INOVANCE

2023

# MD800

# EtherCAT Starting Guide

EtherCAT®

INOVANCE TECHNOLOGY EUROPE

V1.2

# TABLE OF CONTENTS

# 1 GENERAL DATA

Date: 01.07.2023

Hardware: MD800, SI-ECAT card

Software: InoDriverShop for AC drives 3.6.1.16

Info: MD800 EtherCAT communication procedure

# 2 PURPOSE OF THIS DOCUMENT

The purpose of this document is to facilitate the commissioning of EtherCAT communications on the MD800 drives. To perform this procedure, an MD800 and an optional SI-ECAT communications card are required.

# 3 REVISION HISTORY

| Revision | Date | Author | Description |
|---|---|---|---|
| 1.1 | 9 November 21 | RSR | First release |
| 1.2 | 17 July 2023 | RSR | Add section 8.1.1 MD800 control through PLCopen FB<br>Editorial corrections:<br>Drive status bits meaning<br>PDO parameters<br>Velocity mode parameters |

# 4 OVERVIEW

Thank you for using Inovance's MD800 series AC drives and SI-ECAT communication expansion card.

The SI-ECAT card is an EtherCAT fieldbus adapter card, which can be used in the ultra-high speed I/O network. The protocol is applicable on the I/O layer.

This card features high efficiency, flexible topology, and easy operation. It is installed in the MD800 series AC drive to increase the communication efficiency and implement the AC drive networking function, which enables the AC drive to be a slave controlled by the field bus master station.

SI-ECAT accepts the fieldbus master station control. EtherCAT communication supports a minimum synchronization cycle of 500μs. The internal bus between SI-ECAT, rectifier and inverter units have a communication cycle of 40ms.

**NOTE** The SI-ECAT supports the **CiA402 Velocity and Cyclic Synchronous Velocity (CSV)** modes which are suitable for the MD800 open loop (sensorless) operation. MD800 does not support encoder feedback.

This manual requires that the corresponding SI-ECAT card software version is 1.08 or above (after the card is installed and powered on, the function code can be checked in the rectifier FD-91), the associated device description XML file is named "MD800_9Axis_EtherCAT_XML_Vn.nn.xml" (n.nn is the version number, use version above V0.16).

CiA402 Velocity and Cyclic Synchronous Velocity (CSV) modes require the below software version:

- Rectifier software version:
  U05.00 and above (checked by parameter: F0-02 = 05.00)
- Inverter software version:
  U80.03 and above (checked by parameter: F7-10 = 80.03)
- SI-ECAT card:
  V01.15 and above (checked by rectifier parameter: FD-91 = 01.15)

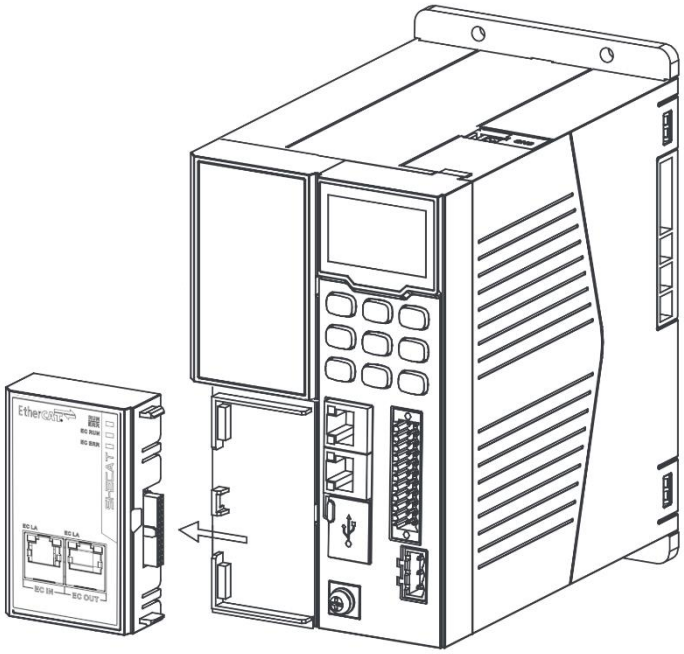
**Before using the product, read this user guide thoroughly.**

# 5 INSTALLING THE SI-ECAT CARD

The SI-ECAT card is designed to be used as an expansion card embedded in the MD800 series drive. The SI-ECAT expansion card is located on the rectifier module.

> Please turn off the inverter power supply before installation and wait for about 10 minutes. After that, the inverter charging indicator light is completely extinguished before installation.
>
> ⚠ After the SI-ECAT card is inserted into the inverter, please check whether it is securely inserted to prevent the signal socket between the boards from being damaged by the pulling force of the external signal cable.
>
> Before replacement, make sure that the network cable has been removed from the terminal of the expansion card.

1. **Disassembly**
   - Insert a flat-blade screwdriver into the groove of the expansion card, and pry out the expansion card to the left with proper force.
2. **Installation**
   - Please install it in the reverse order of the above disassembly process.



## 5.1 HARDWARE LAYOUT

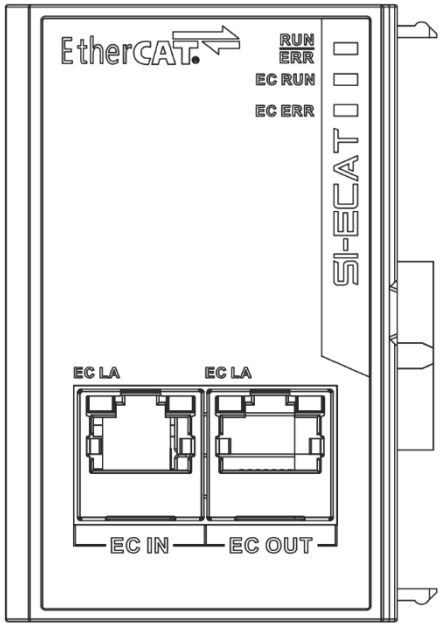



Figure 1 -SI-ECAT card terminal distribution

The SI-ECAT card uses a standard Ethernet RJ45 socket, which is connected to the EtherCAT master station, and its pin signal definition is the same as that of the standard Ethernet

The pins of the network are the same, cross-wire and straight-wire are both possible.

SI-ECAT card terminal function description:

| Terminal symbol | Terminal name | Description |
|---|---|---|
| EC IN | Input port | After installation, EC IN is on the left and EC OUT is on the right when facing to the RJ45 interface. The two interfaces must be connected correctly.<br>The Cat5e shielded twisted pair (STP) network cable must be used for ensuring stability.<br>To improve the anti-interference capability of communication, it is recommended to install it in the expansion card slot 2. |
| EC OUT | Output port | |

SI-ECAT card indicator description:

| Indicator light | | Status description | Approach |
|---|---|---|---|
| RUN/ERR | The green light is always on | The communication is normal | None |
| | The red light is always on | SI-ECAT card and node communication timeout | Check the connector to see if there is interference. |
| | Red light flashes slowly | SI-ECAT card and rectifier communication timeout | 1. Check whether the communication card is installed correctly.<br>2. Check whether the rectifier module is normal. |
| | Red light flashes quickly | SI-ECAT card failure | Check malfunction according to the FAULT code of the rectifier display panel. |

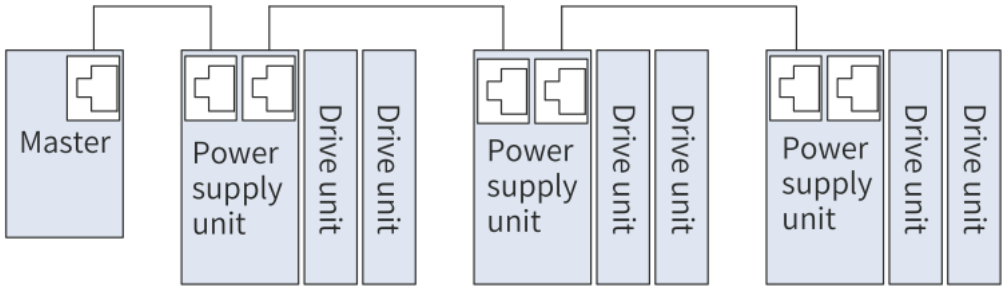
| | | | |
|---|---|---|---|
| EC RUN | Green light off | EtherCAT state machine status: INIT=initialization | None |
| | Green light flashes quickly | EtherCAT state machine status: PREOP=Pre-operation | None |
| | Green light flashes slowly | EtherCAT state machine status: SAFEOP=safe operation | None |
| | Steady green | EtherCAT state machine state: OP= run | None |
| EC ERR | Red light off | EtherCAT communication is trouble-free | None |
| | Red light is always on | EtherCAT communication is faulty | Check the fault code displayed on the rectifier panel |
| EC LA | Yellow light off | Nothing with the previous EtherCAT device connection | None |
| | Yellow light is always on | Already connected with the previous EtherCAT device connection | None |
| | Green light off | No data interaction on the network port | None |
| | Flashing green | Data exchange through the network port | None |

## 5.2 NETWORK TOPOLOGY

The AC drive supports EtherCAT bus. It adopts the standard RJ45 network port and standard connector. The Cat 5e shielded twisted pair cable with iron shell injection molding must be used to connect with the Ethernet master station properly. With relevant communication setting, the communication with the EtherCAT master station can be realized, thus realizing the networking function of the AC drive.

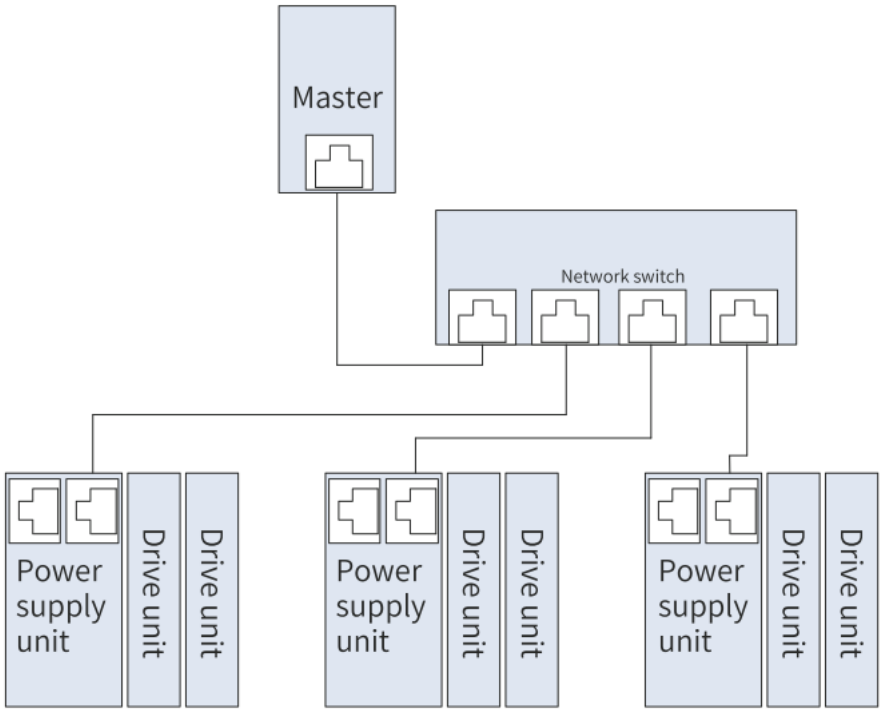
The topological structures supported by EtherCAT include bus, star, and tree topologies. Various networking can be realized by using switches correctly.

Bus topology:




Star topology:

**NOTE** For this type of topology it is necessary to use a special switch such as the Inovance's GR10-EC-6SW 6-Port EtherCAT Branch Module.



# 6 QUICK START COMMISSIONING

After installing the SI-ECAT card on the MD800 series AC drive, complete configuration to enable the communication between them.

The following parameters must be set to enable normal communication between the SI-ECAT card and MD800 series AC drive and connect the SI-ECAT card to the EtherCAT fieldbus network.

The table also shows the basic configuration of the single axis motor map and the different autotune modes. For a more detailed description of the autotune process, consult the MD800 commissioning manual.

| Parameter | Description | Setting Range | Value |
|---|---|---|---|
| | | | |
| **Rectifier communication** | | | |
| FD-10 | Communication protocol selection | 1 : CANopen<br>2 : CANlink<br>3 : Optional communications card | 3 |
| **Inverter communication** | | | |
| F0-02 | Command source selection | 0: External LCD panel/Commissioning software<br>1: Terminal I/O control<br>2: Communication control | 2 |
| F0-03 | Main frequency source X selection | 0: Digital setting (initial value F0-08 can be modified by terminal UP/DOWN, non-retentive at power failure)<br>1: Digital setting (initial value F0-08 can be modified by terminal UP/DOWN, retentive at power failure)<br>2: AI1<br>3: AI2<br>4: (Reserved)<br>5: Pulse reference (DIO1)<br>6: Multi-reference<br>7: Simple PLC<br>8: PID<br>9: Communication setting<br>10: Synchronization control | 9 |
| **Inverter motor configuration** | | | |
| F0-01 | 1st motor control mode | 0: Sensorless vector control (SVC)<br>2: Voltage/Frequency control (V/F control)<br>5: VC++ | 0 |
| F0-10 | Maximum frequency | 5.00 to 590.00 Hz | 50Hz |
| F1-00 | Motor type selection | 0: Common asynchronous motor<br>1: Variable frequency asynchronous motor<br>2: Synchronous motor | 1 |
| F1-01 | Rated motor power | 0.1 to 1000.0 kW | 0.55kW |
| F1-02 | Rated motor voltage | 1 to 2000 V | 380V |
| F1-03 | Rated motor current | 0.01 A to 655.35 A (drive power ≤ 55 kW)<br>0.1 A to 6553.5 A (drive power > 55 kW) | 1.3A |
| F1-04 | Rated motor frequency | 0.01 Hz to maximum frequency (F0-10) | 50Hz |

| | | | |
|---|---|---|---|
| F1-05 | Rated motor rotation speed | 1 RPM to 65535 RPM | 3000RPM |
| F1-37 | Autotuning | Dynamic no-load auto-tuning F1-37 (Auto-tuning selection):<br>0: No operation<br>1: Asynchronous motor static auto-tuning<br>2: Asynchronous motor complete auto-tuning<br>3: Asynchronous motor with-load complete auto-tuning<br>4: Reserved<br>11: Synchronous motor no-load partial auto-tuning (back EMF exclusive)<br>12: Synchronous motor dynamic no-load auto-tuning<br>13: Synchronous motor complete static auto-tuning<br>14: Reserved | 2 |

## 6.1 TARGET FREQUENCY MODE

By default, when inserting the XML file that describes the MD800 drive, the following PDOs are added in the EtherCAT master configuration:

Data received from the EtherCAT master in the inverter:

| RPDO | EtherCAT address | Inverter Parameter | Description |
|---|---|---|---|
| **RPDO1** | **Index**: 2073<br>**SubIndex**: 12<br>**Data type**: UINT | **U3-17** | **Inverter command word** (command source needs to be set to communication F0-02=2)<br>0: Stop according to the stop mode F6-10<br>1: Forward running<br>2: Reverse operation<br>3: Forward jog<br>4: Reverse jog<br>5: Free stop<br>6: Decelerate to stop<br>7: Fault reset |
| **RPDO2** | **Index**: 2073<br>**SubIndex**: 11<br>**Data type**: UINT | **U3-16** | **Inverter target frequency** (the frequency source needs to be set to communication, ie F0-03=9)<br>The function code F8-64 can be used to set whether the writing unit is Hz or rpm. If F8-64 is set to 0, the unit is Hz. The decimal point is the same as F0-22, such as: write ten The hexadecimal number is 1000, F0-22=2, that is, the frequency setting is 10.00Hz.<br>If F8-64 is set to 1, the writing unit is rpm. Such as: write the decimal number 1000, that is, the speed is given It is 1000rpm. |

Data transmitted from the inverter to the EtherCAT master:

| TPDO | EtherCAT address | Inverter Parameter | Description |
|---|---|---|---|
| **TPDO1** | **Index**: 2070<br>**SubIndex**: 45<br>**Data type**: UINT | **U0-68** | **Inverter running status information.** The operating status information of the inverter is defined by bits, as follows:<br><br>**Bit00**: Running status.<br>0: drive stopped<br>1: drive running |

| | | | |
|---|---|---|---|
| | | | **Bit01**: Forward/reverse state<br>0: forward<br>1: reverse<br>**Bit02**: Drive fault status<br>0: no fault<br>1: fault<br>**Bit03**: At target frequency<br>0: target frequency not reached<br>1: target frequency reached<br>**Bit04**: Communication status<br>0 : Communications error<br>1 : Communications OK<br>**Bit05** to **Bit07**: Reserved<br>**Bit08** to **Bit15**: Fault code |
| **TPDO2** | **Index**: 2070<br>**SubIndex**: 1<br>**Data type**: UINT | **U0-00** | **Inverter operating frequency** (unit: 0.01Hz) Returns the actual operating frequency of the current inverter, the returned data value is 16bit unsigned data |

## 6.2 CIA402 VELOCITY MODE

With this mode it can define the speed and acceleration ramps through the objects of the CiA402.

