HV320-ECAT-V2
EtherCAT Communication Card
User Manual

HNC Electric Limited

1. Overview

Thank you for using our company's HV320-V2 series AC drive and EtherCAT expansion card (hereinafter referred to as HV320-ECAT-V2 card).

The HV320-ECAT-V2 card is an EtherCAT fieldbus adapter card that can be used for ultra-high-speed I/O networks. The protocol is applicable to the I/O layer. The card has high efficiency, flexible topology and easy operation.

It is installed in the HV320-V2 series AC drive to increase communication efficiency and realize the networking function of the AC drive. The AC drive is controlled by the fieldbus master. The HV320-ECAT-V2 card can be used for the HV320-V2 series AC drive. The HV320-ECAT-V2 card software version required in this user manual is 1.00 or above (by the parameters on the AC drive after the card is installed and powered on).

The corresponding XML file is HV320-ECAT-V2.xml.

This user manual is only applicable to the HV320-V2 series AC drive. If you need to use the this card on other AC drives, please contact our technicians engineers to check whether it is available and obtain the corresponding information.

Please read this user manual carefully before using this product.

Figure 1-1 Appearance of the HV320-ECAT-V2 card

2. Installation and Setup

2.1 Installing the HV320-ECAT-V2 Card

The HV320-ECAT-V2 card is installed inside the HV320-V2 series AC drive. Before installation, disconnect the power supply of the AC drive and wait for about 10 minutes until the charging indicator on the AC drive lights up. Then, insert the HV320-ECAT-V2 card into the AC drive to avoid damage caused by the tension of the external signal cable on the inter-board signal socket.

Figure 2-1 shows the hardware layout of the HV320-ECAT-V2 card. The 2*8P angled female plug strip (CN1) is used to connect the AC drive. The HV320-ECAT-V2 card provides two network ports U3 for communication with the master station (or the previous slave station) and the next slave station (if present).

For details on the hardware, see Table 2-1

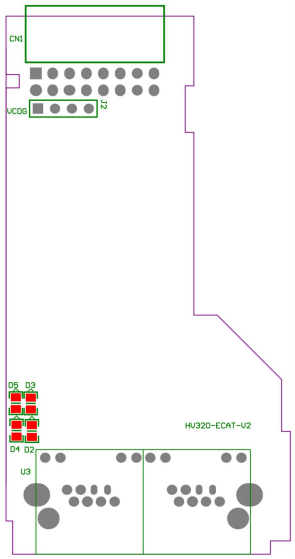


Figure 2-1 HV320-ECAT-V2-EA card (hardware)

Table 2-1 Hardware description of the HV320-ECAT-V2 card

Symbol	Hardware Name	Functional Description
CN1	Pin connector	For connecting AC drives
U3	Network port	Used to communicate with the master (or previous slave) and the next slave (if present). The left one is for input, the right one is for output.
D2	Ethercat Op status indicator (green)	HV320-ECAT-V2 card, see Table 2-2.
D5	Inverter communication indicator light (green)	
D4	Power indicator light (green)	
D3	Ethercat fault indicator (green)	

Table 2-2 Specifications of the HV320-ECAT-V2 card

Indicator signal		status description	solution
D2	Always green	Working in OP state	N/A
	Flashing Green	Working in PREOP/Safe Mode	Check the configuration. Check if the AC drive supports the HV320-ECAT-V2 card and if F0-28 is set to 1. Check if the network port is properly connected.
	OFF state	Disconnect or work in initial mode	Check whether the master station and network ports are connected correctly.
D5	Always green	Normal	N/A
	OFF state	Communication with the drive is lost	Set P0-28 to 1 and check if the AC drive supports the HV320-ECAT-V2 card.
D4	Always green	normal	N/A
	OFF state	The communication board is not powered.	Check whether the J1 connector is connected properly and whether the inverter is powered on.
D3	OFF state	normal	N/A
	Always red	ESC internal fault	Please contact technical support.

2.2 EtherCAT RJ45 interface

The HV320-ECAT-V2 card uses standard Ethernet to connect to the EtherCAT master RJ45 socket. Its pin signal definition is the same as the standard Ethernet pin.

They can be connected using a crossover cable or a straight-through cable.

Table 2-3 EtherCAT communication interface description

Terminal Symbols	Terminal Name	describe
U3	ECAT IN	Network interface . The left side is for input, the right side is for output.
	ECAT OUT	

- After installing the HV320-ECAT-V2 card, ECAT IN is on the left and ECAT OUT is on the right when facing the RJ45 interface. Both interfaces must be connected correctly.
- Cat5e shielded twisted pair (STP) network cables must be used to ensure stability.

3. Communication Configuration

3.1 Communication configuration between HV320-ECAT-V2 card and driver after installing the HV320-ECAT-V2 card on the HV320-V2 series AC drive, complete the communication configuration to achieve communication between them.

■ Communication card settings for driver.

The following parameters must be set to establish an EtherCAT fieldbus network.

