3.6: AMAX-5074 Module LED Indicator			
LED	**Color**	**Indication**	**Behavior**
PWR	Green	ON	Power on
	Orange	ON	Locating Module
Run	Green	ON	EtherCAT Connected
		Blink	EtherCAT Connecting
BUS	Green	ON	BUS power on
OC	RED	ON	BUS Over Current (2A)
OV1	RED	ON	V1 Over-voltage (28.8V)
OV2	RED	ON	V2 Over-voltage (28.8V)
UV1	RED	ON	V1 Under-voltage (19.2V)
UV2	RED	ON	V2 Under-voltage(19.2V)

3.2.3 ID Switch

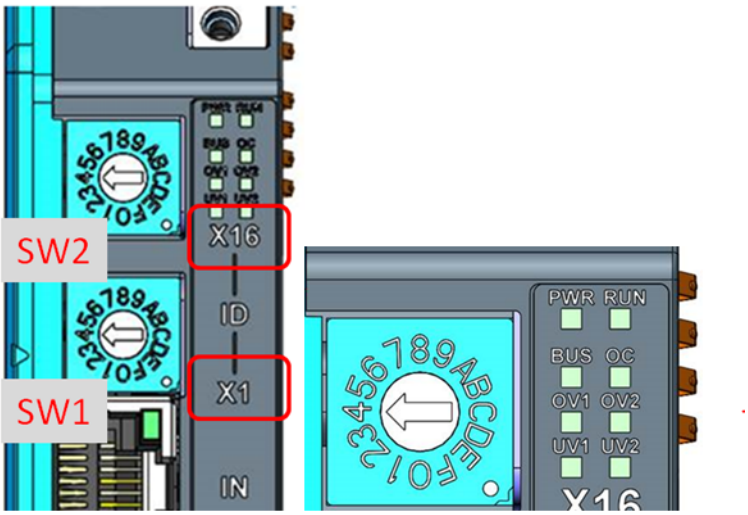


Figure 3.10 AMAX-5074 ID Switch

Table 3.7: AMAX-5074 ID Switch		
Switch Number (Top to Bottom)	**Multiple**	**Range (HEX)**
SW2	X16	0~F
SW1	X1	0~F
Example	(SW2, SW1) = (4, C), then ID = 4x16 + 12x1 = 76	

Note! *Function Reserved, hot connection is currently not supported in CODE-SYS.*

3.2.4 Pin Definition

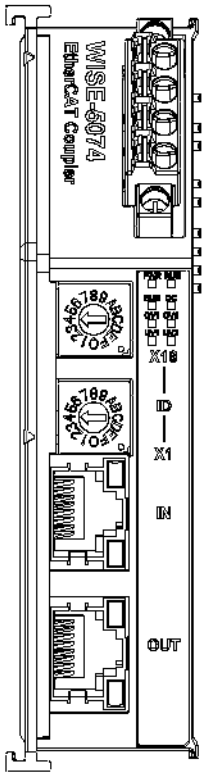


Figure 3.11 AMAX-5074 Module Front View

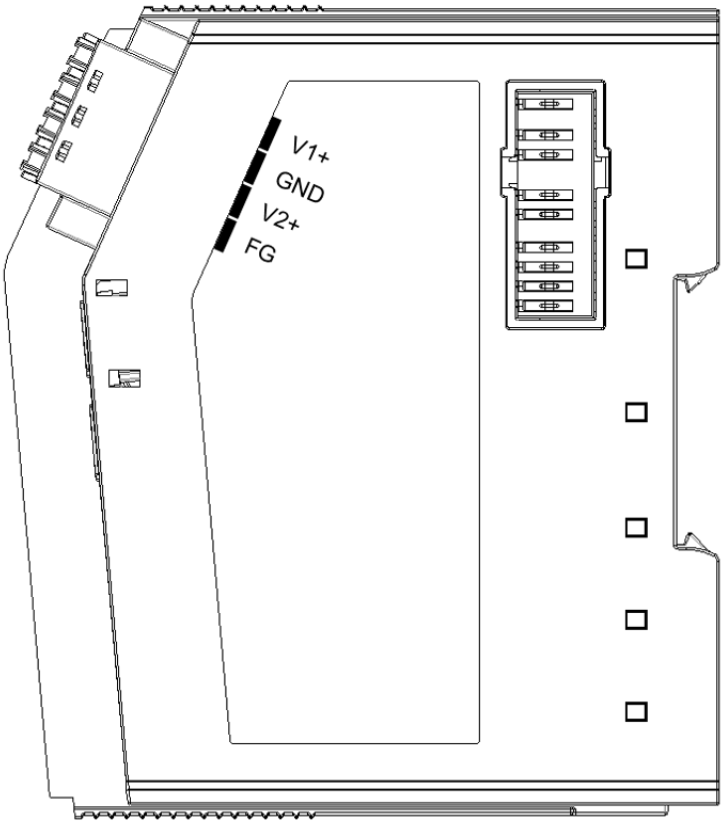


Figure 3.12 AMAX-5074 Module Side View

Table 3.8: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	V1+
2	GND
3	V2+
4	FG

Table 3.9: Lower 2 LAN Port	
LAN Number (Top to Bottom)	**Port Definition**
1	EtherCAT signal input
2	EtherCAT signal output

3.2.5 Application Wiring

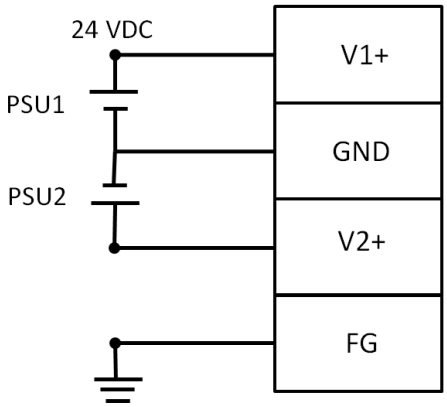


Figure 3.13 Wiring for AMAX-5074 Power Input

3.2.6 AMAX-5074 Object Dictionary

3.2.6.1 Input Data

Table 3.10: Input Data (0x6000:01 - 0x6000:13)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x6000:01	Over_Voltage_1	Voltage 1 > 28.8V (24V*1.2)	UINT	RO	0x0000
0x6000:02	Under_Voltage_1	Voltage 1 < 19.2V (24V*0.8)	UINT	RO	0x0000
0x6000:03	Over_Voltage_2	Voltage 2 > 28.8V (24V*1.2)	UINT	RO	0x0000
0x6000:04	Under_Voltage_2	Voltage 2 < 19.2V (24V*0.8)	UINT	RO	0x0000
0x6000:05	Over_Current	Bus current > 2A	UINT	RO	0x0000
0x6000:06	Device_ID	ID switch	UINT	RO	0x0000
0x6000:11	Voltage_1	Input voltage 1	REAL	RO	0 Dec
0x6000:12	Voltage_2	Input voltage 2	REAL	RO	0 Dec
0x6000:13	Current	Input current	REAL	RO	0 Dec

3.2.6.2 Module Configuration

Table 3.11: Module Configuration (0xF600:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	Locate Module	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00

3.3 AMAX-5079 EtherCAT Extension

The AMAX-5079 is an extension module converting EtherCAT bus to 100BASE-TX Ethernet through RJ-45 LAN port which can be connected to AMAX-5074 EtherCAT coupler or any EtherCAT devices to extend the EtherCAT network. AMAX-5079 should be installed at the end of the EtherCAT terminal and the maximum extension distance is 100m.

Figure 3.14 AMAX-5079 Module

3.3.1 AMAX-5079 Specification

3.3.1.1 General:

- **Certification:** CE, FCC class A
- **Connector':** 1 x RJ45
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** N/A
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** N/A
- **Weight:** Approx. 71g

3.3.1.2 EtherCAT Extension

- **Function:** Conversion of EtherCAT to 100BASE-TX Ethernet for extension of the EtherCAT network
- **Cable:** Ethernet/EtherCAT cable (min. Cat. 5), shielded
- **Distance between stations:** Max. 100 m (100BASETX)
- **Bus Interface:** 1 x RJ45
- **Power from bus:** N/A

3.3.1.3 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

3.3.2 Pin Definition

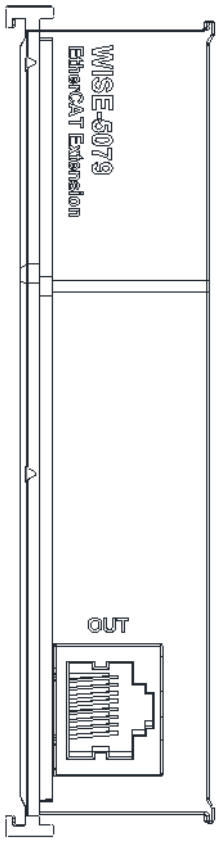


Figure 3.15 AMAX-5079 Module Front View

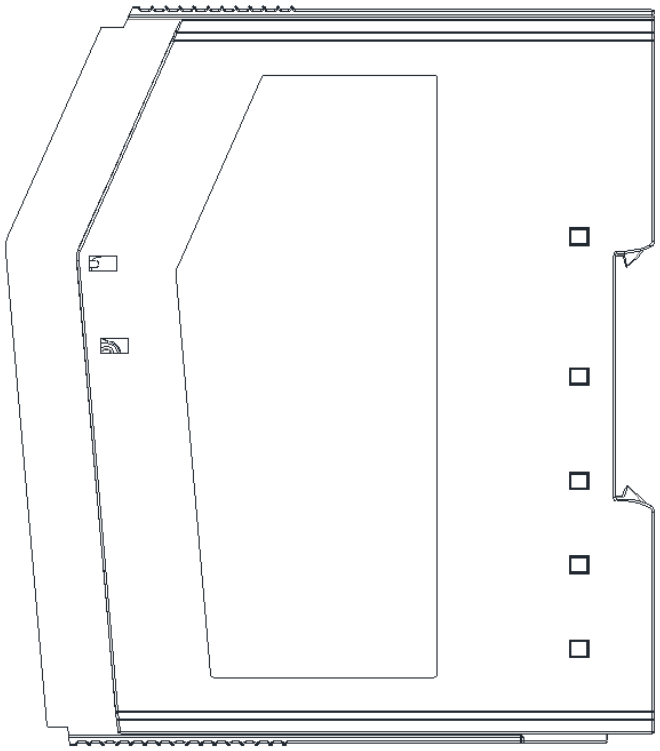


Figure 3.16 AMAX-5079 Module Side View

Table 3.12: LAN Port	
Port Number	**Port Definition**
1	EtherCAT signal output

Chapter 4

Analog Input/Output Modules

4.1 AMAX-5015 4-ch RTD Input Module

The AMAX-5015 is a 16-bit, 4-channel RTD input module that features programmable input ranges on all channels. This module is an extremely cost-effective solution for industrial measurement and monitoring applications. Its opto-isolated inputs provide 2,000 VDC of isolation between the analog input and the module, protecting the module and peripherals from damage due to high input line voltage.

Figure 4.1 AMAX-5015 Module

4.1.1 AMAX-5015 Specification

4.1.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, R/E
- **Weight:** Approx. 80g

4.1.1.2 Analog Input

- **Channel:** 4
- **Input Connection:** 2 or 3 wire
- **Input Impedance:** >10MΩ
- **Temperature Range:**
  - **Pt 100 RTD:**
    Pt -50°C to 150°C
    Pt 0°C to 100°C
    Pt 0°C to 200°C
    Pt 0°C to 400°C
    Pt -200°C to 200°C IEC RTD 100 ohms
    (a = 0.00385)
    JIS RTD 100 ohms
    (a = 0.00392)
  - **Pt 1000 RTD:**
    Pt -40°C to 160°C
  - **Balco 500 RTD:**
    -30°C to 120°C
  - **Ni 518 RTD:**
    -80°C to 100°C
    0°C to 100°C
- **Resolution:** 16 bit with ±0.1% FSR accuracy @25°C
- **Sample Rate:** 100 sample/s (per channel)
- **Burn-out detection:** Yes

4.1.1.3 Protection

- **Isolation Voltage:** 2000V_{DC}

4.1.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

4.1.2 LED Indicator

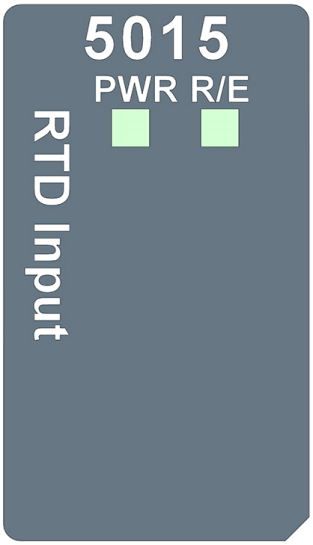


Figure 4.2 AMAX-5015 Module LED Indicator

Table 4.1: AMAX-5015 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating Module
R/E	Green	ON	EtherCAT Connected
		Blink	EtherCAT Connecting
	Red	ON	Module Abnormal [1]

[1]: The cause may be a disconnection or malfunction of the previous (on the left of this module) or this module. Please contact Advantech RMA Centre for further assistance.

4.1.3 Pin Definition

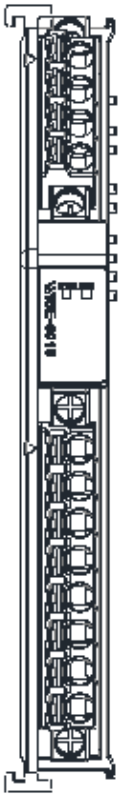


Figure 4.3 AMAX-5015 Module Front View

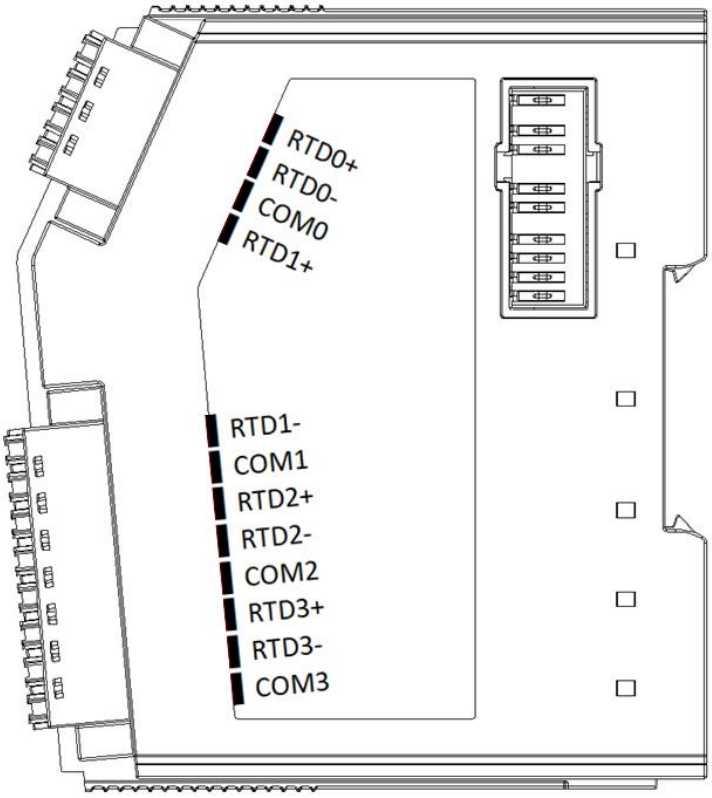


Figure 4.4 AMAX-5015 Module Side View

Table 4.2: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	RTD0+
2	RTD0-
3	COM0
4	RTD1+

Table 4.3: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	RTD1-
2	COM1
3	RTD2+
4	RTD2-
5	COM2
6	RTD3+
7	RTD3-
8	COM3

4.1.4 Application Wiring

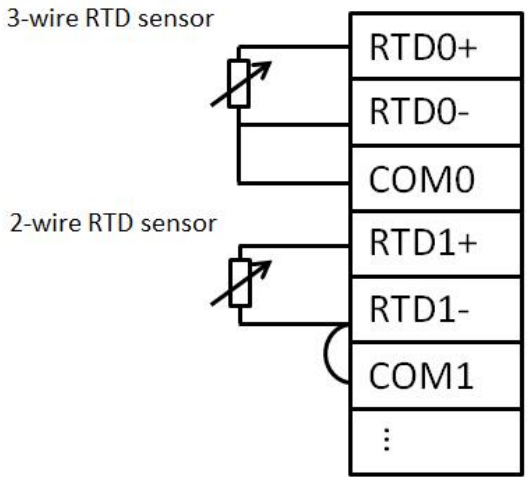


Figure 4.5 Wiring for AMAX-5015

4.1.5 AMAX-5015 Object Dictionary

4.1.5.1 Input Data

Table 4.4: Input Data (0x6000:00 – 0x6030:13)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x60***n***0:01	AI***n***_BurnOut	Burnout detection 0: Disable 1: Enable	BOOL	RO	0x00
0x60***n***0:02	AI***n***_OverRange	Over range detection 0: Disable 1: Enable	BOOL	RO	0x00
0x60***n***0:03	AI***n***_UnderRange	Under range detection 0: Disable 1: Enable	BOOL	RO	0x00
0x60***n***0:11	AI***n***_Raw	Analog input value (raw data)	UINT	RO	0x0000
0x60***n***0:13	AI***n***_Scale [1]	Analog input value (scale data)	DINT	RO	0x0000 0000

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

[1]: This parameter shows the physical temperature value, multiplied by 10, and any digit under the decimal point is rounded.

E.g. (10.26°C -> 103)

Table 4.5: RTD Over/Under Range Limit			
Type	**Type Range**	**Under Temperature**	**Over Temperature**
Pt-100	-50~150°C	-70.85°C	167.18°C
Pt-100	0~100°C	-25.48°C	141.10°C
Pt-100	0~200°C	-25.48°C	260.80°C
Pt-100	0~400°C	-12.76°C	437.70°C
Pt-100	-200~200°C	-205.86°C	224.97°C
Pt-1000	-40~160°C	-40.00°C	160.00°C
Balco	-20~120°C	-39.62°C	141.65°C
Ni	-80~100°C	-96.02°C	128.59°C
Ni	0~100°C	-8.61°C	128.59°C

4.1.5.2 Burnout Detection Configuration

Table 4.6: TBurnout Detection Configuration (0x8000:01 – 0x8030:14)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x80***n***0:01	AI***n***_EnBurnOut	Enable burnout detection 0: Disable 1: Enable	BOOL	RW	0x01
0x80***n***0:11	AI***n***_Range	Input range type	UINT	RW	0x03A4 [1]
0x80***n***0:14	AI***n***_BurnOut-Value	Burnout value 0: Output 0 (up scale) 1: Output 65535 (down scale)	UINT	RW	0x0001

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

[1]: Definition of input RTD types values, please refer to the next table "**Input RTD Type Value in Different Temperature Coefficients**"

Table 4.7: Input RTD Type Value in Different Temperature Coefficients			
Type	**Type Range**	**Temperature Coefficient**	**Value (UINT)**
Pt-100	-50~150°C	385	0x03A4 (default)
Pt-100	0~100°C	385	0x03A5
Pt-100	0~200°C	385	0x03A6
Pt-100	0~400°C	385	0x03A7
Pt-100	-200~200°C	385	0x03A2
Pt-1000	-40~160°C	385	0x03E2
Pt-100	-50~150°C	392	0x03C4
Pt-100	0~100°C	392	0x03C5
Pt-100	0~200°C	392	0x03C6
Pt-100	0~400°C	392	0x03C7
Pt-100	-200~200°C	392	0x03C2
Balco	-20~120°C	500	0x0300
Ni	-80~100°C	518	0x0320
Ni	0~100°C	518	0x0321

4.1.5.3 Module Configuration

Table 4.8: Module Configuration (0xF600:01 - 0xF600:11)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF6000:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00
0xF6000:11	AI_SamplingRate	Sampling rate for all channels 0x0000: 10HZ 0x0001: 400Hz	UINT	RW	0x0001 [1]

[1]: Before revision number: 0x00001003, default sampling rate was 10Hz.

4.2 AMAX-5017C 6-ch Current Input Module

The AMAX-5017C is a 16-bit, 6-channel differential current input module that provides programmable input ranges on all channels, and different channels can be configured using different ranges. You can also use CODESYS to configure range types for each channel. This module is an extremely cost-effective solution for industrial measurement and monitoring applications. The module provides 2000V_{DC} optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules and control unit) won't be affected because it is already isolated.

Figure 4.6 AMAX-5017C Module

4.2.1 AMAX-5017C Specification

4.2.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, R/E
- **Weight:** Approx. 80g

4.2.1.2 Analog Input

- **Channel:** 6 (Differential)
- **Input Impedance:** 120 Ω
- **Input Type:** Current (mA)
- **Voltage/Current Range:** ±20 mA, 0 ~ 20 mA, 4 ~ 20 mA
- **Span Drift:** 6 ppm/°C
- **Resolution:** 16 bit with ±0.2% FSR accuracy @25°C
- **Sampling Rate:** 100 sample/s (per channel)

4.2.1.3 Protection

- **Isolation Voltage:** $2000V_{DC}$

4.2.1.4 Environment

- **Operation Temperature:** -20~55°C (Vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

4.2.2 LED Indicator

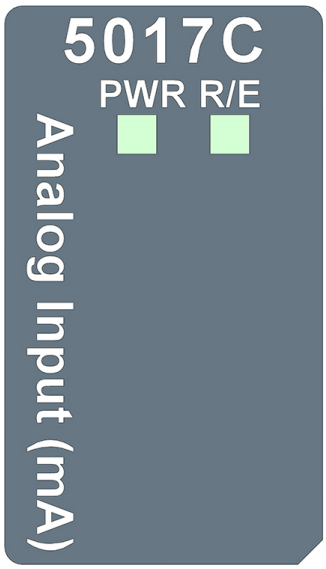


Figure 4.7 AMAX-5017C Module LED Indicator

Table 4.9: AMAX-5017C Module LED Indicator			
LED	**Color**	**Indication**	**Behavior**
Power	Green	ON	Power on
	Orange	ON	Locating Module
R/E	Green	ON	EtherCAT Connected
		Blink	EtherCAT Connecting
	RED	ON	Module Abnormal[1]
		Blink	

[1]: The cause may be a disconnection or malfunction of the previous (on the left of this module) or this module. Please contact Advantech RMA Centre for further assistance.

4.2.3 Pin Definition

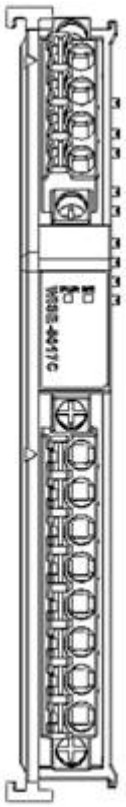


Figure 4.8 AMAX-5017C Module Front View

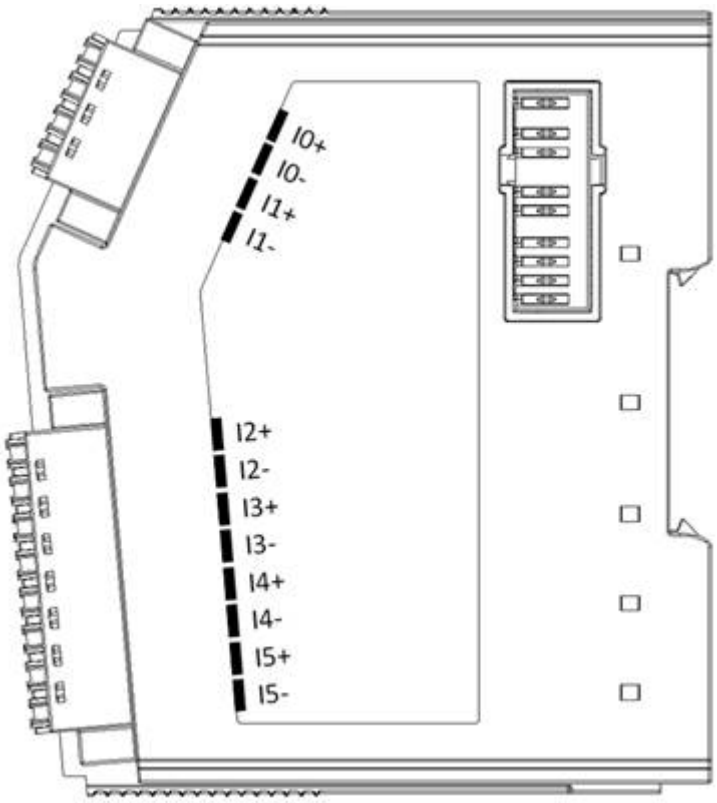


Figure 4.9 AMAX-5017C Module Side View

Table 4.10: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	I0+
2	I0-
3	I1+
4	I1-

Table 4.11: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	I2+
2	I2-
3	I3+
4	I3-
5	I4+
6	I4-
7	I5+
8	I5-

4.2.4 Application Wiring

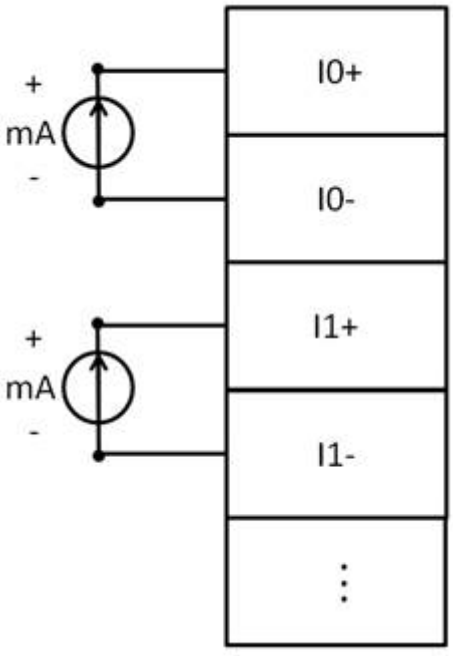


Figure 4.10 Wiring for AMAX-5017C

4.2.5 AMAX-5017C Object Dictionary

4.2.5.1 Input Data

Table 4.12: Input Data (0x6000:01 – 0x6050:11)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x60***n***0:01	AI***n***_BurnOut	Burnout detection 0: Disable 1: Enable	BOOL	RO	0x00
0x60***n***0:02	AI***n***_OverRange	Over range detection 0: Disable 1: Enable	BOOL	RO	0x00
0x60***n***0:03	AI***n***_UnderRange	Under range detection 0: Disable 1: Enable	BOOL	RO	0x00
0x60***n***0:11	AI***n***	Read current input value	UINT	RO	0x0000

n: Range from 0 to 5 refer to Ch.0 to Ch.5.

Converting current input value:

For the range 4~20 mA:

$$I_{in} = (\frac{Raw\ \ Data}{65535} \times 16mA) + 4mA$$

For the range ± 20 mA:

$$I_{in} = (\frac{Raw\ \ Data}{65535} \times 40mA) - 20mA$$

For the range 0~20 mA:

$$I_{in} = \frac{Raw\ \ Data}{65535} \times 20mA$$

4.2.5.2 Burnout Detection Configuration

Table 4.13: Burnout Detection Configuration (0x8000:01 – 0x8050:14)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x80***n***0:01	AI***n***_EnBurnOut	Enable burnout detection 0: Disable 1: Enable	BOOL	RW	0x01
0x80***n***0:11	AI***n***_Range	Input range type [1] 0x0180: 4~20mA 0x0181: ± 20mA 0x0182: 0~20mA	UINT	RW	0x0180
0x80***n***0:14	AI***n***_BurnOut-Value	Burnout value 0: Output 0 (up scale) 1: Output 65535 (down scale)	UINT	RW	0x0001

n: Range from 0 to 5 refer to Ch.0 to Ch.5.

[1]: Input current alarm function only available for current range in 4~20mA. Please refer to the next table "**Input Current Alarm Status**".

Table 4.14: Input Current Alarm Status			
Input Current	**Status**	**Meaning**	**Output Value**
0 ~ 3mA	Burnout	Up Scale	65535
		Down Scale (or burnout detection was disabled)	0
3 ~ 4mA	Under Range		0
> 20mA	Over Range		65535

4.2.5.3 Module Configuration

Table 4.15: Configuration Data (0xF600 - 0xFFFF)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00
0xF600:11	AI_SamplingRate	Sampling rate for all channels 0x0000: 10HZ 0x0001: 600Hz	UINT	RW	0x0001 [1]

[1]: Before revision number: 0x00021003, default sampling rate was 10Hz.

4.3 AMAX-5017V 6-ch Voltage Input Module

The AMAX-5017V is a 16-bit, 6-channel differential voltage input module. All channels can be configured with different input range and range type. This module is an extremely cost-effective solution for industrial measurement and monitoring applications. This module provides 2,000 VDC optical isolation between channels. Either high voltage or current won't damage the entire system (other modules, and control unit) because it is already isolated.

Figure 4.11 AMAX-5017V Module

4.3.1 AMAX-5017V Specification

4.3.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, R/E
- **Weight:** Approx. 80g

4.3.1.2 Analog Input

- **Channel:** 6 (Differential)
- **Input Impedance:** >1MΩ
- **Input Type:** V, mV
- **Voltage Range:** 0~150 mV, ±150 mV, 0~500 mV, ±500 mV, 0~1 V, ±1 V, 0~5 V, ±5 V, 0~10 V, ±10 V
- **Span Drift:** 6 ppm/°C
- **Resolution:** 16-bit with ±0.1% FSR accuracy @25°C
- **Sampling Rate:** 100 sample/s (per channel)
- **Common Mode Voltage:**
  - $200V_{DC}$ @ 600Hz sampling rate
  - $350V_{DC}$ @ 10Hz sampling rate

4.3.1.3 Protection

- **Isolation Voltage:** 2000 V_{DC}

4.3.1.4 Environment

- **Operation Temperature:** -20~55°C (Vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

4.3.2 LED Indicator

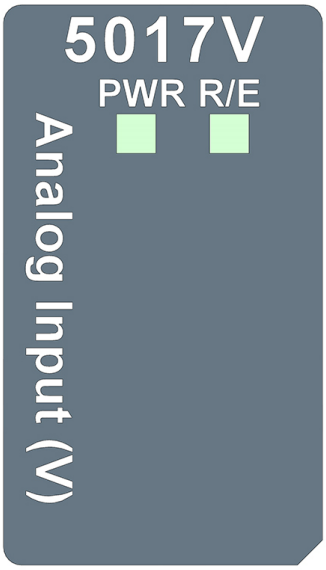


Figure 4.12 AMAX-5017V Module LED Indicator

Table 4.16: AMAX-5017V Module LED Indicator

LED	Color	Indication	Behavior
Power	Green	ON	Power on
	Orange	ON	Locating module
R/E[1]	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting

[1]: If the RED LED blinking, it may be a disconnection or malfunction of the previous (on the left of this module) or this module.

4.3.3 Pin Definition

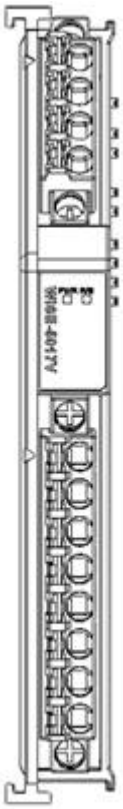


Figure 4.13 AMAX-5017V Module Front View

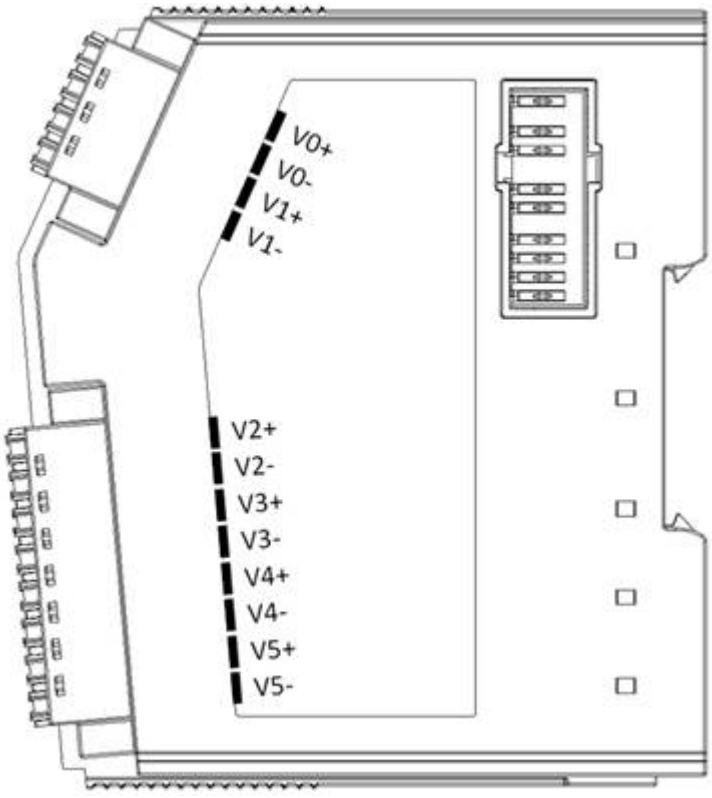


Figure 4.14 AMAX-5017V Module Side View

Table 4.17: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	V0+
2	V0-
3	V1+
4	V1-

Table 4.18: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	V2+
2	V2-
3	V3+
4	V3-
5	V4+
6	V4-
7	V5+
8	V5-

4.3.4 Application Wiring

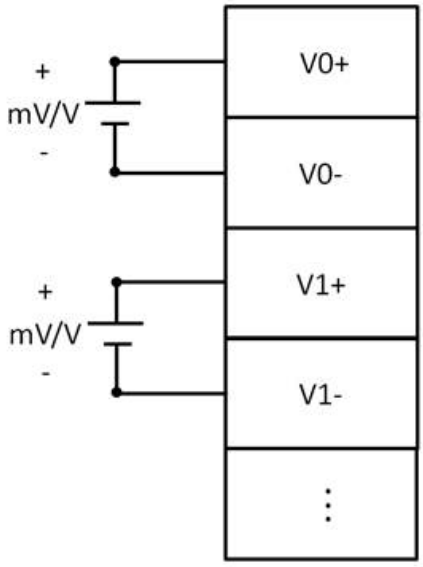


Figure 4.15 Wiring for AMAX-5017V

4.3.5 AMAX-5017V Object Dictionary

4.3.5.1 Input Data

Table 4.19: Input Data (0x6000:01 - 0x6050:11)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x6000:11	AI0	Read voltage input value	UINT	RO	0x0000
0x6010:11	AI1	Read voltage input value	UINT	RO	0x0000
0x6020:11	AI2	Read voltage input value	UINT	RO	0x0000
0x6030:11	AI3	Read voltage input value	UINT	RO	0x0000
0x6040:11	AI4	Read voltage input value	UINT	RO	0x0000
0x6050:11	AI5	Read voltage input value	UINT	RO	0x0000

Converting voltage input value:

For the range ± 150 mV:

$$V_{in} = (\frac{Raw\ \ Data}{65535} \times 300mV) - 150mV$$

For the range ± 500 mV:

$$V_{in} = (\frac{Raw\ \ Data}{65535} \times 1000mV) - 500mV$$

For the range ± 1 V:

$$V_{in} = (\frac{Raw\ \ Data}{65535} \times 2V) - 1V$$

For the range ± 5 V:

$$V_{in} = (\frac{Raw\ \ Data}{65535} \times 10V) - 5V$$

For the range ± 10 V:

$$V_{in} = (\frac{Raw\ \ Data}{65535} \times 20V) - 10V$$

For the range 0~150 mV:

$$V_{in} = \frac{Raw\ \ Data}{65535} \times 150mV$$

For the range 0~500 mV:

$$V_{in} = \frac{Raw\ \ Data}{65535} \times 500mV$$

For the range 0~1 V:

$$V_{in} = \frac{Raw\ \ Data}{65535} \times 1V$$

For the range 0~5 V:

$$V_{in} = \frac{Raw\ \ Data}{65535} \times 5V$$

For the range 0~10 V:

$$V_{in} = \frac{Raw\ \ Data}{65535} \times 10V$$

4.3.5.2 Input Range Configuration

Table 4.20: Input Range Configuration (0x8000:11 - 0x8050:11)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x8000:11	AI0_Range	Input range type	UINT	RW	0x0143 [1]
0x8010:11	AI1_Range	Input range type	UINT	RW	0x0143 [1]
0x8020:11	AI2_Range	Input range type	UINT	RW	0x0143 [1]
0x8030:11	AI3_Range	Input range type	UINT	RW	0x0143 [1]
0x8040:11	AI4_Range	Input range type	UINT	RW	0x0143 [1]
0x8050:11	AI5_Range	Input range type	UINT	RW	0x0143 [1]

[1]: Definition of input range types values, please refer to the next table "**Input Range Type**".

Table 4.21: Input Range Type	
Range Type	**Value (UINT)**
± 150 mV (Full Scale Range)	0x0103
± 500 mV (Full Scale Range)	0x0104
± 1 V (Full Scale Range)	0x0140
± 5 V (Full Scale Range)	0x0142
± 10 V (Full Scale Range)	0x0143 (default)
0~150 mV	0x0105
0~ 500 mV	0x0106
0~1 V	0x0145
0~5 V	0x0147
0~10 V	0x0148

4.3.5.3 Module Configuration

Table 4.22: Configuration Data (0xF600 - 0xFFFF)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED con-trol 0: Turn Off 1: Turn On	BOOL	RW	0x00
0xF600:11	AI_SamplingRate	Sampling rate for all channels 0x0000: 10HZ 0x0001: 600Hz	UINT	RW	0x0001 [1]

[1]: Before revision number: 0x00021003, default sampling rate was 10Hz.

4.4 AMAX-5017H 4-ch High Speed Analog Input Module

The AMAX-5017H is a 16-bit, 4-channel differential analog input module with 10kHz sample rate. All channels can be configured to voltage or current input separately. This module is a cost-effective solution for industrial measurement and monitoring applications. This module provides 2,000 V_{DC} optical isolation between channels. Either high voltage or current won't damage the entire system (other modules, and control unit) because it is already isolated.

Figure 4.16 AMAX-5017H Module

4.4.1 AMAX-5017H Specification

4.4.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, R/E
- **Weight:** Approx. 80g

4.4.2 Analog Input

- **Channel:** 4 (Differential)
- **Input Impedance:**
  - 800 kΩ, for voltage input
  - 500 Ω, for current input
- **Common Voltage Range:** ±275V
- **Input Type:** V, mV, mA
- **Voltage/Current Range:** ±10 V, 0~10V, 0~20mA
- **Accuracy:**
  - ±0.1% FSR for voltage input (25°C)
  - ±0.2% FSR for current input (25°C)
- **Span Drift:** ±30 ppm/°C
- **Zero Drift:** ±8 uV/°C
- **Resolution:** 16-bit
- **Sampling Rate:** 10k sample/s (per channel)

4.4.3 Protection

- Isolation Voltage: 2000 V_{DC}

4.4.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

4.4.5 LED Indicator

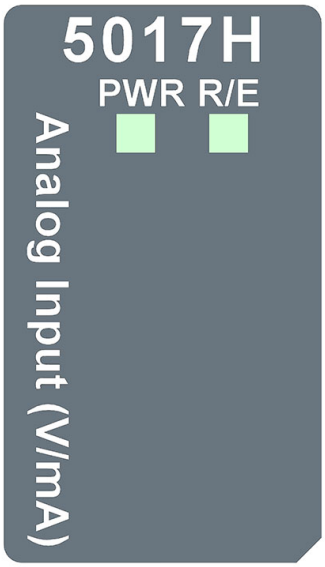


Figure 4.17 AMAX-5017H Module LED Indicator

Table 4.23: AMAX-5017H Module LED Indicator			
LED	**Color**	**Indication**	**Behavior**
Power	Green	ON	Power on
	Orange	ON	Locating module
R/E[1]	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting

[1]: If the RED LED blinking, it may be a disconnection or malfunction of the previous (on the left of this module) or this module.

4.4.6 Pin Definition

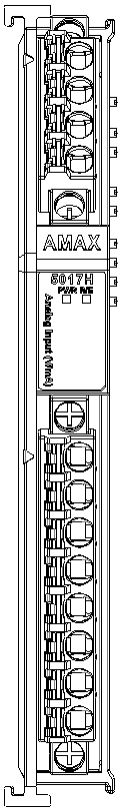


Figure 4.18 AMAX-5017H Module Front View

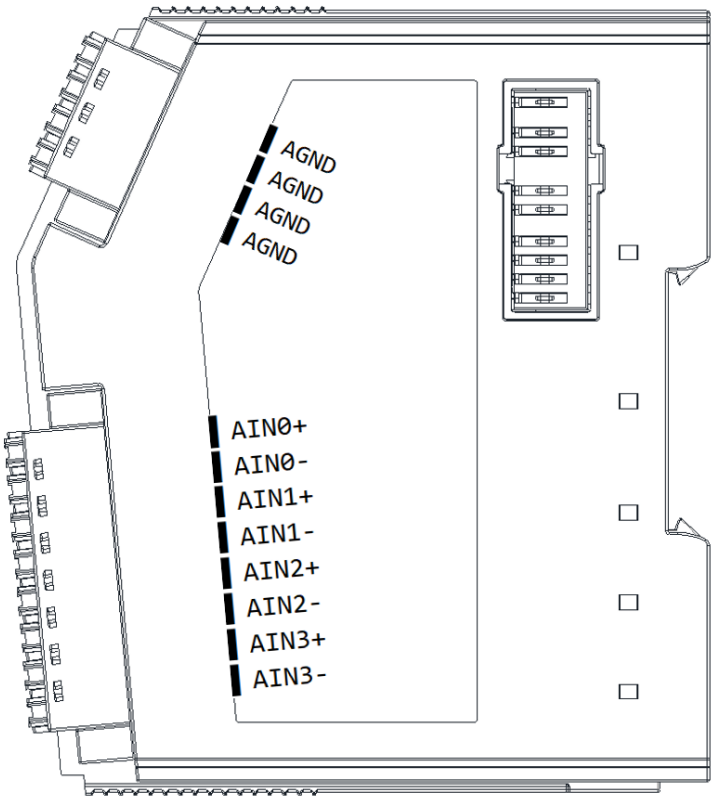


Figure 4.19 AMAX-5017H Module Side View

Table 4.24: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	AGND
2	AGND
3	AGND
4	AGND

Table 4.25: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	AIN0+
2	AIN0-
3	AIN1+
4	AIN1-
5	AIN2+
6	AIN2-
7	AIN3+
8	AIN3-

4.4.7 Application Wiring

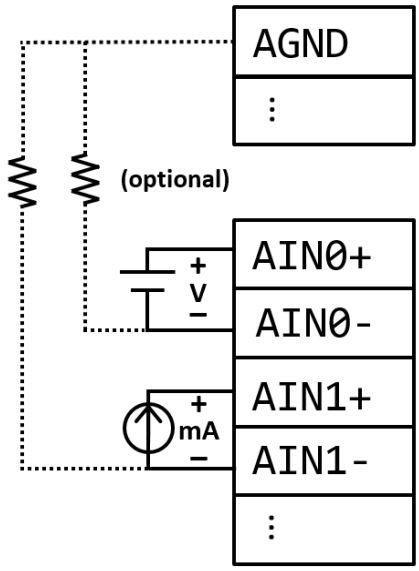


Figure 4.20 Wiring for AMAX-5017H

4.4.8 AMAX-5017H Object Dictionary

4.4.8.1 Input Data

Table 4.26: Input Data (0x6000:11 - 0x6030:11)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x6000:11	AI0	Read voltage input value	UINT	RO	0x0000
0x6010:11	AI1	Read voltage input value	UINT	RO	0x0000
0x6020:11	AI2	Read voltage input value	UINT	RO	0x0000
0x6030:11	AI3	Read voltage input value	UINT	RO	0x0000

4.4.8.2 Input Range Configuration

Table 4.27: Configuration Data (0x8000 - 0x8FFF)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x80***n***0:11	AI0_Range	Input range type ± 10 V: 0x0143 0~10V: 0x0148 0~20mA: 0x0182	UINT	RW	0x143

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

Converting analog input value:

For the range ± 10 V:

$$V_{in} = (\frac{Raw\ \ Data}{65535} \times 20V) - 10V$$

For the range 0~10 V:

$$V_{in} = \frac{Raw\ \ Data}{65535} \times 10V$$

For the range 0~20 mA:

$$I_{in} = \frac{Raw\ \ Data}{65535} \times 20mA$$

4.4.8.3 Module Configuration

Table 4.28: Module Configuration (0xF600:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00

4.5 AMAX-5018 6-ch Thermocouple Input Module

The AMAX-5018 is a 16-bits 6-channel thermocouple module, which supports: J, K, T, E, R, S, B, N type thermocouple and multi-range voltage input (±50 mV, ±100 mV, ±500 mV, ±1 V, ±2.5 V), each channel supports open load detection. The module provides 2000 VDC optical isolation, if any surge voltage or current inputs the channel, the whole system (other modules or control unit) will not be damaged.