The following table shows the necessary settings to work with the speed mode of the CiA402 standard. The configuration is for a motor with these characteristics:

- Max speed 1500 RPM
- Acceleration from 0 to 1500 RPM in 2.5 seconds
- Deceleration from 1500 to 0 RPM in 5 seconds

| Index (hex) | Sub-index (hex) | Drive Parameter | Name | Unit | Value |
|---|---|---|---|---|---|
| | | FD-11 | CANopen402 protocol | | 1 [Enabled] |
| | | F0-19 | Acceleration/Deceleration time unit | | 1 [0.1s] |
| | | F0-25 | Acceleration/Deceleration time base frequency | | 0 [F0-10 (maximum frequency)] |
| | | F8-64 | 7310H address data unit | | 1 [Speed (rpm)] |
| 6060 | 00 | | Modes of operation | - | 2 [velocity mode] |
| 6042 | 00 | | vl target velocity | RPM | |
| 606C | 00 | | Velocity actual value | RPM | |
| 6077 | 00 | | Torque actual value | % | |
| 6046 | 01 | F0-14 | vl velocity min amount | | 0 |
| | 02 | F0-12 | vl velocity max amount. Limited by F0-10 | RPM | 1500 |
| 6048 | 01 | F0-17 | vl velocity acceleration. Delta Speed | 0.1 RPM | 15000 |
| | 02 | | vl velocity acceleration. Delta Time | 0.1s | 25 |
| 6049 | 01 | F0-18 | vl velocity deceleration. Delta Speed | 0.1 RPM | 15000 |

| | | | | | |
|---|---|---|---|---|---|
| | 02 | | vl velocity deceleration. Delta Time | 0.1s | 50 |

**NOTE** See section 7.4.1 for more information on this mode.

## 6.3 CIA402 CYCLIC SYNCHRONOUS MODE (CSV)

In this mode of operation, the host controller gives the target speed in 60FFh to the MD800 drive using PDOs configuration. Speed control and torque control are performed by the drive.

The following table shows the necessary settings to work with the Cyclic Synchronous Mode of the CiA402 standard.

| Index (hex) | Sub-index (hex) | Drive Parameter | Name | Unit | Value |
|---|---|---|---|---|---|
| | | FD-11 | CANopen402 protocol | | 1 [Enabled] |
| | | F8-64 | 7310H address data unit | | 1 [Speed (rpm)] |
| 6060 | 00 | | Modes of operation | - | 9 [Cyclic Synchronous Mode] |
| 60FF | 00 | | Target velocity | RPM | |
| 606C | 00 | | Velocity actual value | RPM | |
| 6077 | 00 | | Torque actual value | % | |

**NOTE** See section 7.4.2 for more information on this mode.

# 7 PARAMETERS: DEFINITION, STORAGE, AND ACCESS

## 7.1 INTRODUCTION TO PARAMETERS

Drive structures its parameters into two main categories: basic function parameters, and monitoring function parameters. Each category is divided in different groups, and each group contains multiple parameters with a related functionality.

Rectifier parameters:

| MD800 rectifier | | | |
|---|---|---|---|
| **Basic function parameters** | Group F | RW | F0, F1, F4, F5, F7, FA, FD, FF, FP |
| | Group A | RW | A0, A1, A3, AC, AE, AF |
| **Monitoring function parameters** | Status data | RO | U0,U2,U3,U4 |

Inverter parameters:

| MD800 inverter | | | |
|---|---|---|---|
| **Basic function parameters** | Group F | RW | F0, F1, F2, F3, F4, F5, F6, F7, F8, F9, FA, FB, FC, FD, FE, FF, FP |
| | Group A | RW | A0, A1, A3, A5, A6, A9, AC, AD, AE, AF |
| **Monitoring function parameters** | Status data | RO | U0,U4,U5 |
| | Communication control parameters | WO | U3 |

To access to a parameter, you must indicate the group to which it belongs, and the ID of the parameter. See the sample below:

| Group Description | Group number | Parameter ID | Parameter Name |
|---|---|---|---|
| F0 - Basic Power Supply Unit | F0 | 16 | F0-16 |
| AF - Process Data Address Mapping | AF | 00 | AF-00 |
| U0 - Monitoring Parameters | U0 | 35 | U0-35 |

## 7.2 MEMORY AREAS AND COMMUNICATION ADDRESSES

Drive has RAM and EEPROM memory. All parameters are placed in both areas in the drive: RAM memory, and EEPROM memory when the drive is power-off.

Parameter communication addresses must be used to perform a read-write and other operations of MD800. Each parameter has its own EPPROM communication address to be accessed.

Furthermore, in the case of Basic Function Parameters, to avoid an intensive use of the drive's EEPROM memory, also they can be accessed to the RAM memory using a particular communication address.

### 7.2.1 EEPROM MEMORY ACCESS

The communication address to access to the EEPROM memory of the parameter, is represented in hexadecimal format.

Following the same way as the parameter name, the communication address is made up of two parts:

- The two most significant digits that represent the group to which the parameter belongs
- And the two least significant digits that represent the ID of the parameter

In the case of groups U0 through U5, the group name is represented by 70 through 75, respectively.

Below, in the table, the addresses of all the drive parameters are represented.

| Group number | Parameter IDs | EEPROM Address |
|---|---|---|
| F0～FE | 00～FF | 0xF000～0xFEFF |
| A0～AF | 00～FF | 0xA000～0xAEFF |
| U0～U5 | 00～FF | 0x7000～0x75FF |

### 7.2.2 RAM MEMORY ACCESS

Only Basic Function Parameters, that is group parameters F0 to FE, and A0 to AF, can be accessed through their RAM communication address.

The communication address to access to the RAM memory of the parameter, is represented in hexadecimal format.

The RAM memory address is based in the EEPROM memory address, but changing the most significant digit for another value. See the correspondence below:

| Parameter group number | EEPROM address | RAM address |
|---|---|---|
| F0～FE | 0xF000～0xFEFF | 0x0000～0x0EFF |
| A0～AF | 0xA000～0xACFF | 0x4000～0x4CFF |
| U0 | 0x7000～0x70FF | - |
| U3 | 0x7300 ~ 0x73ff | - |
| U4 | 0x7400 ~ 0x74ff | - |
| U5 | 0x7500 ~ 0x75ff | - |

## 7.3 ETHERCAT COMMUNICATION

### 7.3.1 ETHERCAT COMMUNICATION ADDRESS

Each MD800 parameter has an EtherCAT communication address associated with it, within the object dictionary. This address allows external communication with that parameter via EtherCAT fieldbus. All addresses in the object dictionary are made up of two parts:

- Object Dictionary Index – Related with the module type and the parameter group
- Object Dictonary Sub-Index – Related with the parameter ID

Each MD800 can control up to 8 Axes plus the rectifier. It is simple to determine the relation between any MD800 parameter and the communication address by this method:

| Module type | Mapping relations |
|---|---|
| Rectifier | Object Dictionary Index = **0x2100** + Parameter Group<br>Object Dictionary Sub-Index = 0x1 + Parameter ID |
| Inverter | Object Dictionary Index = **0x2000** + Group Number + ( (Axis Number – 0x1) * 0x800 )<br>Object Dictionary Sub-Index = 0x1 + Parameter ID |

For example:

For axis 2 parameter F0-03 (Main frequency source X selection) and communication address 0xF003, the corresponding object dictionary index and sub-index are 0x28F0 and 0x04, respectively.

### 7.3.2 PDO AREA DATA

The PDO data is used for the master station to read and write Drive data in real time and perform periodic data exchange. Data communication addresses are directly configured by the Drive. It mainly includes:

1. Real-time setting of Drive control command and target frequency
2. Real-time reading of Drive current state and running frequency
3. Function parameter and monitor data real-time exchange between Drive and EtherCAT master station

There are two types of PDO data:

- **RPDO or RxPDO**. These PDOs contain data received from the Master
- **TPDO or TxPDO**. These PDOs contain data transmitted by MD800

MD800 is a multi-axis device, therefore, it provides to the communications master with an independent set of PDOs for each of its devices. A maximum of 16 RPDOs and 16 TPDOs can be configured for each device.

The tables below indicate the base address for the PDOs of each element of the MD800.

| RECTIFIER | | |
|---|---|---|
| Data PDO area transmitted by RECTIFIER (1A10h) | | |
| Bus Voltage | Module Temperature | Real-Time reading of rectifier parameters |
| TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 1 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1601h) | | | PDO area transmitted by AXIS 1 (1A01h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 2 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1602h) | | | PDO area transmitted by AXIS 2 (1A02h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 3 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1603h) | | | PDO area transmitted by AXIS 3 (1A03h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 4 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1604h) | | | PDO area transmitted by AXIS 4 (1A04h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 5 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1605h) | | | PDO area transmitted by AXIS 5 (1A05h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 6 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1606h) | | | PDO area transmitted by AXIS 6 (1A06h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 7 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1607h) | | | PDO area transmitted by AXIS 7 (1A07h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

| AXIS 8 | | | | | |
|---|---|---|---|---|---|
| PDO area received from Master (1608h) | | | PDO area transmitted by AXIS 8 (1A08h) | | |
| Fixed RPDO | | Variable RPDO | | | |
| Command | Target Frequency | Function parameters | Status | Operating Frequency | Function parameters |
| RPDO1 | RPDO2 | RPDO3 ~ RPDO16 | TPDO1 | TPDO2 | TPDO3 ~ TPDO16 |

By default, when inserting the XML file that describes the MD800 drive, the following PDOs are added in the EtherCAT master configuration: RPDO1, RPDO2, TPDO1, TPDO2.

#### 7.3.2.1 RPDO – DESCRIPTION OF DATA RECEIVED FROM MASTER

Each of the devices of the MD800 receives information from the EtherCAT master in its own RPDO area. This area is described below:

| RPDO | EtherCAT address | Inverter Parameter | Data Type | Description |
|---|---|---|---|---|
| **RPDO1** | **Index**: 0x2073<br><br>**SubIndex**: 0x12 | **U3-17** | UINT | **Inverter command word** (command source needs to be set to communication F0-02=2)<br><br>0: Stop according to the stop mode F6-10<br>1: Forward running<br>2: Reverse operation<br>3: Forward jog<br>4: Reverse jog<br>5: Free stop<br>6: Decelerate to stop<br>7: Fault reset |
| **RPDO2** | **Index**: 0x2073<br><br>**SubIndex**: 0x11 | **U3-16** | UINT | **Inverter target frequency** (the frequency source needs to be set to communication, ie F0-03=9)<br><br>The function code F8-64 can be used to set whether the writing unit is Hz or rpm. If F8-64 is set to 0, the unit is Hz. The decimal point is the same as F0-22, such as: write ten The hexadecimal number is 1000, F0-22=2, that is, the frequency setting is 10.00Hz.<br>If F8-64 is set to 1, the writing unit is rpm. Such as: write the decimal number 1000, that is, the speed is given It is 1000rpm. |

#### 7.3.2.2 TPDO – DESCRIPTION OF DATA TRANSMITTED FROM MD800

Each of the devices of the MD800 transmit information to the EtherCAT master in its own TPDO area. This area is described below:

| TPDO | EtherCAT address | Inverter Parameter | Data Type | Description |
|---|---|---|---|---|
| **TPDO1** | **Index**: 0x2070<br>**Subindex**: 0x45 | **U0-68** | UINT | **Inverter running status information.** The operating status information of the inverter is defined by bits, as follows:<br><br>**Bit00**: Running status.<br>0: drive stopped<br>1: drive running<br>**Bit01**: Forward/reverse state<br>0: forward<br>1: reverse<br>**Bit02**: Drive fault status<br>0: no fault<br>1: fault<br>**Bit03**: At target frequency<br>0: target frequency not reached<br>1: target frequency reached<br>**Bit04**: Communication status<br>0 : Communications error<br>1 : Communications OK<br>**Bit05** to **Bit07**: Reserved<br>**Bit08** to **Bit15**: Fault code |
| **TPDO2** | **Index**: 0x2070<br>**Subindex**: **0x1** | **U0-00** | UINT | **Inverter operating frequency** (unit: 0.01Hz) Returns the actual operating frequency of the current inverter, the returned data value is 16bit unsigned data |

### 7.3.3 SDO MAILBOX DATA

EtherCAT SDO is used to transmit asynchronous data, such as communication, configuration and servo drive running parameter configuration. The EtherCAT CoE service types include:

- Critical event message
- SDO request
- SDO response
- TxPDO
- RxPDO
- Remote TxPDO transmit request
- Remote RxPDO sending request
- SDO information

Currently, the AC drive supports SDO requests and responses. For details about SDO-related parameters, see the MD800 user guides.

### 7.3.4 RELATED PARAMETERS

The following table shows the rectifier parameters related to the SI-ECAT board.

| Function code | Name | Setting Range | Setting Value | Meaning |
|---|---|---|---|---|
| FD-10 | Communication protocol selection | 1：CANopen<br>2：CANlink<br>3：Optional communications card | 3 | Set to 1, for CANopen communication.<br>Set to 2, for CANlink communication.<br>Set to 3, which is the communication card mode. (SI-ECAT mode) |
| FD-50 | Missing station start function | 0: Disable<br>1: Enable | 0 | It can also be operated when the mapping relationship is configured without this station<br>Row. |
| FD-70 | EtherCAT slave name | 0–65535 | 0 | Displays the station number assigned to the slave by the master during EtherCAT communication. |
| FD-71 | EtherCAT slave alias | 0–65535 | 0 | Assigns a station number to the slave during EtherCAT communication in case of a master unable to assign the slave station number automatically.<br>FD-71 = 0: The master assigns the station number automatically.<br>FD-71 ≠ 0: Use the set station number, with the one assigned by the master deactivated. |
| FD-72 | Number of SYNC interrupts allowed by EtherCAT | 0–30 | 10 | Defines the maximum number of master signal loss events allowed by the slave. |
| FD-73 | EtherCAT-Port0 terminal | 0–65535 | 0 | |
| FD-74 | EtherCAT-Port1 terminal | 0–65535 | 0 | |
| FD-75 | EtherCAT port 0/1 Data forwarding error | 0–65535 | 0 | |
| FD-76 | EtherCAT processing unit And PDI error | 0–65535 | 0 | If data exchange error occurs between ESC and internal MCU, keep the setpoint to 0. If the counting value increases, the internal anti-interference performance of the board is abnormal. |
| FD-77 | Port 0/1 lost counter | 0–65535 | 0 | If data link loss is detected by the ESC port, the counting value of the corresponding link loss counter increases.<br>Such scenario may be caused by poor contact or damaged cables. |
| FD-78 | SYNC mode setting | 0–65535 | 0 | 0~1 0 Used to check for setting failure (loss of synchronization) Testing mechanism |
| FD-79 | EtherCAT synchronization | 0–1 | 0 | |

| | | | | |
|---|---|---|---|---|
| | error Monitoring mode settings | | | |
| FD-80 | EtherCAT synchronization frame loss Lost times | 0–65535 | 0 | |
| FD-81 | EtherCAT state machine and PHYLink status | 0–65535 | 0 | |
| FD-82 | EtherCAT - AL fault code | 0: no error<br>1~0xFFFF: Error status code | 0 | Error status code |
| FD-83 | EtherCAT XML file version | 0.00–655.35 | 0.00 | |
| FD-84 | FPGA software version | 0–65535 | 0 | |
| FD-86 | EtherCAT EEPROM read time | 0–65535 | 0 | |
| FD-87 | EtherCAT DC gain parameter | 0–65535 | 0 | |
| FD-88 | EtherCAT DC acceleration Limit value | 0–65535 | 0 | |
| FD-89 | EtherCAT DC speed Limit value | 0–65535 | 0 | |
| FD-90 | EtherCAT DC integration coefficient | 0.00–655.35 | 0.00 | |
| FD-91 | Communication card version | 0.00–655.35 | 0.00 | Communication expansion card software version number. |

## 7.4 CIA402 PROTOCOL

The SI-ECAT only supports the CiA402 PV and CSV profiles. Although these two profiles are open loop since the MD800 does not support speed feedback.