Function code	Name	Content	Settings	Describe
P0-02	Run command source	0: Operation panel running command channel (LED off) 1: Terminal command channel (LED on) 2: Communication command channel (LED flashes)	2	Run command issued via communication
P0-03	Main frequency source X selection	0: Digital setting (preset frequency P0-08, UP/ DOWN can be modified, no memory is stored after power failure) 1: Digital setting (preset frequency P0-08, UP/ DOWN can be modified, power-off memory) 2: AI1 3: AI2 4: AI3 5: PULSE setting (DI5) 6: Multi-segment instructions 7: Simple PLC 8: PID 9: Communication setting	9	Given a target frequency By communication
P0-28	Communication	0: Modbus protocol 1: Communication card	1	Select communication card

Parameters related to communication control

Name	name	content	Index	Sub-index
Set Freq	Set frequency (Hz)	Communication setting frequency: 0Hz ~ P0-14 (minimum unit: 0.01Hz)	16#2073	16#01
Control command	control commands	0001: Forward operation 0002: Reverse operation 0003: Forward jog 0004: Reverse jog 0005: Free stop 0006: Deceleration and stop 0007: Fault reset 0008: Fault reset (fault reset is only possible in communication control mode)	16#2073	16#02
DO	DO	BIT0: RELAY1 output control BIT1: DO1 output control BIT2: RELAY2 output control	16#2073	16#03
AO1	AO1	0～7FFF means 0%～100%	16#2073	16#04
AO2	AO2	0～7FFF means 0%～100%	16#2073	16#05
Drive parameters (commonly used)				
Function code Name	Name	Content	Index	Sub-index
P0-10 Maximum frequency	Maximum output frequency	When P0-20=1, the adjustable range is 50.0Hz ~ 1200.0Hz; When P0-20=2, the adjustable range is 50.00Hz ~ 600.00Hz;	16#20F0	16#0B
P0-17 Acceleration time	Acceleration time	0s ～ 30000s (P0-21=0) 0.0s ~ 3000.0s(P0-21=1) 0.00s ~ 300.00s(P0-21=2)	16#20F0	16#12
P0-18 Deceleration time	Deceleration time	0s ～ 30000s (P0-21=0) 0.0s ~ 3000.0s(P0-21=1) 0.00s ~ 300.00s(P0-21=2)	16#20F0	16#13
P0-19 Acceleration/ Deceleration time unit	Acceleration and deceleration time unit	0: 1 second 1: 0.1 sec 2: 0.01 sec	16#20F0	16#14
U0-05 Output power	Output power (KW)	-	16#2070	16#06
U0-06 DI status	DI input status	-	16#2070	16#07
U0-07 DO State	DO output status	-	16#2070	16#08

The AC drive parameter indicators are described as follows:

Each object in the dictionary should be uniquely addressable by using an index and a sub-index. "index": This field (in hexadecimal) specifies the index of an object of the same type in the dictionary. "Subindex": This field specifies in hexadecimal the offset of each object in the same index in the overall arrangement

The mapping between AC drive parameters and object dictionary is as follows:

Object dictionary index = 0x2000 + parameter group number

Object dictionary subindex = hexadecimal offset in parameter group + 1

By default, when using the HV320-ECAT-V2 card, the written PDO1 and PDO2 are mapped to U3-17 and U3-16. Therefore, the first item of the RPDO must be U3-17; otherwise, the operation will be abnormal. In addition, if the eight high bits of U3-17 are written with any non-zero value, the AC drive will report a communication fault (Err16).

3.2 Communication settings between HV320-ECAT-V2 card and EtherCAT host

Enabling communication between the HV320-ECAT-V2 card and the HV320-V2 series AC drive, connect the EtherCAT master to properly enable the communication between the HV320-ECAT-V2 card and the EtherCAT master as well as the AC drive's networking capabilities.

3.2.1 EtherCAT topology

EtherCAT supports various topologies, including star, bus, and tree topologies, as well as their combinations. This makes device connection and wiring flexible and convenient. The figure below shows the bus topology.

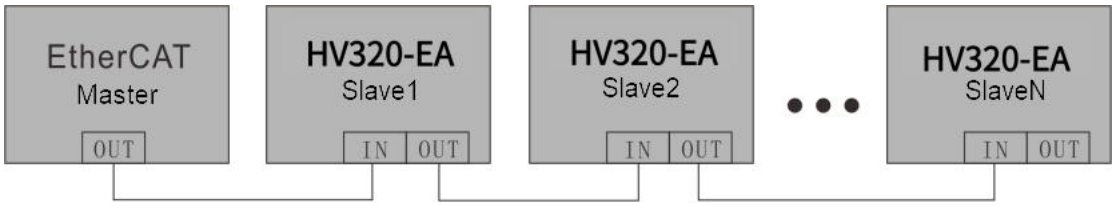


Figure 3-1 Bus topology

3.2.2 EtherCAT Communication Protocol

In DC mode, the DC Sync mode period must be at least 1 ms but less than 100 ms. Otherwise, an EtherCAT communication failure will occur.

■ PDO data description

PDO data is used by the master station to modify and read AC drive data in real time to perform regular data exchange. The data communication address is determined by the AC drive. It mainly includes:

a) Real-time setting of AC drive control commands and target frequency

b) Real-time reading of AC drive current status and operating frequency

c) Function parameters and monitoring data between AC drive and EtherCAT master PDO process data is used for regular data exchange between the master and AC, as described in the following table.

Master sends PDO (0x1600)		
Fixed RPDO		Variable RPDO
AC drive target frequency	AC drive command	Modify the function parameters
RPDO1	RPDO2	RPDO3 to RPDO10
Corresponding AC drive data PDO (0x1A00)		
AC drive status	AC drive operating frequency	Read the function parameters
TPDO1	TPDO2	TPDO3 to TPDO10

Note: A maximum of 10 RPDOs and 10 TPDOs can be configured.