Figure 4.21 AMAX-5018 Module

4.5.1 AMAX-5018 Specification

4.5.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, R/E
- **Weight:** Approx. 80g

4.5.1.2 Thermocouple Input

- **Channel:** 6 (Differential)
- **Input Impedance:** >2M Ω
- **Voltage Input:** ±50 mV, ±100 mV, ±500 mV, ±1 V, ±2.5 V
- **Sensor Type:**
  Type J (0 ~ 760°C)
  Type K (0 ~ 1370°C)
  Type T (-100 ~ 400°C)
  Type E (0 ~ 1000°C)
  Type R (500 ~ 1750°C)
  Type S (500 ~ 1750°C)
  Type B (500~1800°C)
  Type N (-200 ~ 1300°C)
- **Resolution:** 16 bit with ±0.1% FSR accuracy @25°C
- **Sample Rate:** 100 sample/s (per channel)
- **Burn-out detection:** Yes

4.5.1.3 Protection

- **Isolation Voltage:** 2000 V_{DC}

4.5.1.4 Environment

- **Operation Temperature:** -20~55°C (Vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

4.5.2 LED Indicator

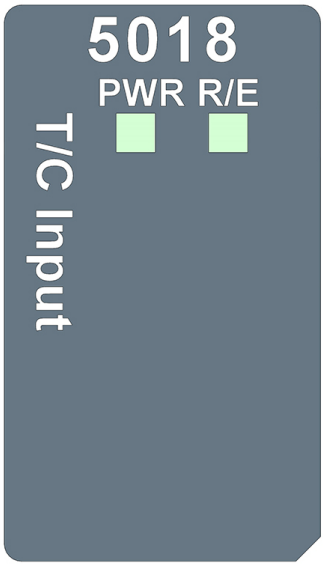


Figure 4.22 AMAX-5018 Module LED Indicator

Table 4.29: AMAX-5018 Module LED Indicator			
LED	**Color**	**Indication**	**Behavior**
Power	Green	ON	Power on
	Orange	ON	Locating module
R/E[1]	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting

[1]: If the RED LED blinking, it may be a disconnection or malfunction of the previous (on the left of this module) or this module.

4.5.3 Pin Definition

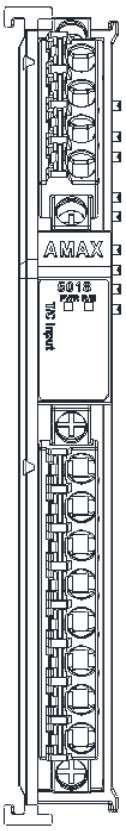


Figure 4.23 AMAX-5018 Module Front View

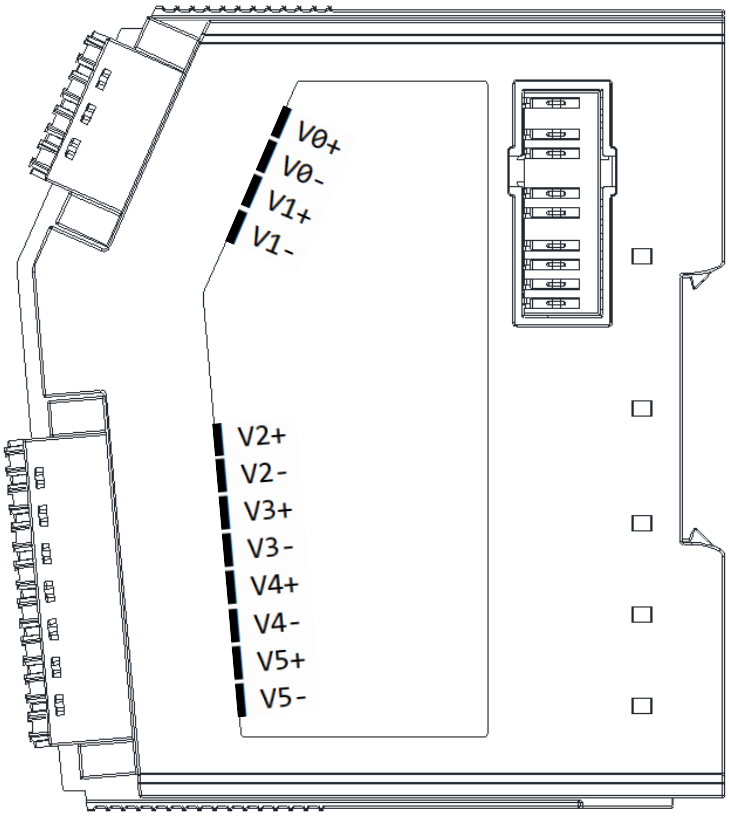


Figure 4.24 AMAX-5018 Module Side View

Table 4.30: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	V0+
2	V0-
3	V1+
4	V1-

Table 4.31: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	V2+
2	V2-
3	V3+
4	V3-
5	V4+
6	V4-
7	V5+
8	V5-

4.5.4 Application Wiring

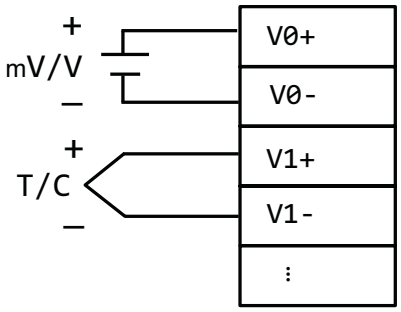


Figure 4.25 Wiring for AMAX-5018

4.5.5 AMAX-5018 Object Dictionary

4.5.5.1 Input Data

Table 4.32: Analog Input (0x6000 - 0x6FFF)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x60***n***0:01	AI***n***_BurnOut	Burnout detection [1]	BOOL	RO	0x00
0x60***n***0:02	AI***n***_OverRange	Over range detection [2]	BOOL	RO	0x00
0x60***n***0:03	AI***n***_Under-Range	Under range detection [2]	BOOL	RO	0x00
0x60***n***0:11	AI***n***_Raw	Analog input value (raw data)	UINT	RO	0x0000
0x60***n***0:13	AI***n***_Scale	Analog input value (scale data)	DINT	RO	0x0000 0000

n: Range from 0 to 5 refer to Ch.0 to Ch.5.

[1]: Burnout Detection can be used when the AIn_EnBurnOut (0x80n0:01) is enabled, this function is only available for thermocouple input.

[2]: Over or Under range detections are only available for thermocouple input, the alarm trigger value shows in the next table "**Thermocouple Alarm Trigger Over/ Under Temperature and Accuracy**".

Table 4.33: Thermocouple Alarm Trigger Over/Under Temperature and Accuracy				
Type	**Type Range**	**Under Temperature Alarm**	**Over Temperature Alarm**	**Accuracy**
J	0~760°C	-80°C	840°C	± 1.5°C
K	0~1370°C	-100°C	1370°C	± 1.5°C
T	-100~400°C	-140°C	400°C	± 1.5°C
E	0~1000°C	-100°C	1000°C	± 1.5°C
R	500~1750°C	320°C	1760°C	± 2.5°C
S	500~1750°C	320°C	1760°C	± 2.5°C
B	500~1800°C	320°C	1820°C	± 3.0°C
N	-200~0°C	-270°C	1300°C	± 8.0°C
	0~1300°C	-270°C	1300°C	± 1.5°C

4.5.5.2 Analog Input (Scaled)

This parameter shows the physical value of temperature or voltage, the value is multiplied by a factor, and any digit under decimal point are rounded, for example:

If selecting voltage input range:

AIn_Scale = Round (Measured voltage x 10000). (E.g. 3.45678 mV -> 34568)

If selecting thermocouple input range:

AIn_Scale = Round (Measured temperature x 10). (10.26°C -> 103)

The actual display range for scaled data shows on the table below:

Table 4.34: Scaled Data Display Range

Type		Scaled Data	Physical Value
± 50mV		-780000~780,000	-78~78 mV
± 100mV		-1560000~1560000	-156~156 mV
± 500mV		-6250000~6250000	-625~625 mV
± 1V		12500~12500	-1.25~1.25 V
± 2.5V		-25000~25000	-2.5~2.5 V
J	0~760°C	0~7600	0~760 °C
K	0~1370°C	0~1370	0~1370 °C
T	-100~400°C	-1000~4000	-100~400 °C
E	0~1000°C	0~10000	0~1000 °C
R	500~1750°C	5000~17500	500~1750 °C
S	500~1750°C	5000~17500	500 ~1750 °C
B	500~1800°C	5000~18000	500~1800 °C
N	-200~1300°C	-2000~13000	-200~1300 °C

4.5.5.3 Burnout Configuration

Table 4.35: Burnout Configuration (0x8000:01 - 0x8050:14)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x80***n***0:01	AI***n***_EnBurnOut	Enable burnout detection [1] 0: Disable 1: Enable	BOOL	RO	0x00
0x80***n***0:11	AI***n***_Range	Input value type [2]	UINT	RO	0x0420 (K type)
0x80***n***0:14	AI***n***_BurnOutValue	Burnout value 0: Output 0 (up scale) 1: Output 65535 (down scale)	UINT	RO	0x0001

n: Range from 0 to 5 refer to Ch.0 to Ch.5.

[1]: When burnout detection is enabled, the limitation of conversion time per channel will be 7.8ms (21.4HZ for all channels)

[2]: AMAX-5018 supporting various voltage and thermocouple input ranges, please refer to the next table "**Input Range Type**"

Table 4.36: Scaled Data Display Range		
Type		**Value (UINT)**
± 50mV		0x0101
± 100mV		0x0102
± 500mV		0x0104
± 1V		0x0140
± 2.5V		0x0141
J	0~760°C	0x0400
K	0~1370°C	0x0420(Default)
T	-100~400°C	0x0440
E	0~1000°C	0x0460
R	500~1750°C	0x0480
S	500~1750°C	0x04A0
B	500~1800°C	0x04C0
N	-200~1300°C	0x04E1

4.5.5.4 Module Configuration

Table 4.37: Module Configuration (0xF600:01 - 0xF600:13)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00
0xF600:03	UnderWindFlow	Set if module is under wind flow 0: False 1: True	BOOL	RW	0x00
0xF600:11	AI_Samplin-gRate	Sampling rate for all channels 0x0000: 10HZ 0x0001: 600Hz	UINT	RW	0x0001 [1]
0xF600:13	CJC_Offset	The CJC offset of the module CJC offset = CJC_Offset/10	DINT	RW	0x0000 0000

[1]: Before revision number: 0x00001003, default sampling rate was 10Hz.

4.6 AMAX-5024 4-ch Analog Output Module

The AMAX-5024 is a 16-bit, 4-channel analog output module that provides programmable output ranges on every channel, and different channels can be configured using different ranges. The module provides 2000 VDC optical isolation, if any high voltage or current damage the channels, the whole system (other modules or control unit) will not be damaged.

Figure 4.26 AMAX-5024 Module

4.6.1 AMAX-5024 Specification

4.6.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, R/E
- **Weight:** Approx. 80g

4.6.1.2 Analog Output

- **Channel:** 4
- **Output Range:** V, mA
- **Output Type:** 0 ~ 5 V, 0 ~10 V, ±5V, ±10V, 4 ~ 20 mA, 0 ~ 20 mA
- **Drift:** ± 50 ppm/°C
- **Resolution:** 16-bit with ±0.01% of FSR accuracy @25°C
- **Current Load Resistor:** Max. 500 Ω
- **Voltage Load Resistor:** Min. 1K Ω
- **Slew Rate:** 1 V/μs for voltage output, 2.4 mA/μs for current output (configurable)
- **Conversion time:** 50 us for all channels

4.6.1.3 Protection

- **Isolation Voltage:** 2000 V_{DC}

4.6.1.4 Environment

- **Operation Temperature:** -20~55°C (Vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

4.6.2 LED Indicator

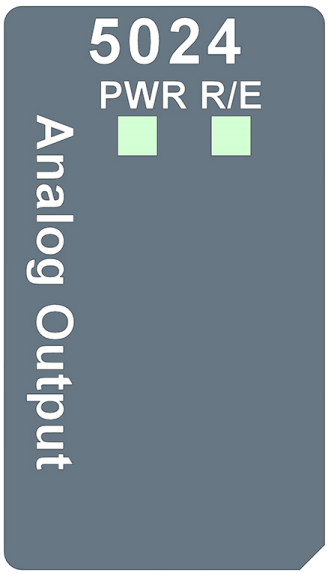


Figure 4.27 AMAX-5024 Module LED Indicator

Table 4.38: AMAX-5024 Module LED Indicator

LED	Color	Indication	Behavior
Power	Green	ON	Power on
	Orange	ON	Locating module
R/E[1]	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting

[1]: If the RED LED blinking, it may be a disconnection or malfunction of the previous (on the left of this module) or this module.

4.6.3 Pin Definition

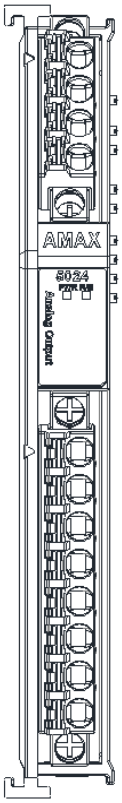


Figure 4.28 AMAX-5024 Module Front View

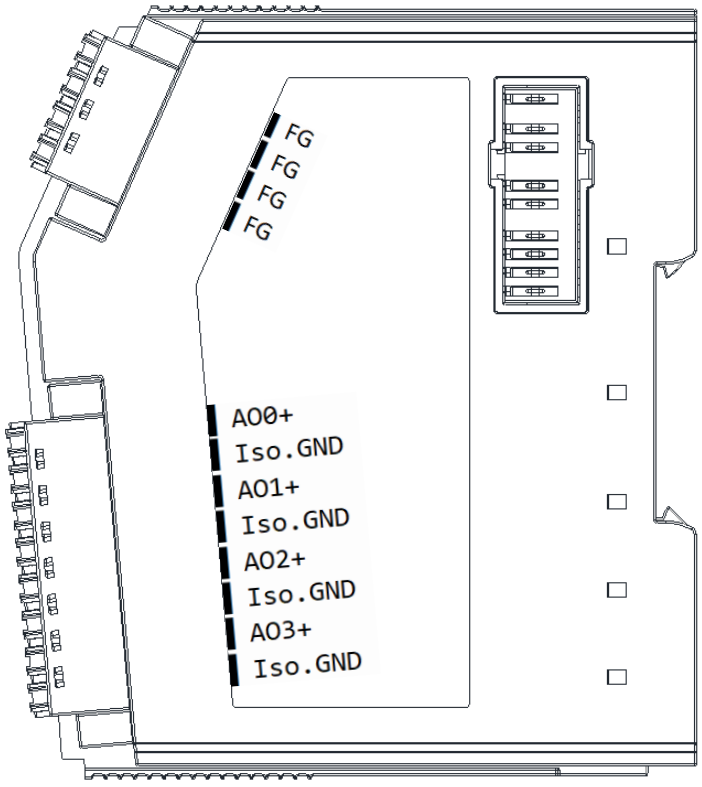


Figure 4.29 AMAX-5024 Module Side View

Table 4.39: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	FG
2	FG
3	FG
4	FG

Table 4.40: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	AO0+
2	Iso. GND
3	AO1+
4	Iso. GND
5	AO2+
6	Iso. GND
7	AO3+
8	Iso. GND

4.6.4 Application Wiring

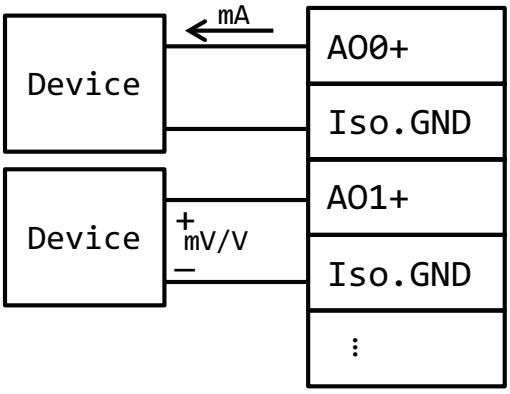


Figure 4.30 Wiring for AMAX-5024

4.6.5 AMAX-5024 Object Dictionary

4.6.5.1 Input Data

Table 4.41: Input Data (0x6000 - 0x6FFF)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x6000:01	AO0_BurnOut	Detect whether the input circuit open	BOOL	RO	0x00
0x6000:11	AO0	Read analogue output value	UINT	RO	0x0000
0x6010:01	AO1_BurnOut	Detect whether the input circuit open	BOOL	RO	0x00
0x6010:11	AO1	Read analogue output value	UINT	RO	0x0000
0x6020:01	AO2_BurnOut	Detect whether the input circuit open	BOOL	RO	0x00
0x6020:11	AO2	Read analogue output value	UINT	RO	0x0000
0x6030:01	AO3_BurnOut	Detect whether the input circuit open	BOOL	RO	0x00
0x6030:11	AO3	Read analogue output value	UINT	RO	0x0000

4.6.5.2 Output Data (0x7000 - 0x7FFF)

Table 4.42: Output Data (0x7000 - 0x7FFF)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x7000:11	AO0	Set analog output value	UINT	RW	0x0000
0x7010:11	AO1	Set analog output value	UINT	RW	0x0000
0x7020:11	AO2	Set analog output value	UINT	RW	0x0000
0x7030:11	AO3	Set analog output value	UINT	RW	0x0000

Converting analog output value:

For the range 0~5 V:

$$V_{out} = \frac{Raw\ \ Data}{65535} \times 5V$$

For the range 0~10 V:

$$V_{out} = \frac{Raw\ \ Data}{65535} \times 10V$$

For the range ± 5 V:

$$V_{out} = (\frac{Raw\ \ Data}{65535} \times 10V) - 5V$$

For the range ± 10 V:

$$V_{out} = (\frac{Raw\ \ Data}{65535} \times 20V) - 10V$$

For the range 4 ~ 20 mA:

$$I_{out} = (\frac{Raw\ \ Data}{65535} \times 16mA) + 4mA$$

For the range 0~20 mA:

$$I_{out} = \frac{Raw\ \ Data}{65535} \times 20mA$$

4.6.5.3 Analogue Output Configuration

Table 4.43: Analogue Output Configuration (0x8000:02 – 0x8030:17)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x80***n***0:02	AO***n***_EnslewRate	Enable slew rate [1] 0: Disable 1: Enable	BOOL	RW	0x00
0x80***n***0:03	AO***n***_EnSafeState	Enable safety value [2] 0: Disable (output last value in the safe state) 1: Enable (output AO***n***_SafeStateValue)	BOOL	RW	0x00
0x80***n***0:04	AO***n***_EnStartupState	Enable start-up value [2] 0: Disable (output 0V/mA in the start-up state) 1: Enable (output AO***n***_StartupStateValue)	BOOL	RW	0x00
0x80***n***0:11	AO***n***_Range	Output range type 0x0147: 0~5V 0x0148: 0~10V 0x0142: ± 5V 0x0143: ± 10V 0x0180: 4~20mA (default) 0x0182: 0~20mA	UINT	RW	0x0180
0x80***n***0:15	AO***n***_SlewRate	Slew rate setting 0x0001: ± 1V(mA)/s (default) 0x0002: ± 2V(mA)/s 0x0004: ± 4V(mA)/s 0x0008: ± 8V(mA)/s 0x0010: ± 16V(mA)/s 0x0020: ± 32V(mA)/s 0x0040: ± 64V(mA)/s	UINT	RW	0x0001
0x80***n***0:16	AO***n***_SafeStateValue	This value will be output when this module is dis-connected	UINT	RW	0x0000
0x80***n***0:17	AO***n***_StartupStateV-alue	Output value at start-up state (not in OP mode).	UINT	RW	0x0000

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

[1]: Slew rate function can't be used under DC mode.

[2]: Start-up state means the stage before entering OP mode. When this module entered OP mode and disconnected, it will output a safe state value (0x80n0:16, AO***n***_SafeStateValue) if the safe state (0x80n0:03, AO***n***_EnSafeState) is enabled.

4.6.5.4 Module Configuration

Table 4.44: Module Configuration (0xF600:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00

Chapter 5

Digital Module

5.1 AMAX-5051 8-ch Digital Input Module

The AMAX-5051 features 8 digital input (sink/source) channels. The digital input channels show LED to indicate digital status. The module provides 2,000 V_{DC} optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 5.1 AMAX-5051 Module

5.1.1 AMAX-5051 Specification

5.1.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, DI status
- **Weight:** Approx. 80g

5.1.1.2 Digital Input

- **Channels:** 8
- **Digital Input:**
  - Dry Contact:
    Logic level 1: close to Iso.GND
    Logic level 0: open
  - Wet Contact:
    Rated voltage: $24V_{DC}$
    Logic level 1: $10\sim30V_{DC}$ and $-10\sim-30V_{DC}$
    Logic level 0: $-3\sim3V_{DC}$
- **Input Delay:**
  - From logic level 0 to 1: 4ms (including 3ms DI filter)
  - From logic level 1 to 0: 4ms (including 3ms DI filter)
- **Digital Filter:** 3ms
- **Typical Input Current:** Logic level 1: 1.3mA~4.3mA (10V~30V)

5.1.1.3 Protection

- **Isolation Voltage:** $2{,}000V_{DC}$

5.1.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

5.1.2 LED Indicator

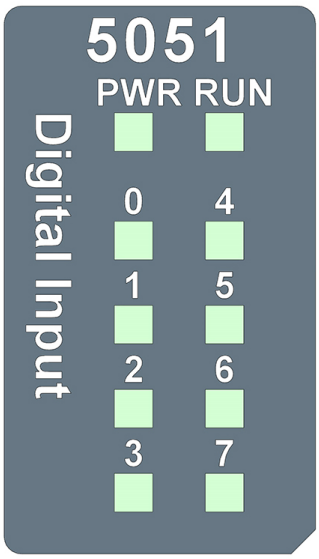


Figure 5.2 AMAX-5051 Module LED Indicator

Table 5.1: AMAX-5051 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating module
Run	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
DI0~7	Green	ON	Dry/Wet Logic "1"
		OFF	Dry/Wet Logic "0"

5.1.3 Pin Definition

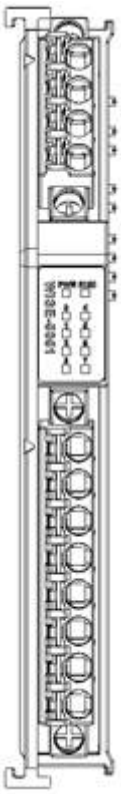


Figure 5.3 AMAX-5051 Module Front View

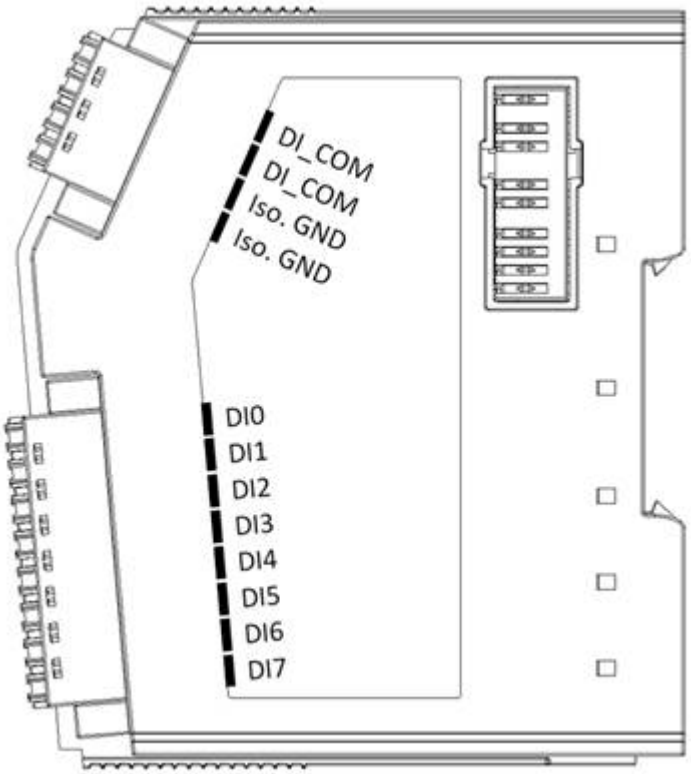


Figure 5.4 AMAX-5051 Module Side View

Table 5.2: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI_COM
2	DI_COM
3	Iso. GND
4	Iso. GND

Table 5.3: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI0
2	DI1
3	DI2
4	DI3
5	DI4
6	DI5
7	DI6
8	DI7

5.1.4 Application Wiring

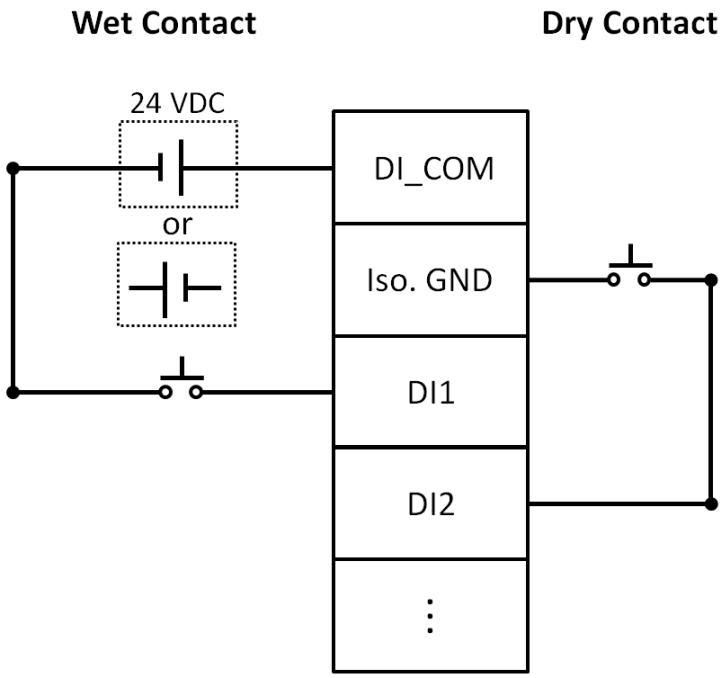


Figure 5.5 Wiring for AMAX-5051

5.1.5 AMAX-5051 Object Dictionary

5.1.5.1 Input Data

Table 5.4: Input Data (0x3001:01 - 0x3001:08)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x3001:01	DI0	Digital Input Channel 0	BOOL	RO	0x00
0x3001:02	DI1	Digital Input Channel 1	BOOL	RO	0x00
0x3001:03	DI2	Digital Input Channel 2	BOOL	RO	0x00
0x3001:04	DI3	Digital Input Channel 3	BOOL	RO	0x00
0x3001:05	DI4	Digital Input Channel 4	BOOL	RO	0x00
0x3001:06	DI5	Digital Input Channel 5	BOOL	RO	0x00
0x3001:07	DI6	Digital Input Channel 6	BOOL	RO	0x00
0x3001:08	DI7	Digital Input Channel 7	BOOL	RO	0x00

5.2 AMAX-5052 16-ch Digital Input Module

The AMAX-5052 features 16 digital input (sink/source) channels. The digital input channels offer LED to indicate digital status. The module provides 2,000 V_{DC} optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 5.6 AMAX-5052 Module

5.2.1 AMAX-5052 Specification

5.2.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 6P+12P push-in terminal (#28~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, DI status
- **Weight:** Approx. 80g

5.2.1.2 Digital Input

- **Channels:** 16
- **Digital Input:**
  - Dry Contact:
    Logic level 1: close to Iso.GND
    Logic level 0: open
  - Wet Contact:
    Rated voltage: $24V_{DC}$
    Logic level 1: 10~30 V_{DC} and -10~-$30V_{DC}$
    Logic level 0: -3~$3V_{DC}$
- **Input Delay:**
  - From logic level 0 to 1: 4ms (including 3 ms DI filter)
  - From logic level 1 to 1: 4ms (including 3 ms DI filter)
- **Digital Filter:** 3ms
- **Typical Input Current:** Logic level 1: 1.3mA~4.3mA (10V~30V)

5.2.1.3 Protection

- **Isolation Voltage:** 2,000V_{DC}

5.2.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

5.2.2 LED Indicator

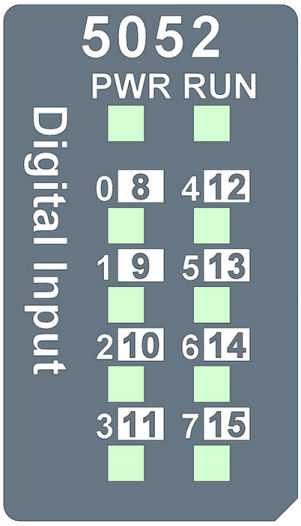


Figure 5.7 AMAX-5052 Module LED Indicator

Table 5.5: AMAX-5052 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating module
Run	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
DI0~7	Green	ON	Dry/Wet Logic "1"
		OFF	Dry/Wet Logic "0"
DI8~15	Yellow	ON	Dry/Wet Logic "1"
		OFF	Dry/Wet Logic "0"

5.2.3 Pin Definition

Figure 5.8 AMAX-5052 Module Front View

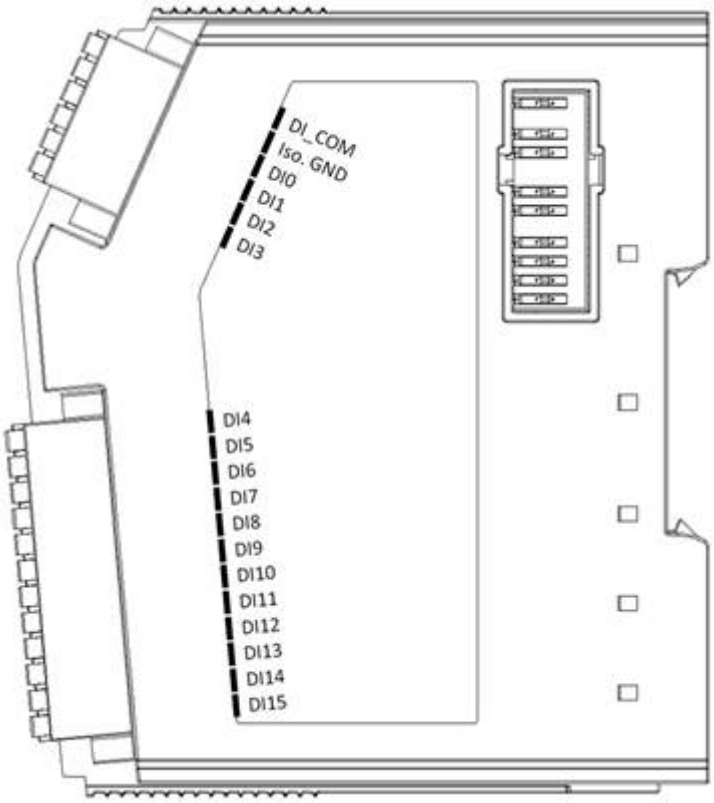


Figure 5.9 AMAX-5052 Module Side View

Table 5.6: Upper 6-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI_COM
2	Iso. GND
3	DI0
4	DI1
5	DI2
6	DI3

Table 5.7: Lower 12-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI4
2	DI5
3	DI6
4	DI7
5	DI8
6	DI9
7	DI10
8	DI11
9	DI12
10	DI13
11	DI14
12	DI15

5.2.4 Application Wiring

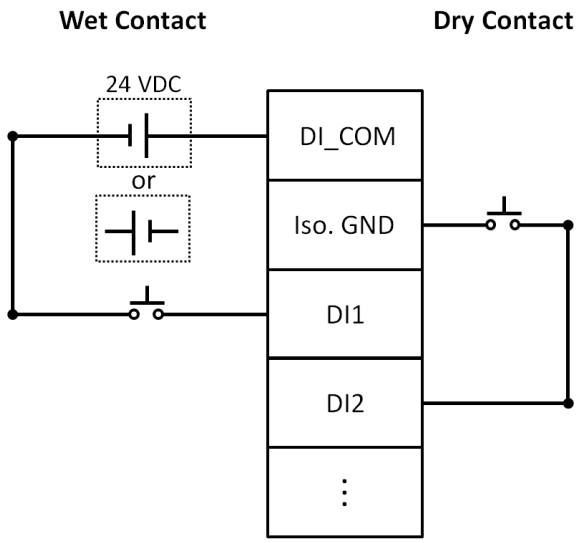


Figure 5.10 Wiring for AMAX-5052

5.2.5 AMAX-5052 Object Dictionary

5.2.5.1 Input Data

Table 5.8: Input Data (0x3001:01 - 0x3002:08)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x3001:01	DI0	Digital Input Channel 0	BOOL	RO	0x00
0x3001:02	DI1	Digital Input Channel 1	BOOL	RO	0x00
0x3001:03	DI2	Digital Input Channel 2	BOOL	RO	0x00
0x3001:04	DI3	Digital Input Channel 3	BOOL	RO	0x00
0x3001:05	DI4	Digital Input Channel 4	BOOL	RO	0x00
0x3001:06	DI5	Digital Input Channel 5	BOOL	RO	0x00
0x3001:07	DI6	Digital Input Channel 6	BOOL	RO	0x00
0x3001:08	DI7	Digital Input Channel 7	BOOL	RO	0x00
0x3002:01	DI8	Digital Input Channel 8	BOOL	RO	0x00
0x3002:02	DI9	Digital Input Channel 9	BOOL	RO	0x00
0x3002:03	DI10	Digital Input Channel 10	BOOL	RO	0x00
0x3002:04	DI11	Digital Input Channel 11	BOOL	RO	0x00
0x3002:05	DI12	Digital Input Channel 12	BOOL	RO	0x00
0x3002:06	DI13	Digital Input Channel 13	BOOL	RO	0x00
0x3002:07	DI14	Digital Input Channel 14	BOOL	RO	0x00
0x3002:08	DI15	Digital Input Channel 15	BOOL	RO	0x00

5.3 AMAX-5056 8-ch Sink-type Digital Output Module

The AMAX-5056 module features 8 digital output (sink) channels. The digital output channels offer LED to indicate digital status. The module provides 2,000 V_{DC} optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 5.11 AMAX-5056 Module

5.3.1 AMAX-5056 Specification

5.3.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, DO status
- **Weight:** Approx. 80g

5.3.1.2 Digital Output:

- **Channels:** 8 (Sink Type)
- **Voltage Rating:** 10~30V_{DC}
- **Rated Current Output:** 0.3A per channel at signal "1"
- **Leakage Current:** 25uA per channel at signal "0"
- **Output Delay:** From logic level 0 to 1: 10us
  From logic level 1 to 0: 100us

5.3.1.3 Protection

- **Isolation Voltage:** 2,000V_{DC}
- Internal Flyback diode for inductive load

5.3.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

5.3.2 LED Indicator

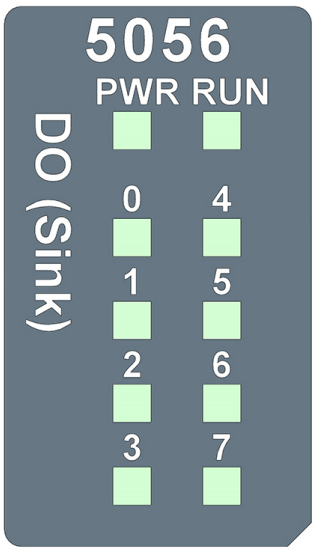


Figure 5.12 AMAX-5056 Module LED Indicator

Table 5.9: AMAX-5056 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating module
Run	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
DO0~7	Green	ON	DO turn on
		OFF	DO turn off

5.3.3 Pin Definition

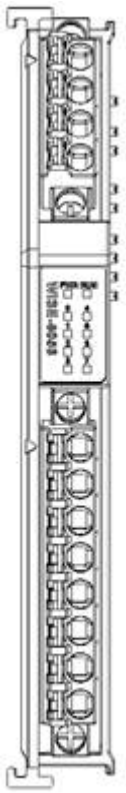


Figure 5.13 AMAX-5056 Module Front View

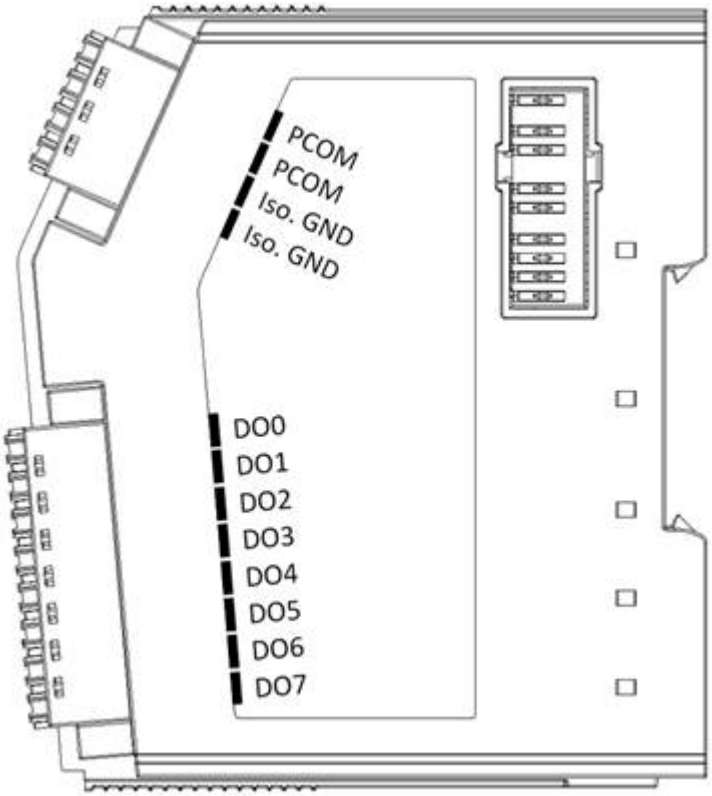


Figure 5.14 AMAX-5056 Module Side View

Table 5.10: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	PCOM
2	PCOM
3	Iso. GND
4	Iso. GND

Table 5.11: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DO0
2	DO1
3	DO2
4	DO3
5	DO4
6	DO5
7	DO6
8	DO7

5.3.4 Application Wiring

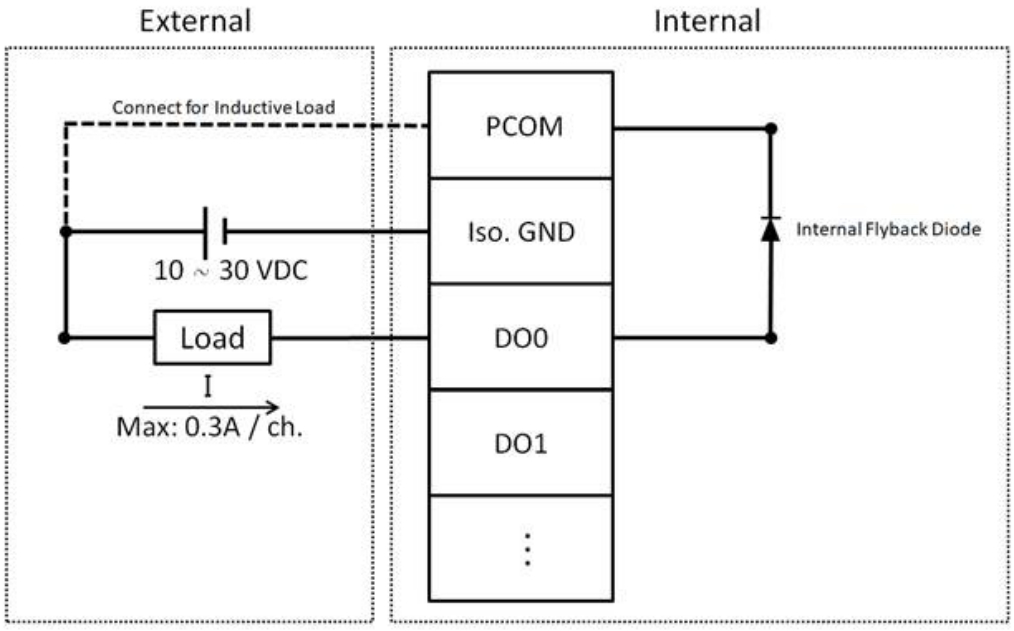


Figure 5.15 Wiring for AMAX-5056

5.3.5 AMAX-5056 Object Dictionary

5.3.5.1 Output Data

Table 5.12: Output Data (0x3101:01 - 0x3101:08)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x3101:01	DO0	Digital Output Channel 0	BOOL	RW	0x00
0x3101:02	DO1	Digital Output Channel 1	BOOL	RW	0x00
0x3101:03	DO2	Digital Output Channel 2	BOOL	RW	0x00
0x3101:04	DO3	Digital Output Channel 3	BOOL	RW	0x00
0x3101:05	DO4	Digital Output Channel 4	BOOL	RW	0x00
0x3101:06	DO5	Digital Output Channel 5	BOOL	RW	0x00
0x3101:07	DO6	Digital Output Channel 6	BOOL	RW	0x00
0x3101:08	DO7	Digital Output Channel 7	BOOL	RW	0x00

5.4 AMAX-5056SO 8-ch Source-type Digital Output Module

The AMAX-5056SO module features 8 digital output (source) channels. The digital output channels offer and LED to indicate digital status. The module provides 2,000 V_{DC} optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 5.16 AMAX-5056SO Module

5.4.1 AMAX-5056SO Specification

5.4.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, DO status
- **Weight:** Approx. 80g

5.4.1.2 Digital Output:

- **Channels:** 8 (Source Type)
- **Voltage Rating:** 10~30V_{DC}
- **Rated Current Output:** 0.5A per channel at signal "1"
- **Leakage Current:** 10uA per channel at signal "0"
- **Output Delay:** From logic level 0 to 1: 150us
  From logic level 1 to 0: 2ms