### 7.4.1 VELOCITY MODE

In this mode of operation, the host controller gives the target speed, acceleration, and deceleration to the MD800 drive. Speed control and torque control are performed by the drive.

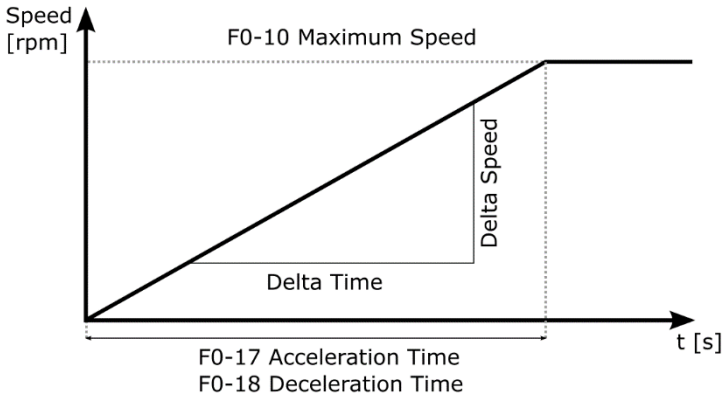
The below table shows the PV profile related objects:

| Index (hex) | Sub-index (hex) | Drive Parameter | Name | Access | Data Type | Unit | Value Range |
|---|---|---|---|---|---|---|---|
| 6040 | 00 | | Control word | RW | Uint16 | - | 0~65535 |
| 6041 | 00 | | Status word | RO | Uint16 | - | 0~65535 |
| 6060 | 00 | | Modes of operation | RW | Int8 | - | 0~9 |
| 6061 | 00 | | Modes of operation display | RO | Int8 | - | 0~9 |
| 6042 | 00 | | vl target velocity | RW | Int16 | Hz/RPM | -32768~32767 |
| 606C | 00 | | Velocity actual value | RO | Int32 | | $-2^{31}$ ~ $(2^{31}-1)$ |
| 6077 | 00 | | Torque actual value | RO | | | |
| 6046 | 01 | F0-14 | vl velocity min amount | RW | Uint32 | | $2^{32}-1$ |
| | 02 | F0-12 | vl velocity max amount | RW | Uint32 | | F0-10 |
| 6048 | 01 | F0-17 | vl velocity acceleration. Delta Speed | RW | Uint32 | | $2^{32}-1$ |
| | 02 | | vl velocity acceleration. Delta Time | RW | Uint16 | | 0~65535 |
| 6049 | 01 | F0-18 | vl velocity deceleration. Delta Speed | RW | Uint32 | | $2^{32}-1$ |
| | 02 | | vl velocity deceleration. Delta Time | RW | Uint16 | | 0~65535 |

With this mode, the acceleration and deceleration ramps are defined to perform the speed profile. If F0-25=0 (Acceleration/deceleration time base frequency) the acceleration and deceleration time are based on this calculations:

$$F0-17\ Acceleration\ Time = \frac{F0-12\ Maximum\ Speed[Hz]}{Acc.Delta\ Speed[Hz]} \times Acc.Delta\ Time[s]$$

$$F0-18\ Deceleration\ Time = \frac{F0-12\ Maximum\ Speed[Hz]}{Dec.Delta\ Speed[Hz]} \times Dec.Delta\ Time[s]$$




### 7.4.2 CYCLIC SYNCHRONOUS VELOCITY MODE (CSV)

In this mode of operation, the host controller gives the target speed in 60FFh to the MD800 drive using PDOs configuration. Speed control and torque control are performed by the drive.

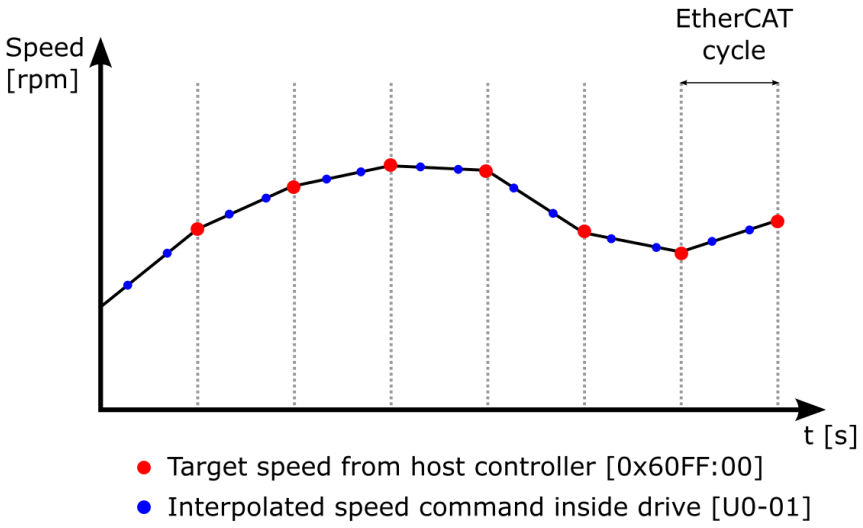
The below table shows the CSV profile related objects:

| Index (hex) | Sub-index (hex) | Drive Parameter | Name | Access | Data Type | Unit | Value Range |
|---|---|---|---|---|---|---|---|
| 6040 | 00 | | Control word | RW | Uint16 | - | 0~65535 |
| 6041 | 00 | | Status word | RO | Uint16 | - | 0~65535 |
| 6060 | 00 | | Modes of operation | RW | Int8 | - | 0~9 |
| 6061 | 00 | | Modes of operation display | RO | Int8 | - | 0~9 |
| 60FF | 00 | | Target velocity | RW | Int32 | RPM | $-2^{31}$ ~ ($2^{31}$-1) |
| 60B1 | 00 | | Velocity Offset | RO | Int32 | RPM | $-2^{31}$ ~ ($2^{31}$-1) |
| 607E | 00 | | Polarity | RO | Uint8 | - | 0~255 |
| 606C | 00 | | Velocity actual value | RO | Int32 | | $-2^{31}$ ~ ($2^{31}$-1) |
| 6077 | 00 | | Torque actual value | RO | Int16 | unit: 0.1% | -32768~32767 |

In this mode the host controller sends a speed command every EtherCAT cycle. The MD800 drive takes care of interpolating the necessary points between each EtherCAT cycle to create a final speed command.

The MD800 is an open loop drive, therefore the final speed of the motor has a small error because the drive has no feedback.

The following image shows how the MD800 interpolates the final speed from the command received from the host controller:


EtherCAT
cycle
Speed
[rpm]
t [s]
Target speed from host controller [0x60FF:00]
Interpolated speed command inside drive [U0-01]

### 7.4.3 CIA402 OBJECT DICTIONARY

This section describes de CiA402 objects implemented in the inverter firmware.

#### 7.4.3.1 MONITORING PARAMETERS

The following section describes the U4 menu parameters that show the values of some of the CiA402 standard objects.

| Function code | CiA402 Object Dictionary | Setting Range | Meaning |
|---|---|---|---|
| U4-00 | 0x6502 (high byte) | | Supported drive modes |
| U4-01 | 0x6502 (low byte) | | |
| U4-02 | 0x603F | 0~65535 | Fault code |
| U4-03 | 0x6040 | 0~65535 | Control Word |
| U4-04 | 0x6041 | 0~65535 | Status Word |
| U4-05 | 0x6042 | -32768 ~ 32767 rpm | vl target velocity |
| U4-06 | 0x6043 | -32768 ~ 32767 rpm | vl velocity demand |
| U4-07 | 0x6044 | -32768 ~ 32767 rpm | vl velocity actual value |
| U4-08 | 0x6046-01 (high byte) | 0~65535 | vl velocity min amount |
| U4-09 | 0x6046-01 (low byte) | 0~65535 | |
| U4-10 | 0x6046-02 (high byte) | 0~65535 | vl velocity max amount |
| U4-11 | 0x6046-02 (low byte) | 0~65535 | |
| U4-12 | 0x6048-01 (high byte) | 1~65535 (unit: RPM) | vl velocity acceleration. Delta speed |
| U4-13 | 0x6048-01 (low byte) | | |
| U4-14 | 0x6048-02 | 0~65536 (unit: s) | vl velocity acceleration. Delta time |
| U4-15 | 0x6049-01 (high byte) | 1~65535 (unit: RPM) | vl velocity deceleration. Delta speed |
| U4-16 | 0x6049-01 (low byte) | | |
| U4-17 | 0x6049-02 | 0~65536 (unit: s) | vl velocity deceleration. Delta time |
| U4-18 | 0x605A | 0~2 | Quick stop option code |
| U4-19 | 0x605B | 0~1 | Shutdown option code |
| U4-20 | 0x605C | 0~1 | Disable operation option code |
| U4-22 | 0x605E | 0~65535 | Fault reaction option code |
| U4-23 | 0x6060 | 0~65535 | Mode of operation |
| U4-24 | 0x6061 | 0~65535 | Mode of operation display |
| U4-36 | 606C (high byte) | $-2^{31}$ ~ ($2^{31}$-1) RPM | Velocity actual value |
| U4-37 | 606C (low byte) | | |
| U4-43 | 6077 | Unit: 0.1% | Torque actual value |
| U4-52 | 607E | 0~255 | Polarity:<br>Bit6 sets the target speed limit to 0, and the target speed is (60ff + 60b1);Set to 1, target speed is - (60ff + 60b1) |
| U4-79 | 60B1 (high byte) | $-2^{31}$ ~ ($2^{31}$-1) RPM | Velocity offset |
| U4-80 | 60B1 (low byte) | | |
| U4-95 | 60FF (high byte) | $-2^{31}$ ~ ($2^{31}$-1) RPM | Target velocity |
| U4-96 | 60FF (low byte) | | |

#### 7.4.3.2 OBJECT DICTIONARY

This section describes the CiA402 objects implemented in the inverter firmware. The inverter only supports the PV and CSV profiles of the CiA402 standard. Therefore, only the objects related to these two profiles are implemented.

| Indexes 603Fh | name | Error Code | | | Setting effective | - | data structure | VAR | data type | Uint16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | TPDO | Correlation mode | ALL | Data range | 0~65535 | factory setting | - |
| The indication of fault code does not comply with the requirements of DS402. The read fault code is the fault code defined by the manufacturer. The upper 8 bits are the main fault code and the lower 8 bits are the fault subcode. For specific meaning, please refer to the Manual of MD800. | | | | | | | | | | |

| Indexes 6040h | name | Control word Control word | Setting effective | Operation setting | data structure | VAR | data type | Uint16 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | RPDO | Correlation mode | ALL | Data range | 0~65535 | factory setting | 0 |

Control command:

| Bit | name | | describe |
|---|---|---|---|
| 0 | The inverter can operate | Switch on | 1-Valid 0 - invalid |
| 1 | Turn on the main circuit | Enable voltage | 1-Valid 0 - invalid |
| 2 | fast stop | Quick stop | 0-Valid 1 - invalid |
| 3 | Inverter operation | Enable operation | 1-Valid 0 - invalid |
| 4~6 | Operation mode related | Operation mode specific | Related to operation mode |

| | | | |
|---|---|---|---|
| 7 | Fault reset | Fault reset | Fault reset, the rising edge is valid and remains 1 invalid |
| 8 | Undefined | Reserved | Undefined |
| 9 | Operation mode related | Operation mode specific | Close first with operation mode |
| 10 | retain | Reserved | Undefined |
| 11~15 | Manufacturer defined | Manufacturer-specific | Manufacturer defined |

Bit8 ~ 15 has no function defined at present.

| Indexes 6041h | name | Status word Status word | Setting effective | - | data structure | VAR | data type | Uint16 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | TPDO | Correlation mode | ALL | Data range | 0~65535 | factory setting | 0 |

Feedback inverter status:

| Bit | name | | describe |
|---|---|---|---|
| 0 | Inverter ready | Ready to switch on | 1-Valid 0 - invalid |
| 1 | The inverter can operate | Switch on | 1-Valid 0 - invalid |
| 2 | Inverter operation | Operation enabled | 1-Valid 0 - invalid |
| 3 | fault | Fault | 1-Valid 0 - invalid |
| 4 | The main circuit is electrically connected | Voltage enabled | 1-Valid 0 - invalid |

| | | | |
|---|---|---|---|
| 5 | fast stop | Quick stop | 0-Valid 1 - invalid |
| 6 | Servo not running | Switch on disabled | 1-Valid 0 - invalid |
| 7 | Undefined | | |
| 8 | Manufacturer defined | Manufacturer-specific | |
| 9 | Remote control | Remote | 1-Control word valid 0 - invalid |
| 10 | Target arrival | Target reach | 1-Valid 0 - invalid |
| 11~15 | Undefined | | |

| Value (binary) | describe |
|---|---|
| Xxxx xxxx x0xx 0000 | Not ready (Not ready to switch on) |
| Xxxx xxxx x1xx 0000 | Start failed (switch on disabled) |
| Xxxx xxxx x01x 0001 | Ready (Ready to switch on) |
| Xxxx xxxx x01x 0011 | Start (Switch on) |
| Xxxx xxxx x01x 0111 | Operation enabled |
| Xxxx xxxx x00x 0111 | Quick stop active |
| Xxxx xxxx x0xx 1111 | Fault reaction active |
| Xxxx xxxx x0xx 1000 | Fault |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Indexes 6042h | name | Target speed vl target velocity | | | Setting effective | Operation setting | data structure | VAR | data type | int16 |
| | Accessibility | RO | Can It | RPDO | Correlation mode | vl | Data range | -32768~32767 | factory | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | ma p | | | | | | settin g | |

(1) The unit of target speed shall be determined according to F8-64: 0 (Hz) 1 (RPM)

(2) When the unit is Hz, the correlation (F0-22) needs to be set according to the unit of frequency. If F0-22 = 2, the frequency resolution is 0.01Hz. Assuming that the target frequency needs to be set to 10.00hz, the communication needs to write 1000; If F0-22 = 1, the frequency resolution is 0.1Hz. Assuming that the target frequency needs to be set to 10.0hz, the communication needs to write 100.

(3) When the unit is rpm, the maximum speed only supports - 32768rpm ~ 32767rpm. If it exceeds this range, please use Hz bit unit to support higher speed setting.

| Indexes 6043h | name | Speed setting vl velocity demand | | | Setting effective | | data structure | VAR | data type | int16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Access ibility | RO | Can It map | RPDO | Correlation mode | vl | Data range | -32768~32767 | factory setting | 0 |

(1) Speed setting, speed setting through ramp generator.

(2) The speed display unit is consistent with the description of 6042h.

| Indexes 6044h | name | Target speed vl velocity actual value | | | Setting effective | | data structure | VAR | data type | int16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | TPDO | Correlation mode | vl | Data range | - 32768~32767 | factory setting | 0 |

(1) The actual operating speed of inverter, if VF control, represents the synchronization frequency; In the case of SVC control, the speed is estimated according to the motor mathematical model.