■ Data sent by the master station

Master sends RPDO	
RPDO1	The AC drive target frequency (frequency source is set to "communication") is in the range from the negative frequency upper limit (negative value) to the positive frequency upper limit (including the decimal point, for example, 2000 corresponds to 20.00 Hz on the AC drive). When the given target frequency exceeds this range, the AC drive operates at the frequency upper limit. For example, if the Frequency High Limit setting is 50.00 Hz and the Comm Setting is 6000, the AC drive will run forward at 50.00 Hz. If the Frequency High Limit setting is 50.00 Hz and the Comm Setting is -6000, the AC drive will run reverse at 50.00 Hz.
RPDO2	AC drive command word (command source is set to "communication")
	0001: Forward operation 0002: Reverse operation 0003: Forward jog 0004: Reverse jog 0005: Free stop 0006: Deceleration and stop 0007: Fault reset 0008: Fault reset (fault reset is only possible in communication control mode)
RPDO3 to PDO10	Modify the function parameter value (P group and H group) in real time without writing into EEPROM (electronic read-only memory)

■ AC drive response data

Corresponding AC drive data TPDO	
TPDO1	AC drive operating status
	0001: Forward operation 0002: Reverse operation 0003: Shutdown
TPDO2	Operating frequency (unit: 0.01 Hz)
	Returns the current AC drive operating frequency. The returned data is 16-bit signed and the received data is 16-bit unsigned. The variable must be mapped to 16-bit signed data.
TPDO3 to PDO10	Read function parameter values (P and H groups) and monitor parameter values (U group)

For details on PDO definitions for other AC drives, refer to the corresponding AC drive user manual.

■ Service Data Object (SDO)

EtherCAT SDO is used to transmit non-cyclic data, such as communication parameter configuration and servo drive operation parameter configuration. EtherCAT CoE service type
include:

1) Key event messages
2) SDO request
3) SDO response
4) TxPDO
5) RxPDO
6) Remote TxPDO send request
7) Remote RxPDO sends a request
8) SDO information

Currently, AC drives support SDO requests and responses. For detailed information on SDO parameters, refer to the HV320-V2 series Inverter user manual.

3.3 The HV320-ECAT-V2 card with a Beckhoff controller

Taking the TwinCAT master from Beckhoff as an example, the HV320-ECAT-V2 card is described.

Note:

A 100M Ethernet adapter with an Intel chip must be used. Other network adapters may not support EtherCAT.

1) Install TwinCAT.

Windows XP system: It is recommended to use tcat_2110_2230.

Windows 7 32-bit system: tcat_2110_2248 is recommended.

2) Copy the EtherCAT configuration file (HV320-ECAT-V2.xml) of the HV320-V2 series inverter to the TwinCAT installation directory.

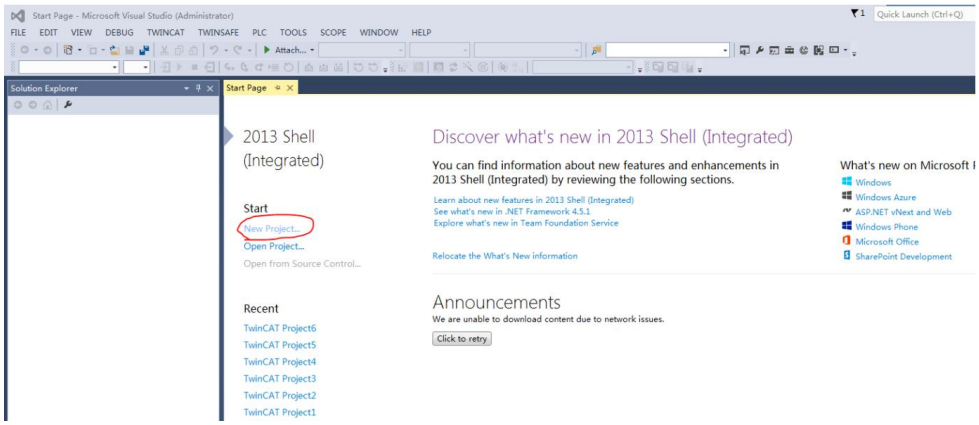
TwinCAT2 directory: TwinCAT\IO\EtherCAT

TwinCAT3 directory: TwinCAT\3.1\config\IO\EtherCAT

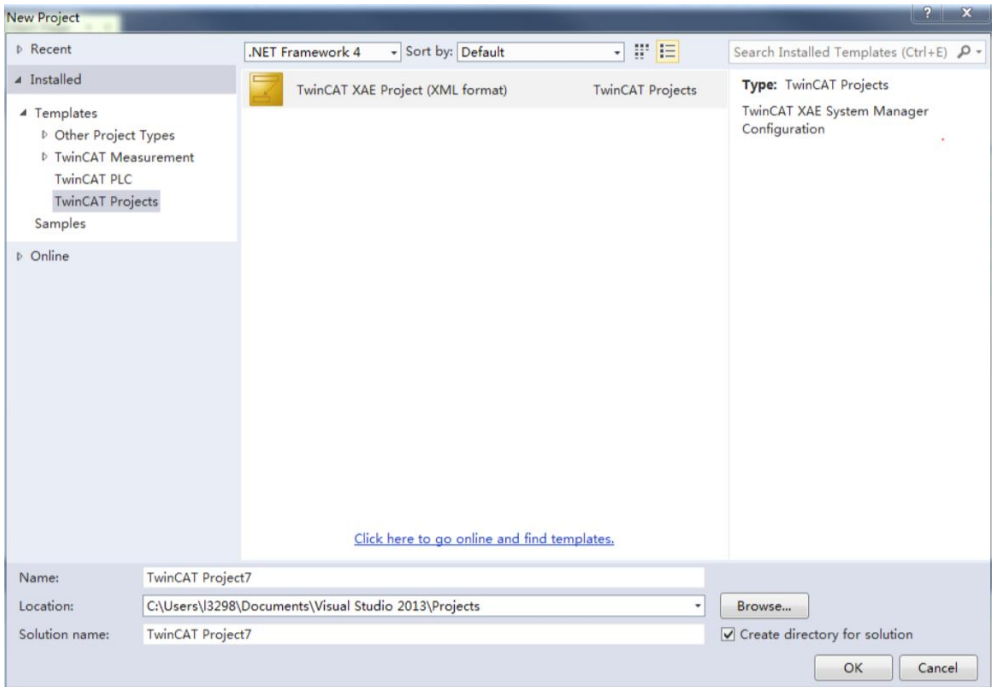
TwinCAT3 is used as an example in the next section. The procedure for TwinCAT2 is similar.