5.4.1.3 Protection

- **Isolation Voltage:** 2,000V_{DC}
- Internal Flyback diode for inductive load

5.4.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

5.4.2 LED Indicator

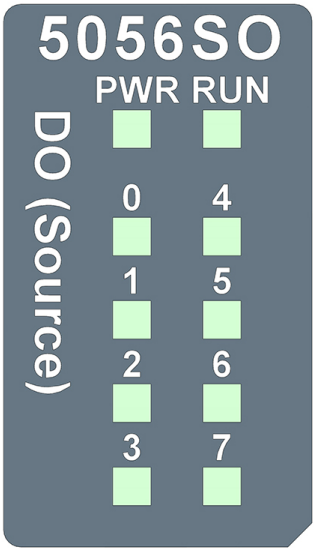


Figure 5.17 AMAX-5056SO Module LED Indicator

Table 5.13: AMAX-5056SO Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating module
Run	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
DO0~7	Green	ON	DO turn on
		OFF	DO turn off

5.4.3 Pin Definition

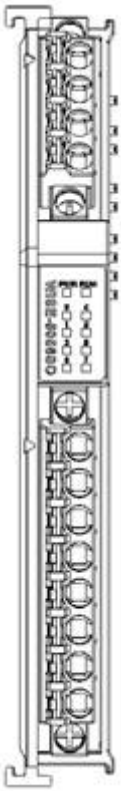


Figure 5.18 AMAX-5056SO Module Front View

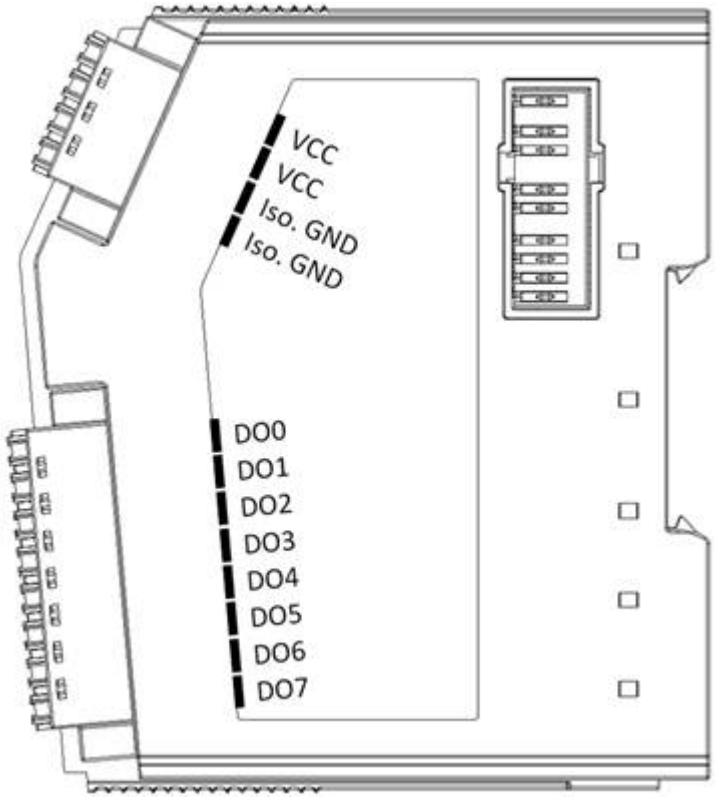


Figure 5.19 AMAX-5056SO Module Side View

Table 5.14: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	VCC
2	VCC
3	Iso. GND
4	Iso. GND

Table 5.15: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DO0
2	DO1
3	DO2
4	DO3
5	DO4
6	DO5
7	DO6
8	DO7

5.4.4 Application Wiring

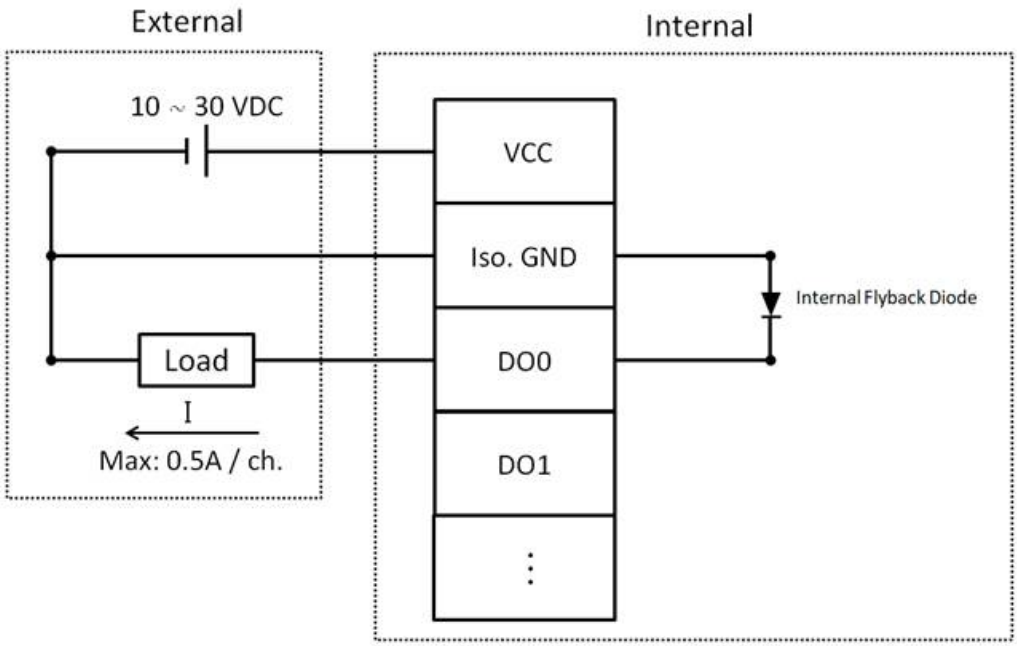


Figure 5.20 Wiring for AMAX-5056SO

5.4.5 AMAX-5056SO Object Dictionary

5.4.5.1 Output Data

Table 5.16: Output Data (0x3101:01 - 0x3101:08)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x3101:01	DO0	Digital Output Channel 0	BOOL	RW	0x00
0x3101:02	DO1	Digital Output Channel 1	BOOL	RW	0x00
0x3101:03	DO2	Digital Output Channel 2	BOOL	RW	0x00
0x3101:04	DO3	Digital Output Channel 3	BOOL	RW	0x00
0x3101:05	DO4	Digital Output Channel 4	BOOL	RW	0x00
0x3101:06	DO5	Digital Output Channel 5	BOOL	RW	0x00
0x3101:07	DO6	Digital Output Channel 6	BOOL	RW	0x00
0x3101:08	DO7	Digital Output Channel 7	BOOL	RW	0x00

5.5 AMAX-5057 16-ch Sink-type Digital Output Module

The AMAX-5057 module features 16 digital output (sink) channels. The digital output channels offer LED to indicate digital status. The module provides 2,000 V_{DC} optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 5.21 AMAX-5057 Module

5.5.1 AMAX-5057 Specification

5.5.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 6P+12P push-in terminal (#28~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2.5W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, DO status
- **Weight:** Approx. 80g

5.5.1.2 Digital Output:

- **Channels:** 16 (Sink Type)
- **Voltage Rating:** 10~30V_{DC}
- **Rated Current Output:** 0.3A per channel at signal "1"
- **Leakage Current:** 25uA per channel at signal "0"
- **Output Delay:** From logic level 0 to 1: 10us
  From logic level 1 to 0: 100us

5.5.1.3 Protection

- **Isolation Voltage:** 2,000V_{DC}
- Internal Flyback diode for inductive load

5.5.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

5.5.2 LED Indicator

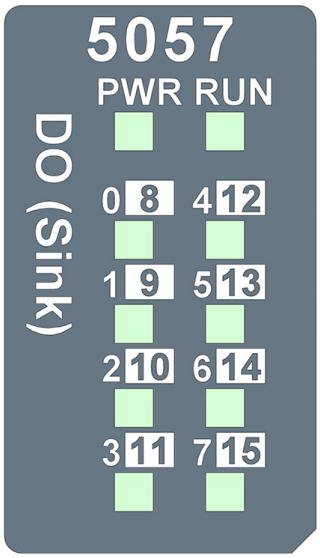


Figure 5.22 AMAX-5057 Module LED Indicator

Table 5.17: AMAX-5057 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating module
Run	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
DO0~7	Green	ON	DO turn on
		OFF	DO turn off
DO8~15	Yellow	ON	DO turn on
		OFF	DO turn off

5.5.3 Pin Definition

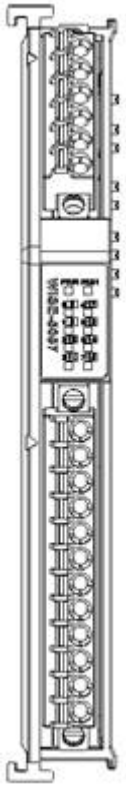


Figure 5.23 AMAX-5057 Module Front View

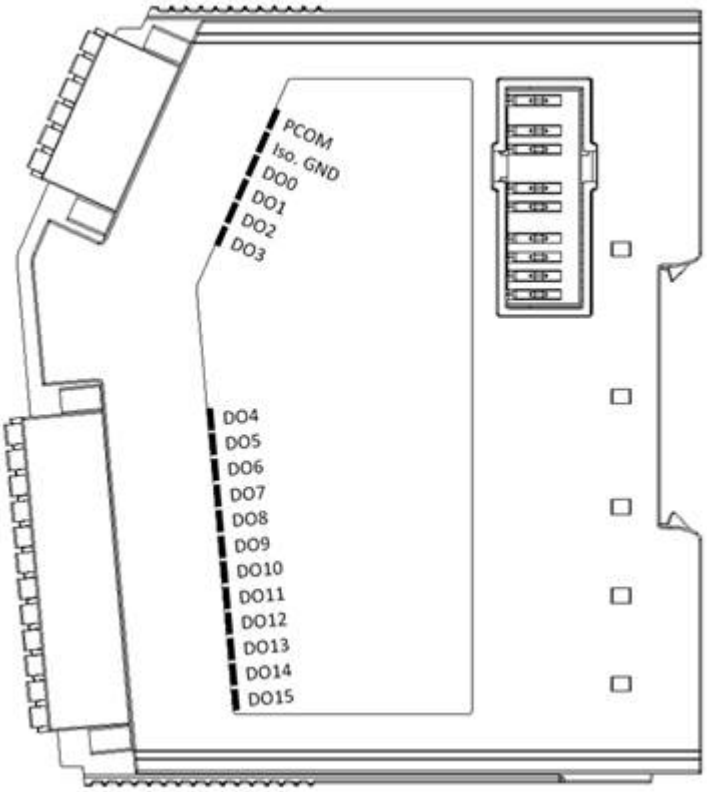


Figure 5.24 AMAX-5057 Module Side View

Table 5.18: Upper 6-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	PCOM
2	Iso. GND
3	DO0
4	DO1
5	DO2
6	DO3

Table 5.19: Lower 12-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DO4
2	DO5
3	DO6
4	DO7
5	DO8
6	DO9
7	DO10
8	DO11
9	DO12
10	DO13
11	DO14
12	DO15

5.5.4 Application Wiring

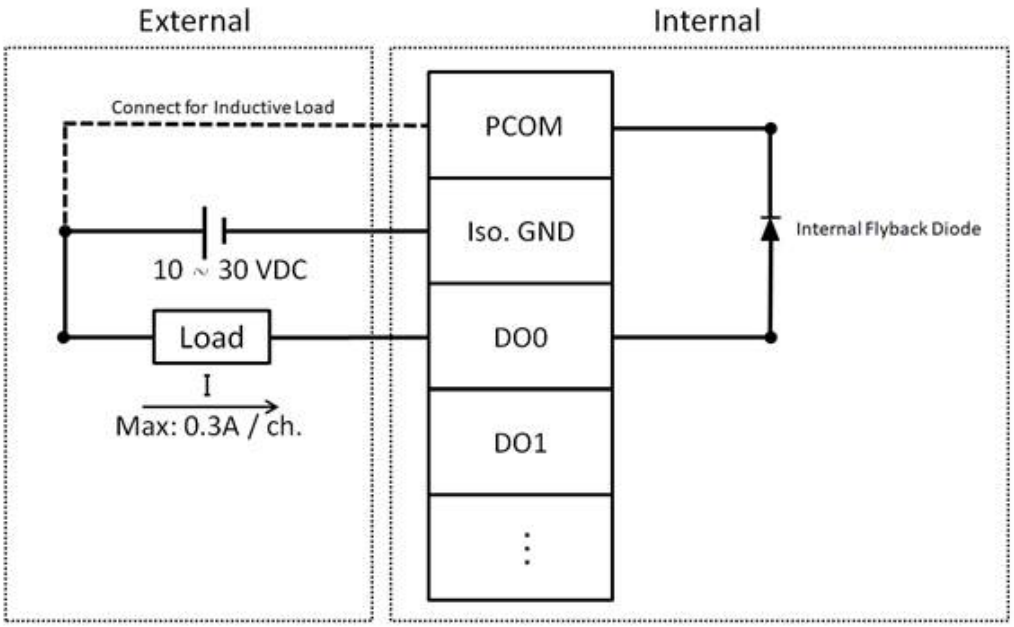


Figure 5.25 Wiring for AMAX-5057

5.5.5 AMAX-5057 Object Dictionary

5.5.5.1 Output Data

Table 5.20: Output Data (0x3101:01 - 0x3102:08)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x3101:01	DO0	Digital Output Channel 0	BOOL	RW	0x00
0x3101:02	DO1	Digital Output Channel 1	BOOL	RW	0x00
0x3101:03	DO2	Digital Output Channel 2	BOOL	RW	0x00
0x3101:04	DO3	Digital Output Channel 3	BOOL	RW	0x00
0x3101:05	DO4	Digital Output Channel 4	BOOL	RW	0x00
0x3101:06	DO5	Digital Output Channel 5	BOOL	RW	0x00
0x3101:07	DO6	Digital Output Channel 6	BOOL	RW	0x00
0x3101:08	DO7	Digital Output Channel 7	BOOL	RW	0x00
0x3102:01	DO8	Digital Output Channel 8	BOOL	RW	0x00
0x3102:02	DO9	Digital Output Channel 9	BOOL	RW	0x00
0x3102:03	DO10	Digital Output Channel 10	BOOL	RW	0x00
0x3102:04	DO11	Digital Output Channel 11	BOOL	RW	0x00
0x3102:05	DO12	Digital Output Channel 12	BOOL	RW	0x00
0x3102:06	DO13	Digital Output Channel 13	BOOL	RW	0x00
0x3102:07	DO14	Digital Output Channel 14	BOOL	RW	0x00
0x3102:08	DO15	Digital Output Channel 15	BOOL	RW	0x00

5.6 AMAX-5057SO 16-ch Source-type Digital Output Module

The AMAX-5057SO module features 16 digital output (source) channels. The digital output channels offer and LED to indicate digital status. The module provides 2,000 V_{DC} optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 5.26 AMAX-5057SO Module

5.6.1 AMAX-5057SO Specification

5.6.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 6P+12P push-in terminal (#28~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2.5W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, DO status
- **Weight:** Approx. 80g

5.6.1.2 Digital Output

- **Channels:** 16 (Source Type)
- **Voltage Rating:** 10~30V_{DC}
- **Rated Current Output:** 0.5A per channel at signal "1"
- **Leakage Current:** 10uA per channel at signal "0"
- **Output Delay:** From logic level 0 to 1: 150us
  From logic level 1 to 0: 2ms

5.6.1.3 Protection

- **Isolation Voltage:** 2,000V_{DC}
- Internal Flyback diode for inductive load

5.6.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

5.6.2 LED Indicator

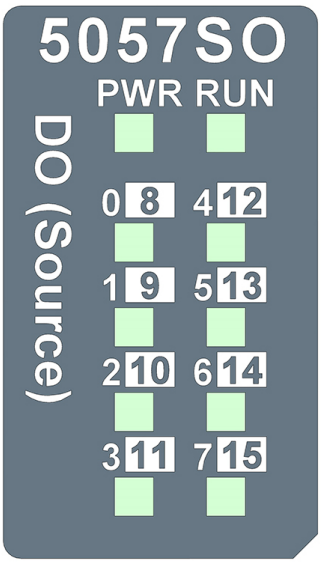


Figure 5.27 AMAX-5057SO Module LED Indicator

Table 5.21: AMAX-5057SO Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating module
Run	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
DO0~7	Green	ON	DO turn on
		OFF	DO turn off
DO8~15	Yellow	ON	DO turn on
		OFF	DO turn off

5.6.3 Pin Definition and Wiring

Figure 5.28 AMAX-5057SO Module Front View

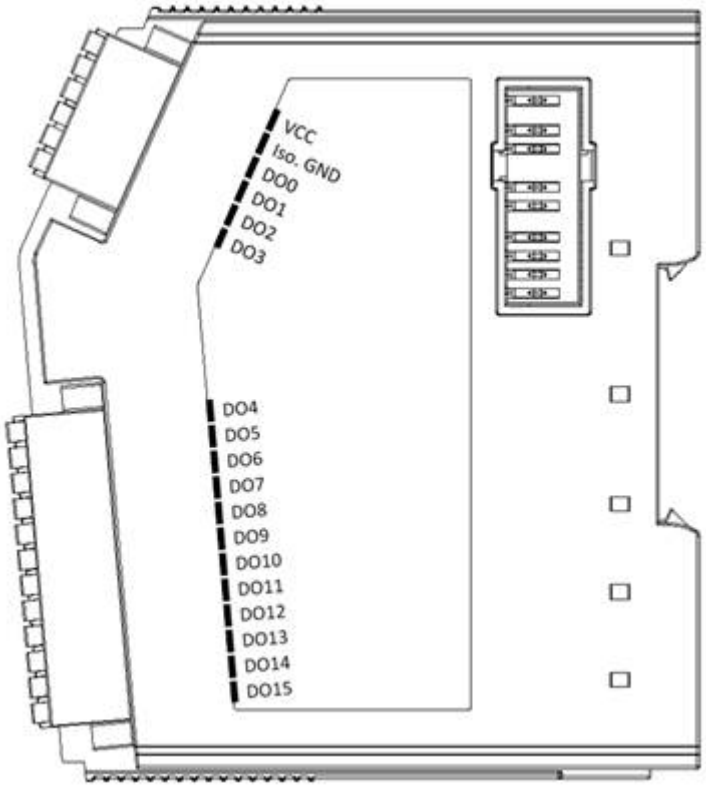


Figure 5.29 AMAX-5057SO Module Side View

Table 5.22: Upper 6-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	VCC
2	Iso. GND
3	DO0
4	DO1
5	DO2
6	DO3

Table 5.23: Lower 12-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DO4
2	DO5
3	DO6
4	DO7
5	DO8
6	DO9
7	DO10
8	DO11
9	DO12
10	DO13
11	DO14
12	DO15

5.6.4 Application Wiring

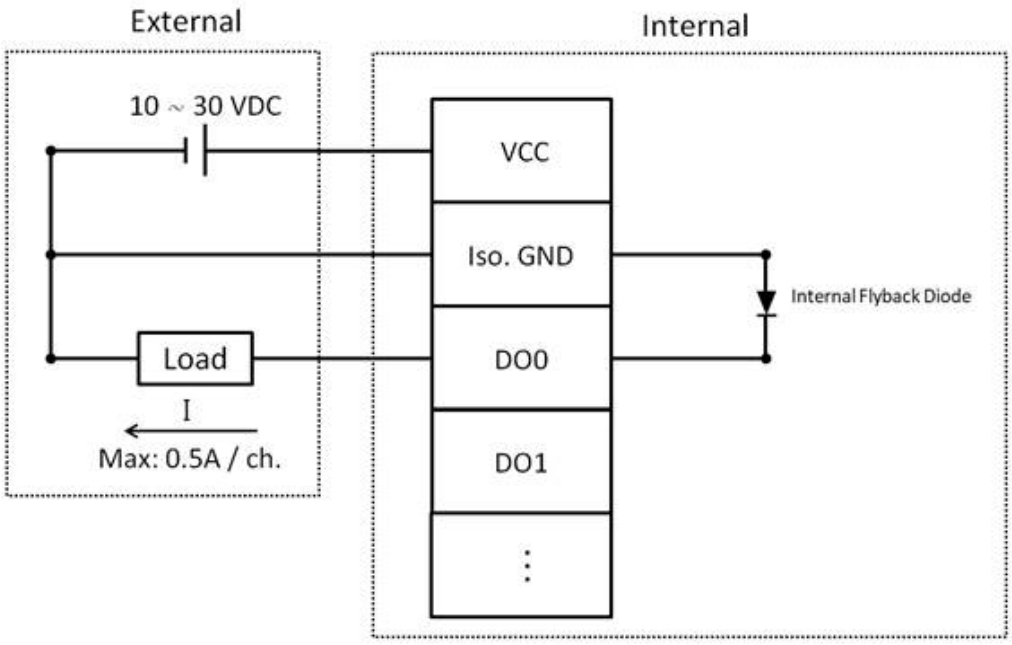


Figure 5.30 Wiring for AMAX-5057SO

5.6.5 AMAX-5057SO Object Dictionary

5.6.5.1 Output Data

Table 5.24: Output Data (0x3101:01 - 0x3102:08)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x3101:01	DO0	Digital Output Channel 0	BOOL	RW	0x00
0x3101:02	DO1	Digital Output Channel 1	BOOL	RW	0x00
0x3101:03	DO2	Digital Output Channel 2	BOOL	RW	0x00
0x3101:04	DO3	Digital Output Channel 3	BOOL	RW	0x00
0x3101:05	DO4	Digital Output Channel 4	BOOL	RW	0x00
0x3101:06	DO5	Digital Output Channel 5	BOOL	RW	0x00
0x3101:07	DO6	Digital Output Channel 6	BOOL	RW	0x00
0x3101:08	DO7	Digital Output Channel 7	BOOL	RW	0x00
0x3102:01	DO8	Digital Output Channel 8	BOOL	RW	0x00
0x3102:02	DO9	Digital Output Channel 9	BOOL	RW	0x00
0x3102:03	DO10	Digital Output Channel 10	BOOL	RW	0x00
0x3102:04	DO11	Digital Output Channel 11	BOOL	RW	0x00
0x3102:05	DO12	Digital Output Channel 12	BOOL	RW	0x00
0x3102:06	DO13	Digital Output Channel 13	BOOL	RW	0x00
0x3102:07	DO14	Digital Output Channel 14	BOOL	RW	0x00
0x3102:08	DO15	Digital Output Channel 15	BOOL	RW	0x00

5.7 AMAX-5060 4-ch Relay with 2-ch DI Module

The AMAX-5060 have 4-ch relay and 2-ch digital inputs module. This module offers LED to indicate digital status and provides 2,000V_{DC} optical isolation between channels. Either high voltage or current won't damage the entire system (other modules, and control unit) because it is already isolated.

Figure 5.31 AMAX-5060 Module

5.7.1 AMAX-5060 Specification

5.7.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2.5W @ 24V_{DC}
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, R/E, R0, R1, R2, R3, DI0, DI1
- **Weight:** Approx. 80g

5.7.1.2 Relay

- **Channels:** 4
- **Relay Type:** Form A (SPST)
- **Contact Rating (Resistive):** $250V_{AC}$@ 5A, $30V_{DC}$@ 5A
- **Breakdown Voltage:** $500V_{AC}$ (50/60Hz)
- **Relay on delay time:** 6ms
- **Relay off delay time:** 3.5ms
- **Total switch time:** 9.5ms
- **Insulation Resistance:** 1 GΩ (min.) @ $500V_{DC}$
- **Maximum Switching Rate:** 20 operations/min (at rated load)
- **Electrical Endurance:** 50,000 operations
- **Mechanical Endurance:** 20,000,000 operations (under no load at an operating frequency of 180 operations/min)

5.7.1.3 Digital Input

- **Channels:** 2
- **Digital Input:**
  - Wet contact:
    Logic level 1: 10~30VDC
    Logic level 0: 0~3VDC
- **Input Delay:**
  - From logic level 0 to 1: 6us
  - From logic level 1 to 0: 45us
- **Digital Filter:**
  - Default setting: Disable (without filter function)
  - Support range: 0.1ms (4.6kHz) to 3276.8ms (0.18Hz) (3ms is default when filter enable)
- **Typical Input Current:** Logic level 1: 1.2mA~4.2mA (10V~30V)

5.7.1.4 Protection

- **Isolation Voltage:** $2,000V_{DC}$

5.7.1.5 Environment

- **Operation Temperature:** -25~55°C (Vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

5.7.2 LED Indicator

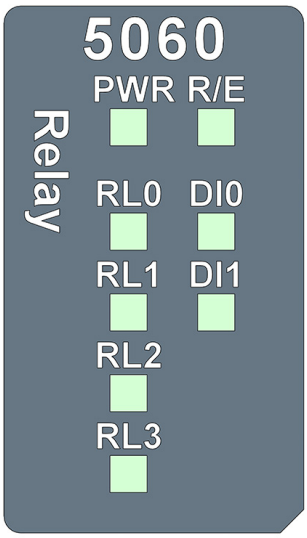


Figure 5.32 AMAX-5060 Module LED Indicator

Table 5.25: AMAX-5060 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power on
	Orange	ON	Locating module
R/E	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
	Red	ON	Module Abnormal [1]
		Blink	
RL0~RL3	Green	ON	Relay turn on
		OFF	Relay turn off
DI0~DI1	Green	ON	Digital Input Logic 1
		OFF	Digital Input Logic 0

[1]: The cause may be a disconnection or malfunction of the previous (on the left of this module) or this module. Please contact Advantech RMA Centre for further assistance.

5.7.3 Pin Definition and Wiring

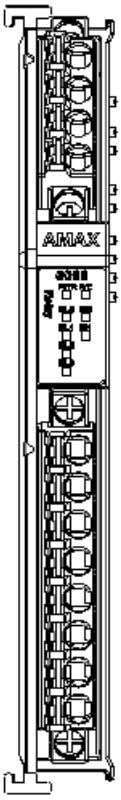


Figure 5.33 AMAX-5060 Module Front View

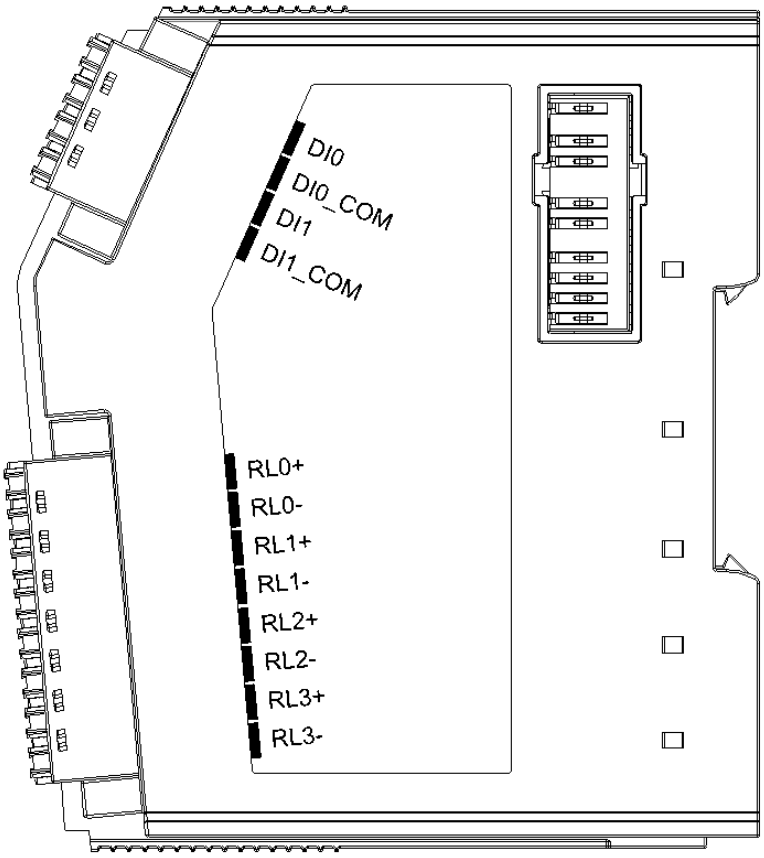


Figure 5.34 AMAX-5060 Module Side View

Table 5.26: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI0
2	DI0_COM
3	DI1
4	DI1_COM

Table 5.27: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	RL0+
2	RL0-
3	RL1+
4	RL1-
5	RL2+
6	RL2-
7	RL3+
8	RL3-

5.7.4 Application Wiring

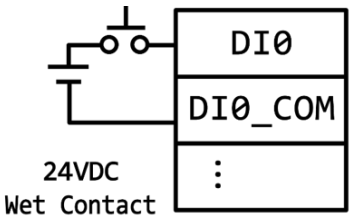


Figure 5.35 Wiring for AMAX-5060 Upper Connector Digital Input

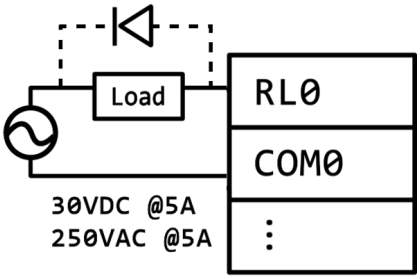


Figure 5.36 Wiring for AMAX-5060 Lower Connector Relay

5.7.5 AMAX-5060 Object Dictionary

5.7.5.1 Digital Input Data

Table 5.28: Digital Input Data (0x6000:01, 0x6010:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x6000:01	DI0	Digital input data	BOOL	RO	0x00
0x6010:01	DI1	Digital input data	BOOL	RO	0x00

5.7.5.2 Digital Output Data (Relay)

Table 5.29: Digital Output Data (Relay) (0x7000:01 - 0x7030:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x7000:01	DO0	Digital output data (Relay)	BOOL	RO	0x00
0x7010:01	DO1	Digital output data (Relay)	BOOL	RO	0x00
0x7020:01	DO2	Digital output data (Relay)	BOOL	RO	0x00
0x7030:01	DO3	Digital output data (Relay)	BOOL	RO	0x00

5.7.5.3 Digital Output (Relay) Safety Function Data

Table 5.30: Digital Output (Relay) Safety Function Data (0x8000:01 - 0x8030:02)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x80***n***0:01	DO***n***_EnSafeState [1]	Enable safety function 0: Disable 1: Enable	BOOL	RW	0x00
0x80***n***0:02	DO***n***_SafeStateValue [2]	Setting output value when this module disconnected 0: Low 1: High	BOOL	RW	0x00

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

[1]: When this parameter was set to "Enable", this module will output DO***n***_SafeStateValue (0x80n0:02). Otherwise, the output will keep the last value when it's disconnected.

[2]: DO***n***_EnSafeState (0x80n0:01) should be enabled if want to use this function.

5.7.5.4 Module Configuration

Table 5.31: Module Configuration (0xF600:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00

5.7.5.5 Digital Input Filter Data

Table 5.32: Digital Input Filter Data (0xF600:04, 0xF600:016)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:04	DI_EnFilter	Enable all DI channels filter 0: Disable 1: Enable	BOOL	RW	0x00
0xF600:16	DI_FilterTime	Filter time of digital input [1] 0: 0.1ms (4.6kHz) 1: 0.2ms (2.6kHz) 2: 0.4ms (1.8kHz) 3: 0.8ms (736Hz) 4: 1.6ms (368Hz) 5: 3.2ms (184Hz) - Default 6: 6.4ms (92Hz) 7: 12.8ms (46Hz) 8: 25.6ms (23Hz) 9: 51.2ms (11.5Hz) 10: 102.4ms (5.8Hz) 11: 204.8ms (2.9Hz) 12: 409.6ms (1.45Hz) 13: 819.2ms (0.72Hz) 14: 1638.4ms (0.36Hz) 15: 3276.8ms (0.18Hz	UINT	RW	0x0005 (3.2ms) (184Hz)

[1]: When estimating the digital input filter range please refer to the Frequency.

5.8 Connection Diagram

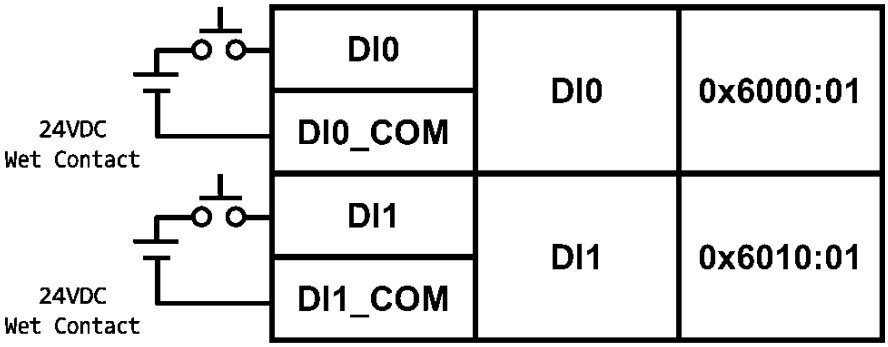


Figure 5.37 AMAX-5060 upper connection diagram

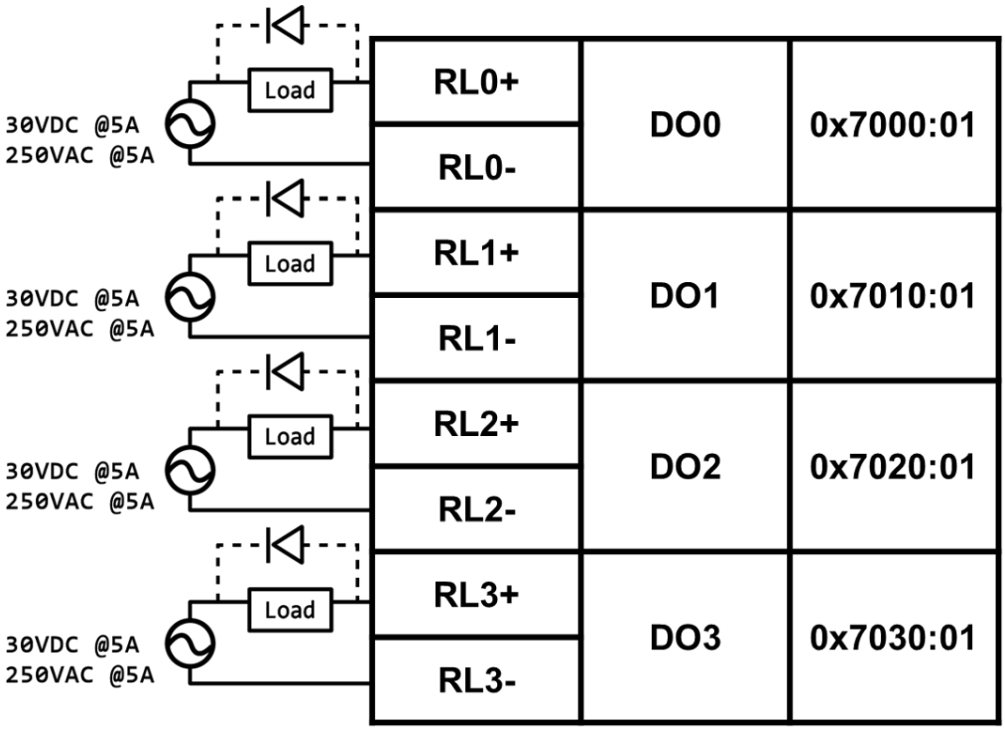


Figure 5.38 AMAX-5060 lower connection diagram

Chapter 6

Counter/Encoder Module

6.1 AMAX-5080 2-ch Counter/Encoder Input Module

The AMAX-5080 is a 32-bit 2-ch counter/encoder module which supports Encoder Mode and Bi-direction mode. It supports up to 1MHz input frequency. The module provides 2000 VDC optical isolation, if any high voltage or current damages the channels, the whole system (other modules or control unit) will not be damaged.

Figure 6.1 AMAX-5080 Module

6.1.1 AMAX-5080 Specification

6.1.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 6P+12P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **Distributed Clock:** Default not supported
- **LED Indicator:** PWR, RUN, A/B/Z/L Status
- **Weight:** Approx. 80g

6.1.1.2 Counter Input

- **Channels:** 2
- **Counter Range:** 32 bit
- **Modes:** Counter (up/down, bi-direction, up, A/B/Z Phase, DI latch)
- **Signal Input:**
  Logic 0: -3…+5 V (EN 61131-2, type 1/3)
  Logic 1: 11…30 V (EN 61131-2, type 3)
- **Input Frequency:** 1 MHz max.

6.1.1.3 Protection

Isolation Voltage: $2,000V_{DC}$

6.1.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

6.1.2 LED Indicator

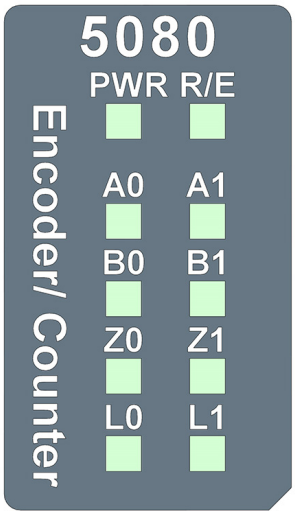


Figure 6.2 AMAX-5080 Module LED Indicator

Table 6.1: AMAX-5080 Module LED Indicator			
LED	**Color**	**Indication**	**Behavior**
PWR	Green	ON	Power on / off
	Orange	ON	Locating module
R/E[1]	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
A0	Green	ON	Signal Input
A1			
B0	Green	ON	Signal Input
B1			
Z0	Green	ON	Signal Input
Z1			
L0	Green	ON	Signal Input
L1			

[1]: If the RED LED blinking, it may be a disconnection or malfunction of the previous (on the left of this module) or this module.

6.1.3 Pin Definition

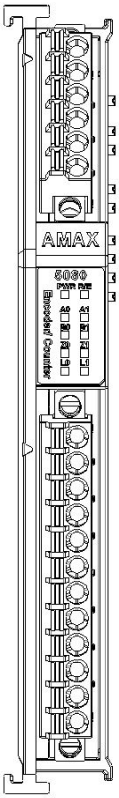


Figure 6.3 AMAX-5080 Module Front View

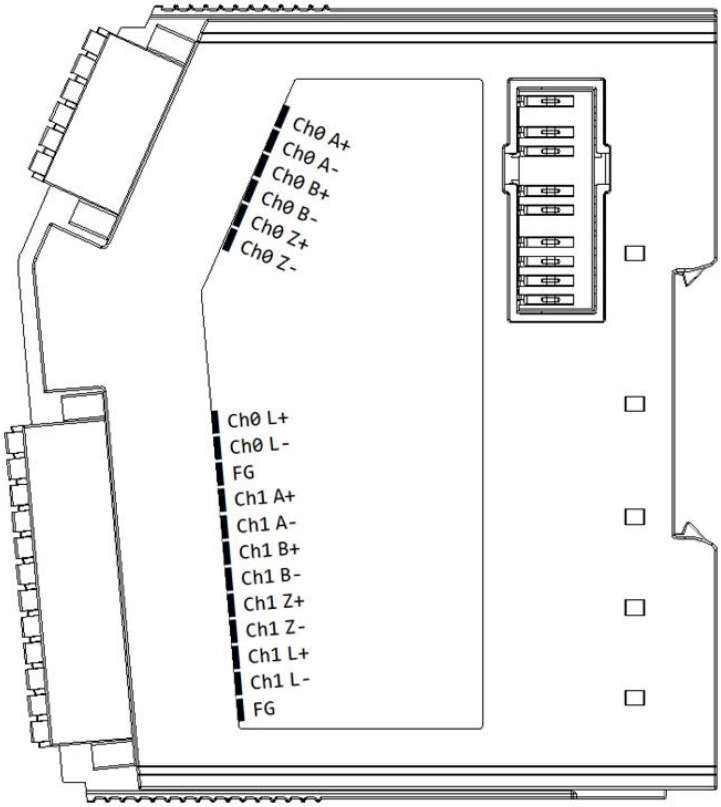


Figure 6.4 AMAX-5080 Module Side View

Table 6.2: Upper 6-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	Ch0 A+
2	Ch0 A-
3	Ch0 B+
4	Ch0 B-
5	Ch0 Z+
6	Ch0 Z-

Table 6.3: Lower 12-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	Ch0 L+
2	Ch0 L-
3	FG
4	Ch1 A+
5	Ch1 A-
6	Ch1 B+
7	Ch1 B-
8	Ch1 Z+
9	Ch1 Z-
10	Ch1 L+
11	Ch1 L-
12	FG

6.1.4 Application Wiring

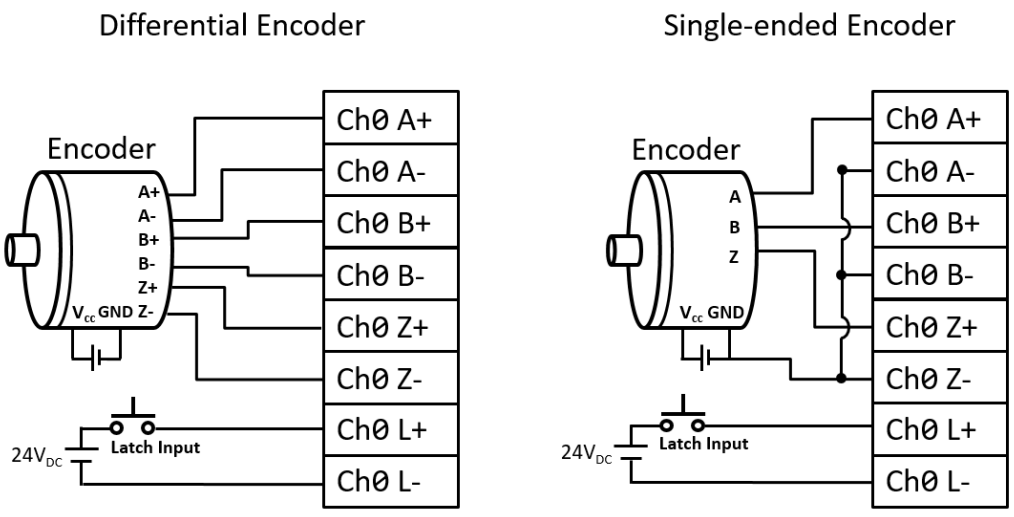


Figure 6.5 Wiring for AMAX-5080

6.1.5 Circuit Layout

6.1.5.1 Encoder Input

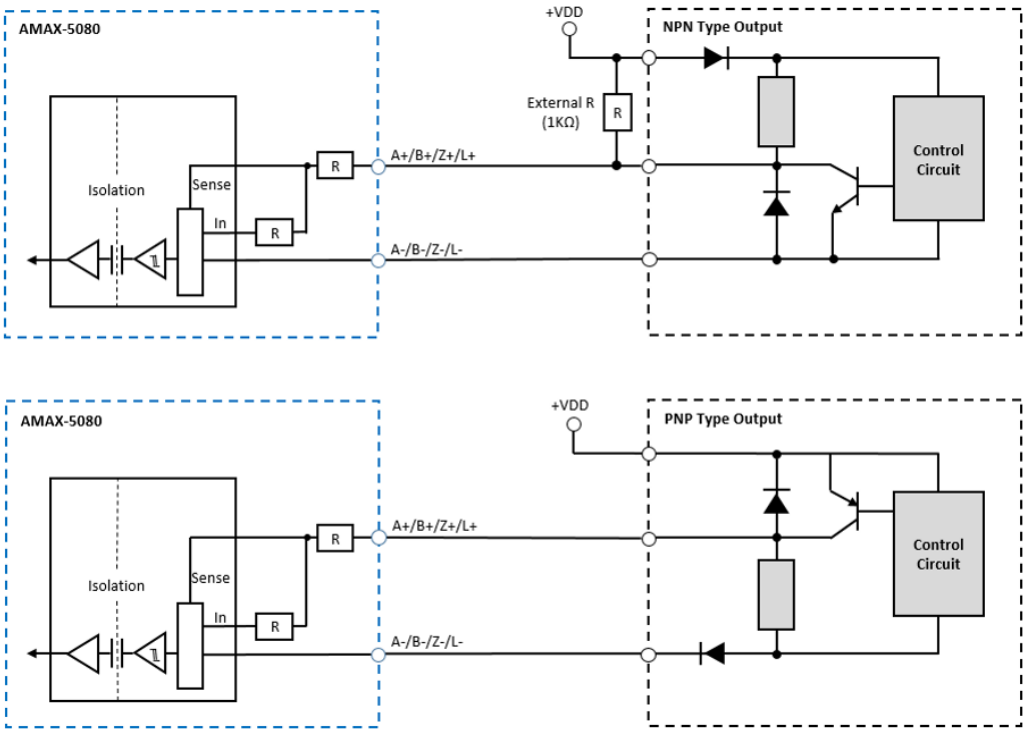


Figure 6.6 AMAX-5080 Encoder Input

6.1.6 AMAX-5080 Counter Mode

The AMAX-5080 supports two counter modes, the counter mode can be set by the Cn_Mode_Select (0x80n0:01) value “0” (Encoder Mode) or “1” (Bi-Direction Mode).