(2) The speed display unit is consistent with the description of 6042h.

| Indexes | name | Min / max speed | Setting effective | | data structure | ARR | data type | Uint32 |
|---|---|---|---|---|---|---|---|---|

| 6046h | | vl velocity min max amount | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | OD data range | factory setting | Od default |
| (1) The minimum or maximum speed at which the inverter operates. | | | | | | | | | | |

| Subindex 0h | name | Number of minimum / maximum speed sub indexes | | | Setting effective | - | data structure | - | data type | Uint8 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | NO | Correlation mode | vl | Data range | - | factory setting | 2 |

| Subindex 1h | name | Minimum speed vl velocity min amount | | | Setting effective | - | data structure | VAR | data type | Uint32 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | 0~65535 | factory setting | 0 |
| (1) The minimum allowable speed of the inverter, in RPM. The actual set value can be seen by querying f0-14, and the unit of f0-14 is Hz | | | | | | | | | | |

| Subindex 2h | name | Maximum speed vl velocity max amount | | | Setting effective | | data structure | VAR | data type | Uint32 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | 0~65535 | factory setting | 1500 |
| (1) The maximum allowable speed of the inverter, in RPM, is limited by the maximum frequency (F0-10). | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Indexes 6048h | name | Acceleration settings vl velocity acceleration | | | Setting effective | | data structure | ARR | data type | Uint32 |
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | OD data range | factory setting | Od default |
| (1) Set the acceleration time of the inverter | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Subindex 0h | name | Number of accelerated sub indexes | | | Setting effective | - | data structure | - | data type | Uint8 |
| | Accessibility | RO | Can It map | NO | Correlation mode | vl | Data range | - | factory setting | 2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Subindex 1h | name | Speed variation Delta speed | | | Setting effective | - | data structure | VAR | data type | Uint32 |
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | 1 ~ 65535 (unit: RPM) | factory setting | 1500 |
| (1) Confirm that F0-25 = 0. If other values are set, the acceleration time will be calculated incorrectly. | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Subindex 2h | name | Time variation Delta time | | | Setting effective | | data structure | VAR | data type | Uint16 |
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | 0 ~ 65536 (unit: s) | factory setting | 20 |
| (1) F0-19 needs to set 1 or 2. If 0 is set, the calculation of acceleration and deceleration time will be inaccurate due to calculation error. | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Indexes<br>6049h | name | Deceleration setting<br>vl velocity deceleration | Setting effective | | data structure | AR R | data type | Uint32 | | |
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | OD data range | factory setting | Od default |
| | | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Subindex<br>0h | name | Number of decelerator indexes | | | Setting effective | - | data structure | - | data type | Uint8 |
| | Accessibility | RO | Can It map | NO | Correlation mode | vl | Data range | - | factory setting | 2 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Subindex<br>1h | name | Speed variation<br>Delta speed | | | Setting effective | - | data structure | VAR | data type | Uint32 |
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | 1~65535 | factory setting | 1500 |
| (1) Confirm that f0-25 = 0. If other values are set, the deceleration time will be calculated incorrectly. | | | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Subindex<br>2h | name | Time variation<br>Delta time | Setting effective | | data structure | VAR | data type | Uint16 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | RPDO | Correlation mode | vl | Data range | 0~65535 | factory setting | 20 |
| (1) F0-19 needs to set 1 or 2. If 0 is set, the calculation of acceleration and deceleration time will be inaccurate due to calculation error. | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Indexes 605Ah | name | Fast shutdown mode selection Quick stop option code | | | Setting effective | | data structure | VAR | data type | Int16 |
| | Accessibility | RW | Can It map | NO | Correlation mode | ALL | Data range | 0~2 | factory setting | 1 |

(1) Setpoint definition

| Set value | Shutdown mode |
|---|---|
| 0 | Coast to stop |
| 1 | Deceleration stop: the deceleration time is f0-18, i.e. the set time of 6049h in VL mode |
| 2 | For emergency stop, the deceleration time is the time set by f8-60 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Indexes 605Bh | name | Stop mode selection Shut down option code | | | Setting effective | | data structure | VAR | data type | Int16 |
| | Accessibility | RW | Can It map | NO | Correlation mode | ALL | Data range | 0~1 | factory setting | 1 |

(1) Setpoint definition

| Set value | Shutdown mode |
|---|---|
| 0 | Coast to stop |
| 1 | Deceleration stop: the deceleration time is f0-18, i.e. the set time of 6049h in VL mode |

| Indexes 605Ch | name | Off enable shutdown mode selection<br>Disable operation option code | | | Setting effective | | data structure | VAR | data type | Int16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | NO | Correlation mode | ALL | Data range | 0~1 | factory setting | 1 |

(1) Setpoint definition

| Set value | Shutdown mode |
|---|---|
| 0 | Coast to stop |
| 1 | Deceleration stop: the deceleration time is f0-18, i.e. the set time of 6049h in VL mode |

| Indexes | name | Fault shutdown mode selection | Setting effective | | data structure | VAR | data type | Int16 |
|---|---|---|---|---|---|---|---|---|

| 605Eh | | Disable operation option code | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | NO | Correlation mode | ALL | Data range | 0 | factory setting | 0 |
| (1) The current value supports 0, coast to stop | | | | | | | | | | |

| Indexes 6060h | name | Mode selection setting Mode of operation | Setting effective | | data structure | VAR | data type | Int8 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | RPDO | Correlation mode | ALL | Data range | 0~9 | factory setting | 2 |

(1) Setpoint definition

| Set value | Operation mode |
|---|---|
| 0 | NA |
| 1 | NA |
| 2 | (speed mode) VL |
| 3 | NA |
| 4 | NA |
| 5 | NA |
| 6 | NA |
| 7 | NA |
| 8 | NA |
| 9 | (periodic synchronous speed mode) CSV |

| Indexes<br>6061h | name | Current mode selection<br>Mode of operation display | Setting effective | - | data structure | VAR | data type | Int8 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | RPDO | Correlation mode | ALL | Data range | 0~9 | factory setting | 9 |

(1) Setpoint definition

| Set value | Operation mode |
|---|---|
| 0 | NA |
| 1 | NA |
| 2 | (speed mode) VL |
| 3 | NA |
| 4 | NA |
| 5 | NA |
| 6 | NA |
| 7 | NA |
| 8 | NA |
| 9 | (periodic synchronous speed mode) CSV |

| Indexes 606Ch | name | Speed feedback<br>Velocity actual value | | | Setting effective | - | data structure | VAR | data type | Int32 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | TPDO | Correlation mode | CSV | Data range | -231~（231-1） | factory setting | - |
| (1) Actual operation speed of inverter | | | | | | | | | | |

| Indexes 6077h | name | Actual torque<br>Torque actual value | | | Setting effective | - | data structure | VAR | data type | Int16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | TPDO | Correlation mode | ALL | Data range | (unit: 0.1%) | factory setting | - |
| (1) The unit is based on the rated torque of the motor | | | | | | | | | | |

| Indexes 607Eh | name | Command polarity<br>Polarity | | | Setting effective | - | data structure | VAR | data type | Uint8 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | TPDO | Correlation mode | CSV | Data range | 0~255 | factory setting | 0 |
| (1) Bit6 sets the target speed limit to 0, and the target speed is (60ff + 60b1);Set to 1, target speed is -(60ff + 60b1) | | | | | | | | | | |

| Indexes 60B1h | name | Speed offset<br>Velocity Offset | Setting effective | - | data structure | VAR | data type | Int32 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | TPDO | Correlation mode | CSV | Data range | -231 ~ (231-1) | factory setting | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | unit: (RPM) | | |

| Indexes 60FFh | name | Target speed Target velocity | Setting effective | - | data structure | VAR | data type | Int32 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can It map | YES | Correlation mode | CSV | Data range | -231 ~ (231-1) unit: (RPM) | factory setting | 0 |

| Indexes 6502h | name | Support mode Supported drive modes | | | Setting effective | - | data structure | VAR | data type | Uint32 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RO | Can It map | RO | Correlation mode | ALL | Data range | 0~232 | factory setting | 0x00000102 |

| bit | Operation mode |
|---|---|
| 0 | NA |
| 1 | VL support |
| 2 | NA |
| 3 | NA |
| 4 | NA |

| | |
|---|---|
| 5 | NA |
| 6 | NA |
| 7 | NA |
| 8 | CSV support |
| 9~31 | retain |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Indexes 20FDh | name | Distribution group parameters | Setting effective | - | data structure | ARR | data type | Uint16 | | |
| | Accessibility | RW | Can It map | NO | Correlation mode | ALL | Data range | | factory setting | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Subindex 8h | name | Does the object dictionary support power down saving | | | Setting effective | - | data structure | VAR | data type | Uint16 |
| | Accessibility | RW | Can It map | RPDO | Correlation mode | ALL | Data range | 0~1 | factory setting | 0 |

(1) Fd-07 control object dictionary can modify whether to save after power failure through SDO, set "0" to not save after power failure, and set "1" to save after power failure.

(2) For some objects only, please refer to the following table:

| Object dictionary | Support SDO power down saving |
|---|---|
| 603F | I won't support it |
| 6040 | It doesn’t support |

| | |
|---|---|
| 6041 | It doesn’t support |
| 6042 | It doesn’t support |
| 6043 | It doesn’t support |
| 6044 | It doesn’t support |
| 6046-0 | It doesn’t support |
| 6046-1 | support |
| 6046-2 | support |
| 6048-0 | It doesn’t support |
| 6048-1 | support |
| 6048-2 | support |
| 6049-0 | It doesn’t support |
| 6049-1 | support |
| 6049-2 | support |
| 605A | support |
| 605B | support |
| 605C | support |
| 605E | support |
| 6060 | support |
| 6061 | It doesn’t support |
| 606C | It doesn’t support |
| 6077 | It doesn’t support |
| 607E | support |
| 60B1 | It doesn’t support |

| | |
|---|---|
| 60FF | It doesn’t support |

| Subindex Ch | name | Support 402 mode | | | Setting effective | - | data structure | VAR | data type | Uint16 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Accessibility | RW | Can it map | RPDO | Correlation mode | ALL | Data range | 0~1 | factory setting | 0 |

(1) Set "0" to work in non 402 mode and "1" to work in 402 mode.

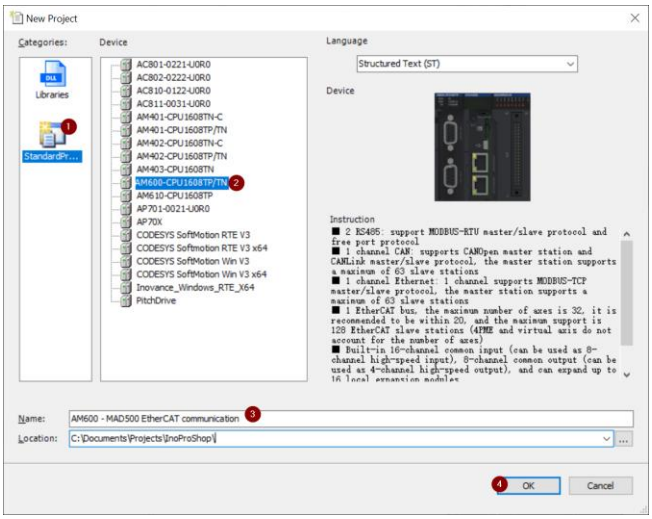
# 8 PROJECT EXAMPLES

## 8.1 INOPROSHOP PROJECT (INOVANCE'S AM/AC SERIES CONTROLLERS)

The AM600 master station is used as an example to describe how to use the SI-ECAT card with the master station.

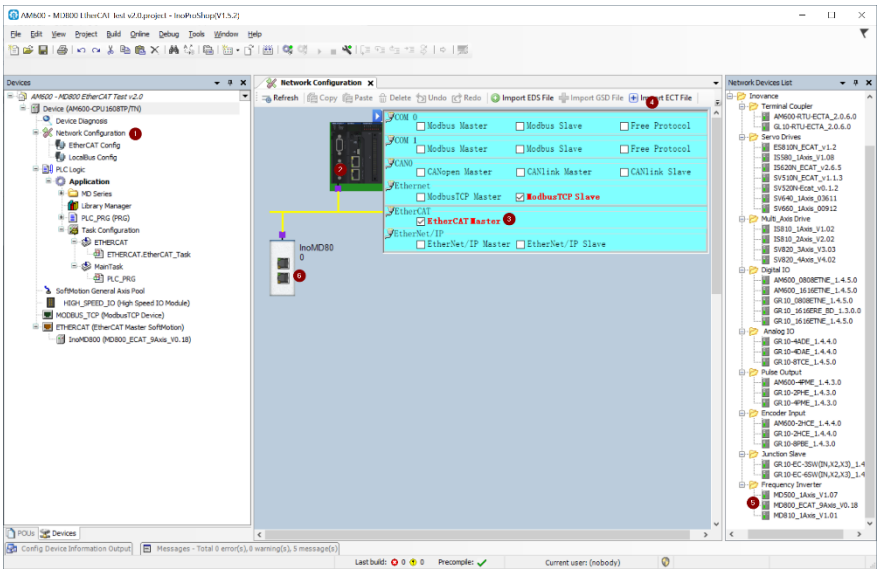
1) Start the software and create an AM600 project.

Select AM600-CPU1608TP, as shown in the following figure.




2) Add the MD500 AC drive slave station.

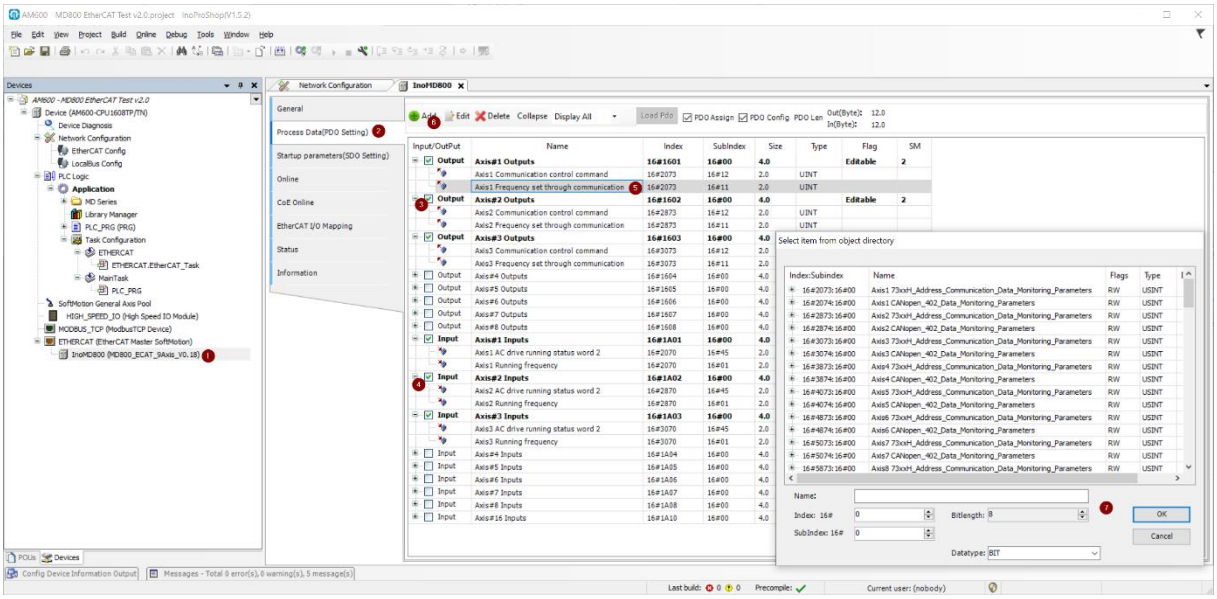
1. Open the network configuration.
2. Select CPU.
3. Enable EtherCAT Master.
4. Import the EtherCAT configuration file of MD500. If any configuration file of other version exists, delete the existing configuration file before importing a new one.
5. Drag the device in the network device list.
6. Add the AC drive slave station, as shown in the following figure.



3) Configure PDO parameters.

1. Select EtherCAT Slave.
2. Open PDO Setting tab.
3. Enable Input/Output PDOs related to each axis. The MD800 can handle up to 8 axes.
4. Select Input/Output PDOs.
5. Click on Add button.
6. Select the required PDO and add to PDO settings list.

Control Command and Inverter State of the RPDO cannot be changed and they must be set as the first items. Otherwise, the running will be abnormal.



### 8.1.1 MD800 CONTROL THROUGH PLCOPEN FB

If the MD800 is configured to work in CSV mode, it can be controlled from the EtherCAT master with the function blocks of the PLCopen standard if the EtherCAT controller allows it.

The **MD800 is an open loop drive**, therefore only FBs that use speed reference can be used. The accuracy of the actual speed at which the drive is moving is that provided by an open loop system.

Supports the following PLCopen blocks:

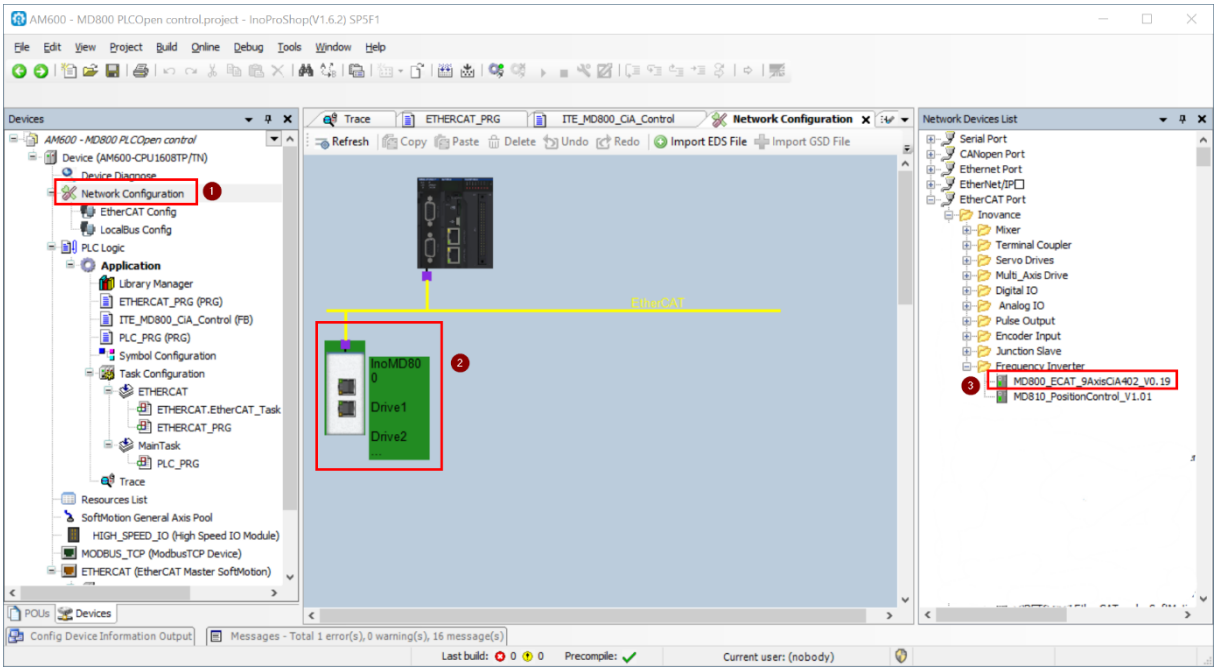
| PLCopen FB | Description |
|---|---|
| **MC_Power** | Enables/disables the drive |
| **MC_MoveVelocity** | Move the axis at specific velocity [uu/second] |
| **MC_Stop** | Stops the axis movement |
| **MC_GearIn** | Speed synchronization of two axes |

This section describes how to perform this control with an INOVANCE AM or AC series controller.