3) Start TwinCAT.

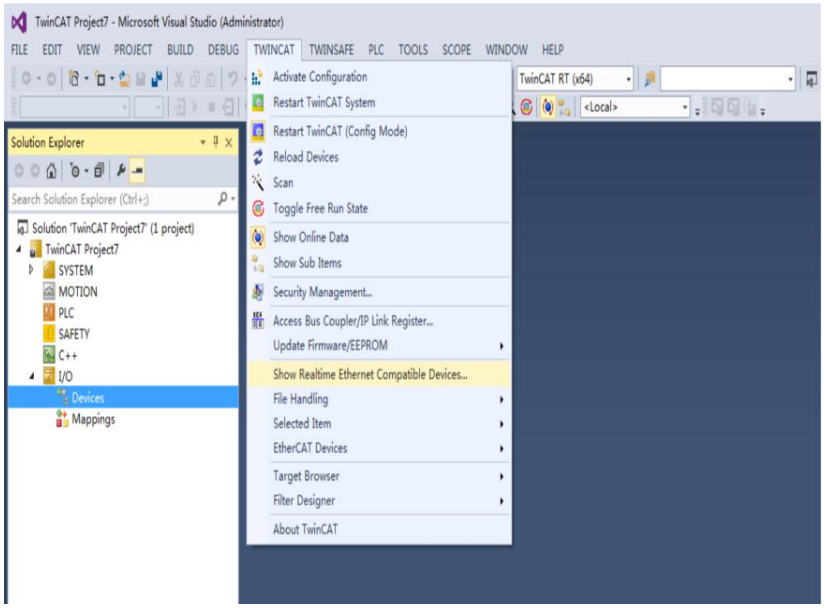
Click New Project to create a project.



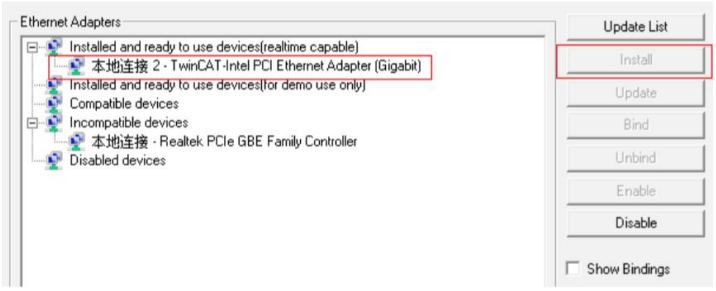
Click OK



4） Install the TwinCAT network adapte driver

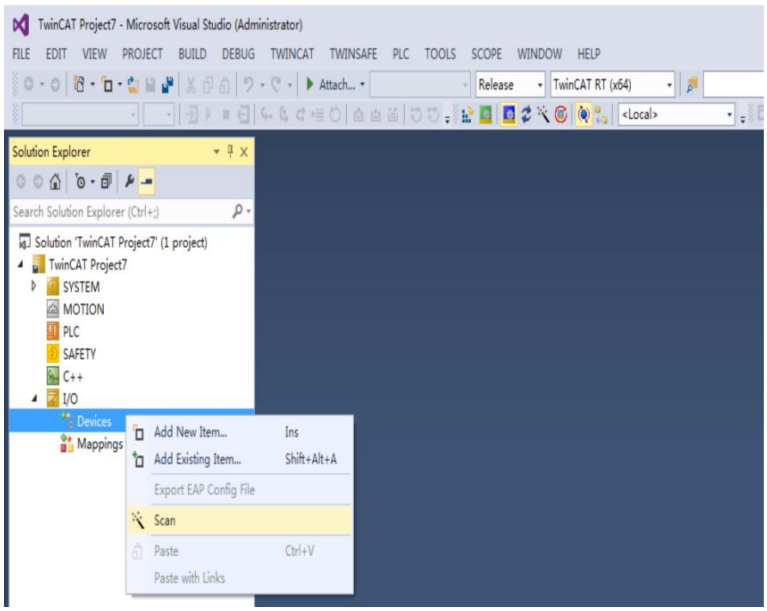


5) Select TWINCAT > Show Real Time Ethernet Compatible Devices… In the dialog box that appears, select the local network adapter in Incompatible devices and click Install. When you install later, the installed network adapter is displayed in "Devices installed and ready to use".



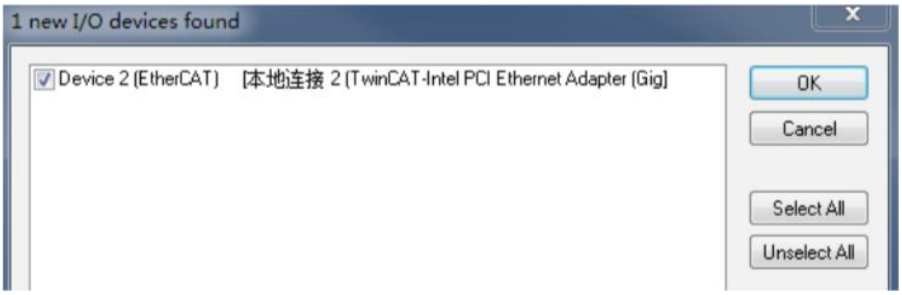
5) Search for devices. Create a project, right-click Devices, and then click Scan to search for devices, such as

As shown below.