- Encoder Mode
- Bi-Direction Mode

Both modes support the following features:

- Overflow/underflow detection and reload counter
- Latch counter value
- Reset counter value
- Set counter value
- Counter frequency measurement
- Input Filter

6.1.6.1 Encoder Mode

The Behavior of A/B Phase 4X Quadrant Counter

The figure below shows Encoder Mode counter behavior. Ch0_A and Ch0_B are single-ended signals from the incremental encoder, if the “A” pulse is rising 90° ahead of the “B” pulse, the counter value increases; if the “B” pulse is rising ahead of the “A”, the counter value decreases.

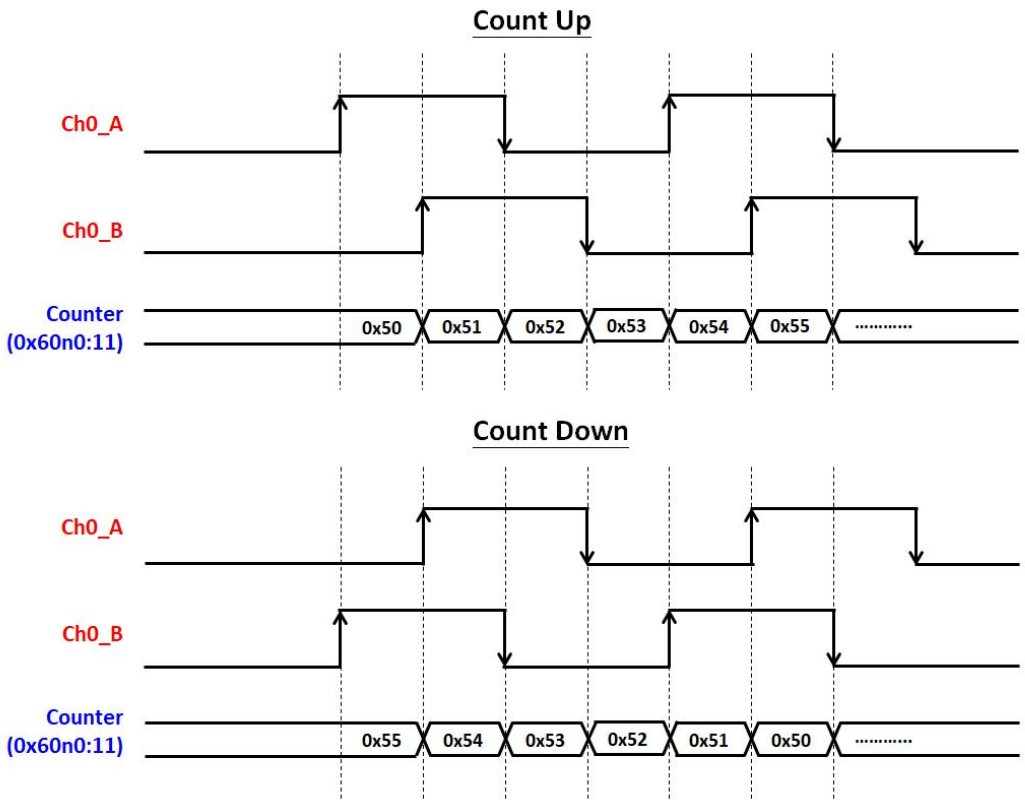


Figure 6.7 Encoder Mode – A/B Phase 4X

Blue are 0x6000, 0x7000, 0x8000 parameters.

Red are external signals.

n range from 0 to 1 refer to Ch.0 to Ch.1

The counter value and A/B signal input status please refer to the table below

Table 6.4: Encoder Mode Parameter

Name	Index
Cl***n***_Counter_Value	0x60***n***0:11
Cl***n***_Status_of_Input_A	0x60***n***0:09
Cl***n***_Status_of_Input_B	0x60***n***0:0A

n: range from 0 to 1 refer to Ch.0 to Ch.1

6.1.6.2 Bi-Direction Mode

The Behavior of Pulse Direction Counter

The figure below shows Bi-Direction Mode counter behavior, Ch0_A is a single-ended pulse from encoder or any pulse generator. Ch0_B is a digital input which indicates the counter direction. When Ch0_B is high, the counter value counts up with the Ch0_A input pulse (Rising Edge-Triggered); when Ch0_B is low, the counter value counts down with the Ch0_A input pulse.

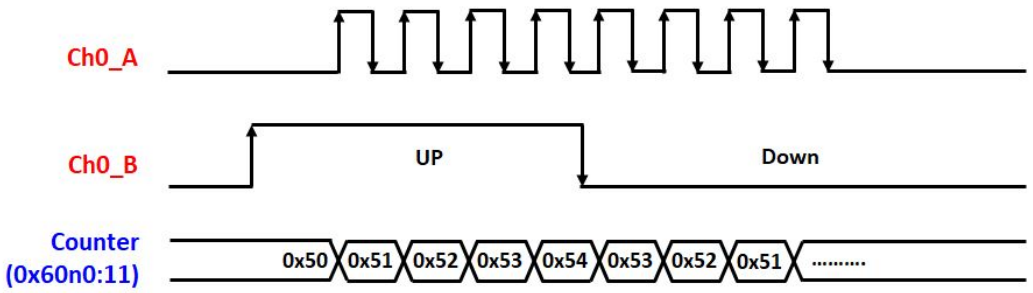


Figure 6.8 Bi-Direction Mode – Pulse Direction

Blue are 0x6000, 0x7000, 0x8000 parameters.

Red are external signals.

n range from 0 to 1 refer to Ch.0 to Ch.1

The counter value and A/B signal input status please refer to the table below

Table 6.5: Bi-Direction Mode Parameter

Name	Index
CI***n***_Counter_Value	0x60***n***0:11
CI***n***_Status_of_Input_A	0x60***n***0:09
CI***n***_Status_of_Input_B	0x60***n***0:0A

n: range from 0 to 1 refer to Ch.0 to Ch.1

6.1.7 Counter Features

These features are all applied for either Encoder Mode or Bi-Direction Mode. The PDO index is listed on 6.1.7 Object description and parameterization.

6.1.7.1 Overflow/Underflow Detection and Reload Counter

Overflow and Underflow

When counter value exceeds the counter boundaries, the CIn_Over_Flow (0x60n0:04) or CIn_Under_Flow (0x60n0:05) will be set to "1" correspondingly. The boundaries can be 0x00/0xFFFFFFFF or 0x00/Cn_Reload_Counter_Values (when the reload counter is set).

The figure below shows an example of overflow/underflow behavior under Bi-direction Mode, the same behavior also applies for Encoder Mode.

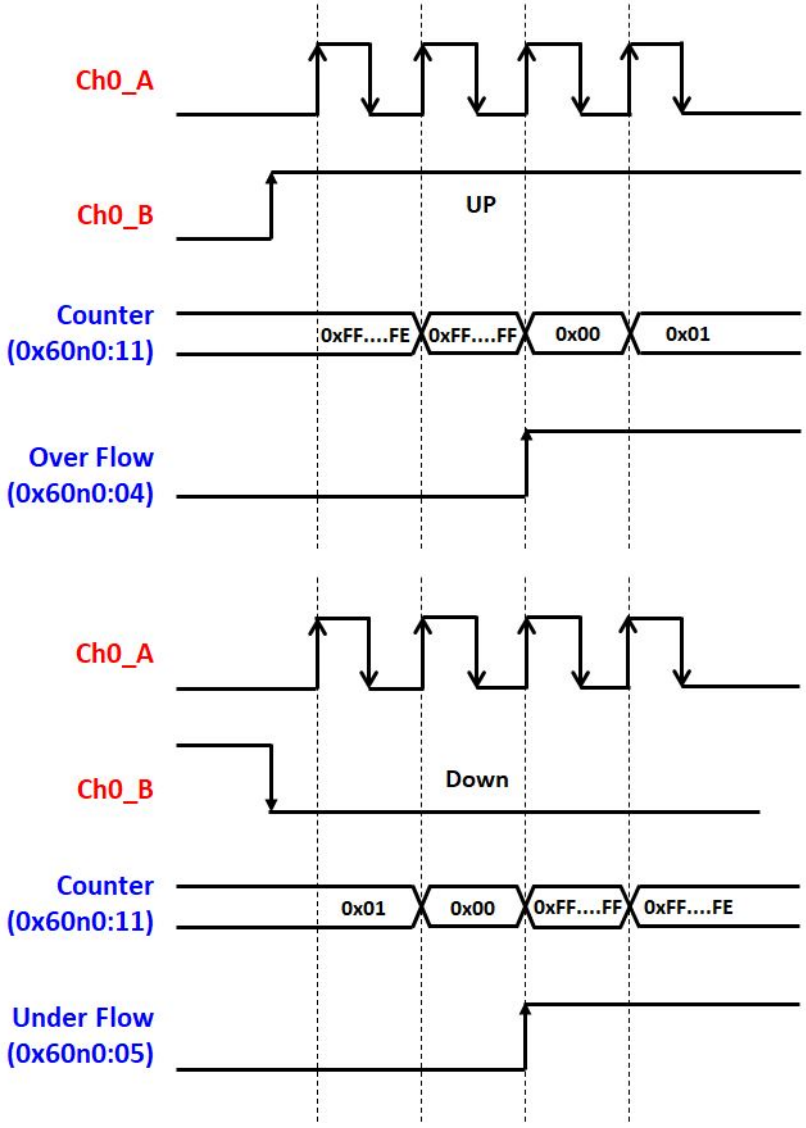


Figure 6.9 Counter Overflow and Underflow

Blue are 0x6000, 0x7000, 0x8000 parameters.

Red are external signals.

n range from 0 to 1 refer to Ch.0 to Ch.1

Reset Underflow and Overflow flag

CIn_Over_Flow will be clear to “0” automatically once the counter value over 1/3 of the 0xFFFFFFFF or Cn_Reload_Counter_Values (when the reload counter is set) after overflow flag is triggered.

CIn_Under_Flow will be clear to “0” automatically once the counter value under 2/3 of the 0xFFFFFFFF or Cn_Reload_Counter_Values (when the reload counter is set) after underflow flag is triggered.

Reload Counter Value

Users can set the Cn_Reload_Counter_Values (0x80n0:07) to adjust the counter boundaries when Cn_Enable_Register_Reload (0x80n0:06) is enabled. The process of boundaries setting and the underflow/overflow status reset count can refer to below example.

Example: Set Reload Counter Value to 0x00003000

Step 1: Set C0_Reload_Counter_Values to 0x00003000

Step 2: Set C0_Enable_Register_Reload to Enable

Step 3: Counter range will become 0 ~ 0x00003000

Table 6.6: Reload Counter Definitions

Reload Register	Reload Value	Counter Boundary	Overflow Status Reset	Underflow Status Reset
Enable	0x0000 3000	0 to 0x0000 3000	0x0000 1000	0x0000 2000
Disable (default)	NA	0 to 0xFFFF FFFF	0x5555 5555	0xAAAA AAAA

Note! *C1_Reload_Counter_values (0x8010:07) only allows setting in the range of 0~0xFFFF.*

6.1.7.2 Latch Counter Value

The counter values can be latched by external signals. Both L or Z pin can be configured independently as an latch signal input pin, the latched counter value can be read at CI0_Latch_Values(0x6000:12). The active polarity (Rising or Falling Edge-triggered) of the latch input signal can also be configured. All related configurable parameters and the status of Z and L pin are listed below:

Table 6.7: Latch Counter Parameters

	Z pin	L pin
Enable Latch	CO***n***_Enable_Latch_Z (0x70***n***0:02)	CO***n***_Enable_Latch_External (0x70***n***0:03)
Enable Latch Valid	CI***n***_Latch_Z_Valid (0x60***n***0:02)	CI***n***_Latch_External_Valid (0x60***n***0:03)
Active Polarity[1]	C***n***_Z_Pulse_Active_Polarity (0x80***n***0:03)	C***n***_External_Latch_Active_Polarity (0x80***n***0:05)
Status	CI***n***_Status_of_Input_Z (0x60***n***0:0C)	CI***n***_Status_of_Input_External_Latch (0x60***n***0:11)

n: range from 0 to 1 refer to Ch.0 to Ch.1

[1]: Active Polarity: Value 0 = Rising Edge. Value 1 = Falling Edge.

The example below shows how to latch the counter value by an external signal at rising edge on Ch0 Z pin under Bi-Direction Mode:

Step 0: Set Rising Edge-Triggered at C0_Z_Pulse_Active_Polarity (0x8000:05)

Step 1: Enable CO0_Enable_Latch_Z (0x7000:02)

Step 2: Check CI0_Latch_Z_Valid (0x6000:02) frequently, if the bit is high, the counter value is successfully latched by an external signal.

Step 3: Read latch values at CI0_Latch_Values (0x6000:12)

Step 4: Before next latch signal coming, the CO0_Enable_Latch_Z (0x7000:02) should be toggled once to clear the CI0_Latch_Z_Valid (0x6000:02) status.

Step 5: Once the CI0_Latch_Z_Valid (0x6000:02) bit is low, the module is ready for the next latching signal.

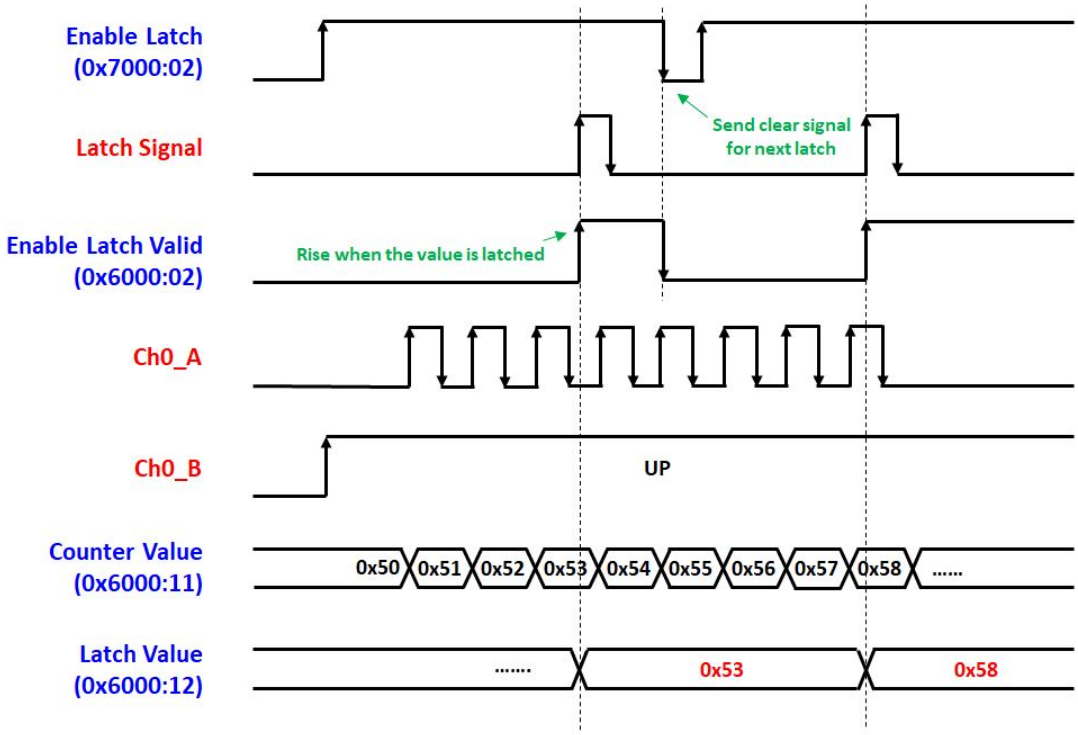


Figure 6.10 Latch Counter by Z pin

Blue are 0x6000, 0x7000, 0x8000 parameters.

Red are external signals.

Note! *CI0_Latch_Values(0x6000:12) can be overwritten by both Z and L pin if those pins are configured correctly.*

6.1.7.3 Reset Counter Value

The counter values can also be reset by external signals.

Both L and Z pin can be configured independently as an reset signal input pin. Once the configured Reset pin is triggered, the CIn_Counter_Value (0x60n0:11) and the CIn_Latch_Values (0x60n0:12) will both reset to “0”.

If the Z or L pin is configured as a reset pin, the latch function of that pin will become invalid automatically.

The index of Enable Rest and the Status of Z and L pin are listed below:

Table 6.8: Reset Counter Parameters

	Z pin	**L pin**
Enable Reset[1]	C***n***_Enable_Z_Pulse_Reset (0x80***n***0:02)	C***n***_Enable_External_Reset (0x80***n***0:04)
Enable Latch	CO***n***_Enable_Latch_Z (0x70***n***0:02)	CO***n***_Enable_Latch_External (0x70***n***0:03)
Status	CI***n***_Status_of_Input_Z (0x60***n***0:0C)	CI***n***_Status_of_Input_External_Latch (0x60***n***0:11)

n: range from 0 to 1 refer to Ch.0 to Ch.1

[1]: Enable Reset: Value 0 = Disable. Value 1 = Enable.

The example below shows how to reset the counter value by an external signal on Ch0 Z pin in Bi-Direction Mode (Ch0 L pin as a Latch input):

Example: Reset Counter Value and Latch Counter Value

Step 1: Set C0_Enable_Z_Pulse_Reset (0x8000:02) to “1”.

Step 2: Set COn_Enable_Latch_Z (0x70n0:02) to "1"

Step 3: An external reset signal (Rising edge-triggered) at Z pin will clear both CIn_Counter_Value (0x6000:11) and CIn_Latch_Values (0x600n0:12)

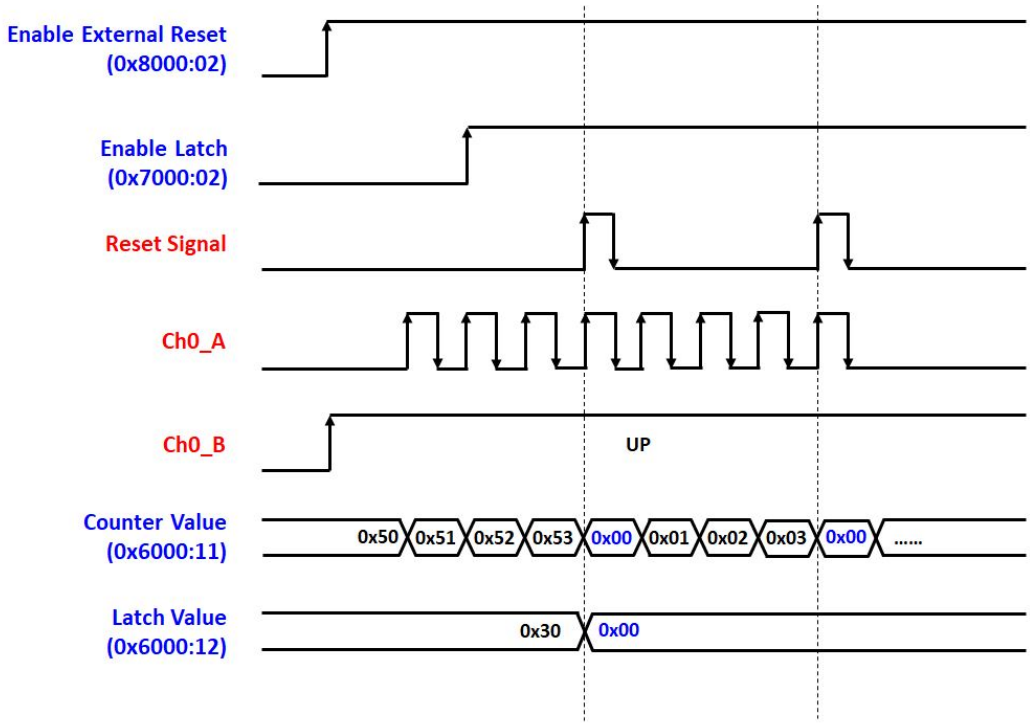


Figure 6.11 Reset Counter by Z pin

Blue are 0x6000, 0x7000, 0x8000 parameters.

Red are external signals.

6.1.7.4 Set Counter Value

The counter value can be overwritten to a desired number by setting at address COn_Set_Counter_Value (0x70n0:11) and COn_Set_Counter (0x70n0:01) no matter if the counter is counting or not. This feature is usually used for restoring the last incremental encoder value after system reboot. Once the counter value is set, the CIn_Set_Counter_Done (0x60n0:01) will be changed to “1”.

Take Ch0 for example, the start counter value can be overwritten by following steps:

Step 1: Set CO0_Set_Counter_Value (0x7000:11) to 0x00

Step 2: Enable CO0_Set_Counter (0x7000:01)

Step 3: When the CI0_Set_Counter_Done (0x6000:01) is true, the counter value is changed

Step 4: CO0_Set_Counter (0x7000:01) should be set to “0” before the next change

Step 5: CI0_Set_Counter_Done (0x6000:01) will set to False along with CO0_Set_Counter

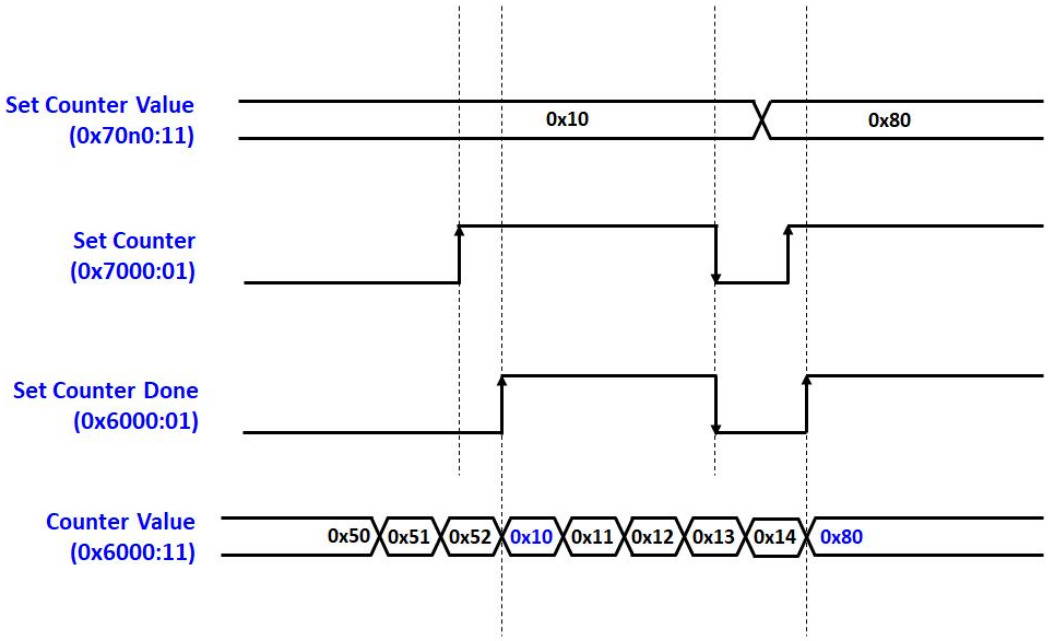


Figure 6.12 Set Counter Value

Note! *The counter value should not be set over Reload Counter Value.*

6.1.7.5 Counter Frequency Measurement

The increment (or decrement) frequency of counter value can be read by CIn_Frequency_Value (0x60n0:13), the value will be updated every second. This feature is often used to determine velocity.

6.1.8 AMAX-5080 Object Dictionary

6.1.8.1 Input Data

Table 6.9: Input Data (0x6000:01 - 0x6010:13)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default**
0x60***n***0:01	CI***n***_Set_Counter_Done	The counter was set	BOOL	RO	0x00
0x60***n***0:02	CI***n***_Latch_Z_Valid	The counter is latched by Z input	BOOL	RO	0x00
0x60***n***0:03	CI***n***_Latch_External_Valid	The counter is latched by L input	BOOL	RO	0x00
0x60***n***0:04	CI***n***_Over_Flow	Counter overflow	BOOL	RO	0x00
0x60***n***0:05	CI***n***_Under_Flow	Counter underflow	BOOL	RO	0x00
0x60***n***0:09	CI***n***_Status_of_Input_A	Status of input A	BOOL	RO	0x00
0x60***n***0:0A	CI***n***_Status_of_Input_B	Status of input B	BOOL	RO	0x00
0x60***n***0:0B	CI***n***_Status_of_Input_Z	Status of input Z	BOOL	RO	0x00
0x60***n***0:0C	CI***n***_Status_of_External_Latch	Status of input L	BOOL	RO	0x00
0x60***n***0:11	CI***n***_Counter_Value	Counter value	UDINT	RO	0x0000 0000
0x60***n***0:12	CI***n***_Latch_Value	Latch value	UDINT	RO	0x0000 0000
0x60***n***0:13	CI***n***_Frequency_Value	Update frequency every second	UDINT	RO	0x0000 0000

n: range from 0 to 1 refer to Ch.0 to Ch.1

6.1.8.2 Output Data

Table 6.10: Output Data (0x7000:01 - 0x7010:11)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default**
0x70***n***0:01	CO***n***_Set_Counter	Set Counter	BOOL	RW	0x00
0x70***n***0:02	CO***n***_Enable_Latch_Z	Enable Z pin counter latching	BOOL	RW	0x00
0x70***n***0:03	CO***n***_Enable_Latch_External	Enable L pin counter latching	BOOL	RW	0x00
0x70***n***0:11	CO***n***_Set_Counter_Value	Set Counter Value	UDINT	RW	0x0000 0000

n: range from 0 to 1 refer to Ch.0 to Ch.1

6.1.8.3 Encoder and Counter Configuration

Table 6.11: Encoder and Counter Configuration (0x7000:01 - 0x7010:11)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default**
0x80***n***0:01	C***n***_Mode_Select	Select Encoder mode 0: Encoder mode 1: Bi-Direction Mode	UINT	RW	0x0000
0x80***n***0:02	C***n***_Enable_Z_Pulse_Reset	Enable Z pulse input to reset counter 0: Disable 1: Enable	UINT	RW	0x0000
0x80***n***0:03	C***n***_Z_Pulse_Active_Polarity	The active polarity of Z input 0: Rising Edge 1: Falling Edge	UINT	RW	0x0000
0x80***n***0:04	C***n***_Enable_External_Reset	Enable external input to reset counter 0: Disable 1: Enable	UINT	RW	0x0000
0x80***n***0:05	C***n***_External_Latch_Active_Polarity	The active polarity of Latch input 0: Rising Edge 1: Falling Edge	UINT	RW	0x0000
0x80***n***0:06	C***n***_Enable_Register_Reload	Enable the register change of reload counter 0: Disable 1: Enable	UINT	RW	0x0000
0x80***n***0:07[1]	C***n***_Reload_Counter_Values	Reload counter value	UDINT	RW	0xFFFF FFFF
0x80***n***0:08	C***n***_Input_Filter_Time	Input Filter Time[2]	UINT	RW	0x0000

n: range from 0 to 1 refer to Ch.0 to Ch.1

[1]: C1_Reload_Counter_values (0x80n0:07) only allows setting in the range of 0~0xFFFF.

[2]: Input filter time please refer to the next table "Input Filter Time".

Table 6.12: Input Filter Time		
Item Name	**Frequency**	**Value**
Disable	Disable	0x0000
0.3 us	1.32 MHz	0x0001
0.6 us	654 KHz	0x0002
1.2 us	370 KHz	0x0003
2.4 us	197 KHz	0x0004
3.6 us	134 KHz	0x0005
4.8 us	101 KHz	0x0006
7.2 us	68 KHz	0x0007
9.6 us	51 KHz	0x0008
14.4 us	34 KHz	0x0009
19.2 us	26.1 KHz	0x000A
28.8 us	17.4 KHz	0x000B
38.4 us	13.1 KHz	0x000C

6.1.8.4 Module Configuration

Table 6.13: Module Configuration (0xF600:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00

6.2 AMAX-5081 1-ch TTL/RS-422 Encoder/Counter Module

The AMAX-5081 is a 32-bit 1-ch counter/encoder module for incremental encoders, which supports TTL or RS422 differential input with up to 10MHz input frequency. The module provides 2000 VDC optical isolation, if any high voltage or current damages the channels, the whole system (other modules or control unit) will not be damaged.

Figure 6.13 AMAX-5081 Module

6.2.1 AMAX-5081 Specification

6.2.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 3W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, R/E, A/B/Z, IN, OUT

6.2.1.2 Counter Input

- **Channels:** 1
- **Counter Range:** 32-bit
- **Modes:**
  Position Measure - Encoder x4
  Position Measure - Pulse/Dir.
  Position Measure - CW/CCW
  Position Measure - Pulse/Gate
  Pulse Train Output
- **Signal Input:**
  - Single-ended
    Logic 0: 0.8 V max.
    Logic 1: 2.8 V min. (12 V max.)
  - Differential
    Logic 0: -0.5 V max. (-12 V min.)
    Logic 1: 0.5 V min. (12 V max.)
- **Input Frequency:** 1 MHz max.

6.2.1.3 Latch Input

- Logic 0: 2V max.
- Logic 1: 5V min. (24V max.)

6.2.1.4 Comparison Output

- 5V TTL
- Logic 0: 0.8 V max.
- Logic 1: 2.0 V min. (5.25 V max.)

6.2.1.5 Protection

Isolation Voltage: 2,000V_{DC}

6.2.1.6 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

6.2.2 LED Indicator

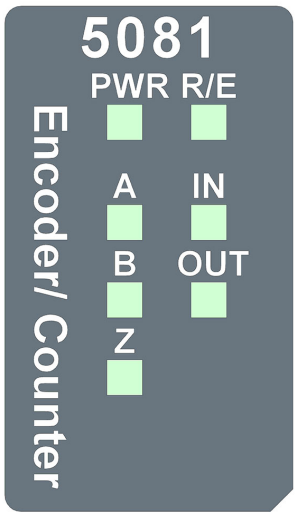


Figure 6.14 AMAX-5081 Module LED Indicator

Table 6.14: AMAX-5081 Module LED Indicator

LED	Color	Indication	Behavior
PWR	Green	ON	Power On
	Orange	ON	Locating Module
R/E[1]	Green	ON	EtherCAT Connected
		Blink	EtherCAT Connecting
A	Green	ON	Encoder Signal Input
B	Green	ON	Encoder Signal Input
Z	Green	ON	Encoder Signal Input
IN	Green	ON	Latch Input
OUT	Green	ON	Compare Output/Pulse Output

[1]: If the RED LED blinking, it may be a disconnection or malfunction of the previous (on the left of this module) or this module.

6.2.3 Pin Definition

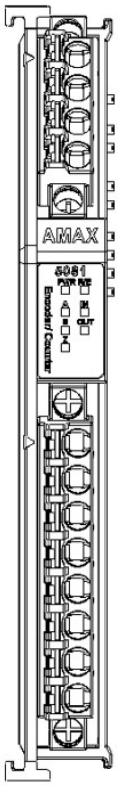


Figure 6.15 AMAX-5081 Module Front View

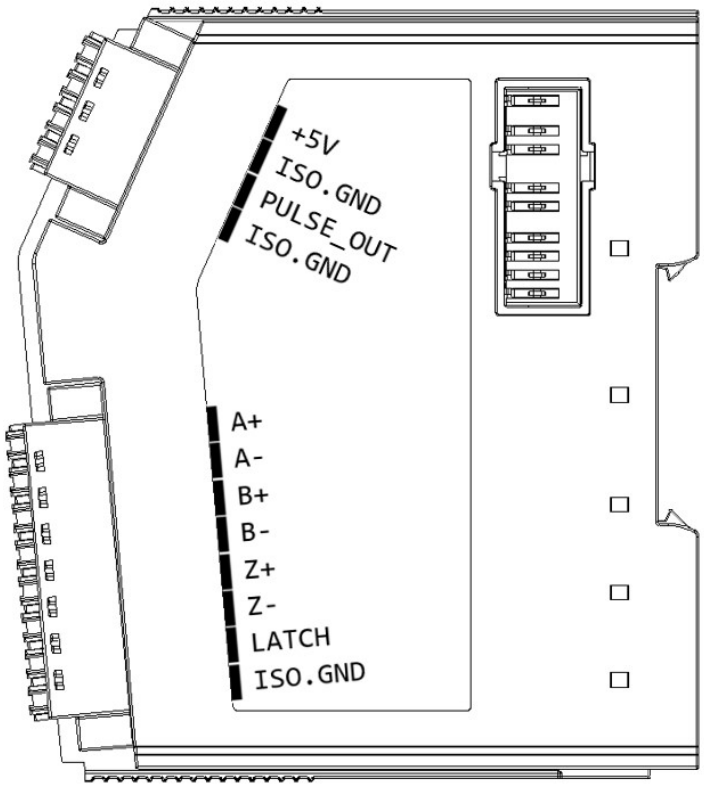


Figure 6.16 AMAX-5081 Module Side View

Table 6.15: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	+5V
2	ISO.GND
3	PULSE_OUT
4	ISO.GND

Table 6.16: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	A+
2	A-
3	B+
4	B-
5	Z+
6	Z-
7	LATCH
8	ISO.GND

6.2.4 Application Wiring

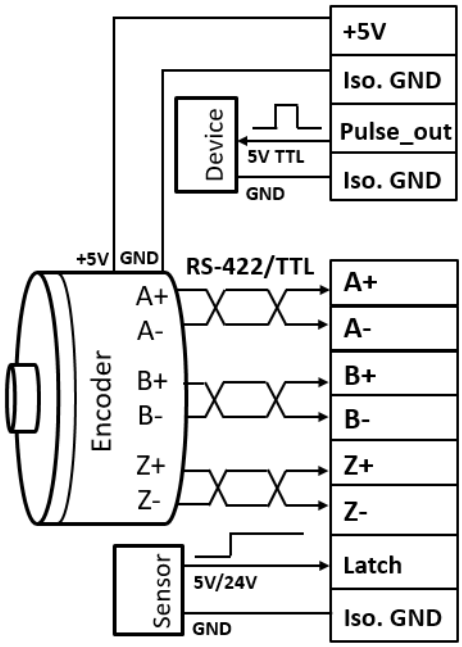


Figure 6.17 Wiring for AMAX-5081

6.2.5 Circuit Layout

6.2.5.1 Encoder Input

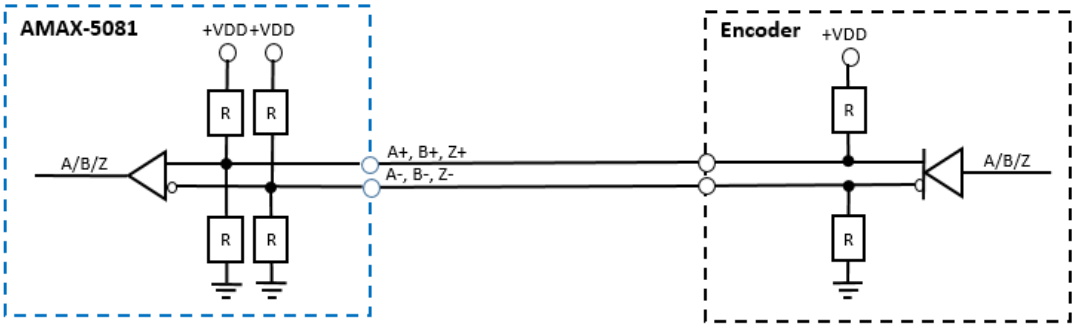


Figure 6.18 AMAX-5081 Encoder Differential Input

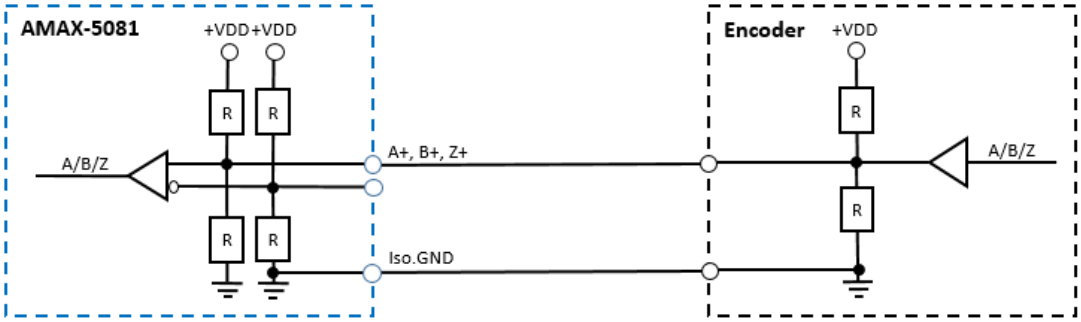


Figure 6.19 AMAX-5081 Encoder Single-Ended Input

6.2.5.2 Latch Input

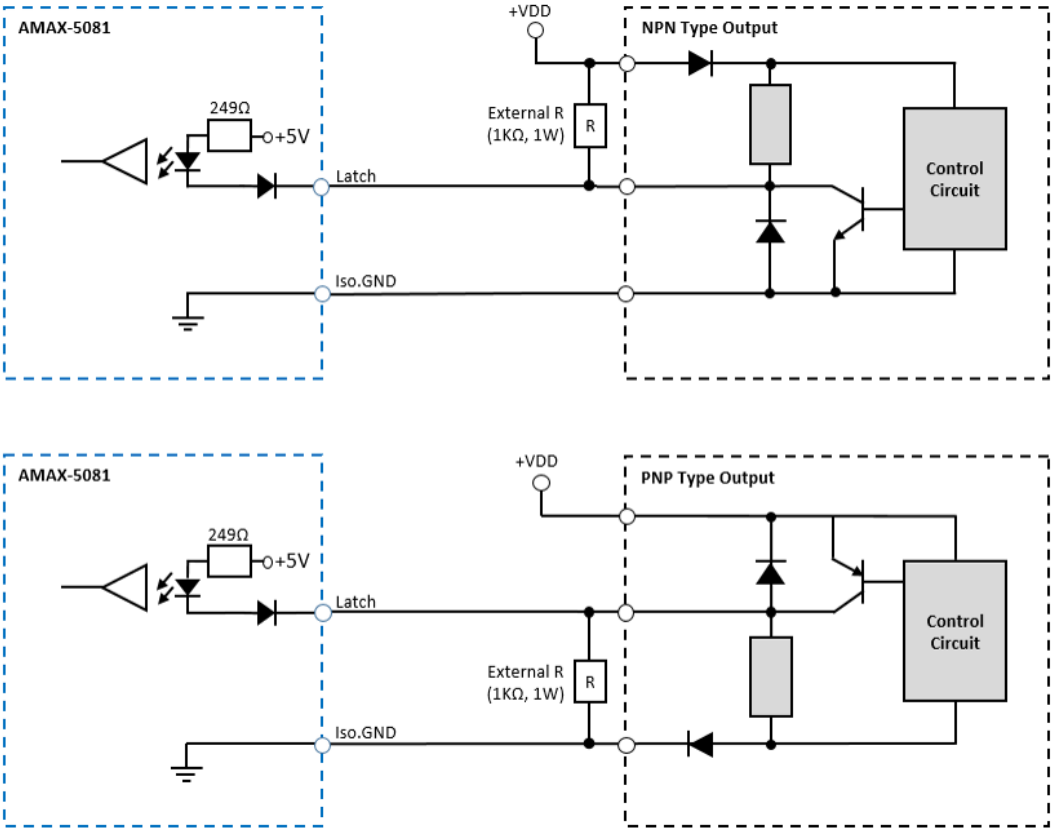


Figure 6.20 AMAX-5081 Latch Input

6.2.5.3 Comparison Output

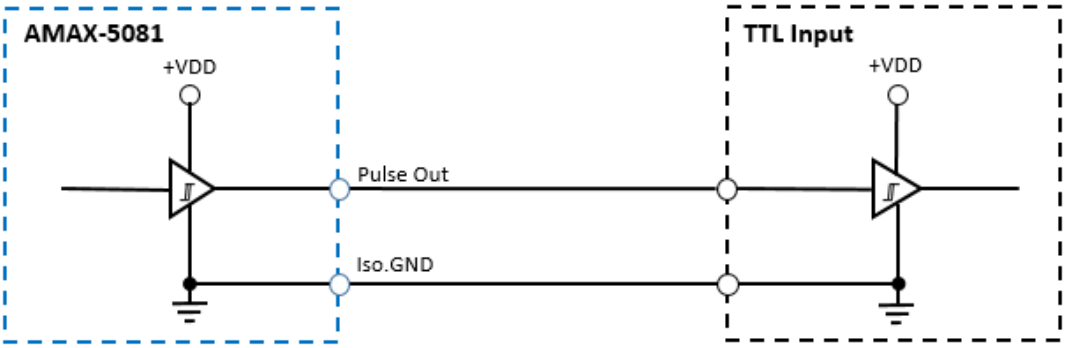


Figure 6.21 AMAX-5081 Comparison Output

6.2.6 AMAX-5081 Counter Mode

The AMAX-5081 supports four encoder/counter modes and one pulse output mode, it can be selected by Mode_Select (0x8000:01).

- 0: Position Measure - Encoder x4
- 1: Position Measure - Pulse/Dir.
- 2: Position Measure - CW/CCW
- 3: Position Measure - Pulse/Gate
- 4: Pulse Train Output

The following features are supported:

- Overflow/underflow detection
- Latch counter value
- Reset counter value
- Set counter value
- Input filter
- Position compare output
- Reversion of A/B phase Input
- Frequency measurement

The supported features for each mode are listed below:

Table 6.17: Supported Features for Each Mode

Feature	Encoder x4	Pulse/Dir.	CW/CCW	Pulse/Gate	Pulse Train Output
Overflow/Underflow detection	O	O	O	O	X
Latch counter value	O	O	O	X	X
Reset counter value	O	O	O	X	X
Set counter value	O	O	O	O	X
Input filter	O	O	O	O	X
Position compare output	O	O	O	O	X
Reversion of A/B phase input	O	X	X	X	X
Frequency measure-ment	O	O	O	O	O

6.2.6.1 PDO Configuration

The PDO assignment should be defined on your EtherCAT MDevice utility. The corresponding pair of the PDO content is required before using the AMAX-5081. (Please refer to PDO assignment (0x1C10 - 0x1C13)).