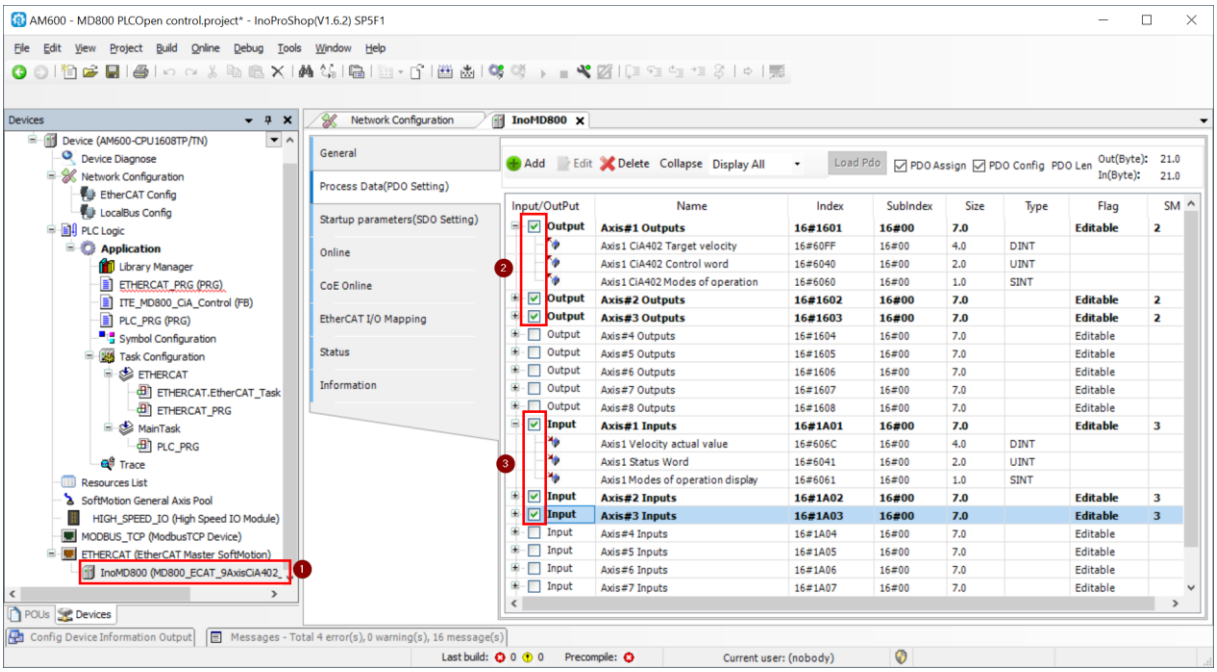
**NOTE** To facilitate the configuration of the MD800 with the PLCopen blocks, it is necessary to use a special XML descriptive file that contains all the PDOs necessary for this type of control. The XML file name is **MD800_9Axis_V0.19 – CiA402.xml**

Follow the steps below in the InoProShop software to configure an MD800 and control it with the PLCopen blocks:

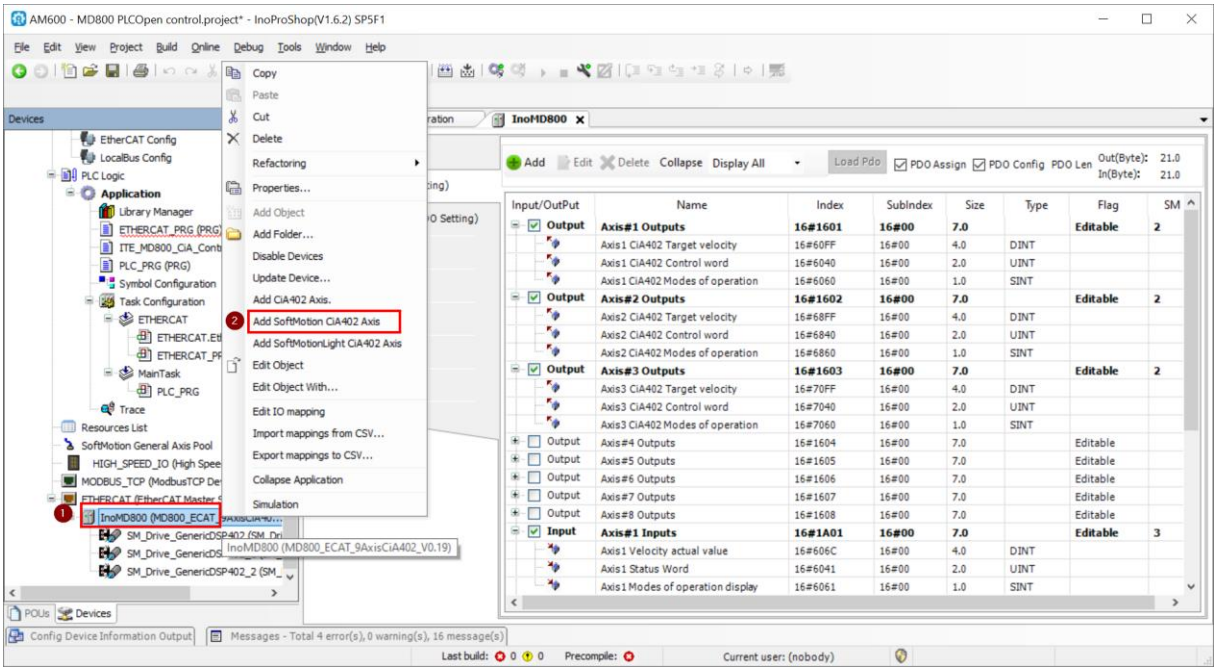
1. Create a new project.
2. If necessary update the XML descriptor with the file **MD800_9Axis_V0.19 – CiA402.xml**
3. Add an MD800 in the network configuration



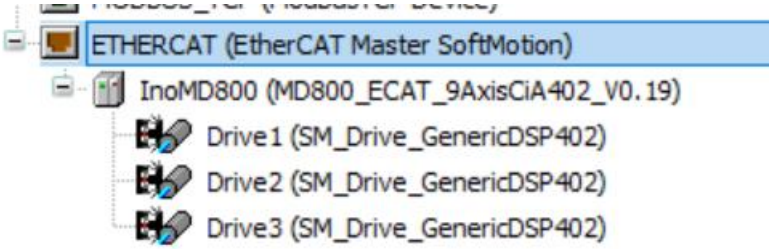

4. It enables the necessary PDOs according to the number of drives that the MD800 rectifier has installed. In this case the following configuration *Rectifier+Dual drive+Single drive* is being used. Therefore we activate 3 output PDOs and 3 input PDOs. One for each driver installed on the rectifier.



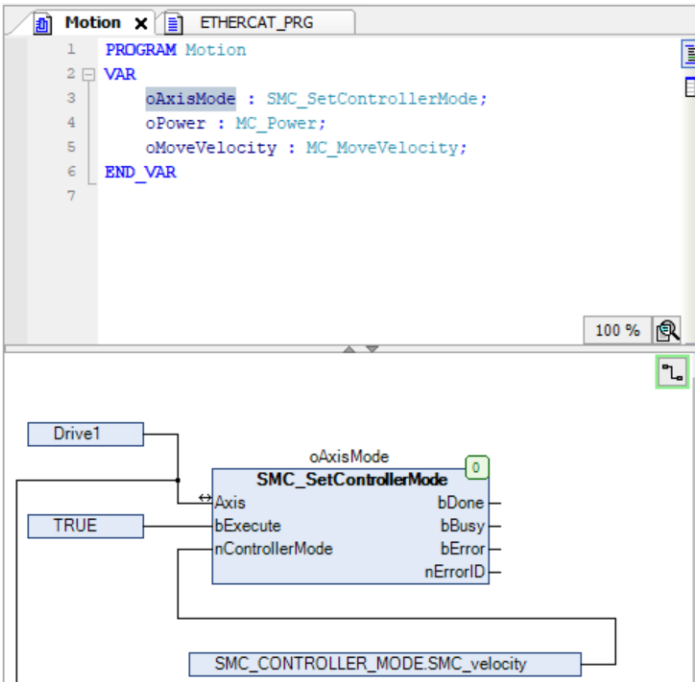

5. In the EtherCAT MD800 slave we add 3 *SoftMotion CiA402 Axis*



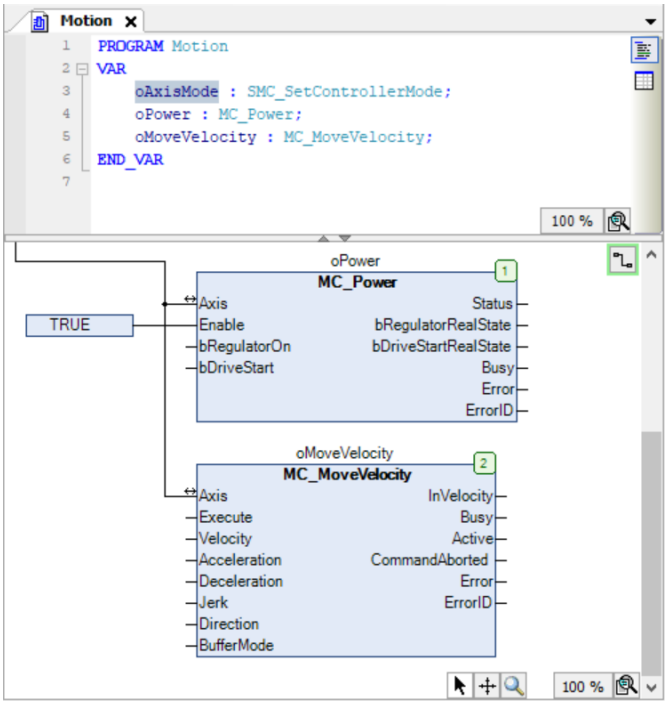

6. Modify the name of the axes according to the needs of the application




7. In order for SoftMotion to be able to use the MD800 drivers correctly, it is necessary to switch the SoftMotion axis to speed mode with the FB SMC_SetControllerMode

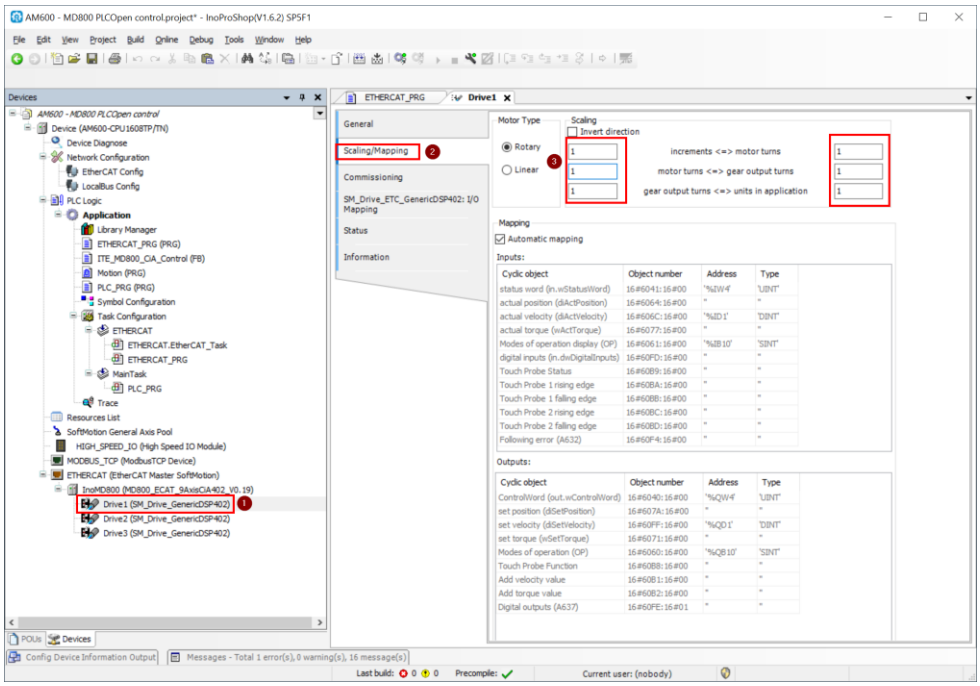



8. Now it is possible to use the MD800 drives with the PLCOpen blocks




User units depend on axis scaling. If the scaling is set to 1:1, the user units are:

- Speed units: rpm/second
- acc/dec units: rpm/second$^2$


AM600 - MD800 PLCOpen control.project* - InoProShop(V1.6.2) SP5F1
File Edit View Project Build Online Debug Tools Window Help
Devices
AM600 - MD800 PLCOpen control
Device (AM600-CPU1608TP/TN)
Device Diagnose
Network Configuration
EtherCAT Config
LocalBus Config
PLC Logic
Application
Library Manager
ETHERCAT_PRG (PRG)
ITE_MD800_CIA_Control (FB)
Motion (PRG)
PLC_PRG (PRG)
Symbol Configuration
Task Configuration
ETHERCAT
ETHERCAT.EtherCAT_Task
ETHERCAT_PRG
MainTask
PLC_PRG
Trace
Resources List
SoftMotion General Axis Pool
HIGH_SPEED_IO (High Speed IO Module)
MODBUS_TCP (ModbusTCP Device)
ETHERCAT (EtherCAT Master SoftMotion)
InoMD800 (MD800_ECAT_9AxisCiA402_V0.19)
Drive1 (SM_Drive_GenericDSP402)
Drive2 (SM_Drive_GenericDSP402)
Drive3 (SM_Drive_GenericDSP402)
ETHERCAT_PRG
Drive1
General
Scaling/Mapping
Commissioning
SM_Drive_ETC_GenericDSP402: I/O Mapping
Status
Information
Motor Type
Rotary
Linear
Scaling
Invert direction
increments <=> motor turns
motor turns <=> gear output turns
gear output turns <=> units in application
Mapping
Automatic mapping
Inputs:
Cyclic object
Object number
Address
Type
Outputs:
Config Device Information Output
Messages - Total 1 error(s), 0 warning(s), 16 message(s)
Last build:
Precompile:
Current user: (nobody)

## 8.2 BECKHOFF'S CONTROLLER

Beckhoff's TwinCAT master station is used as an example to describe the configuration of the SI-ECAT card.

**NOTE**: The 100M Ethernet network adapter with Intel chip must be used. Other network adapters may not support EtherCAT.

1. Install TwinCAT.

   Windows XP system: **tcat_2110_2230** is recommended.

   Windows 7 32-bit system: **tcat_2110_2248** is recommended.

2. Copy the EtherCAT configuration file (MD800_9Axis_V0.18.xml) of MD800 to the

   TwinCAT installation directory.