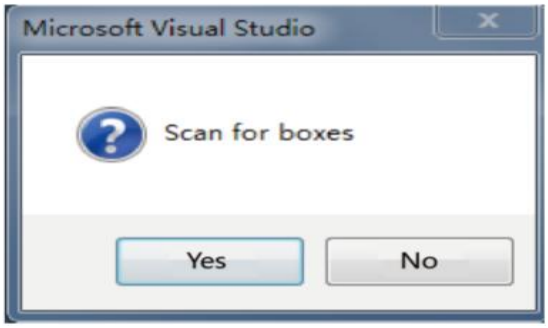


Click OK

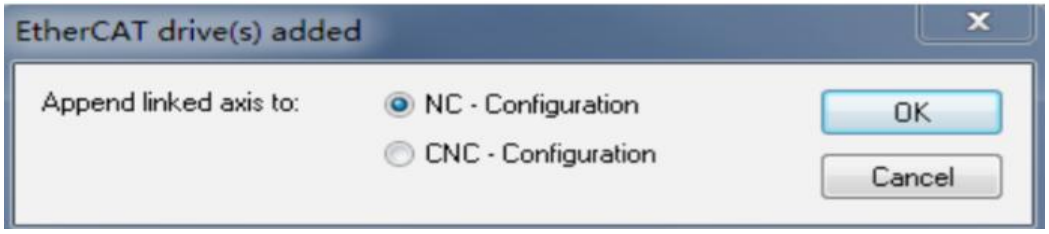
Click OK



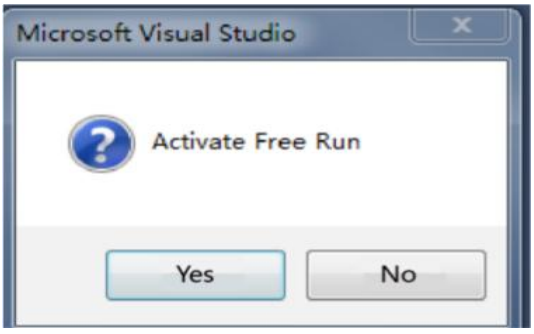
Click Yes

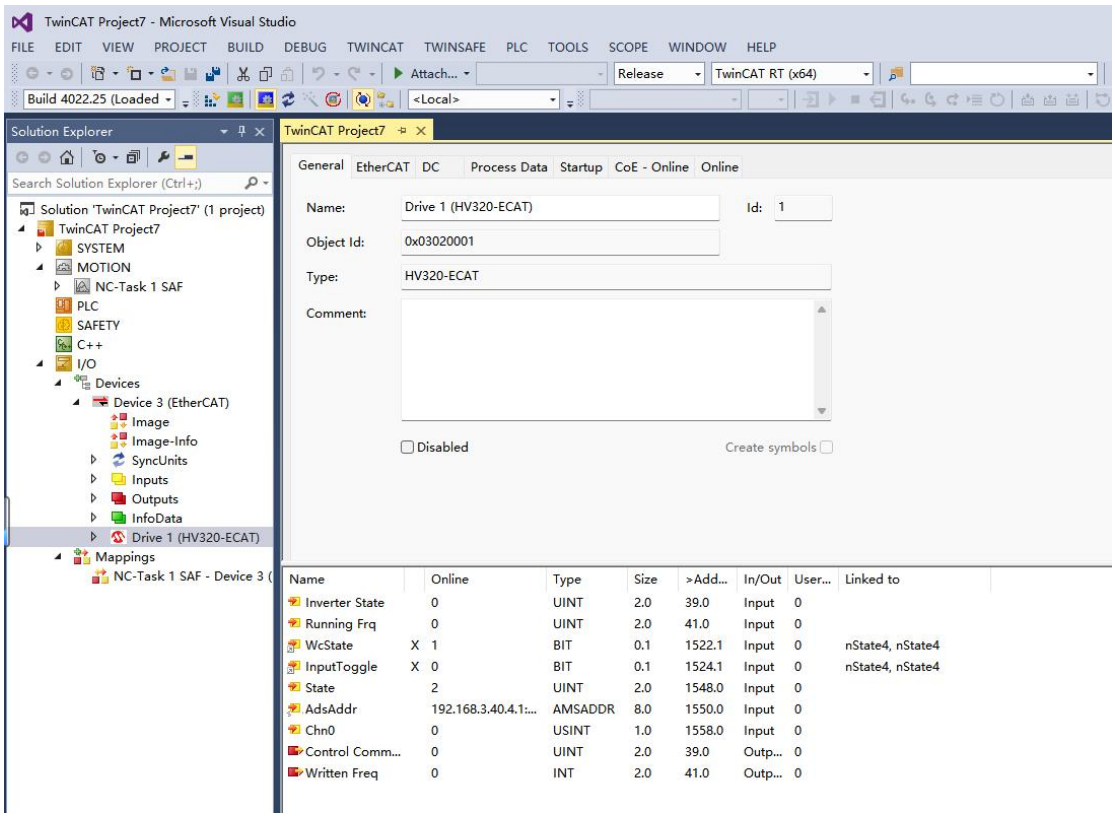


Click OK



Click "No" and the device search is complete, as shown in the following figure:

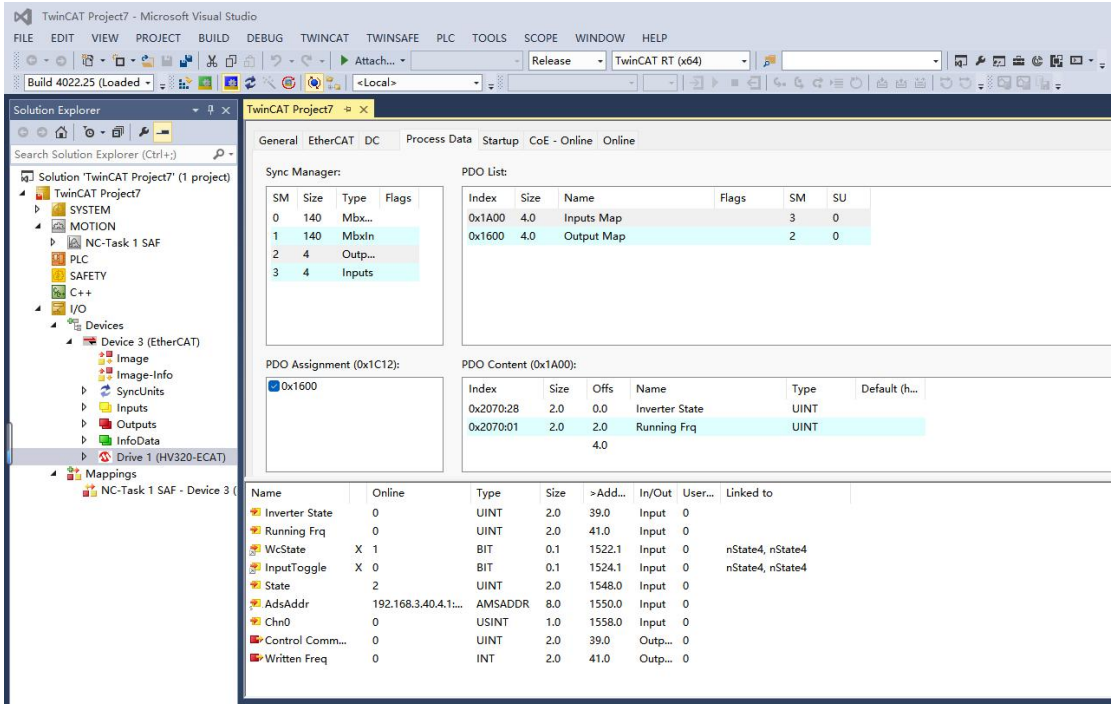




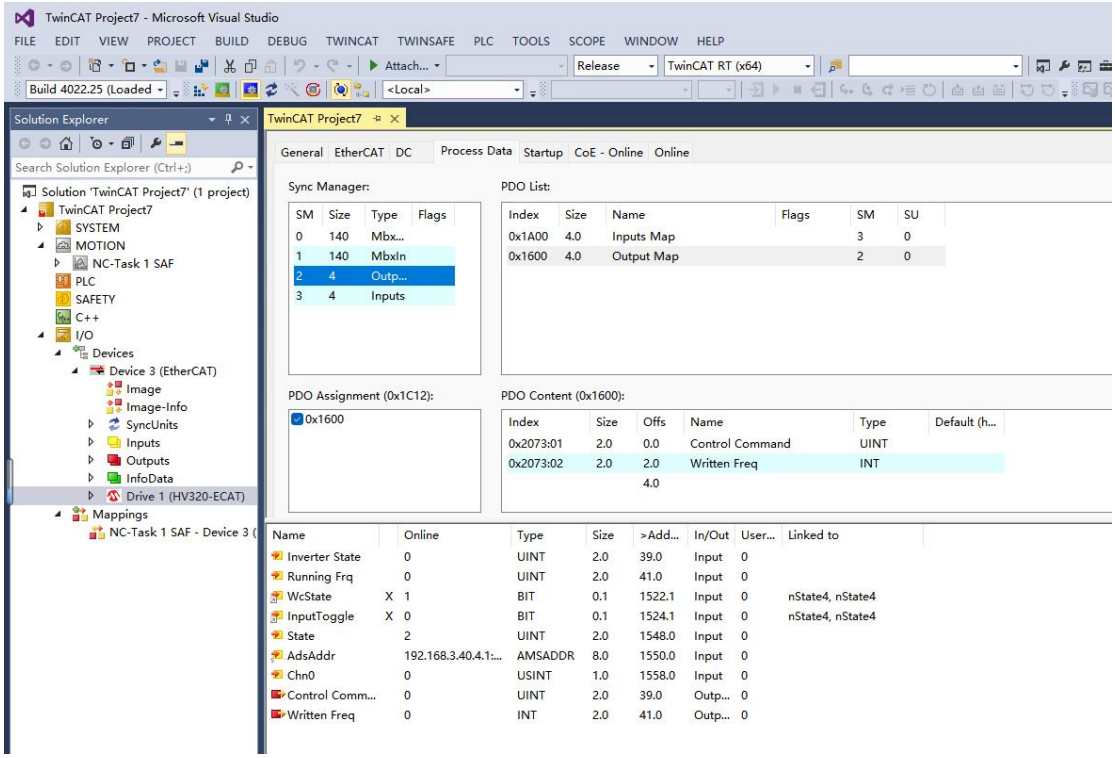
6) Configure PDO parameters.