For example, if you're using the encoder + compare output feature, please select 0x1602 for SM2 and 0x1A02 for SM3. In this way, the related PDO will be added. Figures below show how PDO should be assigned on CODESYS when using the compare output.

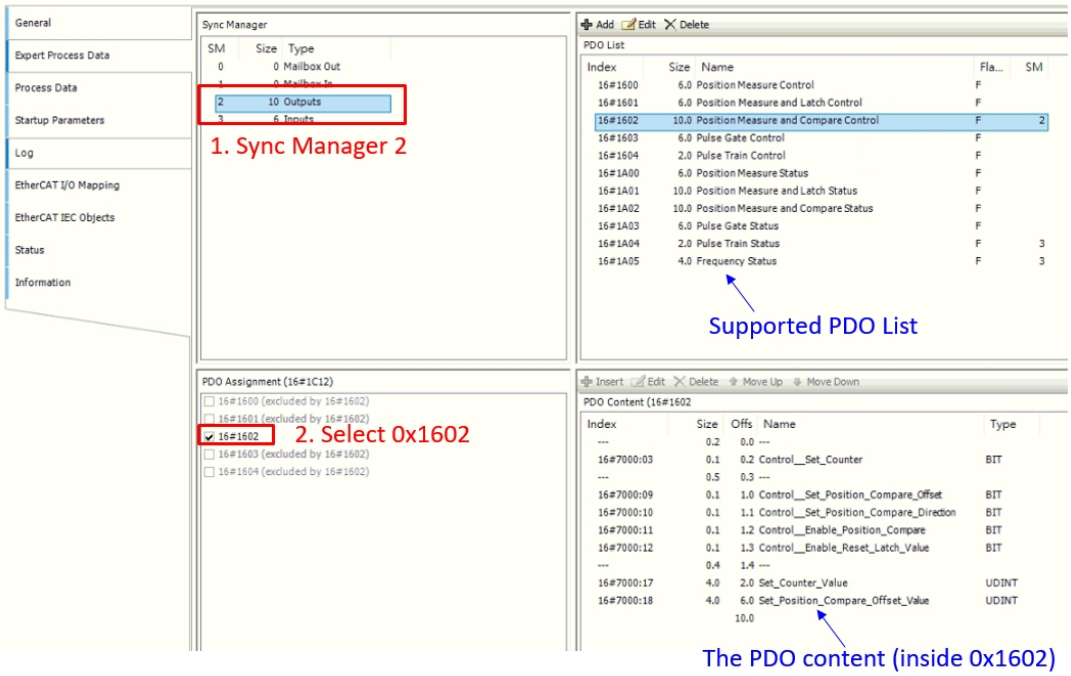


Figure 6.22 PDO assignment for SM2 - CODESYS interface

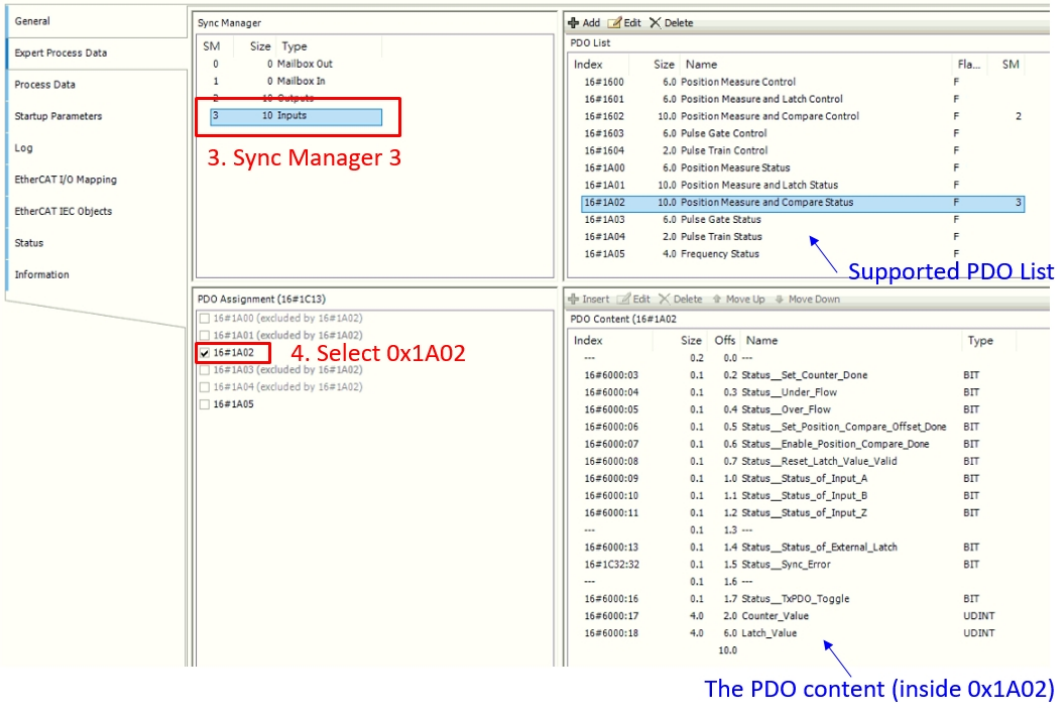


Figure 6.23 PDO assignment for SM3 – CODESYS interface

6.2.6.2 Position Measure - Encoder x4

The Behavior of A/B Phase 4X Quadrant Counter

Below figure shows the counter behavior of Encoder x4 mode. Ch_A and Ch_B are A/B phase encoder signal. If the "A" pulse is rising 90° ahead of the "B" pulse, the counter value is increasing; if the "B" pulse is rising 90° a head of the "A" pulse, the counter value is decreasing.

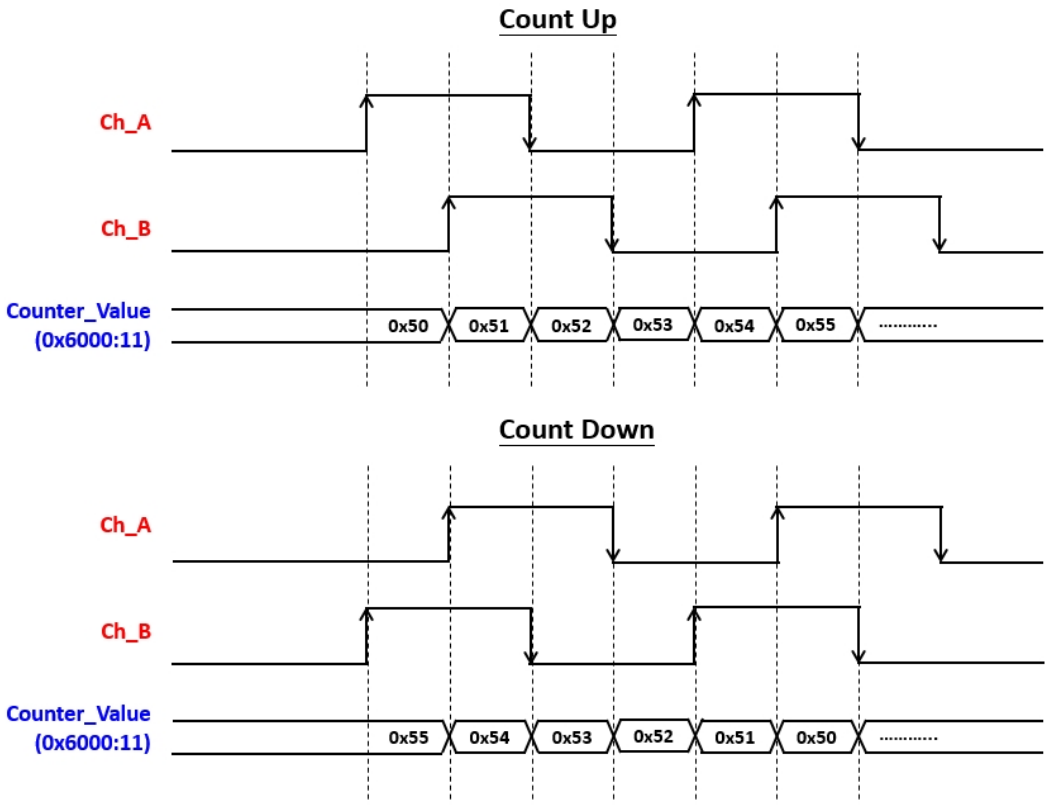


Figure 6.24 Encoder Mode – A/B Phase 4X)

Blue are the 0x6000, 0x7000, 0x8000 parameters.

Red are the external signals.

The counter direction can be reversed by setting the Reversion_Of_Rotation (0x8000:06), the following table is the list of all Encoder x4 mode related parameters.

Table 6.18: Encoder x4 Mode Parameter

Name	Index
Counter_Value	0x6000:11
Status_of_Input_A	0x6000:09
Status_of_Input_B	0x6000:0A
Reversion_Of_Rotation	0x8000:06

6.2.6.3 Position Measure - Pulse/Dir.

The Behavior of Pulse Direction Counter

Below figure shows the counter behavior of Pulse/Direction mode. Ch_A is a pulse from encoder or any pulse generator. Ch_B is a digital input which indicates the counter direction. When Ch_B is high, the counter value counts up with the Ch_A input pulse (Rising Edge-Triggered); when Ch_B is low, the counter value counts down with the Ch_A input pulse.

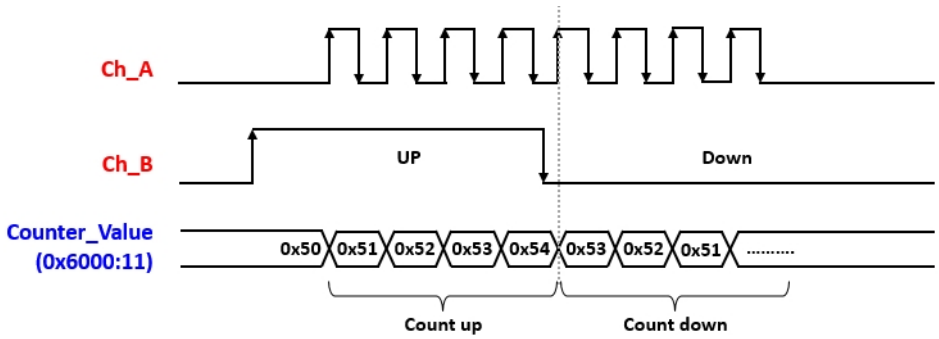


Figure 6.25 Encoder Mode – Pulse/Direction

Blue is the 0x6000, 0x7000, 0x8000 parameters.

Red are the external signals.

The counter value and A, B signal input status can be read at below index:

Table 6.19: Pulse/Direction Mode Parameter

Name	Index
Counter_Value	0x6000:11
Status_of_Input_A	0x6000:09
Status_of_Input_B	0x6000:0A

6.2.6.4 Position Measure - CW/CCW

The Behavior of CW/CCW Counter

Below figure shows the counter behavior of CW/CCW mode. Ch_A and Ch_B are the pulse from encoder or any pulse generator. The counter value counts up with the pulse Ch_A and counts down with the pulse Ch_B.

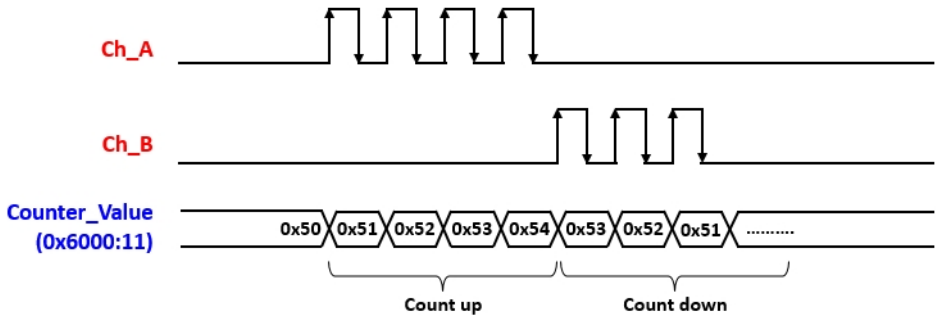


Figure 6.26 Encoder Mode – CW/CCW

Blue are the 0x6000, 0x7000, 0x8000 parameters.

Red are the external signals.

The counter value and A, B signal input status can be read at below Index:

Table 6.20: CW/CCW Mode Parameter	
Name	**Index**
Counter_Value	0x6000:11
Status_of_Input_A	0x6000:09
Status_of_Input_B	0x6000:0A

6.2.6.5 Position Measure - Pulse/Gate

The Behavior of Pulse/Gate Counter

Below figure shows the counter behavior of Pulse/Gate mode. Ch_A is a Pulse from encoder or any pulse generator, the Counter_Value (0x6000:11) is increased along with Pulse signal. The Ch_B is an input digital level as the Gate of the counter value, if the Gate is active, the counter keeps the same value.

The activate polarity of Ch_B can be modified by the parameter Z_And_Gate_Active_Polarity (0x8000:03).

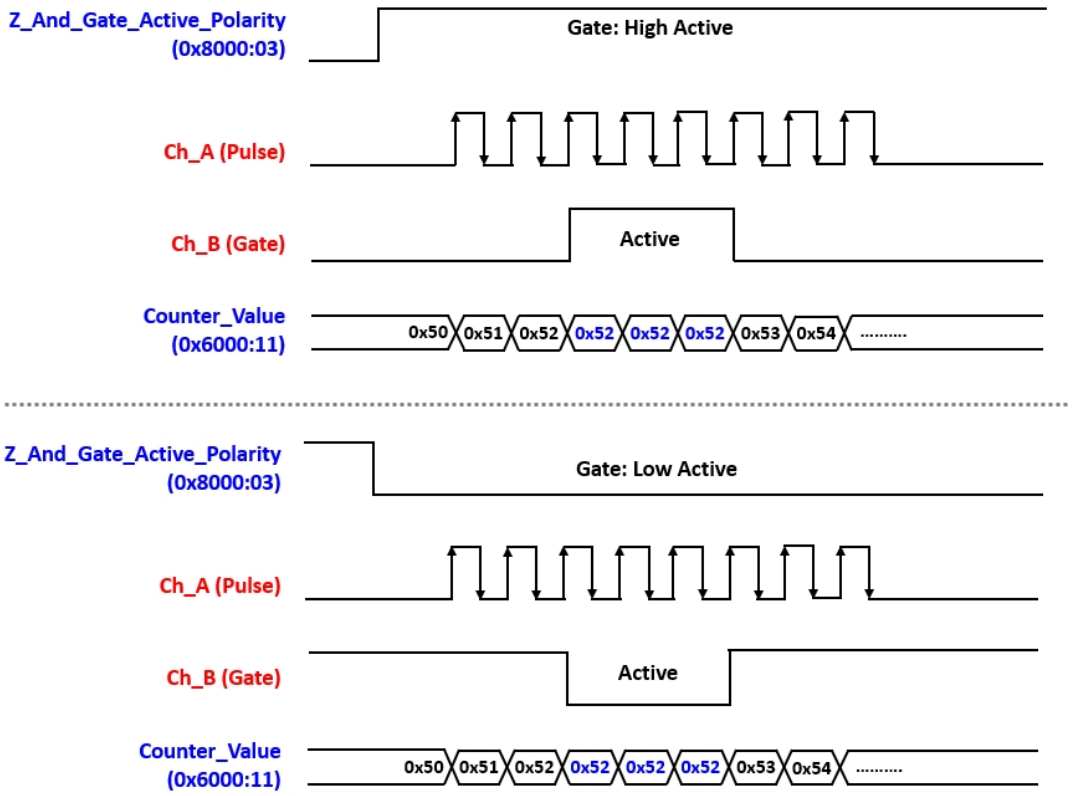


Figure 6.27 Encoder Mode – Pulse/Gate

Blue are the 0x6000, 0x7000, 0x8000 parameters.

Red are the external signals.

The counter value and A, B signal input status can be read at below Index:

Table 6.21: Pulse/Gate Mode Parameter	
Name	**Index**
Counter_Value	0x6000:11
Status_of_Input_A	0x6000:09
Status_of_Input_B	0x6000:0A
Z_And_Gate_Active_Polarity	0x8000:03

6.2.6.6 Pulse Train Output

The Behavior of Pulse Train Output

The Pulse Train Output mode allows AMAX-5081 to generate a train of pulses with programmable frequency and duty cycle for a predetermined number of pulses.

The Pulse Width:

The positive and negative level duration of the pulse output can be adjusted by Pulse_Train_Pos_Width (0x8000:0B) and Pulse_Train_Neg_Width (0x8000:0C). In other words, a desired frequency and duty cycle can be adjusted by modifying these two factors.

One thing to notice is that if Pulse_Train_Pos_Width is set to m, Pulse_Train_Pos_Width is set to n, the duration of high/low level will be m * 50ns and n *50ns, and the number of m and n should between $1\sim2^{32}$.

For example, if Pulse_Train_Pos_Width set to 2000 and the Pulse_Train_Neg_Width set to 1000.

Each output pulse-width will be 100us high + 50us low.

Pulse Train Number:

The total number of pulse output can be set by Pulse_Train_Number (0x8000:0D), the number should between $0\sim2^{32}$ (0 is continues output).

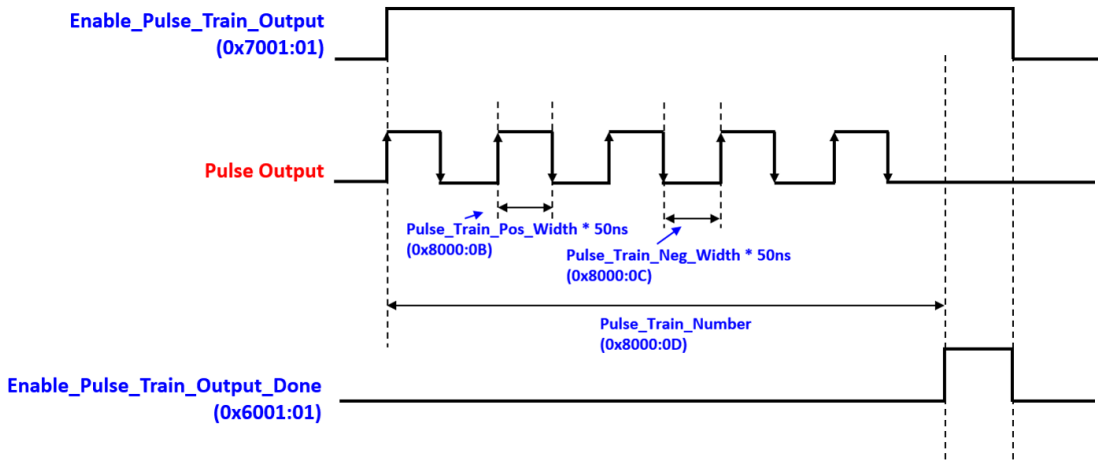


Figure 6.28 Pulse Train Output

Blue are the 0x6000, 0x7000, 0x8000 parameters.

Red is the output signal.

The related parameters are list below:

Table 6.22: Pulse Train Output Mode Parameter	
Name	**Index**
Enable_Pulse_Train_Output_Done	0x6001:01
Enable_Pulse_Train_Output	0x7001:01
Pulse_Train_Pos_Width	0x8000:0B
Pulse_Train_Neg_Width	0x8000:0C
Pulse_Train_Number	0x8000:0D

6.2.7 Counter Features

6.2.7.1 Overflow/Underflow Detection

Overflow and Underflow

When counter value exceeds the counter boundaries, the Under_Flow (0x6000:04) or Over_Flow (0x6000:05) will be set to "1" correspondingly.

The figure below shows an example of overflow/underflow behavior under Pulse/Dir. Mode, the same behavior also applies for other Encoder Modes.

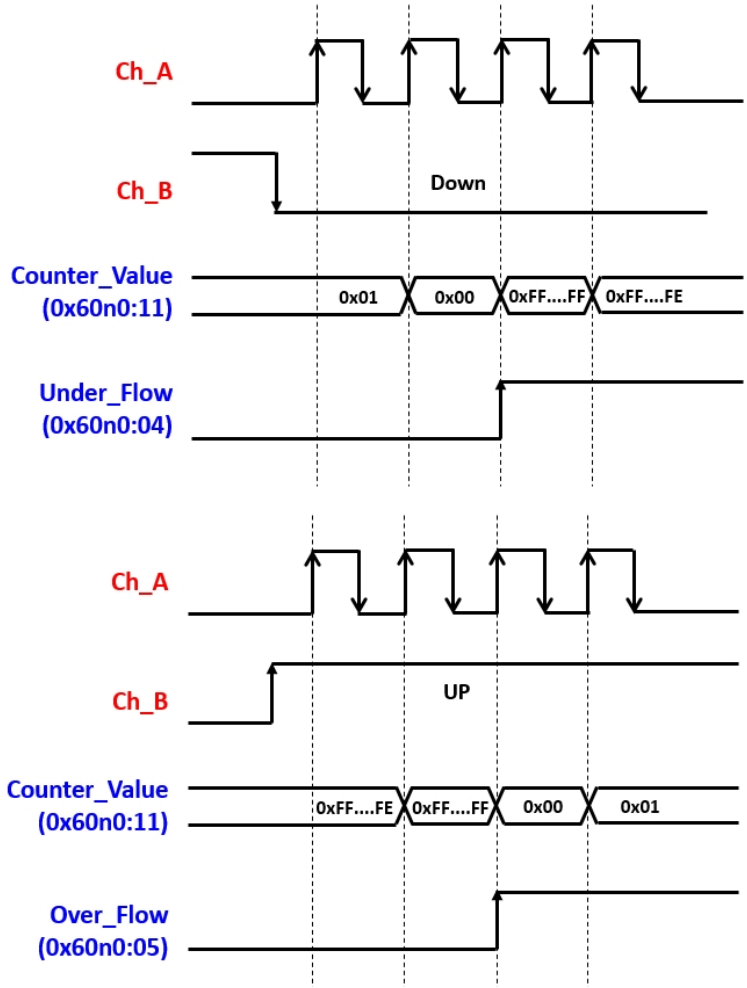


Figure 6.29 Counter Overflow and Underflow Detection

Blue are 0x6000, 0x7000, 0x8000 parameters.

Red are external signals.

n=0~1 for Ch0~1

Reset Underflow and Overflow flags

Over_Flow will be clear to “0” automatically once the counter value over 1/3 of the 0xFFFFFFFF

Under_Flow will be clear to “0” automatically once the counter value under 2/3 of the 0xFFFFFFFF

6.2.7.2 Latch Counter Value

The counter values can be latch by an external signal at AMAX-5081 latch input pin. The latched counter value can be read at Latch_Value (0x6000:12). The active polarity (Rising or Falling Edge-triggered) of latch input signal can also be configured.

Below example shows how to latch the counter value by an external signal at rising edge under Pule/Direction Mode:

Step1: Enable rising edge-triggered at the address Enable_Latch_External_Rising (0x7000:02) (*Enable Enable_Latch_External_Falling (0x7000:04) for falling edge-triggered)

Step2: Check Latch_External_Valid (0x6000:02), if the bit is high, the counter value is successfully latched by an external signal.

Step3: Read latch values at Latch_Value (0x6000:12)

Step4: Before next latch signal comes, the Enable_Latch_External_Rising (0x7000:02) should be toggled once to clear the Latch_External_Valid (0x6000:02) status.

Step5: Once the Latch_External_Valid (0x6000:02) bit is low, the module is ready for the next latching signal.

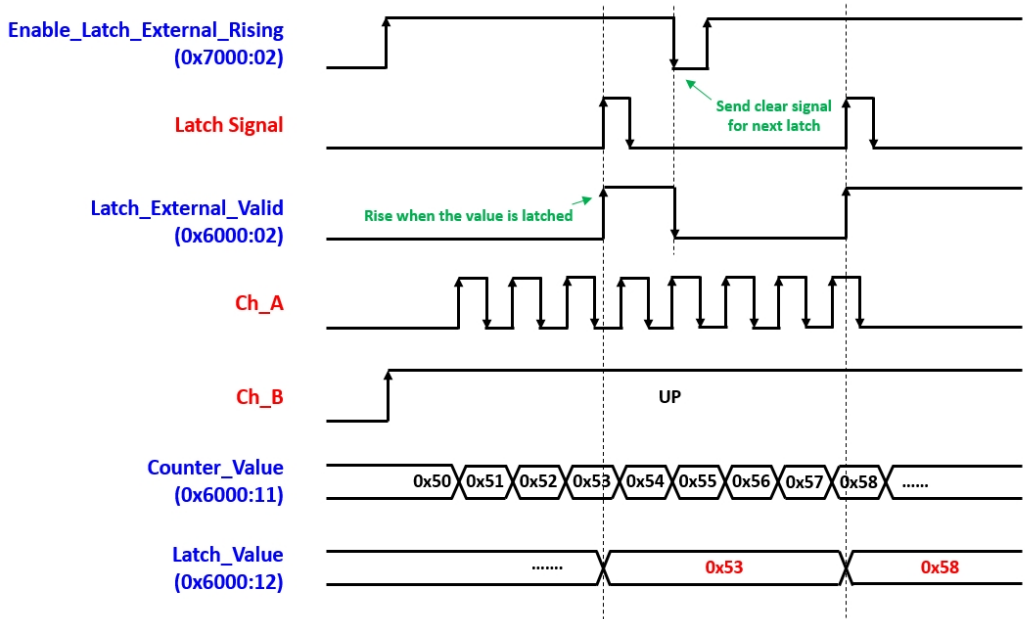


Figure 6.30 Latch Counter by Z pin

Blue are 0x6000, 0x7000, 0x8000 parameters.

Red are external signals.

All related configurable parameters for Latch Counter are listed below:

Table 6.23: Latch Counter Parameter

Name	Index
Enable_Latch_External_Rising	0x7000:02
Enable_Latch_External_Falling	0x7000:04
Counter_Value	0x6000:11
Latch_Value	0x6000:12

6.2.7.3 Reset Counter Value

The counter values can be reset with external signal by configuring the Z pin as the reset input. The reset signal can be triggered by encoder Z signal or any external sensor's signal.

To use the reset feature, please follow the steps below:

Configuration:

- Set Enable_Z_Pulse_Reset (0x8000:02) to 1 (Enable).
- Define Z_And_Gate_Active_Polarity (0x8000:03) as 0 (Rising Edge Active) or 1 (Falling Edge Active).

Enable Input:

Step 1: Set Enable_Latch_Z (0x7000:01) to True.

Step 2: Any reset signal from Z pin, the Counter_Value (0x6000:11) will be cleared.

Step 3: Once counter value is cleared, Latch_Z_Valid (0x6000:01) will be raised to True.

Step 4: Set Enable_Latch_Z (0x7000:01) to False to clear the flag for next input.

* When the reset is done, do the Step1 before next reset signal comes.

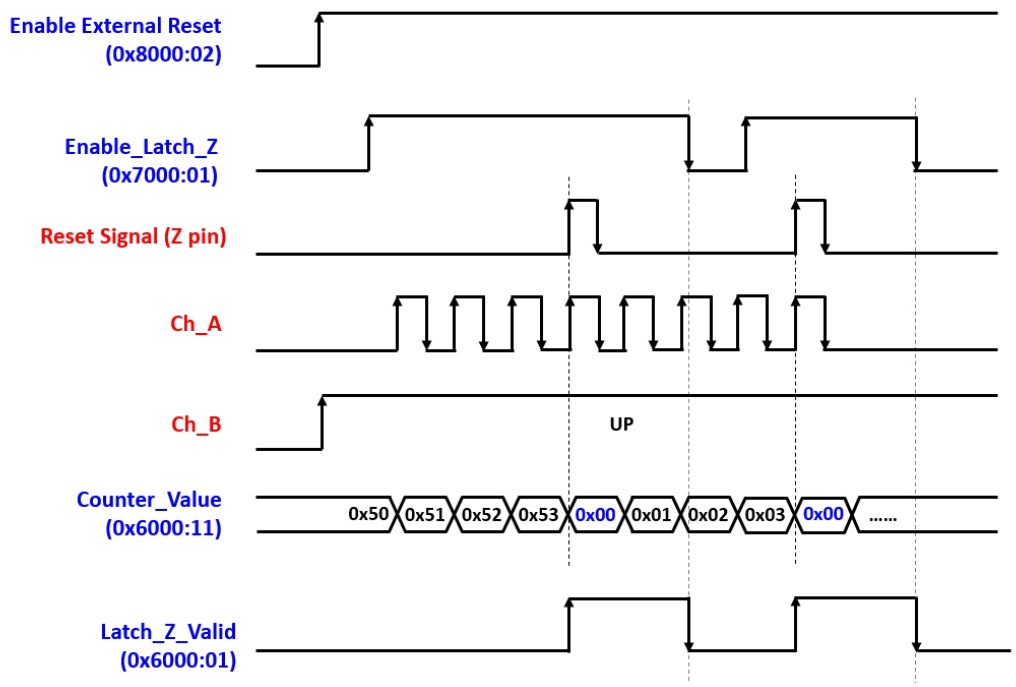


Figure 6.31 Reset Counter Value

6.2.7.4 Set Counter Value

The counter value can be overwritten to a desired number by setting at address Set_Counter_Value (0x7000:11) and Set_Counter (0x7000:03) no matter if the counter is counting or not. This feature is usually used for restoring the last incremental encoder value after system reboot. Once the counter value is set successfully, the Set_Counter_Done (0x6000:03) will be changed to “1”.

For example, the start counter value can be overwritten by following steps:

Step 1: Set Set_Counter_Value (0x7000:11) to assign a counter value to be changed.

Step 2: Enable Set_Counter (0x7000:03) to activate the change of counter value.

Step 3: When the Set_Counter_Done (0x6000:03) is “1”, the counter value is changed

Step 4: Set_Counter (0x7000:03) should be set to “0” before the next change

Step 5: Set_Counter_Done (0x6000:03) will be restored to “0” along with Set_Counter.

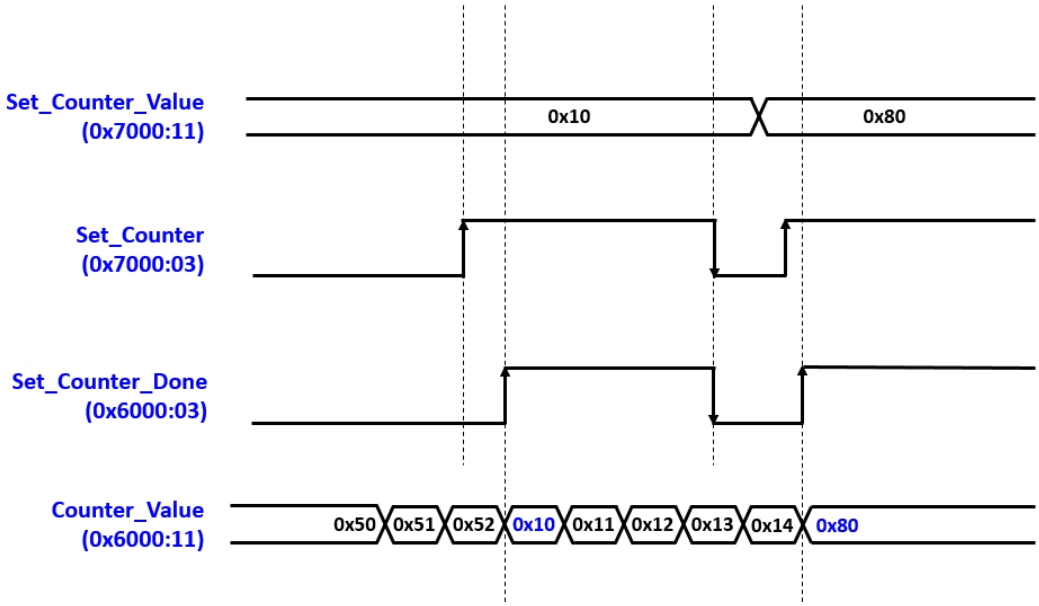


Figure 6.32 Set Counter Value

6.2.7.5 Input Filter

AMAX-5081 supports input filter for A/B/Z/Latch input signal. The selectable filter duration for Input_Filter_Time (0x8000:04) are listed as below:

Table 6.24: Input Filter Level

Filter Level Number	Index
0	Disable Filter
1	1.28 us
2	10.24 us
3	163.84 us
4	1310.00 us (1.31ms)

6.2.7.6 Position Compare Output – Hardware Trigger

The position compare output can let the module generate a pre-defined width of pulse, after a specific triggering signal, the signal can be triggered by hardware or software.

This section will show you how to configure and use hardware triggered position compare output.

Hardware Trigger Behavior

At the moment of AMAX-5081 detect an external signal entering the AMAX-5081 Latch pin, the module will generate a pre-defined width of pulse after a period of Off-set.

Hardware Trigger Configuration:

Configure Position Compare

Step 0: Configure PDO, select Position Measure and Compare Control (0x1602) for SM2 and Position Measure and Compare Status (0x1A02) for SM3.

Step 1: Set Position_Compare_Source_Select (0x8000:07) to 0: HW

Step 2: Set Position_Compare_Latch_Polarity (0x8000:08) to 0: Rising Edge Active; 1: Falling Edge Active.

Step 3: Set Position_Compare_Output_Polarity (0x8000:09) to 0: Initial Low; 1: Initial High.

Set Output Pulse Width

Step 4: Set Position_Compare_Output_Width (0x8000:0A) (Unit:10ns)

Note*: The actual output width is (Position_Compare_Output_Width + 2) * 10ns, and the minimum value for Position_Compare_Output_Width is “1”.

Set Position Compare Offset Value

Step 5: Set Position_Compare_Direction (0x7000:0A) to 0: Forward counting; 1: Reverse counting

Step 6: Set Set_Position_Compare_Offset_Value (0x7000:12) (0 ~ 232).

Step 7: Set Position_Compare_Offset (0x7000:09) to “1” to write the offset into the buffer.

Step 8: Read Set_Position_Compare_Offset_Done (0x6000:06), if the value is “1”, then the offset is written to the buffer successfully.

Step 9: Set Position_Compare_Offset (0x7000:09) to “0” when buffer is written.

Step 10: Read Set_Position_Compare_Offset_Done (0x6000:06) again, if the value is “0”, then the next offset value can be set to the buffer if needed.

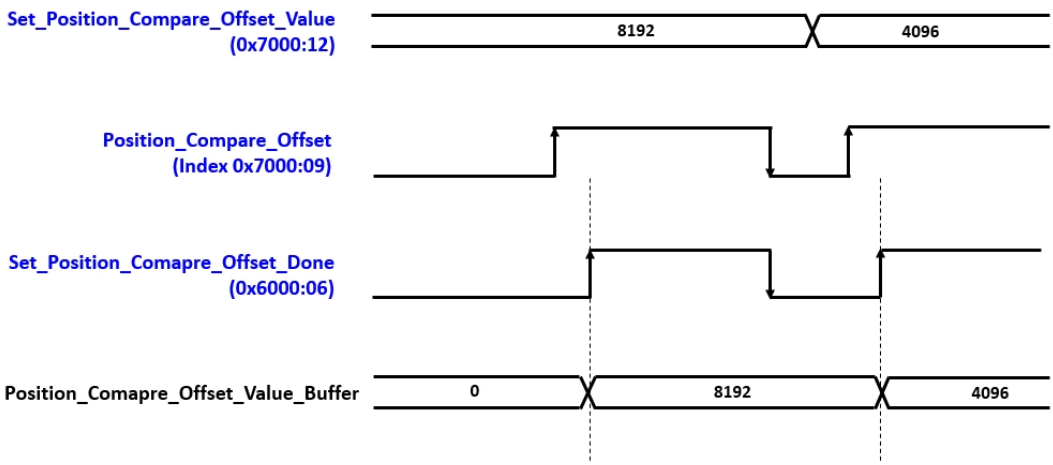


Figure 6.33 Set Position Compare Offset Value

Please refer to the following flow chart to set the position compare output configuration:

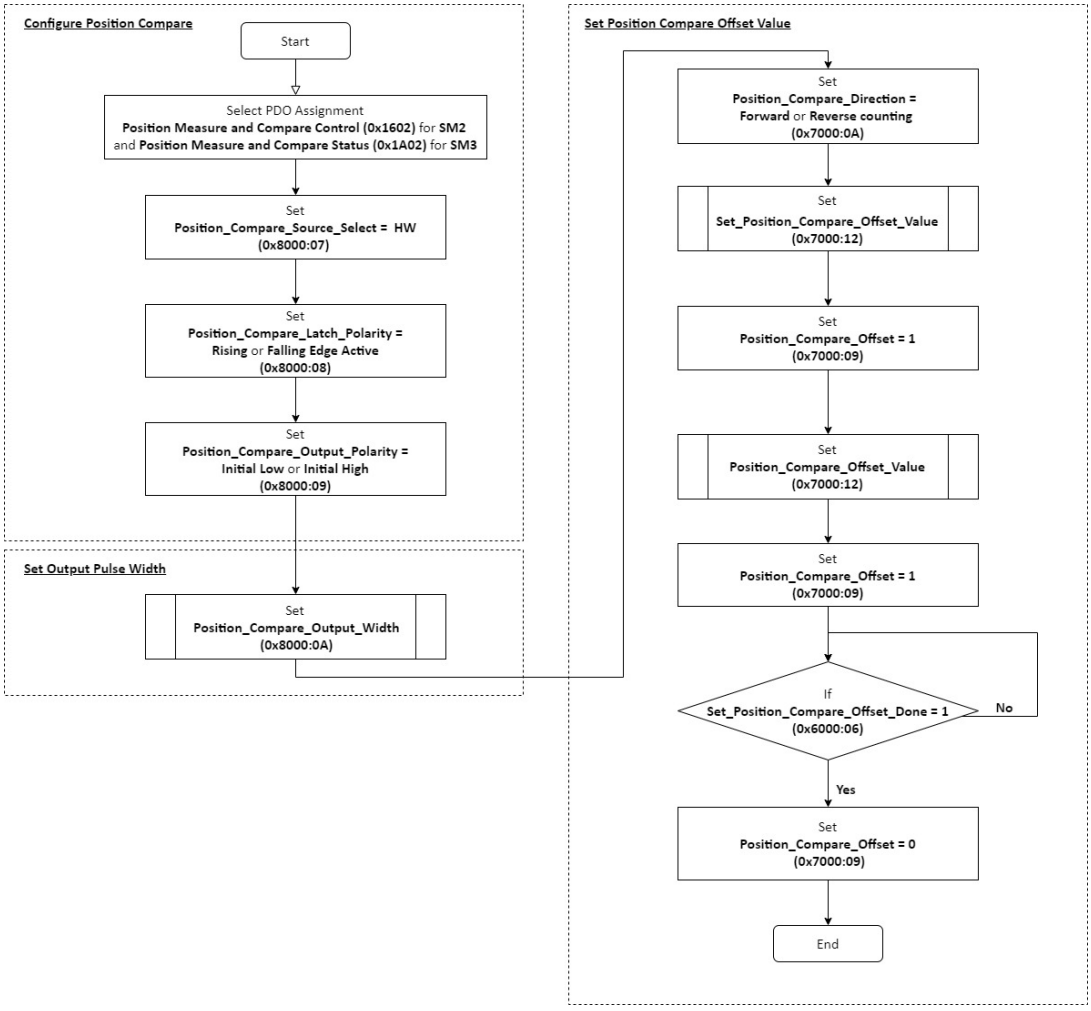


Figure 6.34 AMAX-5081 Hardware Position Compare Configuration – Flow Chart

Hardware Trigger Application:

Step 1: Set Enable_Position_Compare (0x7000:0B) to “1”.

Step 2: When a pulse input to the AMAX-5081 Latch pin, the current counter value will be updated to Latch_Value (0x6000:12).

Step 3: Wait until the Counter_Value (0x6000:11) ≥ Latch_Value (0x6000:12) + Set_Position_Compare_Offset_Value (0x7000:12), the AMAX-5081 Pulse_Output pin will output a pre-defined width of pulse and the Enable_Position_Compare_ Done (0x6000:07) will be raise to “1”.

Step 4: After the pulse output is done, set Enable_Position_Compare (0x7000:0B) to “0”

Step 5: Check if Enable_Position_Compare_ Done (0x6000:07) is changed to “0” coordinately, and back to step1 for the next compare trigger signal.