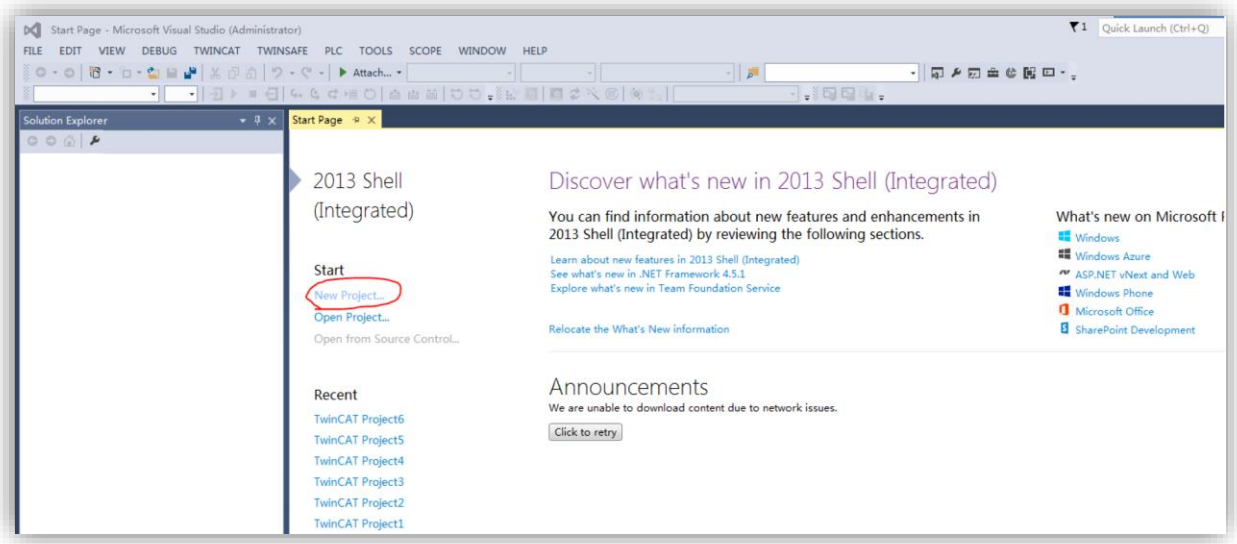
   TwinCAT2 directory: **TwinCAT\IO\EtherCAT**

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

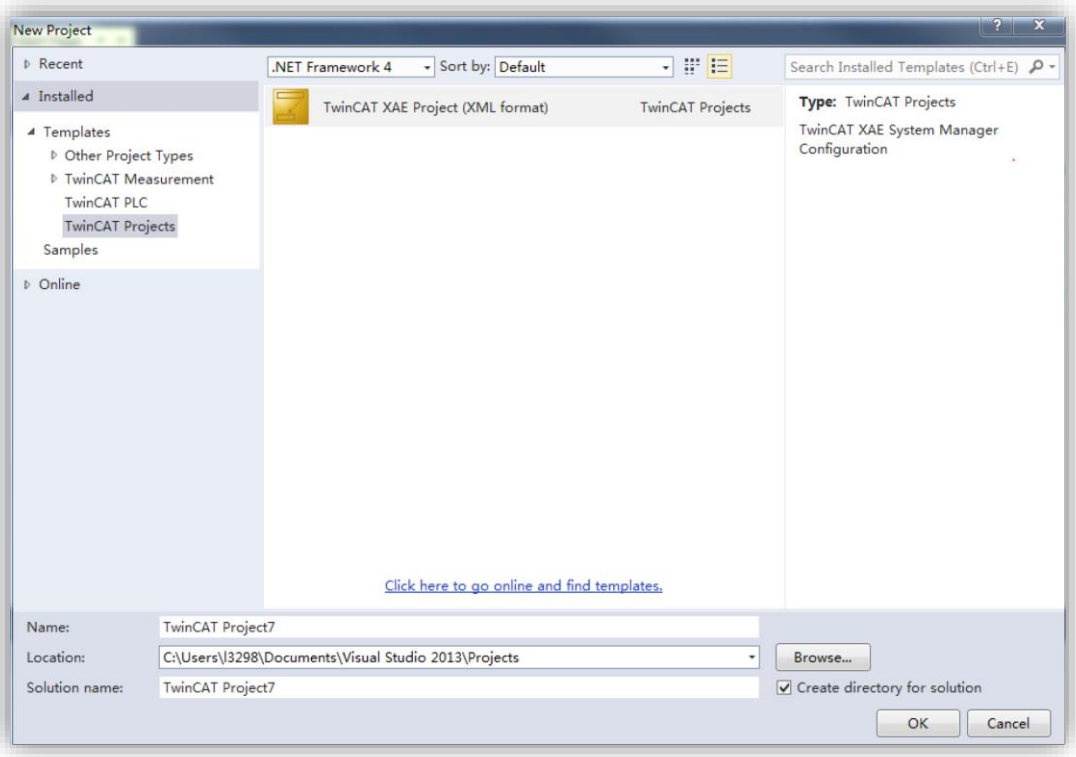
   TwinCAT3 is used as an example in the following section. The operation steps for TwinCAT2 are similar.

3. Start TwinCAT.

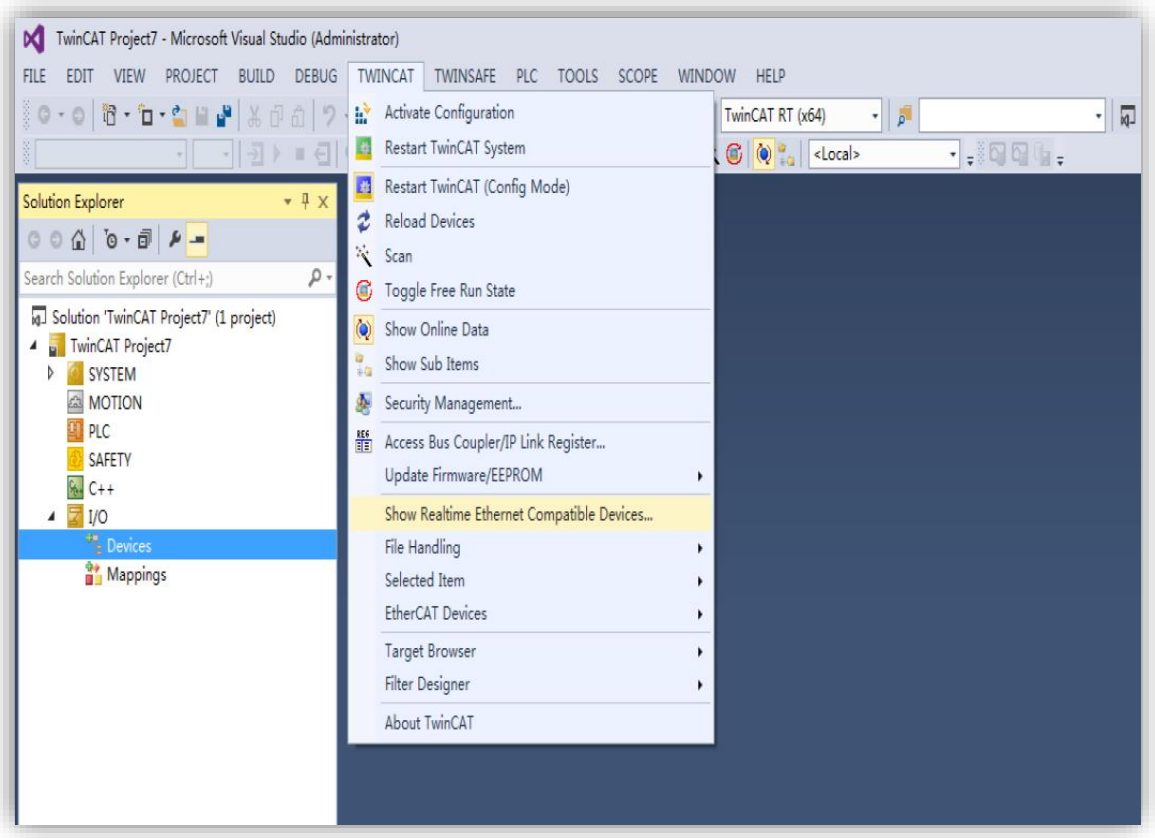
   Click **New Project** to create a project.



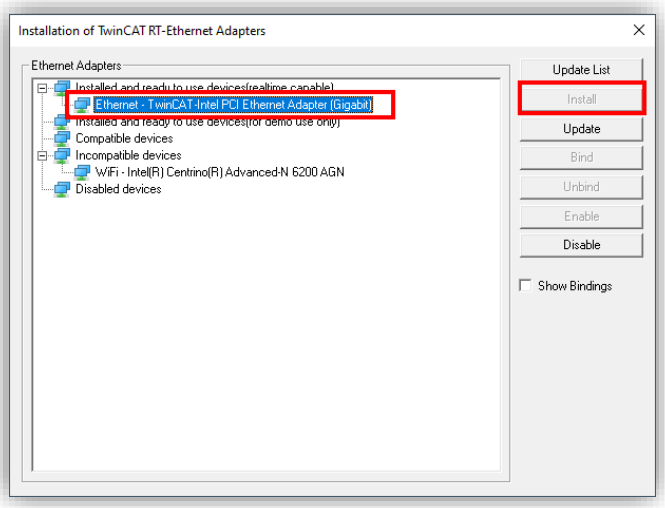
Select TwinCAT XAE Project and click **OK**.




4. Install the TwinCAT network adapter driver.

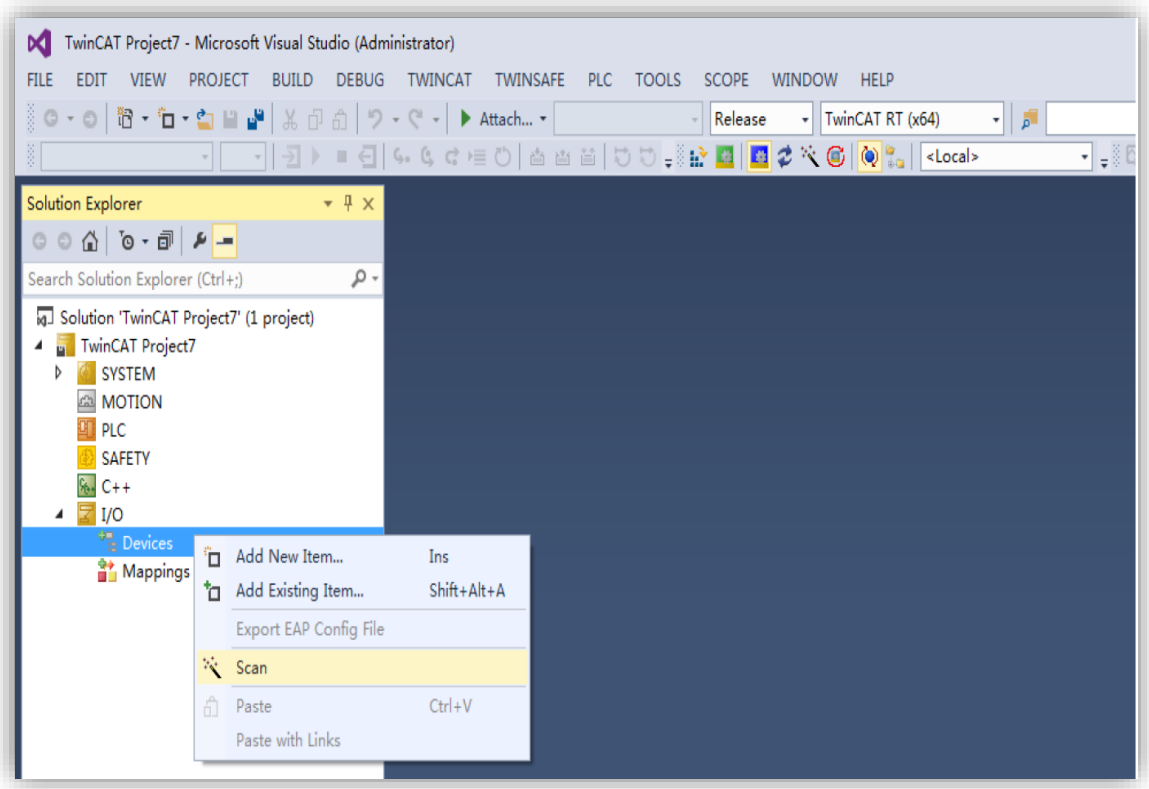


Choose **TWINCAT > Show Real Time Ethernet Compatible Devices**…. In the displayed dialog box, select the local network adapter in **Incompatible devices**, and click **Install**. After installation, the installed network adapter is displayed in **Installed and ready to use devices**.

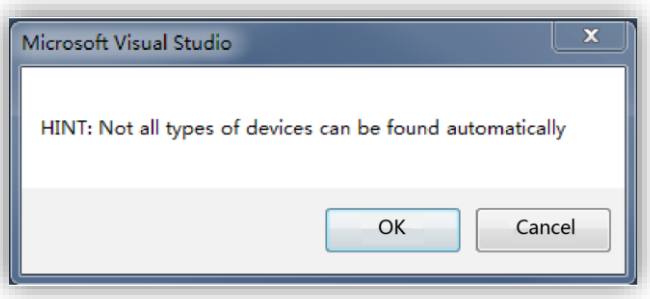



5. Search for devices.

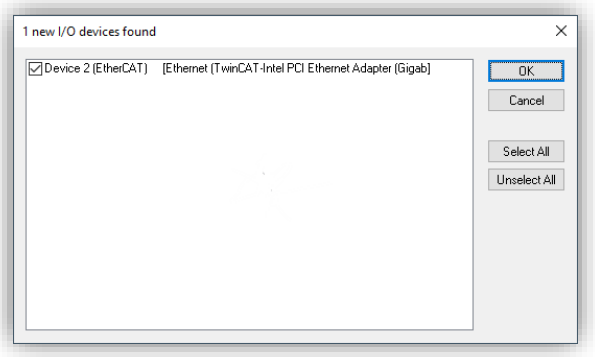
Create a project, right-click Device, and then click Scan to search for devices, as shown in the following figure.



The following message appears. Click **OK**.

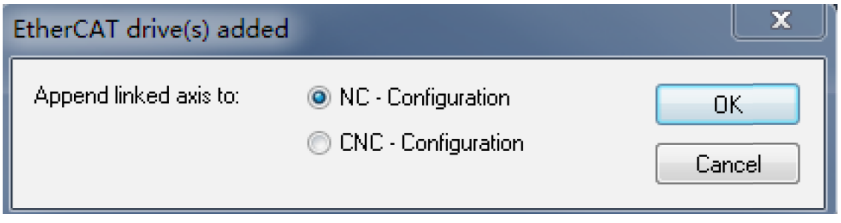



Select EtherCAT device and click **OK**.

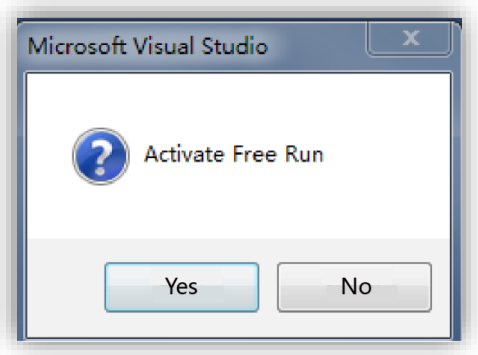



Click **Yes**.

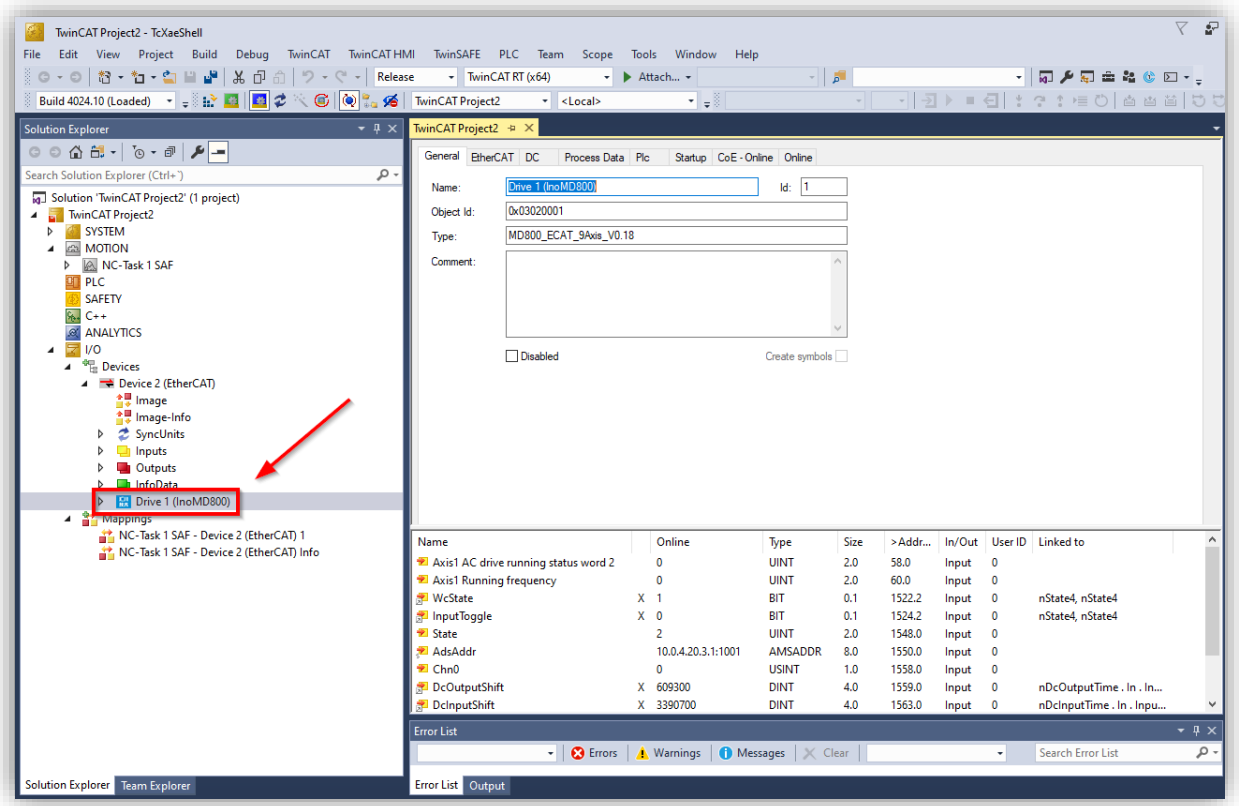

Select NC configuration and click **OK**.