1. Configure TPDO.

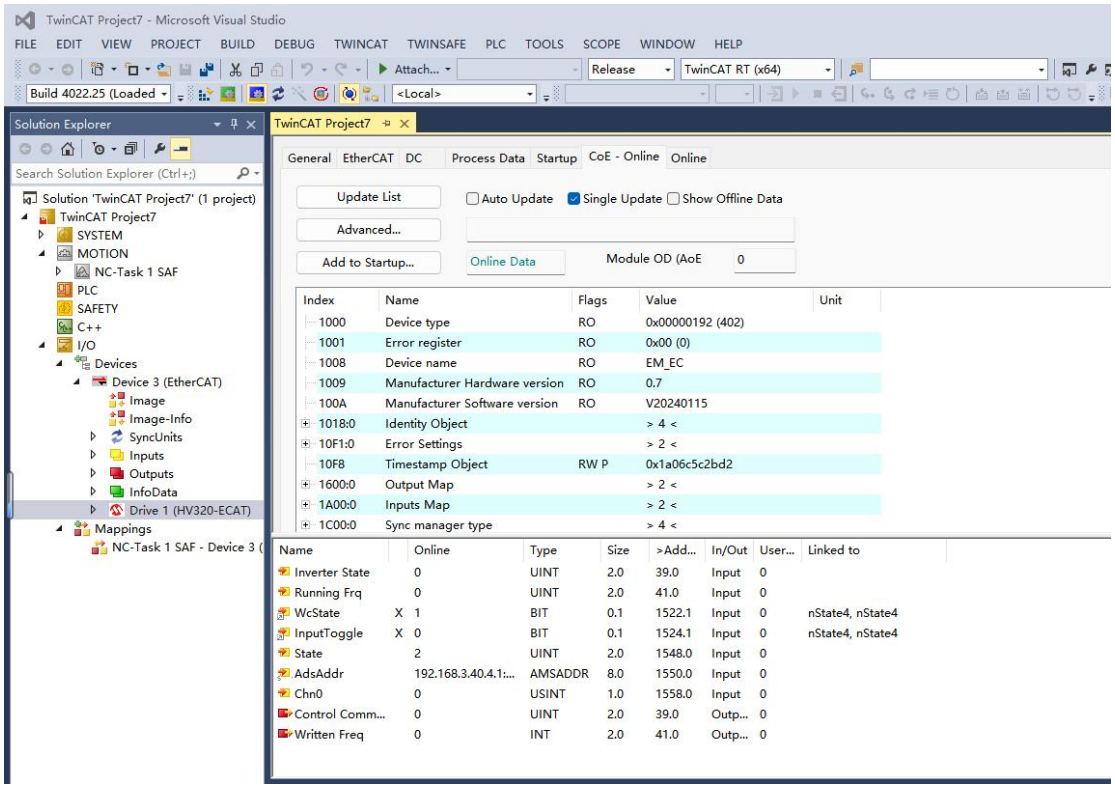
Select 0x1A00 when configuring TPDO. The first two items are set to TPDO by default and cannot be changed. Right-click the location indicated by the red arrow in the figure below to add TPDO mapping as needed.



2. Configure RPDO. Select 0x1600 when configuring RPDO. The first two items are set as RPDO by default and cannot be changed. Right-click the location indicated by the red arrow in the figure below to add RPDO mapping as
needed.