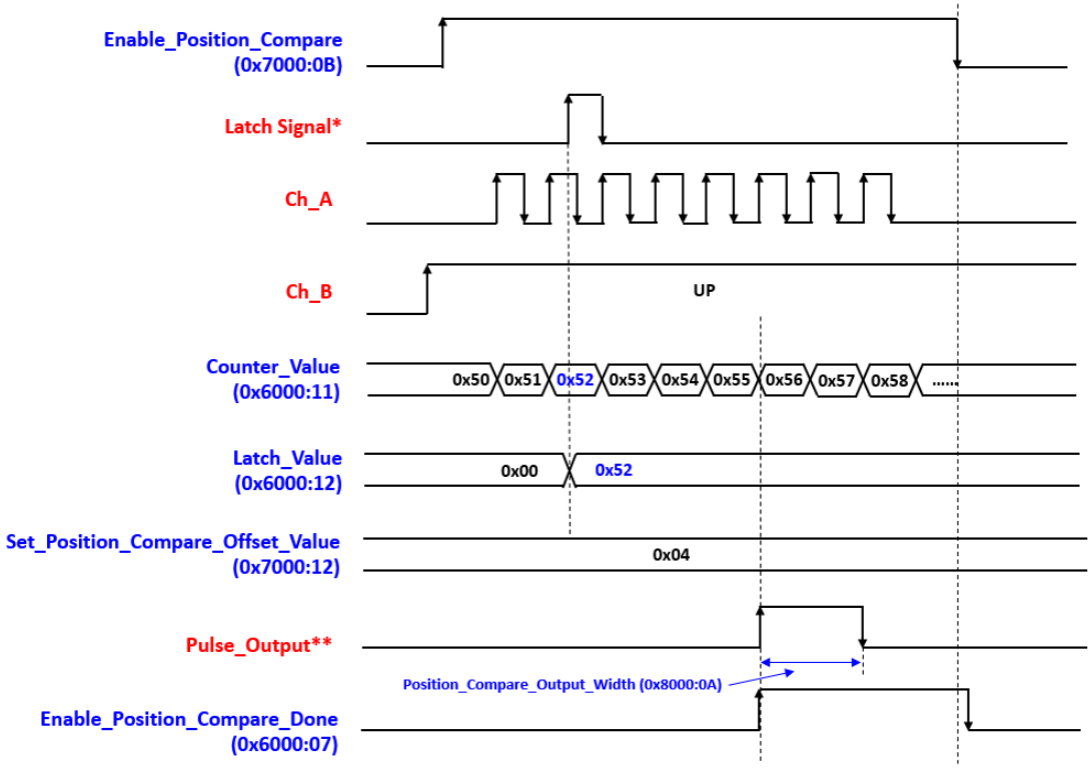


Figure 6.35 AMAX-5081 Hardware Position Compare Application – Timing Diagram

* Latch Signal can be rising edge or falling edge active (Position_Compare_Latch_Polarity (0x8000:08))

** Pulse_Output can be initial low or initial high (Position_Compare_Output_Polarity (0x8000:09))

Please refer to the following flow chart to use the position compare output:

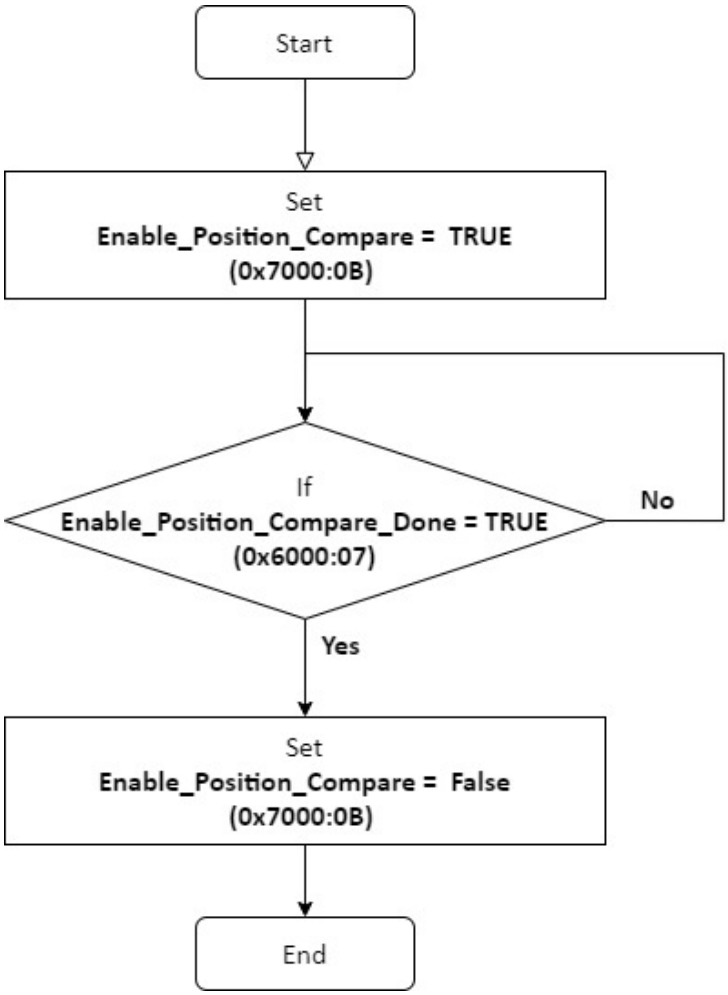


Figure 6.36 AMAX-5081 Hardware Position Compare Application – Flow Chart

6.2.7.7 Position Compare Output – Software Trigger

The position compare output lets the module generate a pre-defined width of a pulse, after a specific triggering signal. The signal can be triggered by hardware or software.

This section will show you how to configure and use software triggered position compare output.

Software Trigger Behavior

At the moment of the EtherCAT MDevice triggers the AMAX-5081 module by PDO, the module will generate a pre-defined width of pulse after a period of Offset.

Please follow the steps below to configure software triggered Position Compare Output function.

Software Trigger Configuration:

Configure Position Compare

Step0: Configure PDO, select Position Measure and Compare Control (0x1602) for SM2 and Position Measure and Compare Status (0x1A02) for SM3.

Step 1: Set Position_Compare_Source_Select (0x8000:07) to 0: SW

Step 2: Set Position_Compare_Output_Polarity (0x8000:09) to 0: Initial Low; 1: Initial High.

Set Output Pulse Width

Step 3: Set Position_Compare_Output_Width (0x8000:0A) (Unit:10ns)

Note*: The actual output width is (Position_Compare_Output_Width + 2) * 10ns, and the minimum value for Position_Compare_Output_Width is “1”.

Set Position Compare Offset Value

Step 4: Set Position_Compare_Direction (0x7000:0A) to 0: Forward counting; 1: Reverse counting

Step 5: Set Set_Position_Compare_Offset_Value (0x7000:12) (0 ~ 232).

Step 6: Set Position_Compare_Offset (0x7000:09) to “1” to write the offset into the buffer.

Step 7: Read Set_Position_Compare_Offset_Done (0x6000:06), if the value is “1”, then the offset is written to the buffer successfully.

Step 8: Set Position_Compare_Offset (0x7000:09) to “0” when buffer is written.

Step 9: Read Set_Position_Compare_Offset_Done (0x6000:06) again, if the value is “0”, then the next offset value can be set to the buffer if needed.

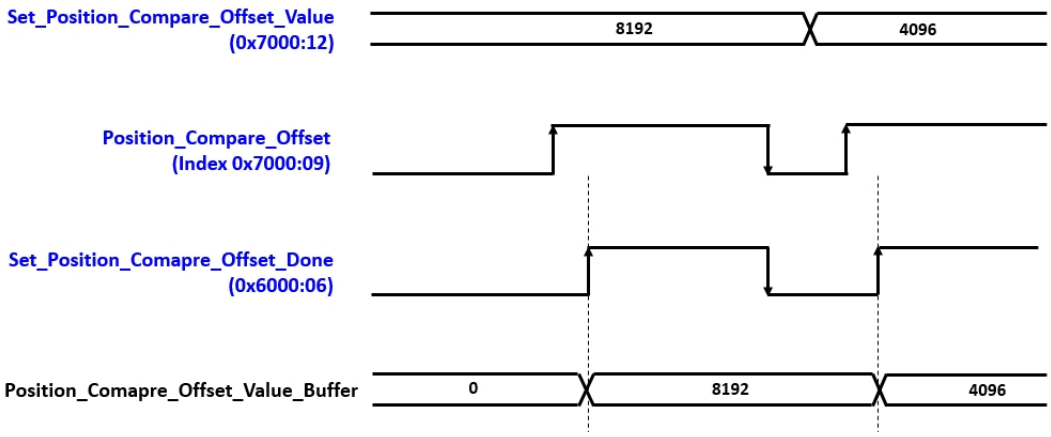


Figure 6.37 Set Position Compare Offset Value

Flow chart to set the position compare output configuration:

Figure 6.38 AMAX-5081 Software Position Compare Configuration – Flow Chart

Software Trigger Application:

Step 1: Set Enable_Position_Compare (0x7000:0B) to “1”, then the current counter value will be updated to Latch_Value (0x6000:12).

Step 2: Wait until the Counter_Value (0x6000:11) ≥ Latch_Value (0x6000:12) + Set_Position_Compare_Offset_Value (0x7000:12), the AMAX-5081 Pulse_Output pin will output a pre-defined width of pulse and the Enable_Position_Compare_ Done (0x6000:07) will be raise to “1”.

Step 3: After the pulse output is done, set Enable_Position_Compare (0x7000:0B) to “0”

Step 4: Check if Enable_Position_Compare_ Done (0x6000:07) is changed to “0” coordinately, and back to step1 for the next compare trigger signal.

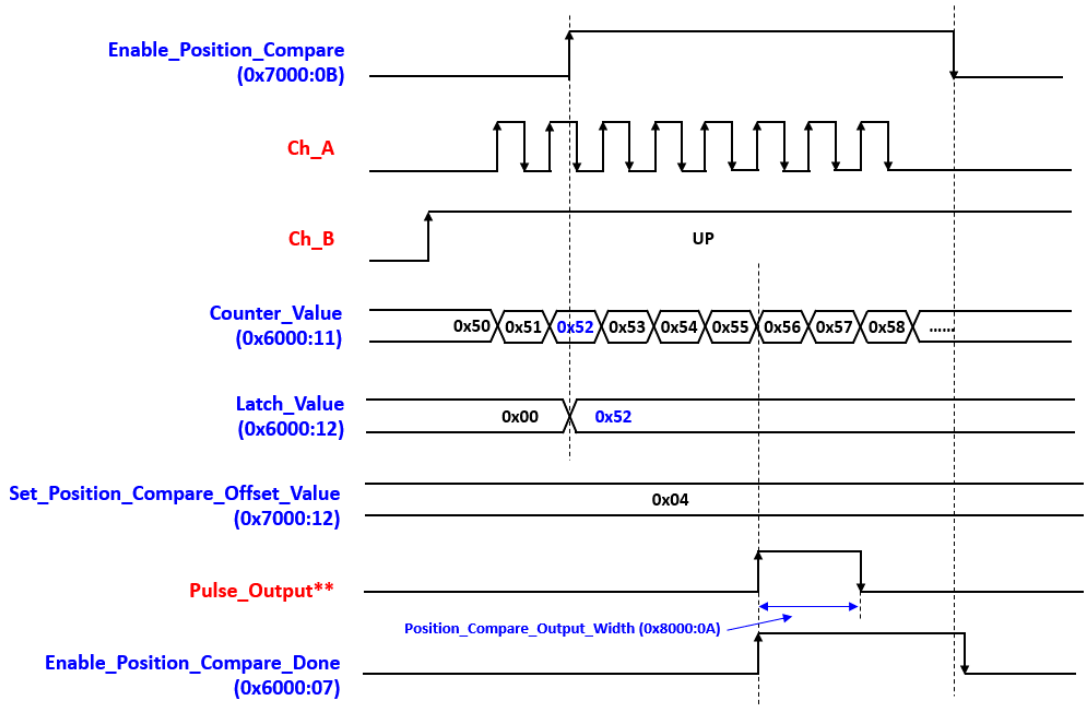


Figure 6.39 AMAX-5081 Software Position Compare Application – Timing Diagram Chart

* Latch Signal can be rising edge or falling edge active (Position_Compare_Latch_Polarity (0x8000:08))

** Pulse_Output can be initial low or initial high (Position_Compare_Output_Polarity (0x8000:09))

Please refer to the following flow chart to use the position compare output:

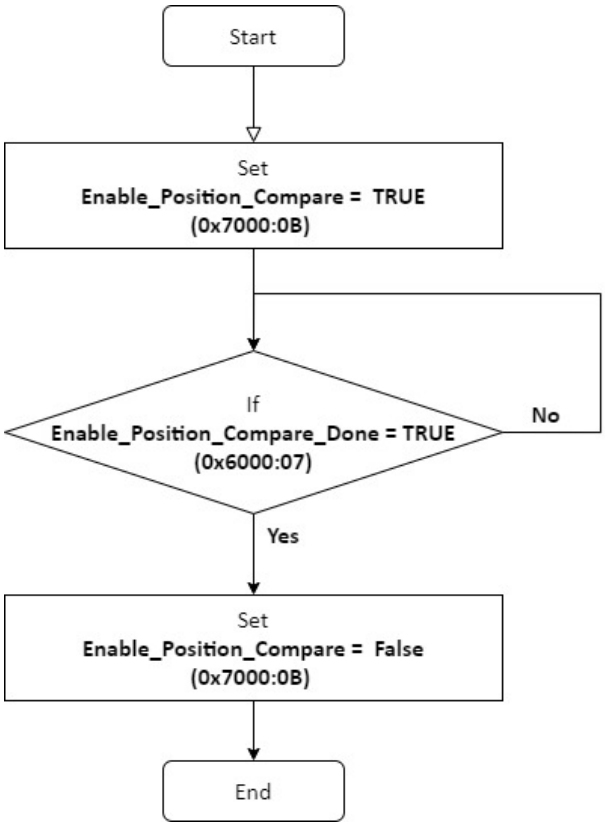


Figure 6.40 AMAX-5081 Software Position Compare Application

6.2.7.8 Reversion of A/B Phase Input

The A/B phase encoder counter direction can be reversed by Reversion_Of_Rotation (0x8000:06), this function only applies on Position Measure - Encoder x4 mode. (0: Disable, 1: Enable)

6.2.7.9 Frequency Measurement

Either Ch_A or Ch_B input pulse frequency can be measured by AMAX-5081, the measurement range is between 1Hz to 5MHz.

There are few settings should be done before using Frequency Measurement function:

1. Select 0x1A05 Frequency Status in SM3 PDO assignment.
2. Select input source ChA or ChB on Frequency_Measure_Input_Select (0x8000:05)

The input pulse frequency will be showed on Frequency_Value (0x6002:01), the value will be updated every second. This feature is often used to determine motor velocity.

6.2.8 AMAX-5081 Object Dictionary

6.2.8.1 Input Data

Table 6.25: Input Data (0x6000:01 - 0x6000:12)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x6000:01	Latch_Z_Valid	The counter is clear by Z input.	BOOL	RO	0x00
0x6000:02	Latch_External_Valid	The counter is latched by L input.	BOOL	RO	0x00
0x6000:03	Set_Counter_Done	The counter was set.	BOOL	RO	0x00
0x6000:04	Under_Flow	Counter under flow	BOOL	RO	0x00
0x6000:05	Over_Flow	Counter Over flow	BOOL	RO	0x00
0x6000:06	Set_Position_Compare_Offset_Done	Set Position Compare Offset Done	BOOL	RO	0x00
0x6000:07	Enable_Position_Compare_Done	Enable Position Compare Done	BOOL	RO	0x00
0x6000:08	Reset_Latch_Value_Valid	Reset Latch Counter Value	BOOL	RO	0x00
0x6000:09	Status_of_Input_A	Status of input A	BOOL	RO	0x00
0x6000:0A	Status_of_Input_B	Status of input B	BOOL	RO	0x00
0x6000:0B	Status_of_Input_Z	Status of input Z	BOOL	RO	0x00
0x6000:0D	Status_of_External_Latch	Status of input External	BOOL	RO	0x00
0x6000:10	TxPDO_Toggle	The TxPDO toggle is toggled by the SubDevice when the data of the associated TxPDO is updated.	BOOL	RO	0x00
0x6000:11	Counter_Value	Counter Value	UDINT	RO	0x0000 0000
0x6000:12	Latch_Value	Latch Value	UDINT	RO	0x0000 0000

6.2.8.2 Pulse Train Output Status

Table 6.26: Pulse Train Output Status (0x6001:01)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x6001:01	Enable_Pulse_Train_Output_-Done	Pulse train output last pulse	BOOL	RO	0x00

6.2.8.3 ENC Frequency Input

Table 6.27: ENC Frequency Input (0x6002:01)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x6002:01	Frequency_Value	Update Frequency every second	UDINT	RO	0x0000 0000

6.2.8.4 Output Data

Table 6.28: Output Data (0x7000:01 - 0x7000:12)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x7000:01	Enable_Latch_Z	Activate saving via input Z.	BOOL	RO	0x00
0x7000:02	Enable_Latch_External_Rising	Activate external latch with positive edge	BOOL	RO	0x00
0x7000:03	Set_Counter	Set Counter	BOOL	RO	0x00
0x7000:04	Enable_Latch_External_Falling	Activate external latch with negative edge	BOOL	RO	0x00
0x7000:09	Set_Position_Compare_Offset	Set Position Compare Offset	BOOL	RO	0x00
0x7000:0A	Set_Position_Compare_Direction	0: Used for forward counting 1:Used for reverse counting	BOOL	RO	0x00
0x7000:0B	Enable_Position_-Compare	Enable Position Compare	BOOL	RO	0x00
0x7000:0C	Enable_Reset_Latch_Value	Enable Reset Latch Counter	BOOL	RO	0x00
0x7000:11	Set_Counter_Value	Set Counter Value	UDINT	RO	0x0000 0000
0x7000:12	Set_Position_Compare_Offset_Value	Set Position Compare Offset Value	UDINT	RO	0x0000 0000

6.2.8.5 Pulse Train Output Status

Table 6.29: Pulse Train Output Status (0x7001:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x7001:01	Enable_-Pulse_Train_Output	Enable pulse train output	BOOL	RO	0x00

6.2.8.6 Encoder and Counter Configuration

Table 6.30: Encoder and Counter Configuration (0x8000:01 – 0x8000:0D)

Index (hex)	Name	Meaning	Data type	Flags	Default
0x8000:01	Mode_Select	Select Encoder/Counter mode 0: Position Measure - Encoder x4 1: Position Measure - Pulse/Dir 2: Position Measure - CW/CCW 3: Pulse/Gate 4: Pulse Train Output	UINT	RW	0x0000
0x8000:02	Enable_Z_Pulse_Reset	A counter reset is triggered via the Z pulse input 0:Disable 1:Enable	UINT	RW	0x0000
0x8000:03	Z_And_Gate_Active_Polarity	Z/Gate Pin Active Polarity 0:Rising Edge(High Active) 1:Falling Edge(Low Active)	UINT	RW	0x0000
0x8000:04	Input_Filter_Time	Filter Timer Select 0: Disable 1: 1.28us 2: 10.24us 3: 163.84us 4: 1.31ms	UINT	RW	0x0000
0x8000:05	Frequency_Measure_Input_Select	Position Measure Input Select 0:Ch A 1:Ch B	UINT	RW	0x0000
0x8000:06	Reversion_Of_Rotation	Activates reversion of rotation 0: Disable 1: Enable	UINT	RW	0x0000
0x8000:07	Position_Compare_Source_Select	Position Compare Source Select 0: HW 1: SW	UDINT	RW	0x0000
0x8000:08	Position_Compare_Latch_Polarity	Position Compare Latch Pin active polarity 0:Rising Edge(High Active) 1:Falling Edge(Low Active)	UINT	RW	0x0000
0x8000:09	Position_Compare_Output_Polarity	Compare Output Polarity 0:Initial Low 1:Initial High	UINT	RW	0x0000
0x8000:0A	Position_Compare_Output_Width	Compare Output Positive Width	UINT	RW	0x0007 A120
0x8000:0B	Pulse_Train_Pos_Width[1]	Pulse Train Positive Width (50ns)	UDINT	RW	0x0001 86A0
0x8000:0C	Pulse_Train_Neg_Width[1]	Pulse Train Negative Width (50ns)	UINT	RW	0x0001 86A0
0x8000:0D	Pulse_Train_Number[2]	Pulse Train Number	UINT	RW	0x0000 0001

[1]: These two factors can adjust the positive and negative level duration of the pulse output. If Pulse_Train_Pos_Width(0x8000:0B) is ***n***, the positive level duration will be ***n*** *50 ns. The setting number should between 1 to 232. For example, if Pulse_Train_Pos_Width and Pulse_Train_Neg_Width be set to 1,000,000 and 2,000,000. Each output pulse will be 50 ms for high and 100 ms for low.

[2]: The total number of the pulse output can be set by Pulse_Train_Number (0x8000:0D), the number should between 0 to 232 (0 is continuous output).

6.2.8.7 Module Configuration

Table 6.31: Module Configuration (0xF600:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00

6.3 AMAX-5082 1-ch SSI Encoder Module

The AMAX-5082 is a 32-bit 1-ch SSI encoder module for absolute encoders, which can interpret Binary or Gray code encoder signal with up to 32-bits resolution. The maximum clock rate is 2MHz, and can be configured by SDO. It also supports compare trigger and latch functions as well as the error detection features.

Figure 6.41 AMAX-5082 Module

6.3.1 AMAX-5082 Specification

6.3.1.1 General:

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 3W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, R/E, CLK, DATA, DO0, DO1, LATCH
- **Weight:** Approx. 80g

6.3.1.2 SSI

- **Channel:** 1
- **Maximum data length:** 32-bit (adjustable)
- **Coding method:** Binary code, gray code
- **Signal Input:** Differential signal (RS485/RS422 compatible)
- **Signal Output:** Differential signal (RS485/RS422 compatible)
- **Data transfer rate:** Up to 2 MHz (adjustable)

6.3.1.3 Latch (Digital Input)

- **Channels:** 1
- **Isolation Voltage:** 2000V_{DC}
- **Signal Input:**
  - "0" signal: -3 to +5V (EN 61131-2, type 1/3),
  - "1" signal: 11 to 30V (EN 61131-2, type 3)
- **Input Frequency:**
  - Frequency mode: 1 Hz to 1MHz max.
  - Counter mode: 1MHz max.

6.3.1.4 Digital Output

- **Channels:** 2
- **Isolation Voltage:** 2000V_{DC}
- **Source Type:** 10 ~ 30V_{DC}, 0.3A @ 25°C (per channel)
- **Output delay:**
  - From logic level 0 to 1: 10us
  - From logic level 1 to 0: 100us

6.3.1.5 Encoder Power Supply

- **Supply Voltage:** 12V
- **Supply Current:** 80mA max.

6.3.1.6 Protection

- **Isolation Voltage:** 2000V_{DC}

6.3.1.7 Environment

- **Operation Temperature:** -25 ~ 45°C (Vertical mounted)
- **Storage Temperature:** -40 ~ 85°C
- **Relative Humidity:** 5 ~ 95% (non-condensing)

6.3.2 LED Indicator

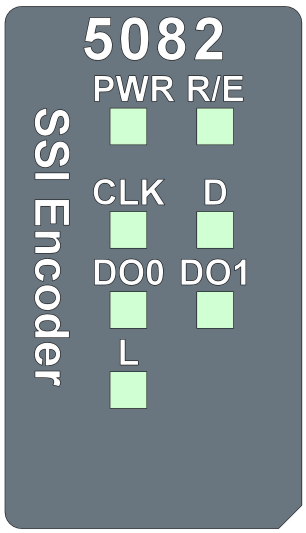


Figure 6.42 AMAX-5082 Module LED Indicator

Table 6.32: AMAX-5082 Module LED Indicator

LED	Colour	Behaviour	Indication
PWR	Green	ON	Power on
	Orange	ON	Locating module
R/E	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
	Red	ON	Module Abnormal [1]
		Blink	
CLK	Green	ON	Encoder clock signal input
		OFF	No signal
D	Green	ON	Encoder data signal input
		OFF	No signal
DO0	Green	ON	Compare out 0
DO1	Green	ON	Compare out 1
L	Green	ON	Latch input

[1]: The cause may be a disconnection or malfunction of the previous (on the left of this module) or this module. Please contact Advantech RMA Centre for further assistance.

6.3.3 Pin Definition

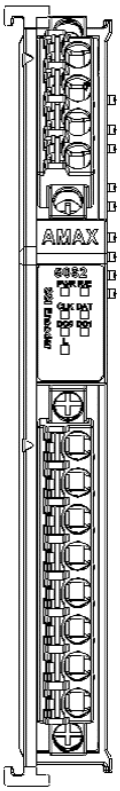


Figure 6.43 AMAX-5082 Module Front View

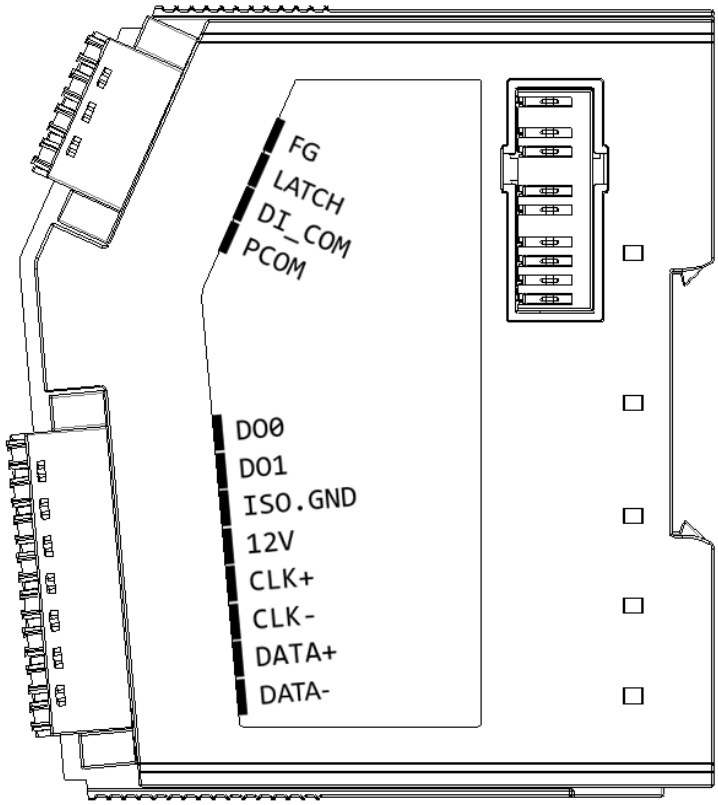


Figure 6.44 AMAX-5082 Module Side View

Table 6.33: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	FG
2	LATCH
3	DI_COM
4	PCOM

Table 6.34: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DO0
2	DO1
3	ISO.GND
4	12V
5	CLK+
6	CLK-
7	DATA+
8	DATA-

6.3.4 Application Wiring

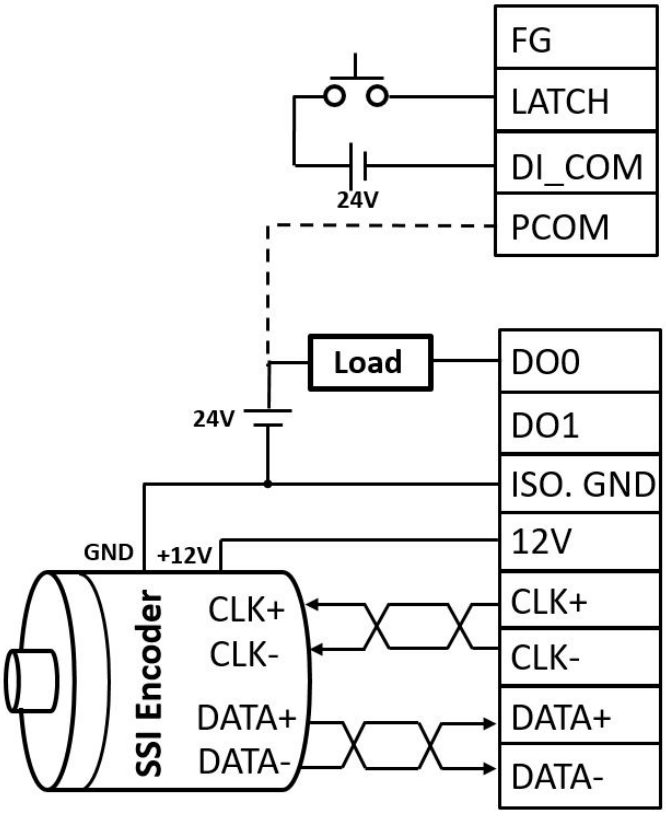


Figure 6.45 Wiring for AMAX-5082

6.3.5 Circuit Layout

6.3.5.1 SSI Input

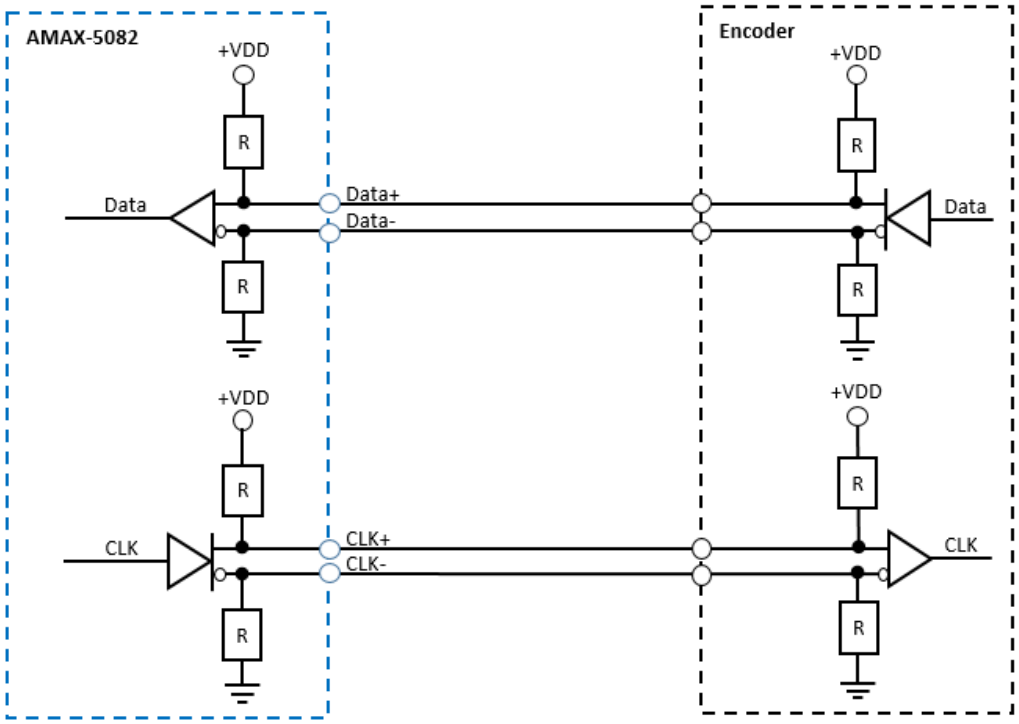
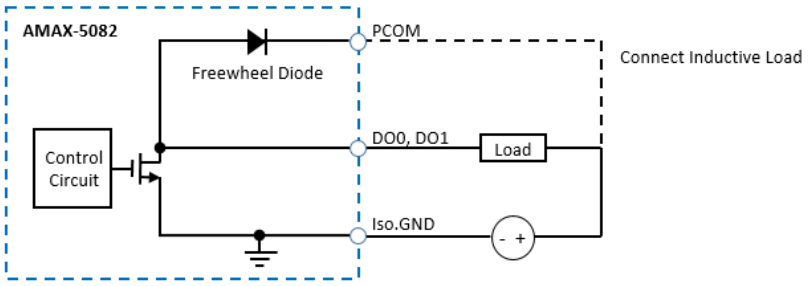


Figure 6.46 AMAX-5082 SSI Input

6.3.5.2 Digital Output



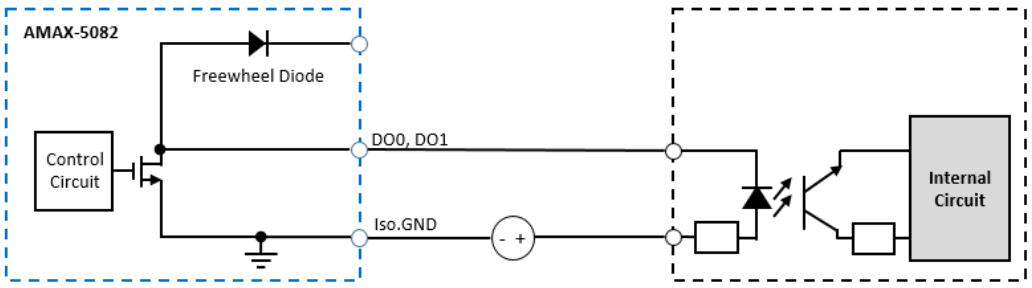


Figure 6.47 AMAX-5082 Digital Output

6.3.5.3 Latch Input

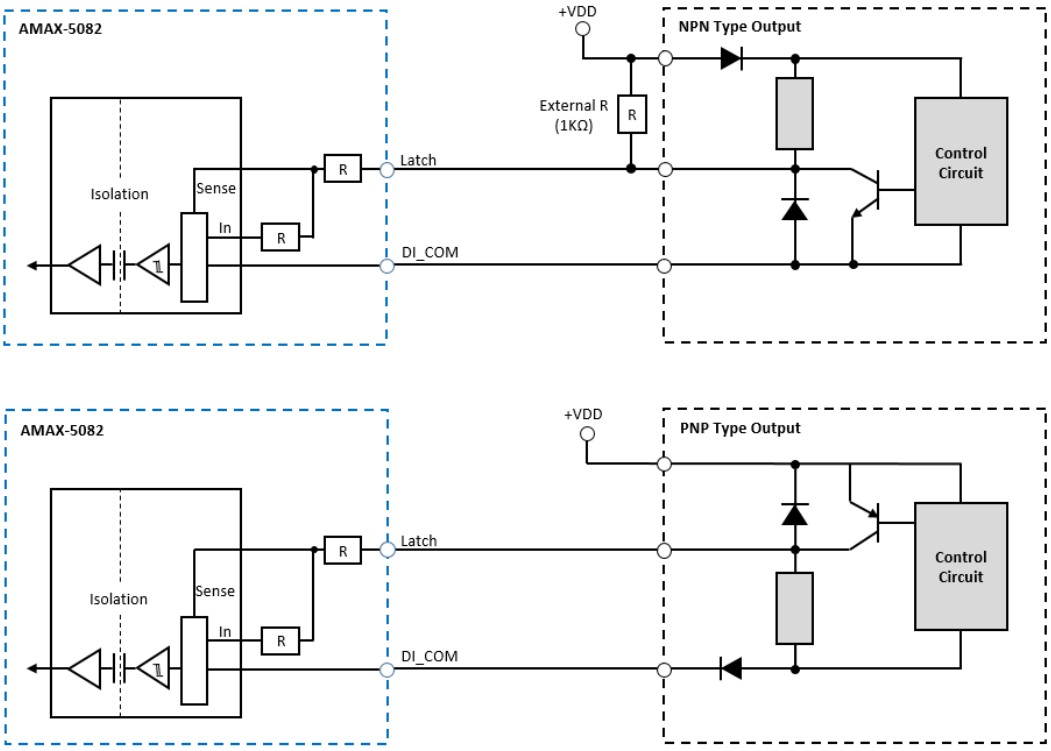


Figure 6.48 AMAX-5082 Latch Input

6.3.6 AMAX-5082 PDO Configuration

The AMAX-5082 supports latch and compare features, the PDO assignment should be defined on your EtherCAT MDevice utility. The corresponding pair of the PDO content is required before using the AMAX-5082. (Please refer to PDO assignment (0x1C10 - 0x1C13)).

For example, if you're using the **position measurement + compare output** feature, please select **0x1601** for **SM2** and **0x1A02** for **SM3**. In this way, the related PDO will be added. Figures below show how PDO should be assigned on CODESYS when using the compare output.

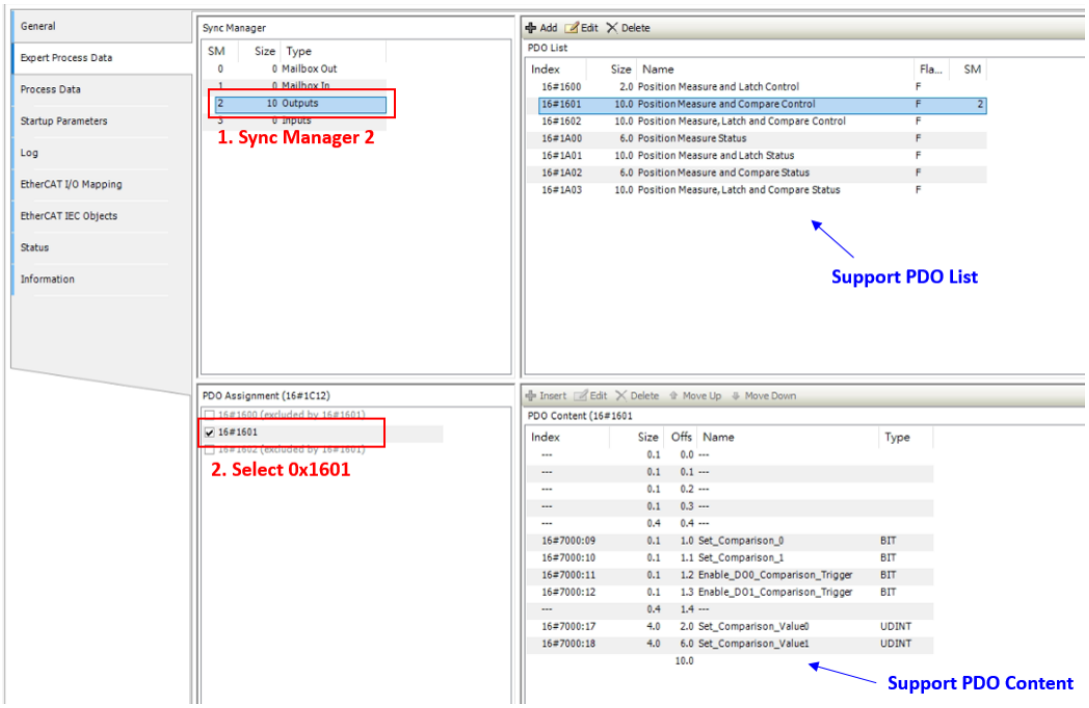


Figure 6.49 PDO assignment for SM2 - CODESYS interface

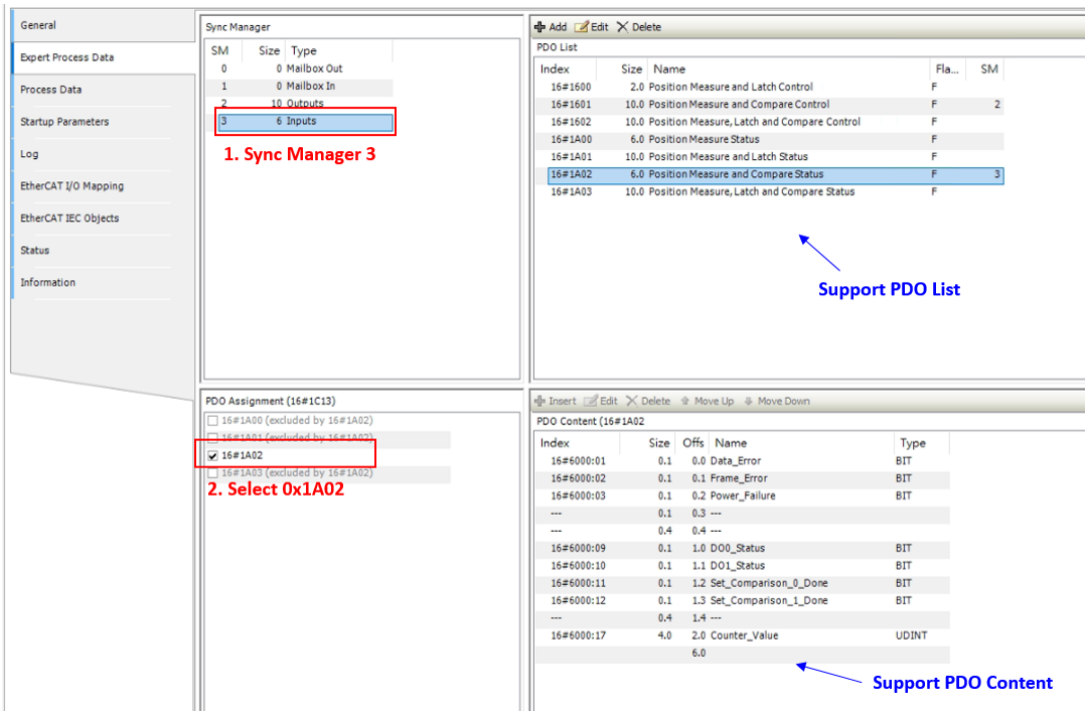


Figure 6.50 PDO assignment for SM3 - CODESYS interface

The following table shows how to select PDO assignment for different modes:

Table 6.35: PDO assignment for different modes		
Name	**SM2**	**SM3**
Position Measurement	X	0x1A00
Position Measurement + Latch	0x1600	0x1A01
Position Measurement + Compare	0x1601	0x1A02
Position Measurement + Latch + Compare	0x1602	0x1A03

6.3.7 SSI Principle

Synchronous Serial Interface (SSI) is a widely used serial interface for industrial applications between a MDevice and a SubDevice. The MDevice (AMAX-5082) sends a repetitive clock pulse (CLK+, CLK-) to the SubDevice (e.g. rotary encodes), and the SubDevice sends back datagram (D+, D-) correspondingly.

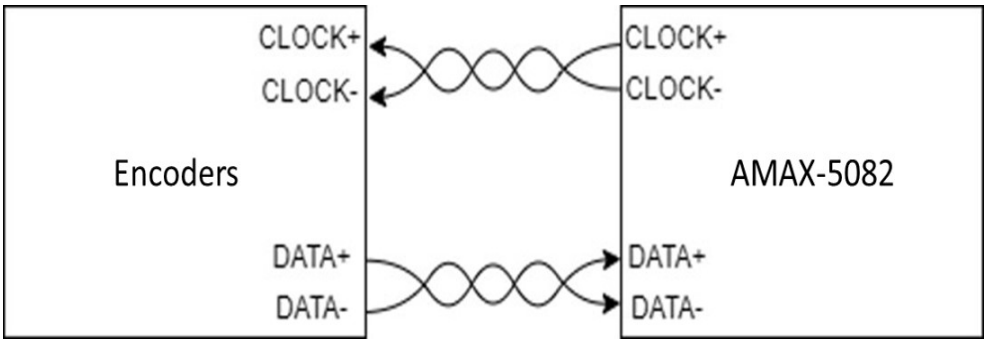


Figure 6.51 SSI block diagram

6.3.8 AMAX-5082 Encoder Features

6.3.8.1 SSI Encoder Settings and Diagnostic Information

There are few settings need to be done before you use AMAX-5082. Thus, the correct encoder's counter value can be read at **Counter_Value (0x6000:11)**.

Table 6.36: Counter Value (0x6000:11)	
Name	**Index**
Counter_Value	0x6000:11

SSI Coding

Dual (Binary) and Gray code are both supported by AMAX-5082, the default is Gray code.

Table 6.37: SSI Coding Value (0x8000:04)	
Name	**Index**
SSI_Coding	0x8000:04

Baudrate

The maximum data rate of SSI communication is related to the resolution and the cable length, AMAX-5082 support 4 sets of Baudrate settings: 2MHz, 1.5MHz, 1MHz and 500kHz.

Table 6.38: Baud Rate Value (0x8000:05)	
Name	**Index**
SSI_Baudrate	0x8000:05

Resolution

The SSI encoder's resolution is decided by the sum of the single-turn and multi-turn resolution. The AMAX-5082 will interpret the datagram from encoder by the setting of SSI_Sum_Multi-turn_Single-turn between 8 ~ 32 bits.

Table 6.39: Resolution Value (0x8000:06)	
Name	**Index**
SSI_Sum_Multi-turn_Single-turn	0x8000:06

Inhibit Time

The inhibit time is the interval that the AMAX-5082 generates the clock pulse sets, which also means the update rate of the counter's value in the SubDevice module. But one thing to be noticed, the counter's update rate also restrict by Baudrate, resolution and the monoflop time(Refer to the tm in the figure below), so the inhibit time will auto adjust to the minimum required time in order to get the complete datagram.

Table 6.40: Inhibit Time Value (0x8000:03, 0x8000:08)	
Name	**Index**
SSI_Inhibit_Time	0x8000:03
SSI_Inhibit_Time_Value	0x8000:08

Data Error

If the CLK line drop-out, the encoder's DATA line will stay at high level, which means the AMAX-5082 will receive 0xFFFF…. In this case, the **Data_Error (0x6000:01)** status will be raised.

Table 6.41: Data Error (0x6000:01)	
Name	**Index**
Data_Error	0x6000:01

Frame Error

When one complete datagram is transited, the Data line should be pulled to low level for 20us after the last CLK is sent (Refer to the tp in the diagram below). If the Data is not at low level in this period, the **Frame_Error (0x6000:02)** will be raised.

Table 6.42: Frame Error Value (0x8000:01, 0x6000:02)	
Name	**Index**
SSI_Frame_Error	0x8000:01
Frame_Error	0x6000:02

Power Failure

If the power failure detection is enabled, the AMAX-5082 will interpret the LSB as the power failure bit(s).