Click **No**.




Now the equipment search is complete, as shown in the following figure:



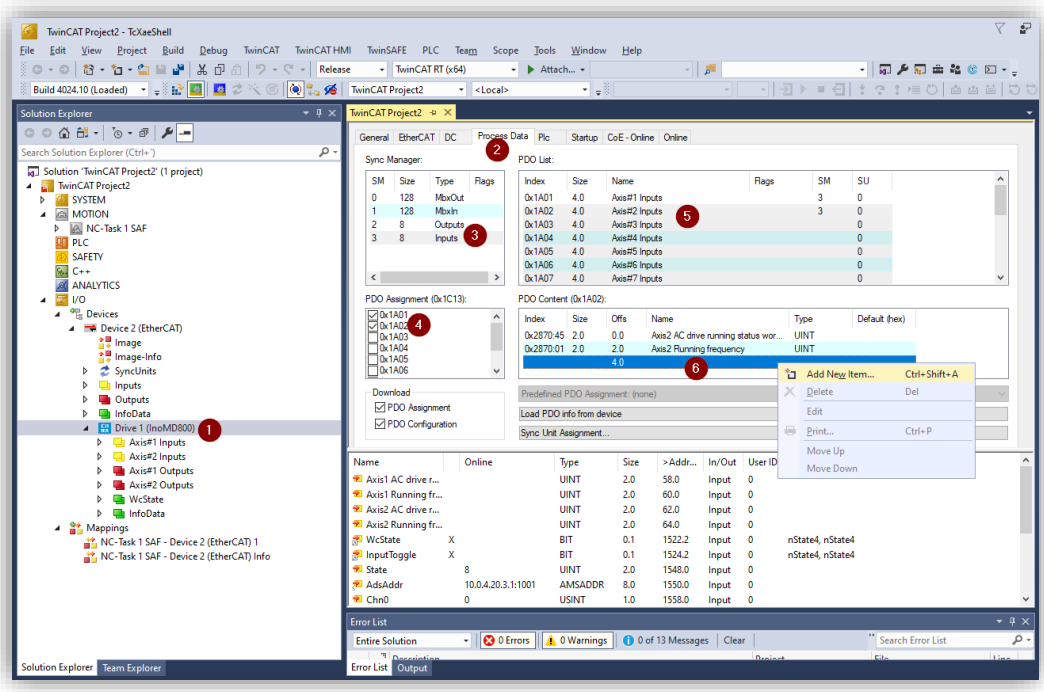
### 8.2.1 CONFIGURE PDO PARAMETERS.

**Configure TPDO.**

1) Open drive configuration
2) Open “Process Data” tab
3) Select “Inputs”
4) Select 0x1A01, 0x1A02, 0x1A03, etc. to enable axis 1, axis 2, axis 3, etc. PDO inputs.
5) Select the corresponding index to configure the PDOs
6) The first two items are set to TPDO by default and cannot be changed. Right click at the position indicated by step 6 in the following figure to add the TPDO mapping as required.

Each drive or the rectifier has a specific index:

- 0x1A01 Drive 1
- 0x1A02 Drive 2
- 0x1A03 Drive 3
- 0x1A04 Drive 4
- 0x1A05 Drive 5
- 0x1A06 Drive 6
- 0x1A07 Drive 7
- 0x1A08 Drive 8
- 0x1A10 Rectifier




**Configure RPDO.**

7) Open drive configuration

8) Open “Process Data” tab

9) Select “Outputs”

10) Select 0x1601, 0x1602, 0x1603, etc. to enable axis 1, axis 2, axis 3, etc. PDO outputs.

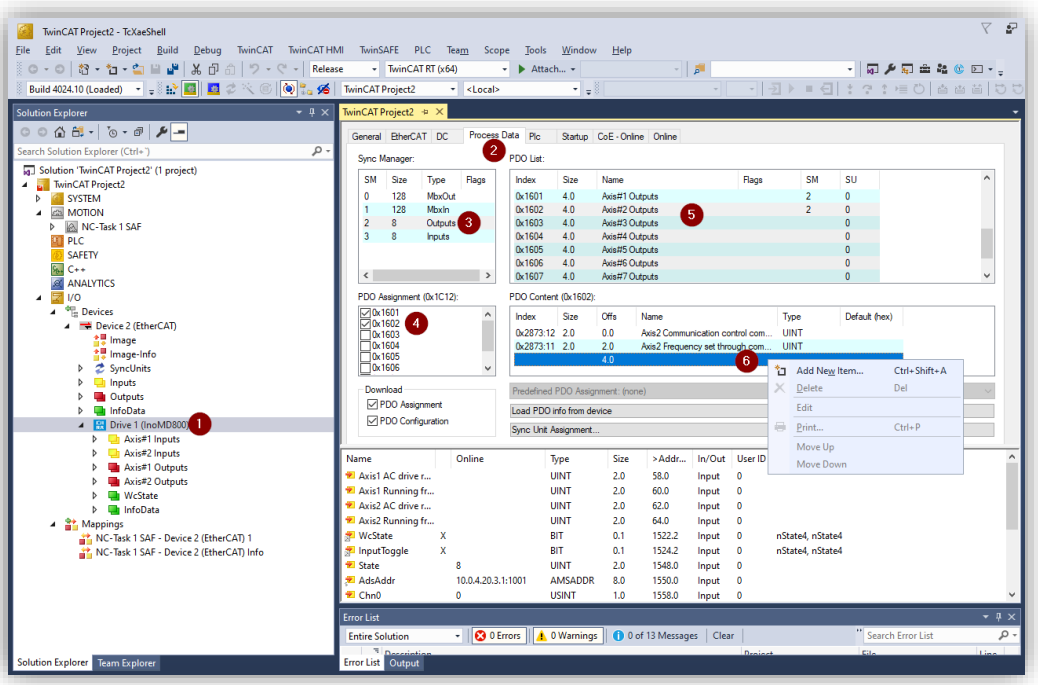
11) Select the corresponding index to configure the PDOs

12) The first two items are set to RPDO by default and cannot be changed. Right click at the position indicated by step 6 in the following figure to add the RPDO mapping as required.

Each drive has a specific index:

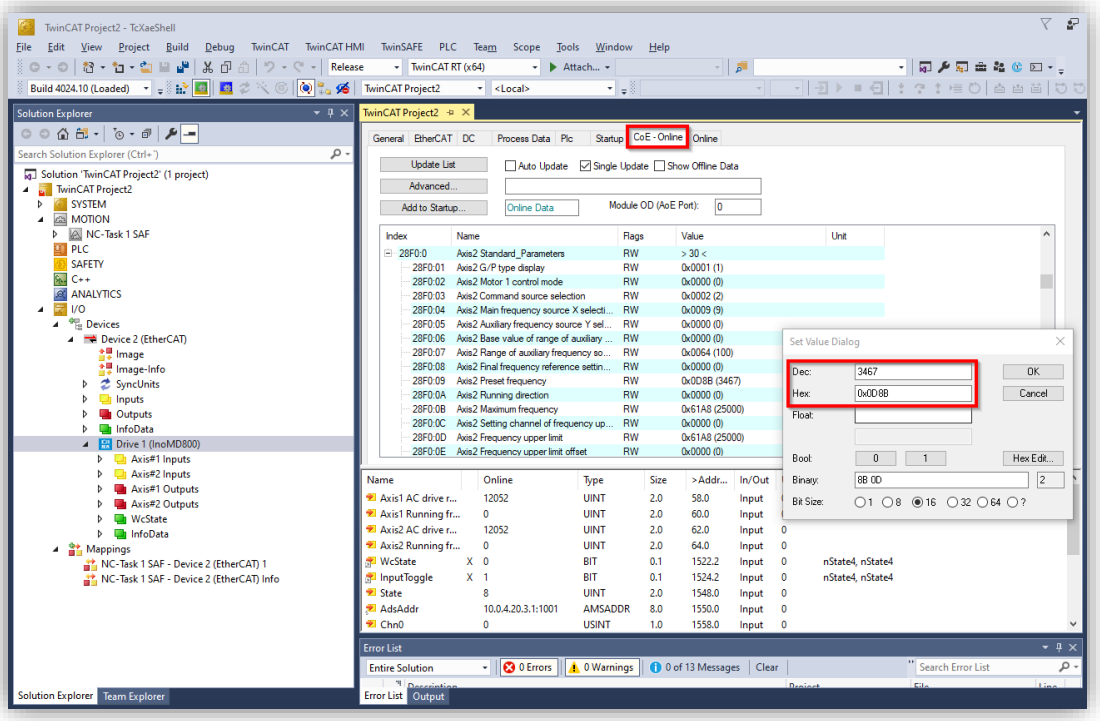
- 0x1601 Drive 1
- 0x1602 Drive 2
- 0x1603 Drive 3
- 0x1604 Drive 4
- 0x1605 Drive 5
- 0x1606 Drive 6
- 0x1607 Drive 7

- 0x1608 Drive 8



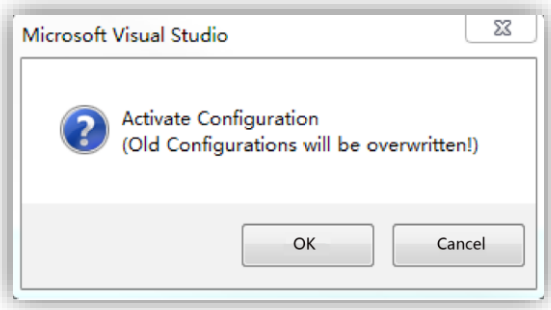
2. View the SDO data list.

After the OP state is activated, you can view real-time data in the SDO data list or double-click the object dictionary to modify the SDO data.

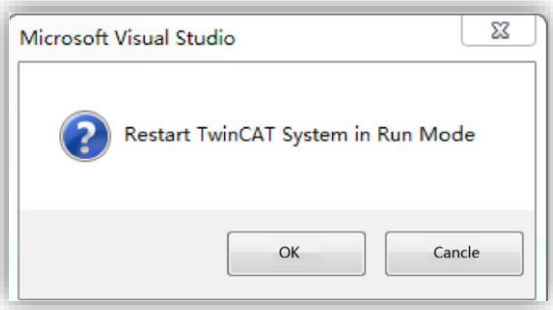


3. Activate the configuration and switch over to the running mode.

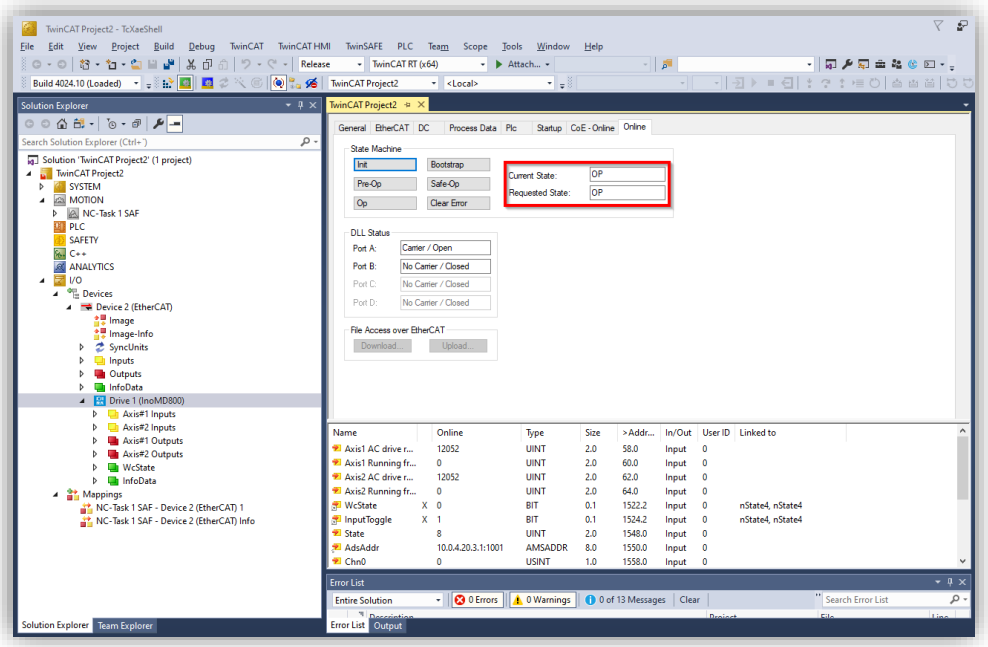
Click  . The following dialog box is displayed.




Click **OK**.

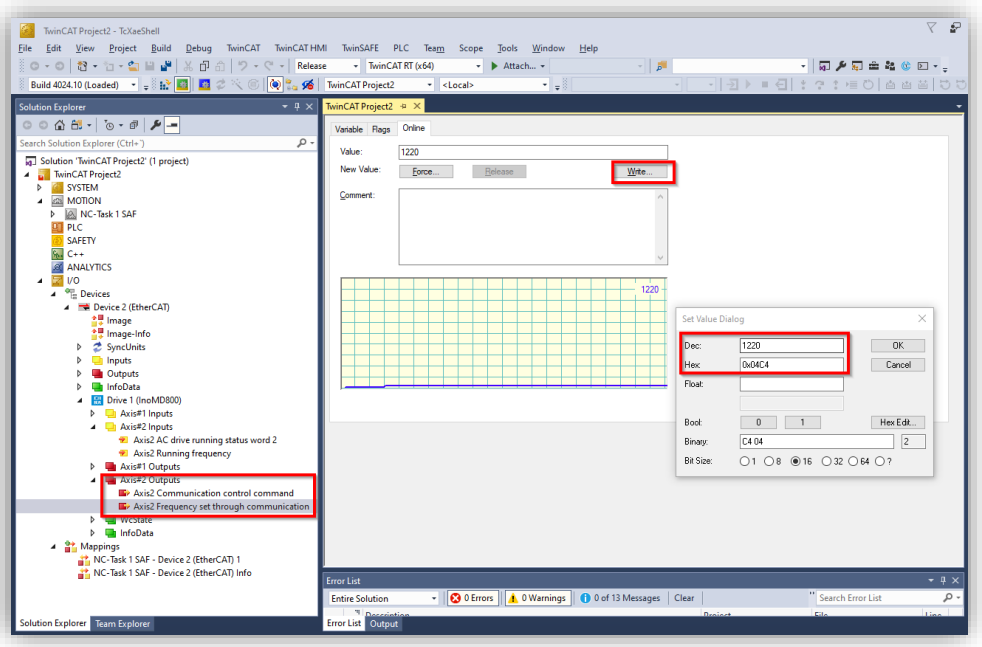



Click OK to enter the OP state.