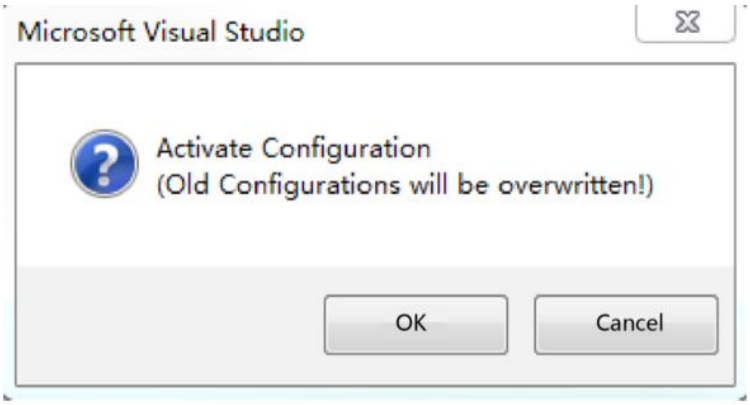


3. View the SDO data list. After the OP state is activated, you can view the real-time data in the SDO data list.

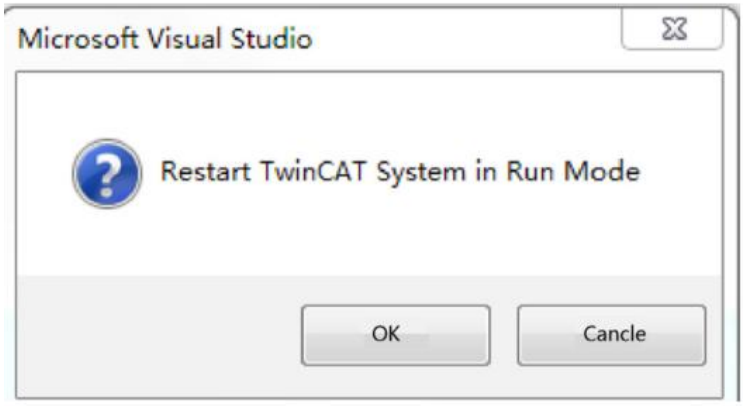


4. Activate the configuration and switch to run mode.

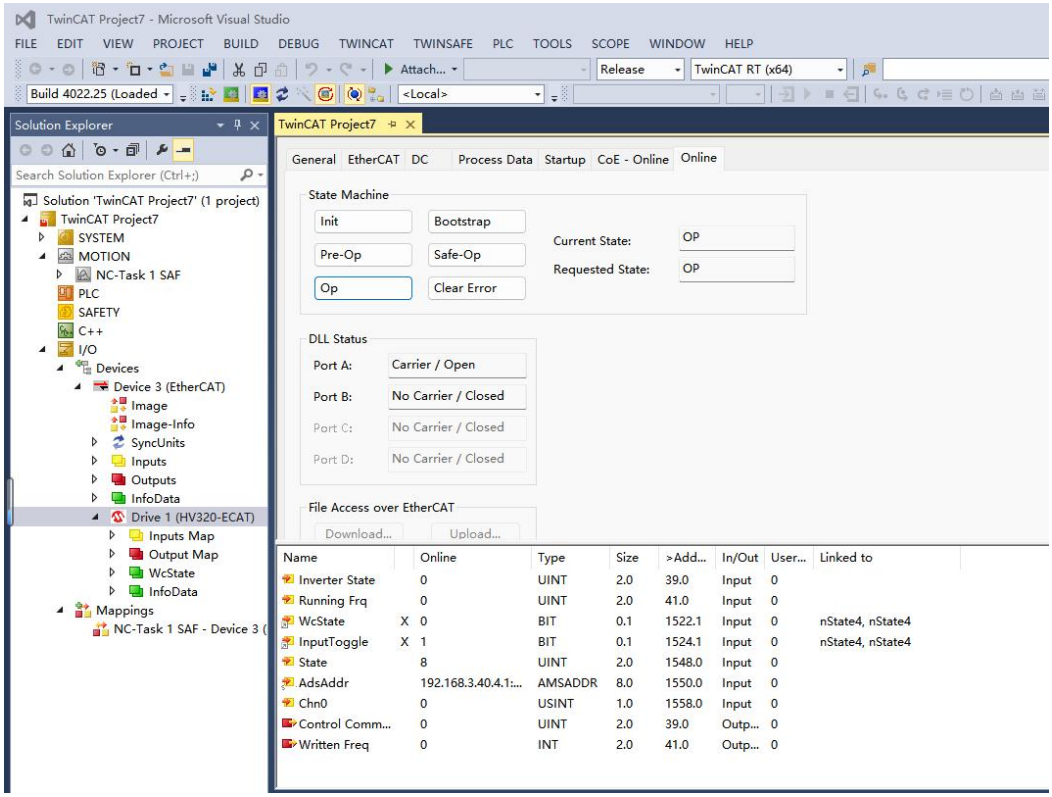
Clicking  will display the following dialog box.



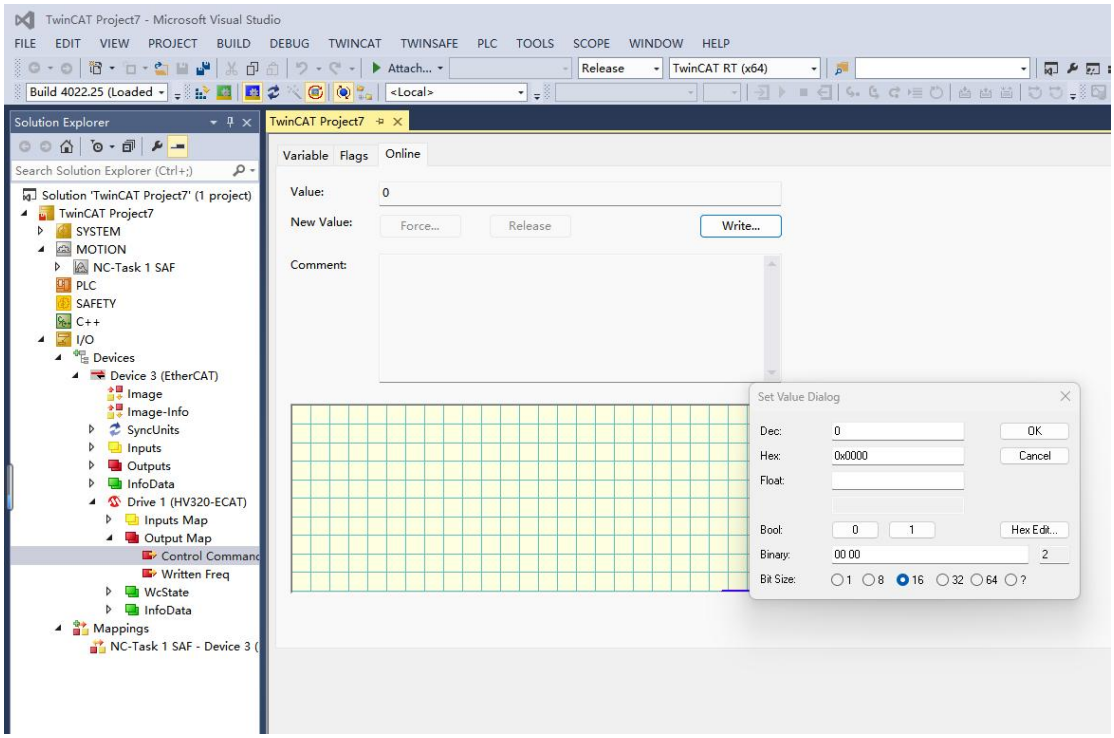
Click OK



Click "OK" to enter the OP state



5. Control the AC drive through PDO. Write the corresponding value through the configured RPDO to control the AC drive.



Troubleshooting

The following table describes possible faults and AC drives that may occur during use of the HV320-ECAT-V2 card.

Table 4-1 Causes and solutions

Fault name	Possible reason	solution
Communication failure between HV320-ECAT-V2 card and AC drive	1. AC drives do not support EtherCAT communication. The communication configuration of the 2HV320-ECAT-V2 card is incorrect. 3.HV320-ECAT-V2 card hardware failure	1. Check whether the AC drive supports EtherCAT communication. 2. Set EtherCAT communication parameters correctly. 3. Replace the HV320-ECAT-V2 card.

When a slave node fails, the HV320-ECAT-V2 card can be directly replaced (only the HV320-ECAT-V2 card is faulty) without performing device configuration again.

Prerequisites for direct replacement of HV320-ECAT-V2 cards:

1. Ensure the wiring sequence is consistent before and after replacing the HV320-ECAT-V2 card.

2. The internal XML file versions of the original HV320-ECAT-V2 card and the new HV320-ECAT-V2 card must be consistent.

3. If a workstation alias device is configured for the original HV320-ECAT-V2 card, the device must be consistent with the original device.

Edition: V2.0
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