Table 6.43: Power Failure Value (0x8000:02, 0x8000:07, 0x6000:03)	
Name	**Index**
SSI_Power_Failure_Bit	0x8000:02
SSI_Error_Bit_Length	0x8000:07
Power_Failure	0x6000:03

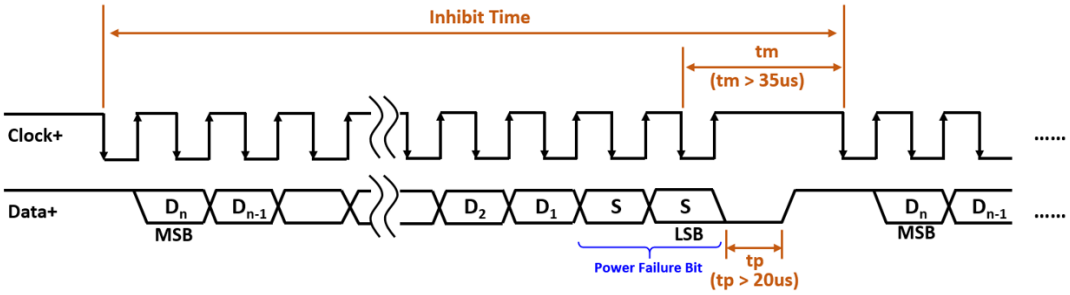


Figure 6.52 AMAX-5082 SSI Data Transmission

6.3.8.2 Latch Function

The counter values of encoder can be latch by an external signal at AMAX-5082 latch input pin. The latched counter value can be read at **Latch_Value (0x6000:12)**. The active polarity (Rising or Falling edge-triggered) of latch input signal can also be configured.

Below example shows how to latch the counter value by an external signal at rising edge:

Step 1: Enable rising edge-triggered at the address **Enable_Latch_Rising (0x7000:02)** (***Enable_Latch_External_Falling (0x7000:04)** for falling edge triggered)

Step 2: When the external latch signal is arrived, the **External_Latch_Valid (0x6000:04)** will be raised to high accordingly, which means the counter value is successfully latched by the module.

Step 3: Then, the latch values can be read at **Latch_Value (0x6000:12)**

Step 4: Before next latch signal arrives, the **Enable_Latch_External_Rising (0x7000:02)** should be toggled once to clear the **External_Latch_Valid (0x6000:04)** status.

Step 5: Once the **External_Latch_Valid (0x6000:04)** bit is low, the module is ready for the next latching signal.

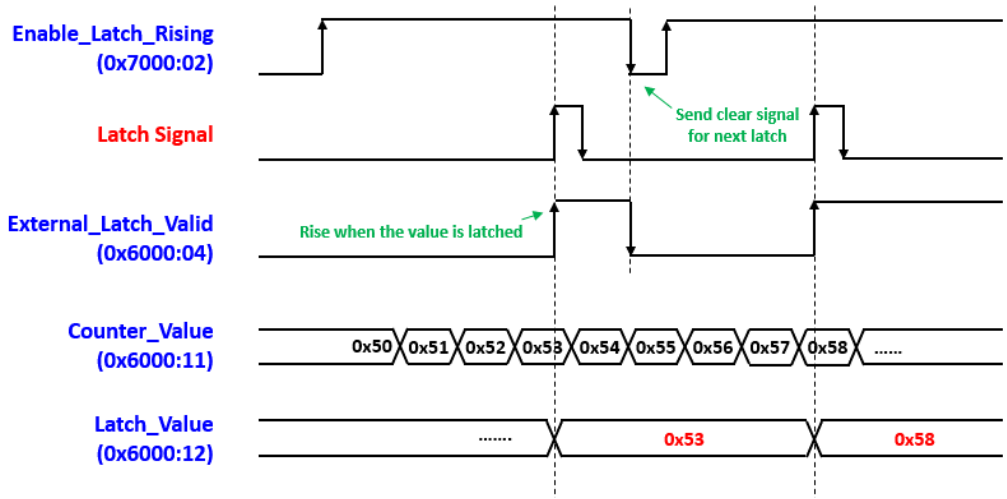


Figure 6.53 Latch Counter by Latch pin

Blue means the 0x6000, 0x7000, 0x8000 parameters.
Red means the external input signal.

The AMAX-5082 module requires processing time to interpret SSI datagram, so the encoder's actual position, counter value and the latch captured value might slightly different.

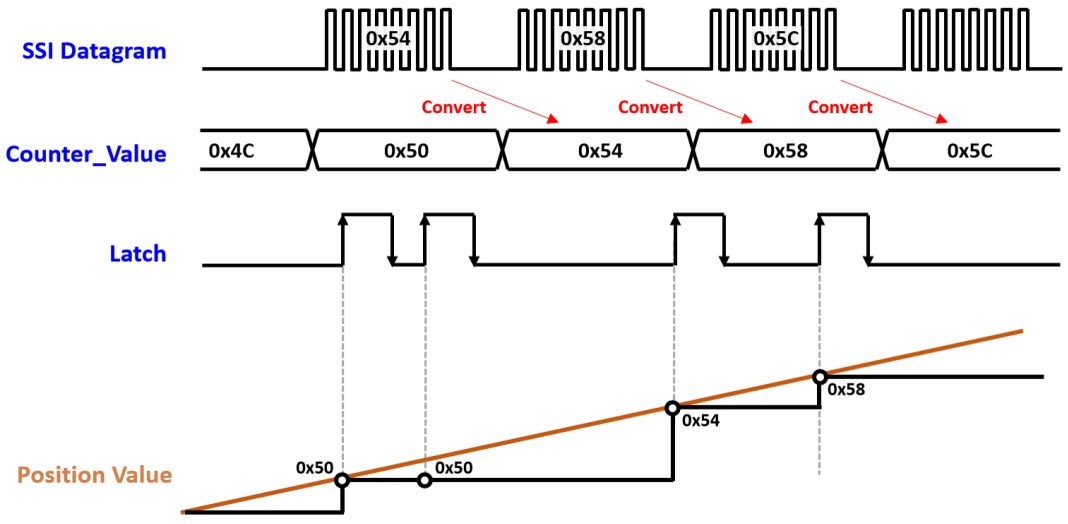


Figure 6.54 Latch Capture Value

In addition, latch input also supports digital filter with following options, it can be selected in the address of **Latch_Input_Filter_Time (0x8000:09).**

Table 6.44: Latch Input Filter Time		
Item Name	**Frequency**	**Value**
Disable	Disable	0x0000
0.3 us	1.32 MHz	0x0001 (Default)
0.6 us	654 KHz	0x0002
1.2 us	370 KHz	0x0003
2.4 us	197 KHz	0x0004
3.6 us	134 KHz	0x0005
4.8 us	101 KHz	0x0006
7.2 us	68 KHz	0x0007
9.6 us	51 KHz	0x0008
14.4 us	34 KHz	0x0009
19.2 us	26.1 KHz	0x000A
28.8 us	17.4 KHz	0x000B
38.4 us	13.1 KHz	0x000C

All related configurable parameters for latch counter are listed below:

Table 6.45: Latch Counter Configurable Parameters	
Name	**Index**
External_Latch_Valid	0x6000:04
Counter_Value	0x6000:11
Latch_Value	0x6000:12
Enable_Latch_Rising	0x7000:02
Enable_Latch_Falling	0x7000:04
Latch_Input_Filter_Time	0x8000:09

6.3.8.3 Position Compare Output

AMAX-5082 has two different type of position compare output modes corresponding to DO0 and DO1 output pins, and these two compare output modes can be worked at the same time.

DO0 Comparison function

There are two DO0 output criteria for **DO0 comparison function**:

1. The **Counter_Value (0x6000:11)** falls in the area between the **low limit value** to the **Set_Comparison_Value0 (0x7000:11)**.

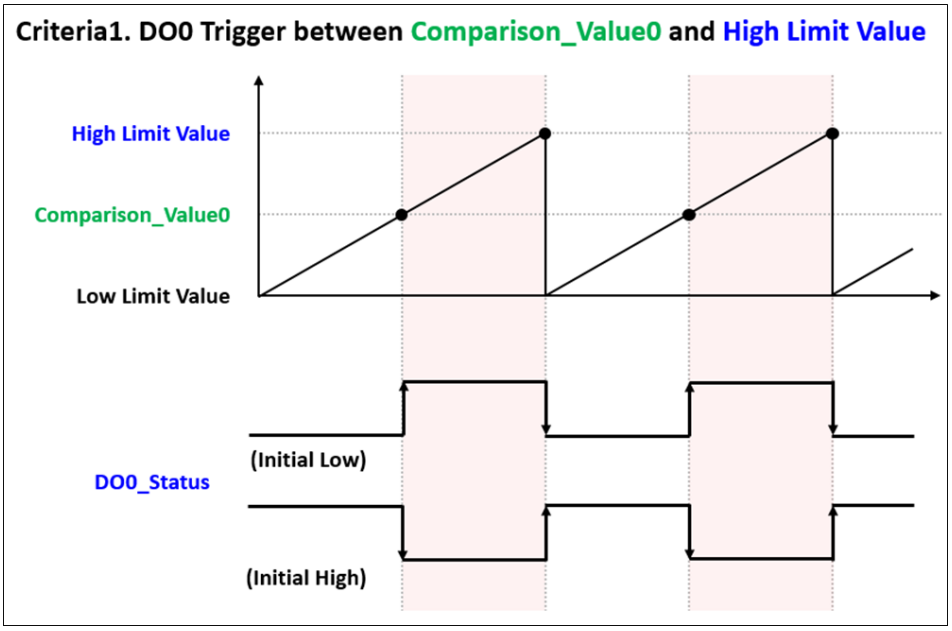


Figure 6.55 AMAX-5082 DO0 Comparison Function Criteria1

2. The **Counter_Value (0x6000:11)** falls in the area between the **Set_Comparison_Value0 (0x7000:11)** to the **high limit value**.

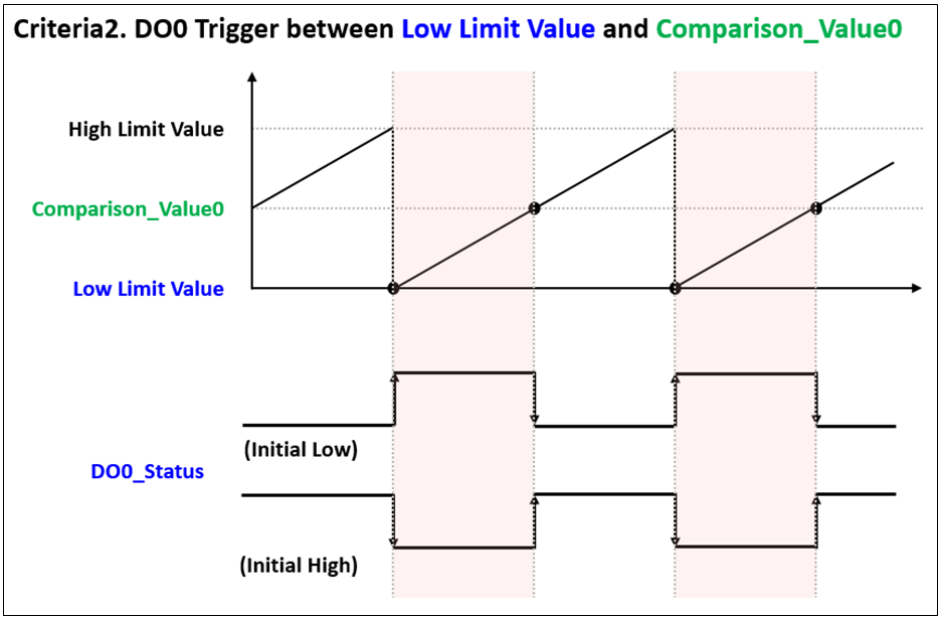


Figure 6.56 AMAX-5082 DO0 Comparison Function Criteria2

* The **low limit value** is **0**, and the **high limit value** is the **fall scale range** of the **SSI_Sum_Multi-turn_Single-turn (0x8000:06)**.

(e.g. if the overall resolution of encoder is 16 bits, then the high limit value is 6,5535)

The following steps is the example of using **DO0 Comparison function**:

Step 1: Set **DO0_Output_Trigger_Mode (0x8000:0A)** to **0**, which means the DO0 will be triggered when the counter value is between comparison value0 and low limit.

Step 2: Set **DO0_Output_Polarity(0x8000:0B)** to **0**, which means DO0's status is initial low, and will be pushed to high when it is triggered.

Step 3: Set **Comparison_Value0 (0x7000:11)** to a number between **0** and **encoder resolution**. Take **0x03** as an example.

Step 4: Set **Set_Comparison_0 (0x7000:09)** to **1** to assign comparison value to the module, then the **Set_Comparison_0_Done (0x6000:0B)** will be raised to "true" correspondingly if the value is successfully assigned.

Step 5: Set **Enable_DO0_Comparison_Trigger (0x7000:0B)** to "1", then the position comparison will be started.

Step 6: When the counter value falls in the output criteria, the **DO0_Status (0x6000:09)** will be raised to 1 along with the DO0 output.

* Note: If users need to assign a new Comparison_Value0, just toggle **Set_Comparison_0** after the value is set.

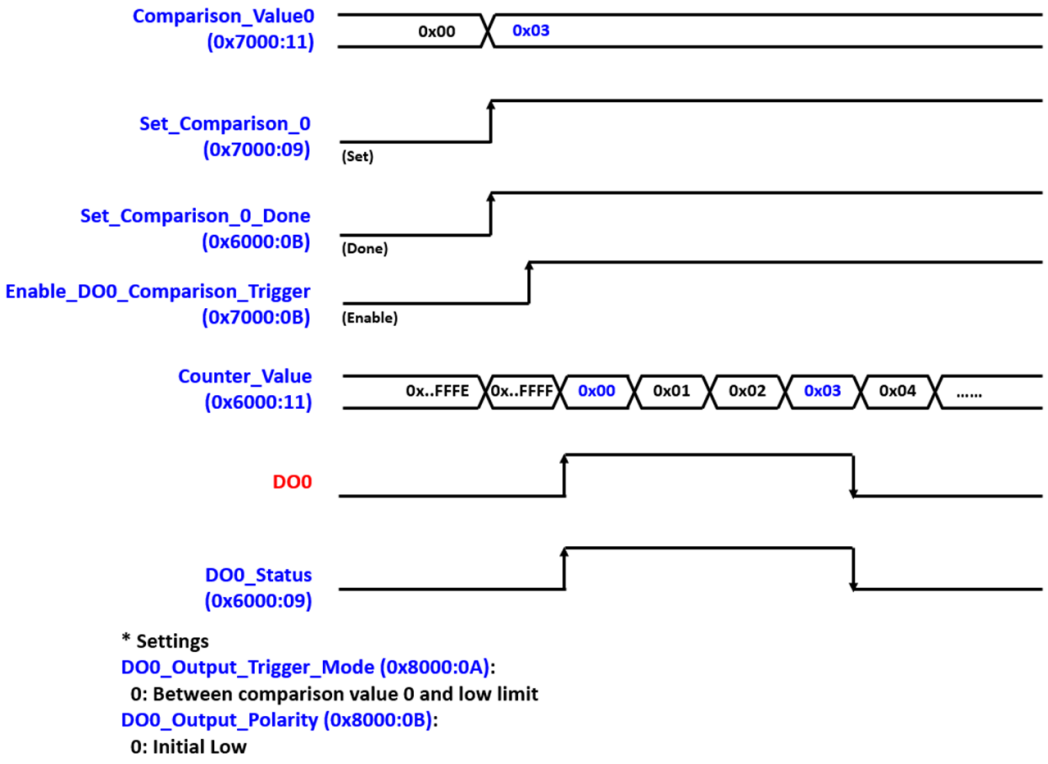


Figure 6.57 AMAX-5082 DO0 Comparison function - Timing Diagram Chart

Blue means the 0x6000, 0x7000, 0x8000 parameters.

Red means the physical output signal.

All related configurable parameters for **DO0 Comparison function** are listed below:

Table 6.46: DO0 Configurable Parameters	
Name	**Index**
DO0_Status	0x6000:09
Set_Comparison_0_Done	0x6000:0B
Counter_Value	0x6000:11
Set_Comparison_0	0x7000:09
Enable_DO0_Comparison_Trigger	0x7000:0B
Set_Comparison_Value0	0x7000:11
SSI_Sum_Multi-turn_Single-turn	0x8000:06
Comparison_DO0_Output_Trigger_Mode	0x8000:0A
Comparison_DO0_Output_Polarity	0x8000:0B

DO1 Comparison function

DO1 output criteria is simply to compare whether the **Counter_Value (0x6000:11)** is falls in the area between **Set_Comparison_Value0 (0x7000:11)** to **Set_Comparison_Value1 (0x7000:12).**

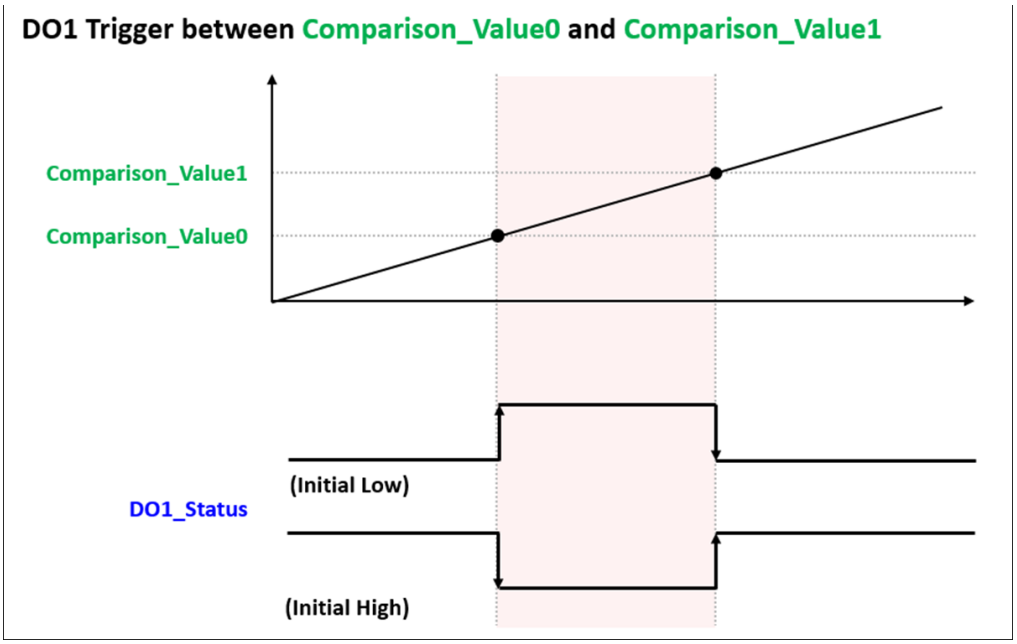


Figure 6.58 AMAX-5082 DO1 Comparison Function

The following steps is the example of using **DO1 Comparison function**:

Step 1: Set **DO1_Output_Polarity(0x8000:0C)** to **0**, which means DO1's status is initial low, and will be pushed to high when it is triggered.

Step 2: Set **Comparison_Value0 (0x7000:11)** and **Comparison_Value1 (0x7000:12)** to a number between **0** and **encoder resolution**. Take **0x03** and **0x06** as an example.

Step 3: Set **Set_Comparison_0 (0x7000:09)** and **Set_Comparison_1 (0x7000:0A)** to 1 to assign comparison value to the module, then the **Set_Comparison_0_Done (0x6000:0B)** and **Set_Comparison_1_Done (0x6000:0C)** will be raised to "true" correspondingly if the value is successfully assigned.

Step 4: Set **Enable_DO1_Comparison_Trigger (0x7000:0C)** to "1", then the position comparison will be started.

Step 5: When the counter value falls in the output criteria, the **DO1_Status (0x6000:0A)** will be raised to 1 along with the DO1 output.

* Note: If users need to assign new **Comparison_Value0** and **Comparison_Value1**, just toggle **Set_Comparison_0** and **Set_Comparison_1** after the value is set.

All related configurable parameters for **DO1 Comparison function** are listed below:

Table 6.47: DO0 Configurable Parameters

Name	Index
DO1_Status	0x6000:0A
Set_Comparison_0_Done	0x6000:0B
Set_Comparison_1_Done	0x6000:0C
Counter_Value	0x6000:11
Set_Comparison_0	0x7000:09
Set_Comparison_1	0x7000:0A
Enable_DO1_Comparison_Trigger	0x7000:0C
Set_Comparison_Value0	0x7000:11
Set_Comparison_Value1	0x7000:12
Comparison_DO1_Output_Polarity	0x8000:0C

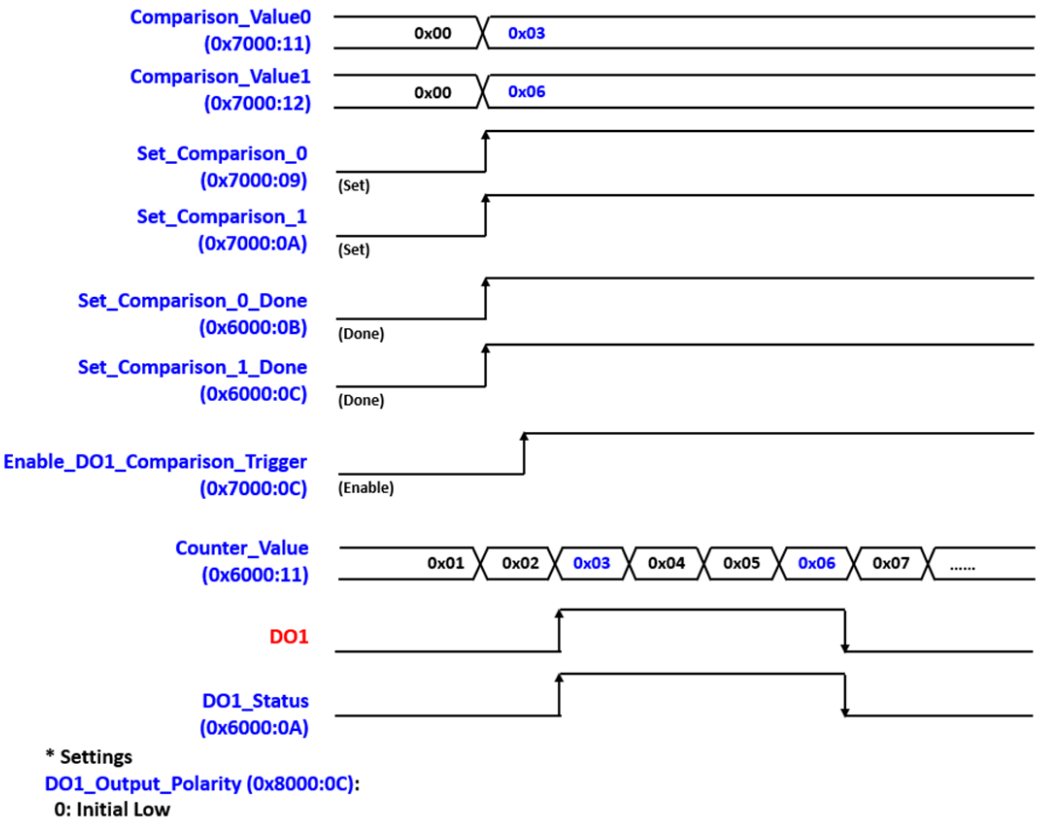


Figure 6.59 AMAX-5082 DO1 Comparison function - Timing Diagram Chart

Blue means the 0x6000, 0x7000, 0x8000 parameters.
Red means the physical output signal.

6.3.9 AMAX-5082 Object Dictionary

6.3.9.1 Input Data

Table 6.48: Input Data (0x6000:01 - 0x6000:12)

Index (hex)	Name	Meaning	Data type	Flags	Default value
0x6000:01	Data_Error[1]	Status of SSI data error 0: Data error do not occur. 1: Data error occur.	BOOL	RO	0x00
0x6000:02	Frame_Error[1]	Status of SSI frame error 0: Frame error do not occur.	BOOL	RO	0x00
0x6000:03	Power_Failure	Status of encoder power failure 0: Power failure do not occur. 1: Power failure occur.	BOOL	RO	0x00
0x6000:04	External_Latch_Valid	Status of valid external latch 0: invalid external latch. 1: valid external latch.	BOOL	RO	0x00
0x6000:09	DO0_Status	DO0 status of polarity 0: Pull low. 1: Pull high.	BOOL	RO	0x00
0x6000:0A	DO1_Status	DO1 status of polarity 0: Pull low. 1: Pull high.	BOOL	RO	0x00
0x6000:0B	Set_Comparison_0_-Done	Set comparison value 0 status 0: Not yet. 1: Done.	BOOL	RO	0x00
0x6000:0C	Set_Comparison_1_-Done	Set comparison value 0 status 0: Not yet. 1: Done.	BOOL	RO	0x00
0x6000:11	Counter_Value	Counter Value	UDINT	RO	0x0000 0000
0x6000:12	Latch_Value	Latch Value	UDINT	RO	0x0000 0000

[1]: For diagnosis, please refer to the next table “**Data and Frame Error Types Diagnosis**”

Table 6.49: Data and Frame Error Types Diagnosis		
Data_Error (0x6000:01)	**Frame_Error (0x6000:02)**	**Possible error type**
Fales	Fales	If bits are shifted in the counter value despite correct CoE parameterization, this may be to do with the clock lines being swapped
Fales	True	There is an incorrect data frame, the data frame was not concluded with zero or possibly - Wire breakage in the clock lines - Incorrect parameterization in the CoE
True	Fales	SSI input error: - SSI without power supply - Broken wire at SSI data inputs D+ or D- If no data communication takes place the SSI input of the terminal is on low level.
True	True	- Broken wire at SSI data inputs D+ or D- - Data cables interchanged

6.3.9.2 Output Data

Table 6.50: Output Data (0x7000:02 - 0x7000:12)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x7000:02	Enable_Latch_Rising	Enable Latch rising trigger. 0: Disable. 1: Enable.	BOOL	RW	0x00
0x7000:04	Enable_Latch_Falling	Enable latch falling trigger. 0: Disable 1: Enable	BOOL	RW	0x00
0x7000:09	Set_Comparison_0	Set comparison value 0. 0: Clear 1: Set	BOOL	RW	0x00
0x7000:0A	Set_Comparison_1	Set comparison value 1. 0: Clear. 1: Set.	BOOL	RW	0x00
0x7000:0B	Enable_DO0_Comparison_Trigger	Enable DO0 comparison function 0: Disable. 1: Enable.	BOOL	RW	0x00
0x7000:0C	Enable_DO1_Comparison_Trigger	Enable DO1 comparison function 0: Disable. 1: Enable.	BOOL	RW	0x00
0x7000:11	Set_Comparison_Value0	Set comparison value 0 0x00~0xFFFFFFFF	UDINT	RW	0x0000 0000
0x7000:12	Set_Comparison_Value1	Set comparison value 1 0x00~0xFFFFFFFF	UDINT	RW	0x0000 0000

6.3.9.3 SSI Configuration

Table 6.51: SSI Configuration (0x8000:01 – 0x8000:0C)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x8000:01	SSI_Frame_Error	Enable/Disable SSI frame error detection 0: Disable 1: Enable (default)	UINT	RW	0x0001
0x8000:02	SSI_Power_Failure_Bit	Enable/Disable SSI power failure bit detection 0: Disable (default) 1: Enable	UINT	RW	0x0000
0x8000:03	SSI_Inhibit_Time	Enable SSI inhibit time 0: Disable (default) 1: Enable	UINT	RW	0x0000
0x8000:04	SSI_Coding	Encoder coding type 0: Dual code (Binary code)1: Gray code (default)	UINT	RW	0x0001
0x8000:05	SSI_Baudrate	SSI baud rate 0: 2MHz 1: 1.5MHz 2: 1MHz (default) 3: 500kHz	UINT	RW	0x0002
0x8000:06	SSI_Sum_Multi-turn_S-ingle-turn	Encoder sum of single turn and multi-turn length 8~32: 8~32 bits	UINT	RW	0x0019
0x8000:07	SSI_Error_Bit_Length	Encoder error bit length 0: 1bit (default) 1: 2bits	UINT	RW	0x0000
0x8000:08	SSI_Inhibit_Time_Value	SSI interval time value 0x0000 (default) to 0xFFFF (1 count = 1us)	UINT	RW	0x0000
0x8000:09	Latch_Input_Filter_Time	Latch input filter time [1]	UINT	RW	0x0001
0x8000:0A	Comparison_DO0_Out-put_Trigger_Mode	Comparison DO0 output trig-ger mode 0: Between comparison value 0 and low limit (default) 1: Between comparison value 0 and high limit	UINT	RW	0x0000
0x8000:0B	Comparison_DO0_Out-put_Polarity	Comparison DO0 output ini-tial polarity 0: Initial Low (default) 1: Initial High	UINT	RW	0x0000
0x8000:0C	Comparison_DO1_Out-put_Polarity	Comparison DO1 output ini-tial polarity 0: Initial Low (default) 1: Initial High	UINT	RW	0x0000

[1]: Latch input filter time index please refer to the next table "**Latch Input Filter Time**".

Table 6.52: Latch Input Filter Time		
Item Name	**Frequency**	**Value**
Disable	Disable	0x0000
0.3 us	1.32 MHz	0x0001 (Default)
0.6 us	654 KHz	0x0002
1.2 us	370 KHz	0x0003
2.4 us	197 KHz	0x0004
3.6 us	134 KHz	0x0005
4.8 us	101 KHz	0x0006
7.2 us	68 KHz	0x0007
9.6 us	51 KHz	0x0008
14.4 us	34 KHz	0x0009
19.2 us	26.1 KHz	0x000A
28.8 us	17.4 KHz	0x000B
38.4 us	13.1 KHz	0x000C

6.3.9.4 Module Configuration

Table 6.53: SSI Module Configuration (0xF600:01)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0xF600:01	LocateModule	Locate LED control 0: Turn Off 1: Turn On	BOOL	RW	0x00

Chapter 7

Digital I/O Module w/ Timestamp

7.1 The Benefit of Time-stamping Digital I/O

7.1.1 The EtherCAT data transfer in cycle base

For the standard EtherCAT digital I/O module, PDO data is transferred cyclically, and the digital signal state is detected or set at a specific time in the cycle, which means the response of the I/O is restricted by the EtherCAT cycle time. There will be some limitations for both digital input and digital output in some application cases.

Take digital input as an example, if an external sensors response time is shorter than the EtherCAT cycle time, the input signal may not be detected. As shown below, if the EtherCAT cycle time is 1ms, and the sensor's input signal is 200µs for example, the sensors state change may be lost in this application (first pulse in the figure). Only the digital status at the moment of PDO data transfer can be detected (second pulse in the figure).

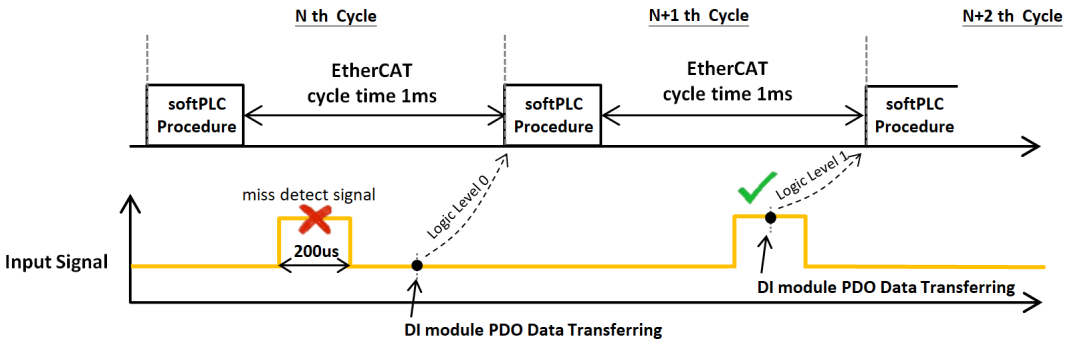


Figure 7.1 Standard Digital Input Module Signal Acquisition

Take digital output as another example, if two digital output modules are distributed to two different stations, when the MDevice sets an output signal to both modules, the actual output will have little time difference between two modules as shown in the figure below. Even though the time difference is smaller than a cycle time, it can be critical especially on the application which needs synchronized signal output.

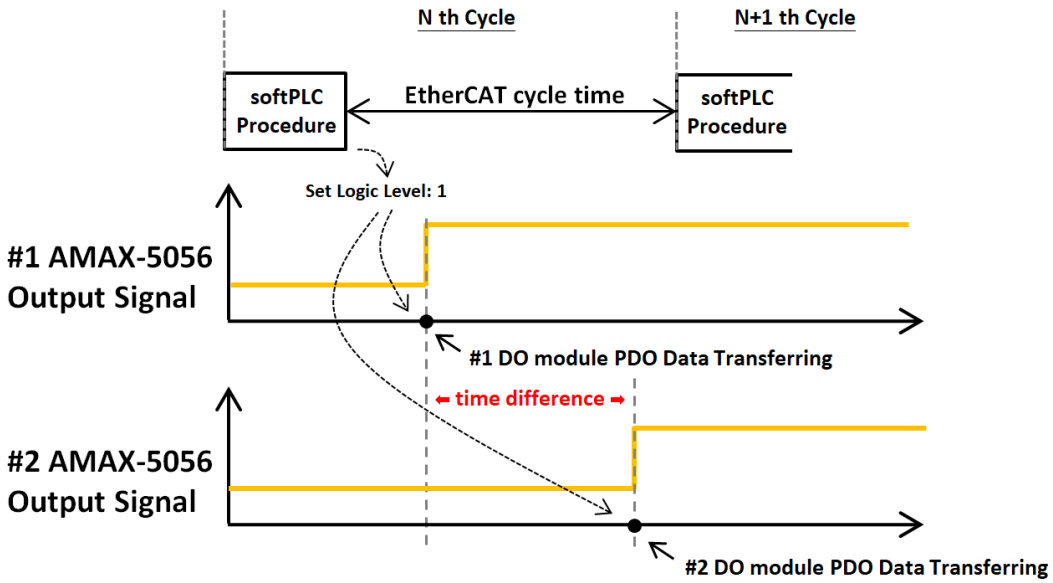


Figure 7.2 Standard Digital Output Module (SM mode)

Thus, shortening the EtherCAT cycle time is required for both scenarios. But most of the time, the limitation of the EtherCAT cycle time is restricted by the number of Sub-Device devices and the total data length of the PDOs and also, the minimum cycle times of the EtherCAT protocol which is about 100µs. Furthermore, shortening the EtherCAT cycle time will also increase the load of the MDevice controller since the data acquisition frequency is increased; the system resource will be occupied by the data acquisition tasks. Therefore, a time-stamping function for digital IO modules has been designed for these advance applications.

7.1.2 The EtherCAT data transfer in time base

Benefiting from the EtherCAT distributed clock mechanism, all EtherCAT SubDevice are able to synchronize to MDevice controller's system time in a 64-bits timestamp value with a resolution of 1ns. (The timestamp format is starting from 1.1.2000 00:00)

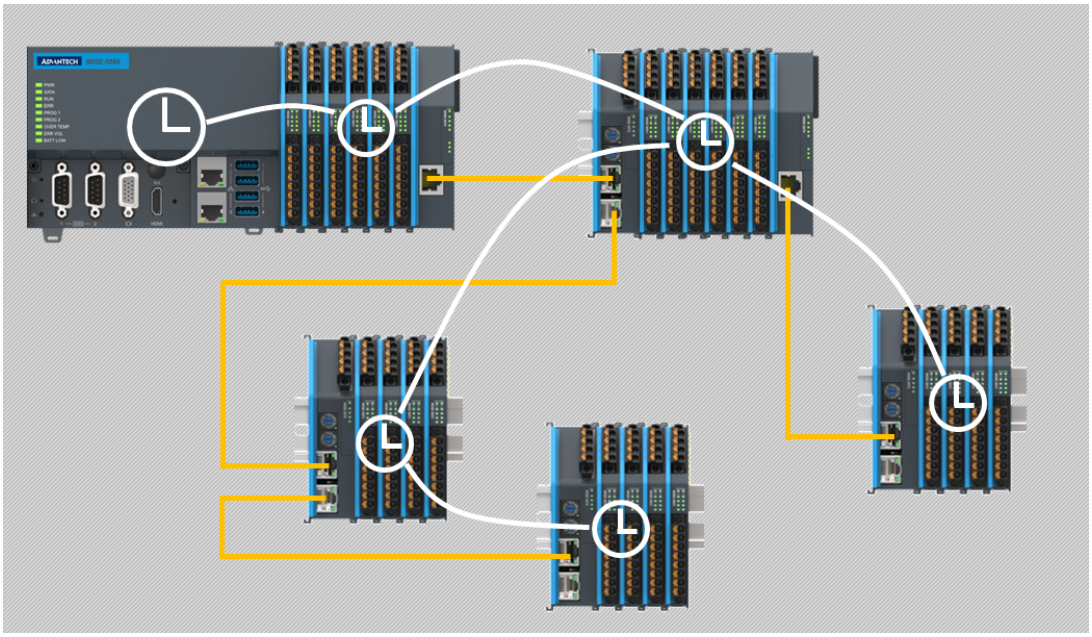


Figure 7.3 EtherCAT Distributed Clock

The time-stamped digital input/output signal transfers data via the EtherCAT bus, which makes the data exchange more precise and easier from the PLC cycle.

Digital Input with Timestamp

In order to latch the input signal, the digital input module contains a set of parameters to record the precise timestamp for each rising-edge (th) and falling-edge (tl).

One thing to be noticed, is that there is only one set of timestamp can be stored in the module, so the user should select the latching mode: Single Event or Continuous (default).

The Single Event mode only latches the first rising-edge and falling-edge timestamp and ignores any state change afterward. The Continuous mode will continuously update the latest timestamp of state change.

Each rising-edge (th) and falling-edge (tl) can be set to Single Event mode or Continuous mode independently.

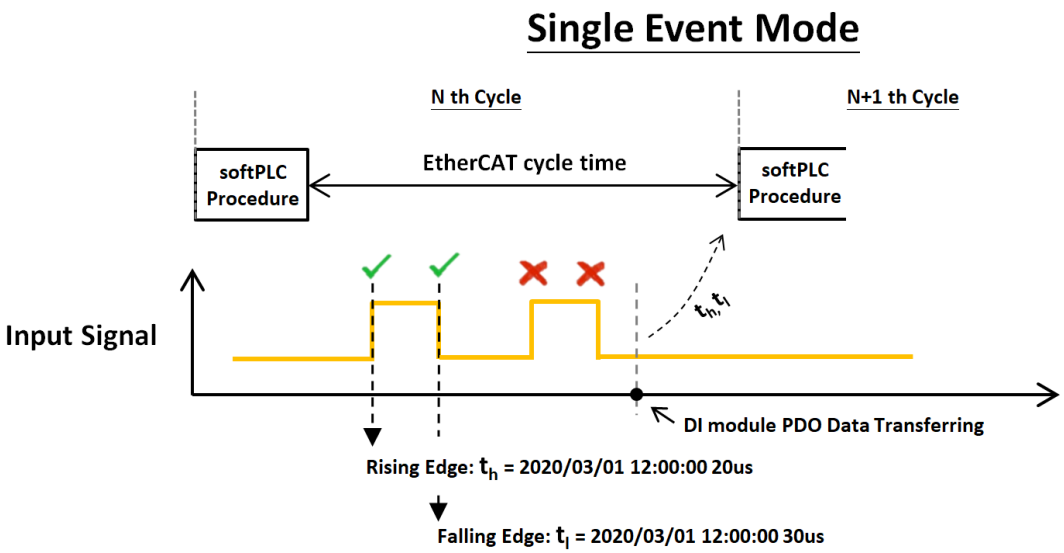


Figure 7.4 Digital Input with Timestamp - Single Event Mode

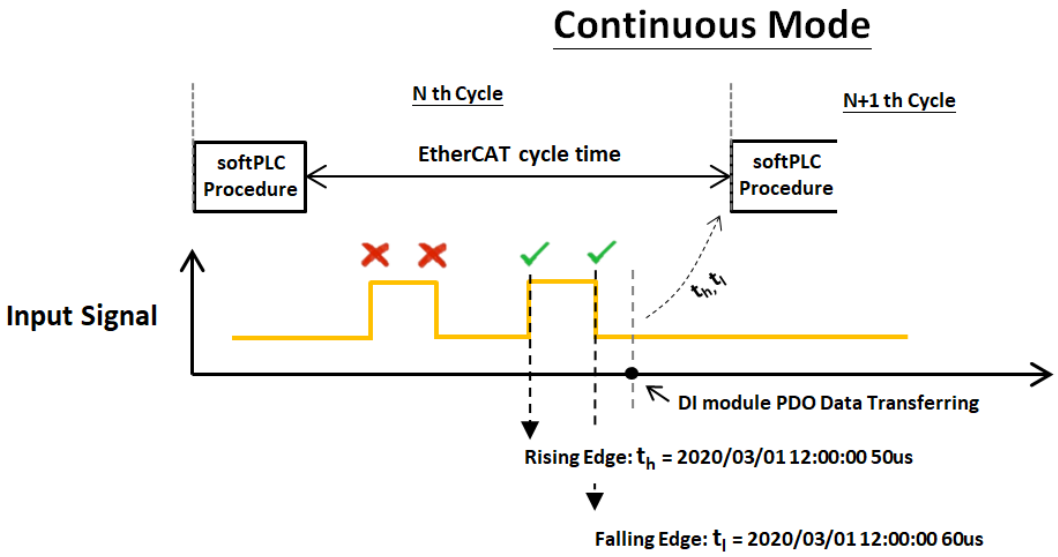


Figure 7.5 Digital Input with Timestamp - Continuous Mode

Digital Output with Timestamp

By setting Start Time and Activation to the time-stamping digital output module, the preset logic level will be activated at any specific time of the cycle as figure below. With this characteristic, the possibility of synchronizing multiple output signals can be realized.

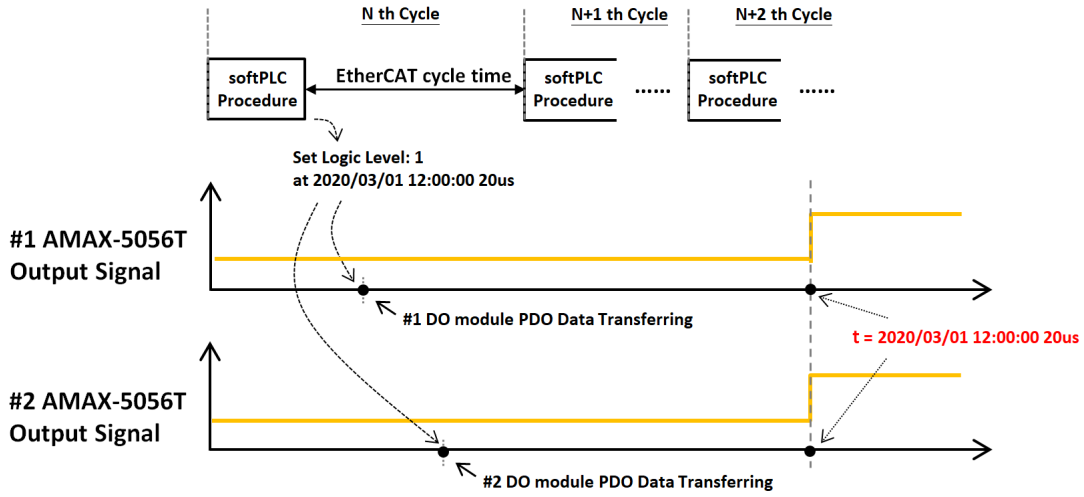


Figure 7.6 Digital Output with Timestamp

To sum up, these are the major benefits of using time-stamp technology on EtherCAT IO modules:

- Enabling the precise and deterministic IO responses.
- Releasing the data process from cycle base to time base, increasing the flexibility of cycle time of whole system.
- Reduces processor loading by reducing the data acquisition frequency.

7.2 AMAX-5051T 8-ch Digital Input Module (w/ 2-ch timestamp)

The AMAX-5051T is an 8-ch digital input module (including 2-ch timestamp DI). The timestamp enables a precise and deterministic DI latching at a resolution of 1ns. The digital input channels offer LED to indicate digital status. The module provides 2,000 VDC optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 7.7 AMAX-5051T Module

7.2.1 AMAX-5051T Specification

7.2.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, RUN, DI status
- **Weight:** Approx. 80g

7.2.1.2 Digital Input (w/ timestamp)

- **Channels:** 2 (DI0_TS~DI1_TS)
- **Digital Input:**
  - Wet Contact (only):
    Logic level 1: 11~30 V_{DC}
    Logic level 0: -3~5 V_{DC}
    (similar to EN 61131-2, type 3)
- **Input Delay:** < 0.5 us
- **DI Latch:** First Edge & Last Edge DI Latch
- **Resolution Timestamp:** 1ns
- **Typical Input Current:** Logic level 1: 1.4mA~4.3mA (11V~30V)

7.2.1.3 Digital Input (w/o timestamp):

- **Channels:** 6 (DI2~DI7)
- **Digital Input:**
  - Dry Contact:
    Logic level 1: close to Iso.GND
    Logic level 0: open
  - Wet Contact:
    Logic level 1: 11~30 V_{DC}
    Logic level 0: -3~5 V_{DC}
    (similar to EN 61131-2, type 3)
- **Input Delay:** < 10us
- **Typical Input Current:** Logic level 1: 1.4mA~4.3mA (11V~30V)

7.2.1.4 Protection

Isolation Voltage: 2,000V_{DC}

7.2.1.5 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

7.2.2 LED Indicator

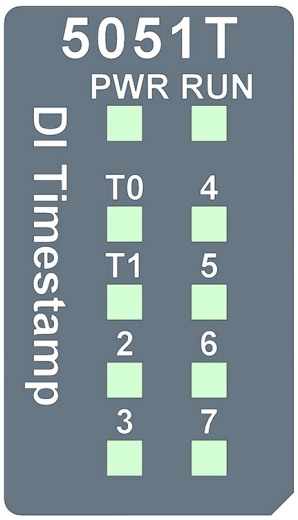


Figure 7.8 AMAX-5051T Module LED Indicator

Table 7.1: AMAX-5051T Module LED Indicator			
LED	**Colour**	**Behaviour**	**Indication**
PWR	Green	ON	Power On
	Orange	ON	Locating odule
RUN	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
T0~1 (Time Stamp)	Green	ON	Wet Logic “1”
		OFF	Wet Logic “0”
DI2~7	Green	ON	Dry/Wet Logic “1”
		OFF	Dry/Wet Logic “0”

7.2.3 Pin Definition

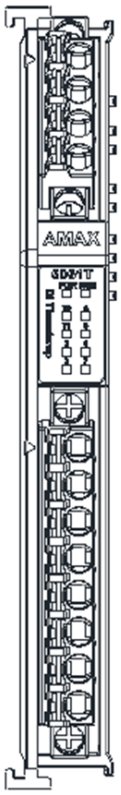


Figure 7.9 AMAX-5051T Module Front View

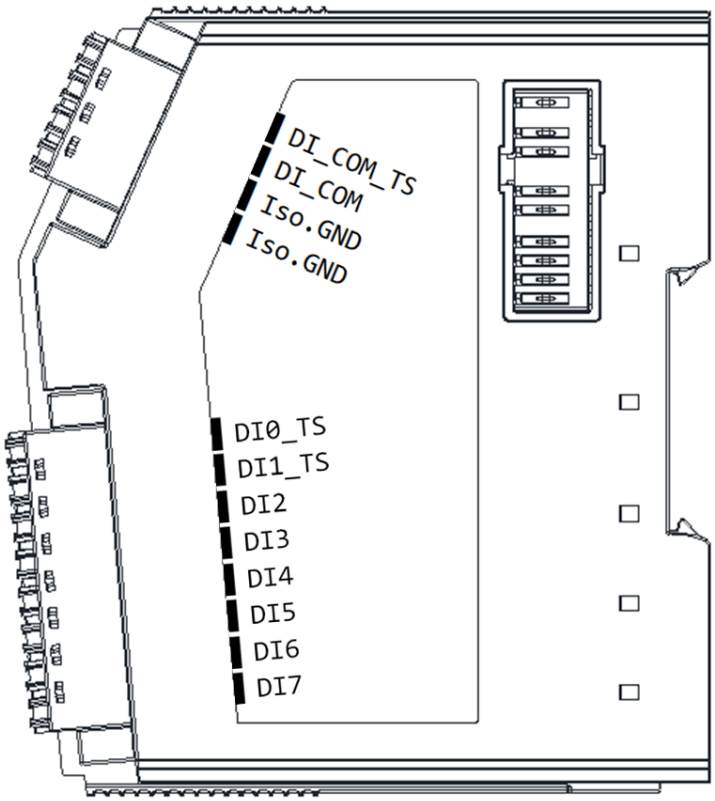


Figure 7.10 AMAX-5051T Module Side View

Table 7.2: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI_COM_TS
2	DI_COM
3	Iso.GND
4	Iso.GND

Table 7.3: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI0_TS
2	DI1_TS
3	DI2
4	DI3
5	DI4
6	DI5
7	DI6
8	DI7

7.2.4 Application Wiring

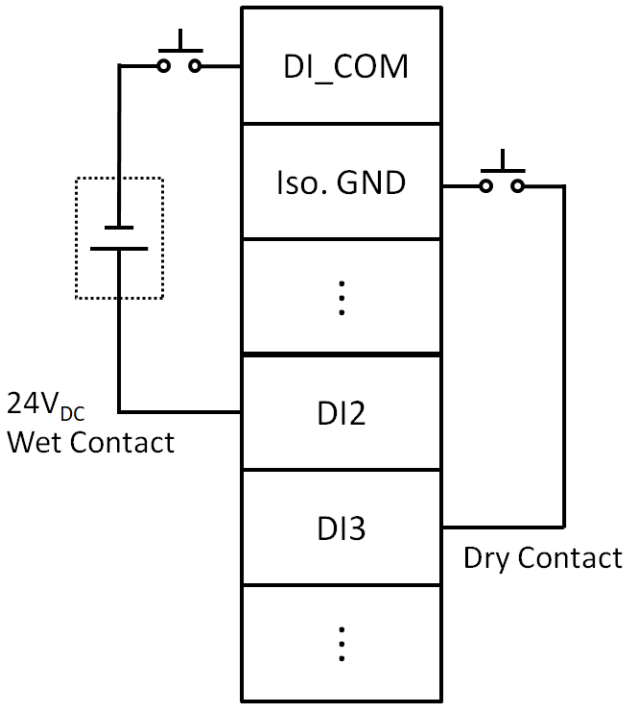


Figure 7.11 Wiring for AMAX-5051T standard DI

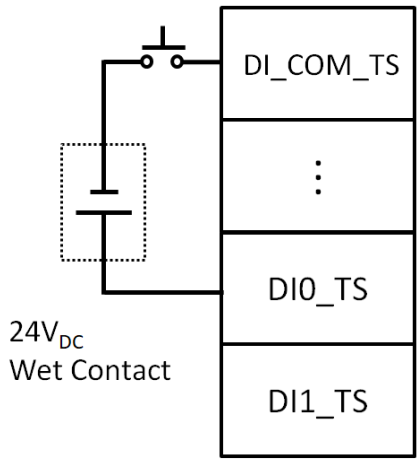


Figure 7.12 Wiring for AMAX-5051T timestamp DI

7.2.5 AMAX-5051T Object Dictionary

7.2.5.1 Time Stamp Input Data

Table 7.4: Input Data (0x1D09)

Index (hex)	Name	Meaning	Data type	Flags	Default value
1D09:10	SysTime	32bit/64bit System Time	UDINT	RO	0x00
1D09:AE	Status0[1]	Timestamp DI0 latch status Logic level 0: 0x00 Logic level 0 to 1: 0x01 Logic level 1: 0x01 Logic level 1 to 0: 0x02	USINT	RO	0x00
1D09:AF	Status1[1]	Timestamp DI1 latch status Logic level 0: 0x00 Logic level 0 to 1: 0x01 Logic level 1: 0x01 Logic level 1 to 0: 0x02	USINT	RO	0x00
1D09:B0	LatchPos0[2]	The time of the first/last rising signal edge of DI0	ULINT	RO	0 Dec
1D09:B8	LatchNeg0[3]	The time of the first/last falling signal edge of DI0	ULINT	RO	0 Dec
1D09:C0	LatchPos1[2]	The time of the first/last rising signal edge of DI1	ULINT	RO	0 Dec
1D09:C8	LatchNeg1[3]	The time of the first/last falling signal edge of DI1	ULINT	RO	0 Dec

[1]: The status0 and status1 are the change record of timestamp DI0 and DI1 within a cycle, only SingleEventMode will change the status. The statuses are displayed only in one EtherCAT cycle, the read of LatchPos and LatchNeg resets the status 0/1.

[2]: The LatchPos0/1 is the time of the first/last rising edge, depending on the setting of SingleEventMode or ContinuousMode.

[3]: The LatchNeg0/1 is the time of the first/last falling edge, depending on the setting of SingleEventMode or ContinuousMode. The time of LatchPos/LatchNeg is presented in the form of 64-bit timestamp.

7.2.5.2 Input Data

Table 7.5: Input Data (0x6000:01 - 0x6000:08)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x6000:01	DI0	Digital Input Channel 0	BOOL	RO	0x00
0x6000:02	DI1	Digital Input Channel 1	BOOL	RO	0x00
0x6000:03	DI2	Digital Input Channel 2	BOOL	RO	0x00
0x6000:04	DI3	Digital Input Channel 3	BOOL	RO	0x00
0x6000:05	DI4	Digital Input Channel 4	BOOL	RO	0x00
0x6000:06	DI5	Digital Input Channel 5	BOOL	RO	0x00
0x6000:07	DI6	Digital Input Channel 6	BOOL	RO	0x00
0x6000:08	DI7	Digital Input Channel 7	BOOL	RO	0x00

7.3 AMAX-5056T 2-ch Timestamp Digital Output Module

The AMAX-5056T is a 2-ch timestamp digital output module. The timestamp enables a precise DO sync. at a resolution of 1ns. The digital output channels offer LED to indicate digital status. The module provides 2,000 VDC optical isolation between channels. If any high voltage or current damages the channels, the whole system (other modules, and control unit) won't be affected because it is already isolated.

Figure 7.13 AMAX-5056T Module

7.3.1 AMAX-5056T Specification

7.3.1.1 General

- **Certification:** CE, FCC class A
- **Connector:** Pluggable 4P+8P push-in terminal (#24~16 AWG)
- **Module Enclosure:** Polycarbonate
- **Power Consumption:** 2W @ $24V_{DC}$
- **Protocol:** EtherCAT
- **Transmission Rate:** 100Mbps
- **LED Indicator:** PWR, RUN, DO status
- **Weight:** Approx. 80g

7.3.1.2 Timestamp Digital Output

- **Channels:** 2
- **Digital Output:**
  - Rated Voltage:
    10~30 VDC
  - Rated Current Output:
    Logic level 1: 0.3A per channel
    Logic level 0: 25 μA per channel (leakage current)
- **Output Delay:** < 0.5 us
- **Resolution Timestamp:** 1ns

7.3.1.3 Protection

Isolation Voltage: 2,000V_{DC}

7.3.1.4 Environment

- **Operation Temperature:** -25~60°C (vertical mounted)
- **Storage Temperature:** -40~85°C
- **Relative Humidity:** 5~95% (non-condensing)

7.3.2 LED Indicator

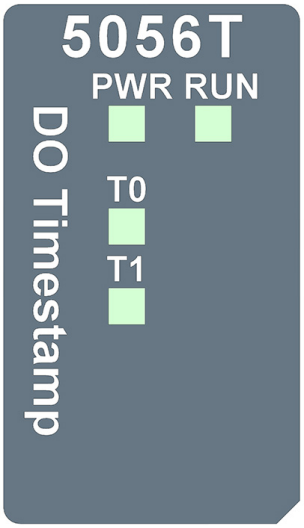


Figure 7.14 AMAX-5056T Module LED Indicator

Table 7.6: AMAX-5056T Module LED Indicator

LED	Colour	Behaviour	Indication
PWR	Green	ON	Power On
	Orange	ON	Locating module
RUN	Green	ON	EtherCAT connected
		Blink	EtherCAT connecting
T0~1 (Time Stamp)	Green	ON	Wet Logic "1"
		OFF	Wet Logic "0"

7.3.3 Pin Definition

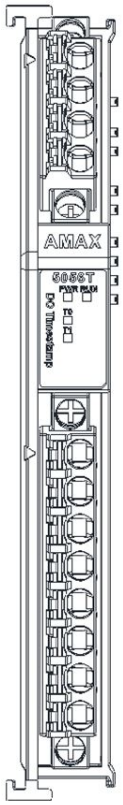


Figure 7.15 AMAX-5056T Module Front View

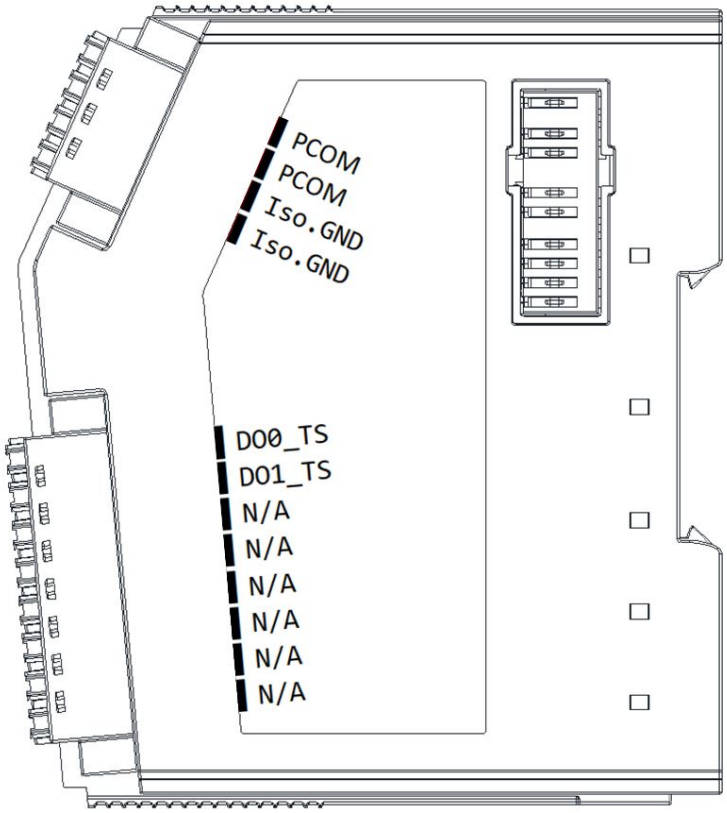


Figure 7.16 AMAX-5056T Module Side View

Table 7.7: Upper 4-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	PCOM
2	PCOM
3	Iso.GND
4	Iso.GND

Table 7.8: Lower 8-Pin Connector	
Pin Number (Top to Bottom)	**Pin Definition**
1	DI0_TS
2	DI1_TS
3	N/A
4	N/A
5	N/A
6	N/A
7	N/A
8	N/A

7.3.4 Application Wiring

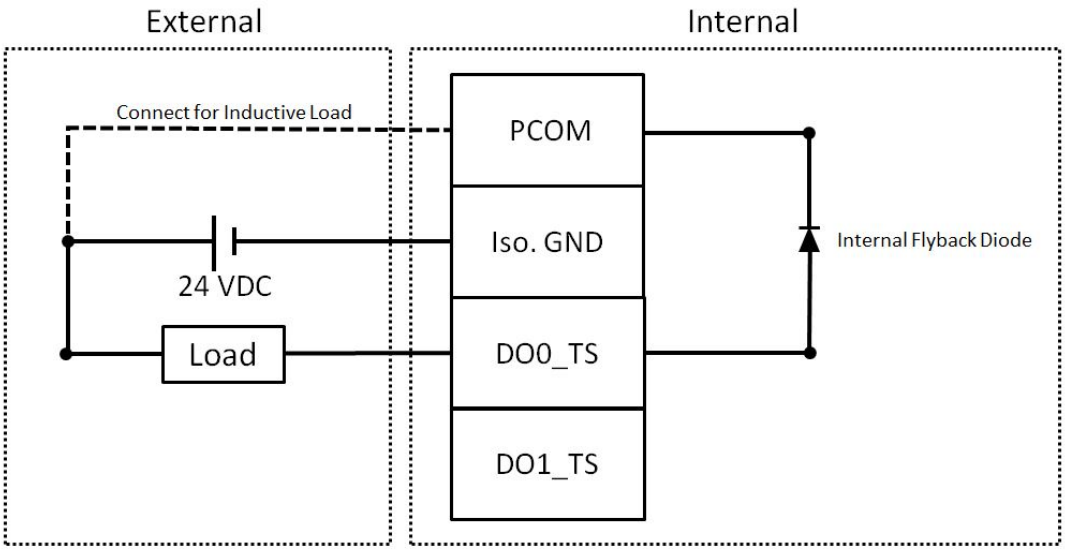


Figure 7.17 Wiring for AMAX-5056T timestamp DI

7.3.5 AMAX-5056T Object Dictionary

7.3.5.1 Input Data

Table 7.9: Input Data (0x1D09:10)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x1D09:10	SysTime	32bit System Time	ULINT	RO	0 Dec

7.3.5.2 Output Data

Table 7.10: Output Data (0x1D09:81, 0x1D09:90)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x1D09:81	Active	Active	USINT	RW	0x00
0x1D09:90	StartTime	Output start time	ULINT	RW	0 Dec

7.3.5.3 Digital Output Data

Table 7.11: Digital Output Data (0x3001:01, 0x3001:02)					
Index (hex)	**Name**	**Meaning**	**Data type**	**Flags**	**Default value**
0x3001:01	DO0	Digital Output Channel 0	BOOL	RW	0x00
0x3001:02	DO1	Digital Output Channel 1	BOOL	RW	0x00

Appendix A

WatchDog Config & PDO Assign

A.1 Watch Dog Configuration

Table A.1: Watch Dog Configuration (0x0400, 0x0410, 0x0420)				
Index (hex)	**Name**	**Meaning**	**Flags**	**Default value**
0x0400	Multiplier	Number of 25 MHz tics (minus 2) that represent the basic watchdog increment.	RW	0x09C2 2498 (Dec)
0x0410	PDI	Watchdog starts counting again with every PDI access.	RW	0x03E8 1000 (Dec)
0x0420	SM [1]	The watchdog for all SyncManagers.	RW	0x03E8 1000 (Dec)

[1]: Watchdog will be disabled when the value is set to 0. Please know the risk if you disable the Watchdog, MainDevice won't receive the notifications when the modules disconnected. For the output value in different Watchdog states please refer to the next table "**Module's Output Value in Different Watchdog Configurations**"

Table A.2: Module's Output Value in Different Watchdog Configurations			
Register Setting	**Output State in OP mode**	**Disconnect**	**Next PDO**
WDT=1000us	High	Low	High
	Low	Low	Low
WDT=Disable	High	High	High
	Low	Low	Low

A.2 PDO Assignment

A.2.1 Power Input and Coupler

A.2.1.1 AMAX-5001 PDO Assignment

Table A.3: AMAX-5001 PDO Assignment (SM3: 0x1A00)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A00	32	Inputs process data mapping	0x6000:01	Over_Voltage_1
			0x6000:02	Under_Voltage_1
			0x6000:03	Over_Voltage_2
			0x6000:04	Under_Voltage_2
			0x6000:05	Over_Current
			0x6000:06	DI0
			0x6000:07	DI1
			0x6000:08	DI2
			0x6000:09	DI3
			0x6000:11	Voltage_1
			0x6000:12	Voltage_2
			0x6000:13	Current

A.2.1.2 AMAX-5074 PDO Assignment

Table A.4: AMAX-5074 PDO Assignment (SM3: 0x1A00)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A00	24	Inputs process data mapping	0x6000:01	Over_Voltage_1
			0x6000:02	Under_Voltage_1
			0x6000:03	Over_Voltage_2
			0x6000:04	Under_Voltage_2
			0x6000:05	Over_Current
			0x6000:06	Device_ID
			0x6000:11	Voltage_1
			0x6000:12	Voltage_2
			0x6000:13	Current

A.2.2 Analog Input and Output

A.2.2.1 AMAX-5015 PDO Assignment

Table A.5: AMAX-5015 PDO Assignment (SM3: 0x1A00 – 0x1A03)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A0***n***	10	Analog Input Channel ***n*** process data mapping	0x60***n***0:01	AI***n***_BurnOut
			0x60***n***0:02	AI***n***_OverRange
			0x60***n***0:03	AI***n***_UnderRange
			0x60***n***0:11	AI***n***_Raw
			0x60***n***0:13	AI***n***_Scale

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

A.2.2.2 AMAX-5017C PDO Assignment

Table A.6: AMAX-5017C PDO Assignment (SM3: 0x1A00 – 0x1A05)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A0***n***	4	Analog Input Channel ***n*** process data mapping	0x60***n***0:01	AI***n***_BurnOut
			0x60***n***0:02	AI***n***_OverRange
			0x60***n***0:03	AI***n***_UnderRange
			0x60***n***0:11	AI***n***

n: Range from 0 to 5 refer to Ch.0 to Ch.5.

A.2.2.3 AMAX-5017V PDO Assignment

Table A.7: AMAX-5017V PDO Assignment (SM3: 0x1A00 – 0x1A05)				
Index(hex)	**Size(byte)**	**Name**	**PDO Content(hex)**	
0x1A0***n***	4	Analog Input Channel ***n*** process data mapping	0x60***n***0:11	AI***n***

n: Range from 0 to 5 refer to Ch.0 to Ch.5.

A.2.2.4 AMAX-5017H PDO Assignment

Table A.8: AMAX-5017H PDO Assignment (SM3: 0x1A00 – 0x1A03)			
Index(hex)	**Size(byte)**	**Name**	**PDO Content(hex)**
0x1A0***n***	4	Analog Input Channel ***n*** process data mapping	0x60***n***0:11 AI***n***

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

A.2.2.5 AMAX-5018 PDO Assignment

Table A.9: AMAX-5018 PDO Assignment (SM3: 0x1A00 – 0x1A05)			
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**
0x1A0***n***	10	Analog Input Channel ***n*** process data mapping	0x60***n***0:01 AI***n***_BurnOut
			0x60***n***0:02 AI***n***_OverRange
			0x60***n***0:03 AI***n***_UnderRange
			0x60***n***0:11 AI***n***_Raw
			0x60***n***0:13 AI***n***_Scale

n: Range from 0 to 5 refer to Ch.0 to Ch.5.

A.2.2.6 AMAX-5024 PDO Assignment

Table A.10: AMAX-5024 PDO Assignment (SM2: 0x1600 – 0x1603, SM3: 0x1A00 – 0x1A03)			
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**
0x160***n***	4	Analog Output Channel ***n*** process data mapping	0x70n0:11 AO***n***
0x1A0***n***	4	Read Analog Output Channel ***n*** process data mapping	0x60n0:01 AO***n***_BurnOut
			0x60n0:11 AO***n***

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

A.2.3 Digital Input and Output

A.2.3.1 AMAX-5051 PDO Assignment

Table A.11: AMAX-5051 PDO Assignment (SM0: 0x1A00)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A00	1	Digital Input	0x3001:01	DI0
			0x3001:02	DI1
			0x3001:03	DI2
			0x3001:04	DI3
			0x3001:05	DI4
			0x3001:06	DI5
			0x3001:07	DI6
			0x3001:08	DI7

A.2.3.2 AMAX-5052 PDO Assignment

Table A.12: AMAX-5052 PDO Assignment (SM0: 0x1A00)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A00	2	Digital Input	0x3001:01	DI0
			0x3001:02	DI1
			0x3001:03	DI2
			0x3001:04	DI3
			0x3001:05	DI4
			0x3001:06	DI5
			0x3001:07	DI6
			0x3001:08	DI7
			0x3002:01	DI8
			0x3002:02	DI9
			0x3002:03	DI10
			0x3002:04	DI11
			0x3002:05	DI12
			0x3002:06	DI13
			0x3002:07	DI14
			0x3002:08	DI15

A.2.3.3 AMAX-5056 PDO Assignment

Table A.13: AMAX-5056 PDO Assignment (SM0: 0x1600)			
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**
0x1600	1	Digital Output	0x3101:01 DO0
			0x3101:02 DO1
			0x3101:03 DO2
			0x3101:04 DO3
			0x3101:05 DO4
			0x3101:06 DO5
			0x3101:07 DO6
			0x3101:08 DO7

A.2.3.4 AMAX-5056SO PDO Assignment

Table A.14: AMAX-5056SO PDO Assignment (SM0: 0x1600)			
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**
0x1600	1	Digital Output	0x3101:01 DO0
			0x3101:02 DO1
			0x3101:03 DO2
			0x3101:04 DO3
			0x3101:05 DO4
			0x3101:06 DO5
			0x3101:07 DO6
			0x3101:08 DO7

A.2.3.5 AMAX-5057 PDO Assignment

Table A.15: AMAX-5057 PDO Assignment (SM0: 0x1600, SM1: 0x1601)			
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**
0x1600	1	Digital Output Port 0	0x3101:01 DO0
			0x3101:02 DO1
			0x3101:03 DO2
			0x3101:04 DO3
			0x3101:05 DO4
			0x3101:06 DO5
			0x3101:07 DO6
			0x3101:08 DO7
0x1601	1	Digital Output Port 1	0x3102:01 DO8
			0x3102:02 DO9
			0x3102:03 DO10
			0x3102:04 DO11
			0x3102:05 DO12
			0x3102:06 DO13
			0x3102:07 DO14
			0x3102:08 DO15

A.2.3.6 AMAX-5057SO PDO Assignment

Table A.16: AMAX-5057SO PDO Assignment (SM0: 0x1600, SM1: 0x1601)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1600	1	Digital Output Port 0	0x3101:01	DO0
			0x3101:02	DO1
			0x3101:03	DO2
			0x3101:04	DO3
			0x3101:05	DO4
			0x3101:06	DO5
			0x3101:07	DO6
			0x3101:08	DO7
0x1601	1	Digital Output Port 1	0x3102:01	DO8
			0x3102:02	DO9
			0x3102:03	DO10
			0x3102:04	DO11
			0x3102:05	DO12
			0x3102:06	DO13
			0x3102:07	DO14
			0x3102:08	DO15

A.2.3.7 AMAX-5060 PDO Assignment

Table A.17: AMAX-5060 PDO Assignment (SM2: 0x1600 – 0x1603, SM3: 0x1A00 – 0x1A01)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x160***n***	0.1	Digital Output Channel ***n***	0x70n0:01	DO***n***
0x1A0***k***	0.1	Digital Input Channel ***k***	0x60k0:01	DI***k***

n: Range from 0 to 3 refer to Ch.0 to Ch.3.

k: Range from 0 to 1 refer to Ch.0 to Ch.1.

A.2.4 Counter and Encoder

A.2.4.1 AMAX-5080 PDO Assignment

Table A.18: AMAX-5080 PDO Assignment (SM2: 0x1600 – 0x1601, SM3: 0x1A00 – 0x1A01)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x160***n***	6	ENC Output Channel ***n*** process data mapping	0x70***n***0:01	COn_Set_Counter
			0x70***n***0:02	COn_Enable_Latch_Z
			0x70***n***0:03	COn_Enable_Latch_External
			0x70***n***0:11	COn_Set_Counter_Value
0x1A0***n***	14	ENC Input Channel ***n*** process data mapping	0x60***n***0:01	CIn_Set_Counter_Done
			0x60***n***0:02	CIn_Latch_Z_Valid
			0x60***n***0:03	CIn_Latch_External_Valid
			0x60***n***0:04	CIn_Over_Flow
			0x60***n***0:05	CIn_Under_Flow
			0x60***n***0:09	CIn_Status_of_Input_A
			0x60v0:0A	CIn_Status_of_Input_B
			0x60***n***0:0B	CIn_Status_of_Input_Z
			0x60***n***0:0C	CIn_Status_of_External_Latch
			0x60***n***0:11	CIn_Counter_Value
			0x60***n***0:12	CIn_Latch_Value
			0x60***n***0:13	CIn_Frequency_Value

n: range from 0 to 1 refer to Ch.0 to Ch.1

A.2.4.2 AMAX-5081 PDO Assignment

Table A.19: AMAX-5081 PDO SM2 Assignment (0x1600 – 0x1604, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1600[1]	6	Position Measure Control	0x7000:03	Set_Counter
			0x7000:11	Set_Counter_Value
0x1601[1]	6	Position Measure and Latch Control	0x7000:01	Enable_Latch_Z
			0x7000:02	Enable_Latch_External_Rising
			0x7000:03	Set_Counter
			0x7000:04	Enable_Latch_External_Falling
			0x7000:0C	Enable_Reset_Latch_Value
			0x7000:11	Set_Counter_Value
0x1602[1]	10	Position Measure and Compare Control	0x7000:03	Set_Counter
			0x7000:09	Set_Position_Compare_Offset
			0x7000:0A	Set_Position_Compare_Direction
			0x7000:0B	Enable_Position_Compare
			0x7000:0C	Enable_Reset_Latch_Value
			0x7000:11	Set_Counter_Value
			0x7000:12	Set_Position_Compare_Offset_Value
0x1603[1]	6	Pulse Gate Control	0x7000:03	Set_Counter
			0x7000:11	Set_Counter_Value
0x1604[1]	2	Pulse Train Control	0x7001:01	Enable_Pulse_Train_Output

[1]: 0x1600 to 0x1604 are mutually exclusive, the control mode should align with 0x1C13.

Table A.20: AMAX-5081 PDO SM2 Assignment Comparison (0x1600 – 0x1603, Selectable)					
Index (hex)	**Name**	**SM2 Index**			
		0x1600	**0x1601**	**0x1602**	**0x1603**
0x7000:01	Enable_Latch_Z		V		
0x7000:02	Enable_Latch_External_Rising		V		
0x7000:03	Set_Counter	V	V	V	V
0x7000:04	Enable_Latch_External_Falling		V		
0x7000:09	Set_Position_Compare_Offset			V	
0x7000:0A	Set_Position_Compare_Direction			V	
0x7000:0B	Enable_Position_Compare			V	
0x7000:0C	Enable_Reset_Latch_Value		V	V	
0x7000:11	Set_Counter_Value	V	V	V	V
0x7000:12	Set_Position_Compare_Offset_Value			V	

Table A.21: AMAX-5081 PDO SM3 Assignment (0x1A00 – 0x1A05, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A00[1]	6	Position Measure Status	0x6000:03	Set_Counter_Done
			0x6000:04	Under_Flow
			0x6000:05	Over_Flow
			0x6000:09	Status_of_Input_A
			0x6000:0A	Status_of_Input_B
			0x6000:0B	Status_of_Input_Z
			0x6000:0D	Status_of_External_Latch
			0x1C32:00	Status_Sync_Error
			0x6000:10	TxPDO_Toggle
			0x6000:11	Counter_Value
0x1A01[1]	10	Position Measure and Latch Status	0x6000:01	Latch_Z_Valid
			0x6000:02	Latch_External_Valid
			0x6000:03	Set_Counter_Done
			0x6000:04	Under_Flow
			0x6000:05	Over_Flow
			0x6000:08	Reset_Latch_Value_Valid
			0x6000:09	Status_of_Input_A
			0x6000:0A	Status_of_Input_B
			0x6000:0B	Status_of_Input_Z
			0x6000:0D	Status_of_External_Latch
			0x1C32:00	Status_Sync_Error
			0x6000:10	TxPDO_Toggle
			0x6000:11	Counter_Value
			0x6000:12	Latch_Value
0x1A02[1]	10	Position Measure and Compare Status	0x6000:03	Set_Counter_Done
			0x6000:04	Under_Flow
			0x6000:05	Over_Flow
			0x6000:06	Set_Position_Compare_Offset_Done
			0x6000:07	Enable_Position_Compare_Done
			0x6000:08	Reset_Latch_Value_Valid
			0x6000:09	Status_of_Input_A
			0x6000:0A	Status_of_Input_B
			0x6000:0B	Status_of_Input_Z
			0x6000:0D	Status_of_External_Latch
			0x1C32:00	Status_Sync_Error
			0x6000:10	TxPDO_Toggle
			0x6000:11	Counter_Value
			0x6000:12	Latch_Value

Table A.21: AMAX-5081 PDO SM3 Assignment (0x1A00 – 0x1A05, Selectable)				
0x1A03[1]	6	Pulse Gate Status	0x6000:03	Set_Counter_Done
			0x6000:04	Under_Flow
			0x6000:05	Over_Flow
			0x6000:03	Set_Counter_Done
			0x6000:09	Status_of_Input_A
			0x6000:0A	Status_of_Input_B
			0x6000:0B	Status_of_Input_Z
			0x6000:0D	Status_of_External_Latch
			0x1C32:00	Status_Sync_Error
			0x6000:10	TxPDO_Toggle
			0x6000:11	Counter_Value
0x1A04[1]	2	Pulse Train Status	0x6001:01	Enable_Pulse_Train_Output_Done
0x1A05	4	Frequency Status	0x6002:01	Frequency_Value

[1]: 0x1A00 to 0x1A04 are mutually exclusive, the control mode should align with 0x1C12.

Table A.22: AMAX-5081 PDO SM3 Assignment Comparison (0x1A00 – 0x1A03, Selectable)					
Index (hex)	**Name**	**SM3 Index**			
		0x1A00	**0x1A01**	**0x1A02**	**0x1A03**
0x6000:01	Latch_Z_Valid		V		
0x6000:02	Latch_External_Valid		V		
0x6000:03	Set_Counter_Done	V	V	V	V
0x6000:04	Under_Flow	V	V	V	V
0x6000:05	Over_Flow	V	V	V	V
0x6000:06	Set_Position_Compare_Offset_Done			V	
0x6000:07	Enable_Position_Compare_Done			V	
0x6000:08	Reset_Latch_Value_Valid		V	V	
0x6000:09	Status_of_Input_A	V	V	V	V
0x6000:0A	Status_of_Input_B	V	V	V	V
0x6000:0B	Status_of_Input_Z	V	V	V	V
0x6000:0D	Status_of_External_Latch	V	V		V
0x6000:10	TxPDO_Toggle	V	V	V	V
0x6000:11	Counter_Value	V	V	V	V
0x6000:12	Latch_Value		V	V	
0x1C32:00	Status_Sync_Erro	V	V	V	V

A.2.4.3 AMAX-5082 PDO Assignment

Table A.23: AMAX-5082 PDO SM2 Assignment (0x1600 – 0x1602, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1600 [1]	2	Position Measure and Latch Control	0x7000:02	Enable_Latch_Rising
			0x7000:04	Enable_Latch_Falling
0x160 [1]	10	Position Measure and Compare Control	0x7000:09	Set_Comparison_0
			0x7000:0A	Set_Comparison_1
			0x7000:0B	Enable_DO0_Comparison_Trigger
			0x7000:0C	Enable_DO1_Comparison_Trigger
			0x7000:11	Set_Comparison_Value0
			0x7000:12	Set_Comparison_Value1
0x1602 [1]	10	Position Measure, Latch and Compare Control	0x7000:02	Enable_Latch_Rising
			0x7000:04	Enable_Latch_Falling
			0x7000:09	Set_Comparison_0
			0x7000:0A	Set_Comparison_1
			0x7000:0B	Enable_DO0_Comparison_Trigger
			0x7000:0C	Enable_DO1_Comparison_Trigger
			0x7000:11	Set_Comparison_Value0
			0x7000:12	Set_Comparison_Value1

[1]: 0x1600 to 0x1602 are mutually exclusive, the control mode should align with 0x1C13.

Table A.24: AMAX-5082 PDO SM2 Assignment Comparison (0x1600 – 0x1602, Selectable)				
Index (hex)	**Name**	**SM2 Index**		
		0x1600	**0x1601**	**0x1602**
0x7000:02	Enable_Latch_Rising	V		V
0x7000:04	Enable_Latch_Falling	V		V
0x7000:09	Set_Comparison_0		V	V
0x7000:0A	Set_Comparison_1		V	V
0x7000:0B	Enable_DO0_Comparison_Trigger		V	V
0x7000:0C	Enable_DO1_Comparison_Trigger		V	V
0x7000:11	Set_Comparison_Value0		V	V
0x7000:12	Set_Comparison_Value1		V	V

Table A.25: AMAX-5082 PDO SM3 Assignment (0x1A00 – 0x1A03, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A00 [1]	6	Position Measure Status	0x6000:01	Data_Error
			0x6000:02	Frame_Error
			0x6000:03	Power_Failure
			0x6000:11	Counter_Value
0x1A01 [1]	10	Position Measure and Latch Status	0x6000:01	Data_Error
			0x6000:02	Frame_Error
			0x6000:03	Power_Failure
			0x6000:04	External_Latch_Valid
			0x6000:11	Counter_Value
			0x6000:12	Latch_Value
0x1A02 [1]	6	Position Measure and Compare Status	0x6000:01	Data_Error
			0x6000:02	Frame_Error
			0x6000:03	Power_Failure
			0x6000:09	DO0_Status
			0x6000:0A	DO1_Status
			0x6000:0B	Set_Comparison_0_Done
			0x6000:0C	Set_Comparison_1_Done
			0x6000:11	Counter_Value
0x1A03 [1]	10	Position Measure, Latch and Compare Status	0x6000:01	Data_Error
			0x6000:02	Frame_Error
			0x6000:03	Power_Failure
			0x6000:04	External_Latch_Valid
			0x6000:09	DO0_Status
			0x6000:0A	DO1_Status
			0x6000:0B	Set_Comparison_0_Done
			0x6000:0C	Set_Comparison_1_Done
			0x6000:11	Counter_Value
			0x6000:12	Latch_Value

[1]: 0x1A00 to 0x1A03 are mutually exclusive, the control mode should align with 0x1C12.

Table A.26: AMAX-5082 PDO SM3 Assignment Comparison (0x1A00 – 0x1A03, Selectable)					
Index (hex)	Name	SM3 Index			
		0x1A00	0x1A01	0x1A02	0x1A03
0x6000:01	Data_Error	V	V	V	V
0x6000:02	Frame_Error	V	V	V	V
0x6000:03	Power_Failure	V	V	V	V
0x6000:04	External_Latch_Valid		V		V
0x6000:09	DO0_Status			V	V
0x6000:0A	DO1_Status			V	V
0x6000:0B	Set_Comparison_0_Done			V	V
0x6000:0C	Set_Comparison_1_Done			V	V
0x6000:11	Counter_Value	V	V	V	V
0x6000:12	Latch_Value		V		V

A.2.5 Digital IO with Timestamp

A.2.5.1 AMAX-5051T PDO Assignment

Table A.27: AMAX-5051T PDO SM0 Assignment (0x1A00 – 0x1A15, Partial Selectable)				
Index (hex)	Size (byte)	Name	PDO Content (hex)	
0x1A00	0.1	Channel 0	0x6000:01	DI0
0x1A01	0.1	Channel 1	0x6000:02	DI1
0x1A02	0.1	Channel 2	0x6000:03	DI2
0x1A03	0.1	Channel 3	0x6000:04	DI3
0x1A04	0.1	Channel 4	0x6000:05	DI4
0x1A05	0.1	Channel 5	0x6000:06	DI5
0x1A06	0.1	Channel 6	0x6000:07	DI6
0x1A07	0.1	Channel 7	0x6000:08	DI7
0x1A10 [1]	2	Latch	0x1D09:AE	Status0
			0x1D09:AF	Status1
0x1A11 [1]	6	Latch	0x1D09:AE	Status0
			0x1D09:B0	LatchPos0
0x1A12 [1]	18	Latch	0x1D09:AE	Status0
			0x1D09:B0	LatchPos0
			0x1D09:B8	LatchNeg0
0x1A13 [1]	34	Latch	0x1D09:AE	Status0
			0x1D09:AF	Status1
			0x1D09:B0	LatchPos0
			0x1D09:B8	LatchNeg0
			0x1D09:C0	LatchPos1
			0x1D09:C8	LatchNeg1
0x1A14 [2]	4	SysTime	0x1D09:10	SysTime
0x1A15 [2]	8	SysTime	0x1D09:10	SysTime

[1]: 0x1A10 to 0x1A13 are selectable and mutually exclusive.

[2]: 0x1A14 to 0x1A15 are selectable and mutually exclusive.

Table A.28: AMAX-5051T PDO SM1&SM2 Assignment (0x1A10 – 0x1A15, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A10[1]	2	Latch	0x1D09:AE	Status0
			0x1D09:AF	Status1
0x1A11[1]	6	Latch	0x1D09:AE	Status0
			0x1D09:B0	LatchPos0
0x1A12[1]	18	Latch	0x1D09:AE	Status0
			0x1D09:B0	LatchPos0
			0x1D09:B8	LatchNeg0
0x1A13[1]	34	Latch	0x1D09:AE	Status0
			0x1D09:AF	Status1
			0x1D09:B0	LatchPos0
			0x1D09:B8	LatchNeg0
			0x1D09:C0	LatchPos1
			0x1D09:C8	LatchNeg1
0x1A14[2]	4	SysTime	0x1D09:10	SysTime
0x1A15[2]	8	SysTime	0x1D09:10	SysTime

[1]: 0x1A10 to 0x1A13 are selectable and mutually exclusive. Only can be selected either SM1 or SM2.

[2]: 0x1A14 to 0x1A15 are selectable and mutually exclusive. Only can be selected either SM1 or SM2.

A.2.5.2 AMAX-5056T PDO Assignment

Table A.29: AMAX-5056T PDO SM0 Assignment (0x1610, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1610	1	DC Sync Activate	0x1D09:81	Activate

Table A.30: AMAX-5056T PDO SM1 Assignment (0x1611, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1611	10	DC Sync Activate	0x1D09:90	StartTime

Table A.31: AMAX-5056T PDO SM2 Assignment (0x1600 - 0x1601)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1600	0.1	Channel 0	0x3001:01	DO0
0x1601	0.1	Channel 1	0x3001:02	DO1

Table A.32: AMAX-5056T PDO SM3 Assignment (0x1A00, Selectable)				
Index (hex)	**Size (byte)**	**Name**	**PDO Content (hex)**	
0x1A00	8	SysTime	0x1D09:10	SysTime

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