4. Control the AC drive through PDO.

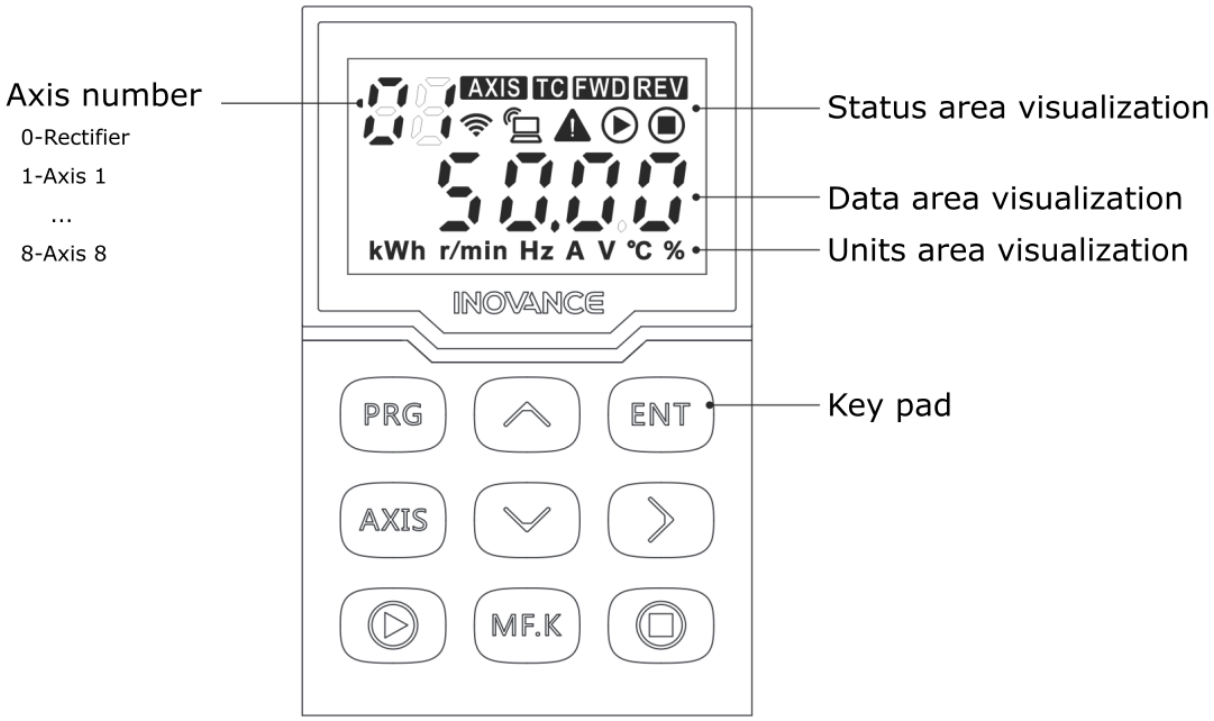
Write corresponding values through the configured RPDO to control the AC drive.



# 9 MD800 BRIEF DESCRIPTION

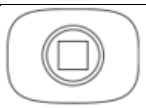
## 9.1 KEYPAD

The LED operation panel can display operating status, parameter settings, fault information, etc. The below image shows the operation panel distribution:




Key description:

| Button | Name | Function |
|---|---|---|
| PRG | Programming key | Return to the previous screen;<br>Enter the first level menu. |
| ENT | Enter | Go to the next screen;<br>Confirmation of mode, parameter and set value. |
| AXIS | Multi-axis switch key | To switch between multiple axes, rectifier is selected by default. |
| ^ | Increment key | Change (increase) the parameter number and set value. |
| v | Decrement key | Change (decrease) the parameter number and set value. |
| > | Shift key | Shift left to select display parameters.<br>The digits that need to be changed when setting parameter numbers and values are shifted to the left. |
| MF.K | Multi-function selection key | According to the set value of F7-01, switch between the selected functions. |

| | | |
|---|---|---|
|  | Run key | In the start-stop control mode of the operation panel, it is used for running operation. |
|  | Stop command / fault reset | In the running state, it is used to stop the running operation.<br>In the fault alarm state, it is used to reset operation. |

## 9.2 INVERTER MODULE LEDS

**Table 1 - Description of Inverter Module Indicators**

| Indicator symbol | Indicator name | Status description |
|---|---|---|
| PWR (yellow) | Power Indicator | Steady on: The device is in the power-on state.<br>Off: The device is powered off |
| RUN (green) | Running lights | Steady on: The device is in operation.<br>Off: The device is in a stopped state.<br>Flashing: operated by rectifier keyboard |
| ERR (red) | Alarm indicator | Steady on: The device is malfunctioning.<br>Off: The device is normal.<br>Flashing: The device has an alarm |

## 9.3 RECTIFIER MODULE DISPLAY

Keypad Data Display

- Axis number

  Two-digit digital tube display, 0 means rectifier module, 1~8 means inverter module.

- Status display area

**Table 2 - Status icon description**

| Icon | Name | Function description | Status description |
|---|---|---|---|
|  | Axis (AXIS) | Multi-axis switch key | – |
|  | Torque control (TC) | Torque control mode | Steady on: the device is in torque control mode<br>Blinking: the device is in the state of autotuning |
|  | Forward (FWD) | Forward running | – |
|  | Reverse (REV) | Reverse running | – |
|  | Wi-Fi | Wi-Fi connection mode | – |
|  | Remotely | Remote connection mode | Steady on: The command source is selected as the terminal control channel<br>Blinking: The command source is selected as the communication control channel |

| | | | |
|---|---|---|---|
|  | Alert | Alarm status | Steady on: The device is malfunctioning<br>Flashing: The device has an alarm |
|  | Run | Operating status | – |
|  | Stop | Stop status | – |

- Data display area

  There are a total of 5 LED data displays on the operation panel, which can display the set frequency, output frequency, various monitoring data, and alarm codes.

- Unit display area

| Unit | Description |
|---|---|
| kWh | Energy unit |
| r/min | Speed unit |
| Hz | Frequency unit |
| A | Current unit |
| V | Voltage unit |
| ℃ | Temperature unit |
| % | Percentage |

### 9.3.1 RELATED PARAMETERS

| Parameter | Parameter name | Default Value | Setting Range | Description |
|---|---|---|---|---|
| F7-01 | MF.K key function selection | 0 | 0: MF.K is invalid<br>1: Switch between terminal command channel or communication command<br>2: Forward and reverse switching<br>3: Forward jog<br>4: Reverse jog | The MF.K key on the operation panel is a multi-function key, and the MF.K key is set by this parameter<br>Function:<br>0: MF.K is invalid<br>This key has no function.<br>1: Switch between terminal command channel or communication command<br>F0-02 is set to 0 (operation panel), there is no effect after pressing the MF.K key<br>F0-02 Set to 1 (terminal), through the MF.K key can be realized between the terminal and the operation panel<br>Switch; F0-02 is set to 2 (communication), through the MF.K key can realize the communication and |

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| | | | | Switch between operation panels.<br>2: Forward and reverse switching<br>Switch the direction of frequency command by MF.K key. This function is only available when the command source is running.<br>It is valid when the command is the operation panel.<br>3: Forward jog<br>Realize forward jog (FJOG) by MF.K key. This function is only available in the command source<br>It is valid when the line command is the operation panel.<br>4: Reverse jog<br>Reverse jog (RJOG) is realized by MF.K key. This function only runs at the command source<br>It is valid when the command is an operation panel. |
| F7-02 | STOP key function | 0 | 0: Only in keyboard operation mode: STOP/RES<br>1: In any operation mode, the STOP/RES key stops | The STOP button on the operation panel is the stop/reset button, set STOP behavior by this parameter<br>The function of the key.<br>0: Only in the keyboard operation mode, the stop function of the STOP key is valid<br>Only in the keyboard operation mode, the stop reset function of the STOP key is valid.<br>1: In any operation mode, the stop function of the STOP key is valid<br>In any operation mode, the stop reset function of the STOP key is valid. |
| F7-03 | Display parameter 1 | 31 | BIT00: Operating frequency (Hz)<br>BIT01: Setting frequency (Hz)<br>BIT02: Bus voltage (V)<br>BIT03: Output voltage (V)<br>BIT04: Output current (A)<br>BIT05: output power (kW)<br>BIT06: Output torque (%)<br>BIT07: DI input status<br>BIT08: DO output status<br>BIT09: AI1 voltage (V)<br>BIT10: AI2 voltage (V) | If you need to display the following parameters during operation, set their corresponding positions to 1. Set this binary number to hexadecimal and set it in F7-03.<br>Pressing the shift key  the configured parameters can be displayed |

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| | | | BIT11: AI3 voltage (V)<br>BIT12: count value<br>BIT13: length value<br>BIT14: Load speed display<br>BIT15: PID setting | |
| F7-04 | Display parameter 2 | 0 | BIT00: PID feedback<br>BIT01: PLC stage<br>BIT02: reserved<br>BIT03: Operating frequency 2 (Hz)<br>BIT04: Remaining running time<br>BIT05: reserved<br>BIT06: reserved<br>BIT07: reserved<br>BIT08: Linear speed<br>BIT09: Current power-on time (Min)<br>BIT10: current running time (Min)<br>BIT11: reserved<br>BIT12: Communication setting value<br>BIT13: reserved<br>BIT14: Main frequency X display<br>BIT15: auxiliary frequency Y display | If you need to display the following parameters during operation, set their corresponding positions to<br>1. Set this binary number to hexadecimal and set it in F7-04.<br>Pressing the shift key the configured parameters can be displayed |
| F7-05 | Stop display parameters | 51 | BIT00: set frequency (Hz)<br>BIT01: bus voltage (V)<br>BIT02: DI input status<br>BIT03: DO output status<br>BIT04: AI1 voltage (V)<br>BIT05: AI2 voltage (V)<br>BIT06: AI3 voltage (V)<br>BIT07: Count value<br>BIT08: length value<br>BIT09: PLC stage<br>BIT10: Load speed display<br>BIT11: PID setting<br>BIT12: reserved | If you need to display the following parameters during stop state, set their corresponding positions to 1,<br>Convert this binary number to hexadecimal and set it in F7-05.<br>Pressing the shift key the configured parameters can be displayed |
| FP-01 | Parameter initialization | 1 | 0: No operation<br>1: Restore factory parameter mode 1<br>2: Clear record information<br>4: Backup user current parameters | Set the corresponding actions when the inverter performs parameter initialization.<br>0: No operation<br>The inverter does not perform any operation.<br>1: Restore factory parameter mode 1 |

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| | | | 501: Restore user backup parameters | Most of the inverter function parameters are restored to the factory parameters, but the motor parameters<br>Maximum frequency (F0-10), frequency command decimal point (F0-22), fault record Information, cumulative running time (F7-09), cumulative power-on time (F7-12),<br>The cumulative power generation (F7-13) and cumulative power consumption (F7-14) will not recover.<br>2: Clear record information<br>Clear the inverter fault record information, accumulated running time (F7-09), accumulated up Electricity time (F7-12), cumulative power generation (F7-13), cumulative power consumption (F7-14).<br>4: Backup user current parameters<br>Back up the parameter settings set by the current user.<br>501: Restore user backup parameters<br>Restore the parameter setting value backed up by setting FP-01 to 4. |

## 9.4 DIGITAL I/O CONFIGURATION

### 9.4.1 DRIVES DIGITAL I/O CONFIGURATION

| Function code | Name | Setting Range | Meaning |
|---|---|---|---|
| F4-00 | DI1 hardware source selection | 0: no choice<br>1: Rectifier-DI1<br>2: Rectifier-DI2<br>3: Rectifier-DI3<br>4: Rectifier-DI4<br>5: Rectifier-DIO1<br>6: Rectifier-DIO2<br>7: Rectifier-DIO3<br>8: Rectifier-DIO4<br>101: Expansion card 1-DI1<br>102: Expansion card 1-DI2<br>103: Expansion card 1-DI3<br>104: Expansion card 1-DI4<br>105: Expansion card 1-DI5<br>106: Expansion card 1-DI6<br>107: Expansion card 1-DI7<br>108: Expansion card 1-DI8<br>201: Expansion card 2-DI1<br>202: Expansion card 2-DI2<br>203: Expansion card 2-DI3<br>204: Expansion card 2-DI4<br>205: Expansion card 2-DI5<br>206: Expansion card 2-DI6<br>207: Expansion card 2-DI7<br>208: Expansion card 2-DI8 | Select the source of the input terminal. |
| F4-01 | DI1 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-02 | DI2 hardware source selection | See function code F4-00 setting range | Select the source of the input terminal. |
| F4-03 | DI2 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-04 | DI3 hardware source selection | See function code F4-00 setting range | Select the source of the input terminal. |
| F4-05 | DI3 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-06 | DI4 hardware source selection | See function code F4-00 setting range | Select the source of the input terminal. |
| F4-07 | DI4 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-08 | DI5 hardware source selection | See function code F4-00 setting range | Select the source of the input terminal. |
| F4-09 | DI5 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-10 | DI6 hardware source selection | See function code F4-00 setting range | Select the source of the input terminal. |

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| F4-11 | DI6 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-12 | DI7 hardware source selection | See function code F4-00 setting range | Select the source of the input terminal. |
| F4-13 | DI7 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-14 | DI8 hardware source selection | See function code F4-00 setting range | Select the source of the input terminal. |
| F4-15 | DI8 terminal function selection | 0-63. See table below | Select the function of the input terminal. |
| F4-17 | Terminal command mode | 0: Two-wire type 1<br>Two-wire mode 1, access to 2 DI terminals, one is used to control the start and stop of the inverter in forward rotation, and the other is used to control the start and stop of the reverse rotation.<br>1: Two-wire type 2<br>Two-wire mode 2, access 2 DI terminals, one is used to control the start and stop of the inverter, and the other is used to control the running direction.<br>2: Three-wire 1<br>Three-wire mode 1, access 3 DI terminals, one is used to control the start and stop of the inverter, and the other 2 are used to control the running direction.<br>3: Three-wire 2<br>Three-wire mode 2, access 3 DI terminals, one is used to control the start of the inverter, one is used to control the stop, and the other one is used to control the running side to. | There are four different ways to control the operation of the inverter through external terminals. |
| F4-18 | Terminal UP/DOWN change rate | 0.001Hz/s~65.535Hz/s | The rate of change when adjusting the frequency through the terminal UP or DOWN When DI terminal function selection is set to terminal UP or terminal DOWN, this parameter needs to be set (the value of F4-01~F4-15 is 6 or 7). |
| F4-19 | DI1 delay time | 0.0s~3600.0s | When the state of the digital input terminal DI changes, the inverter delay time for the change. Currently only DI1, DI2, DI3 have set delay |
| F4-20 | DI2 delay time | 0.0s~3600.0s | When the state of the digital input terminal DI changes, the inverter |

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| | | | delay time for the change. Currently only DI1, DI2, DI3 have set delay |
| F4-21 | DI3 delay time | 0.0s~3600.0s | When the state of the digital input terminal DI changes, the inverter delay time for the change. Currently only DI1, DI2, DI3 have set delay |
| F4-22 | DI input terminal valid state setting 1 | Ones place:<br>0: High level active<br>1: active low<br>Ten:<br>0: High level active<br>1: active low<br>hundreds:<br>0: High level active<br>1: active low<br>Thousands:<br>0: High level active<br>1: active low<br>Ten thousand:<br>0: High level active<br>1: active low | Set the effective mode of DI1~DI5 terminal through the ones place, tens place, hundreds place, thousands place and ten thousand place of this parameter.<br>0: high level active<br>DI terminals (DI1~DI5) are valid when connected to COM, and invalid when disconnected from COM.<br>1: Active low<br>DI terminals (DI1~DI5) are invalid when connected to COM, and valid when disconnected from COM. |
| F4-23 | DI input terminal valid state setting 2 | Ones place:<br>0: High level active<br>1: active low<br>Ten:<br>0: High level active<br>1: active low<br>hundreds:<br>0: High level active<br>1: active low<br>Thousands:<br>0: reserved<br>Ten thousand:<br>0: reserved | Set the effective mode of DI1~DI8 terminal through the ones place, tens place, hundreds place, thousands place and ten thousand place of this parameter.<br>0: high level active<br>DI terminals (DI6~DI8) are valid when connected to COM, and invalid when disconnected from COM.<br>1: Active low<br>DI terminals (DI6~DI8) are invalid when connected to COM, and valid when disconnected from COM. |
| F4-25 | AI1 hardware source selection | 0: no choice<br>1: Rectifier AI1<br>2: Rectifier AI2<br>101: Expansion card 1 AI1<br>102: Expansion card 1 AI2<br>201: Expansion card 2 AI1<br>202: Expansion card 2 AI2 | Select the source of the analog quantity/temperature input. |
| F4-27 | AI2 hardware source selection | 0: no choice<br>1: Rectifier AI1<br>2: Rectifier AI2<br>101: Expansion card 1 AI1<br>102: Expansion card 1 AI2<br>201: Expansion card 2 AI1<br>202: Expansion card 2 AI2 | Select the source of the analog quantity/temperature input. |
| F4-29 | AI3 hardware source selection | 0: no choice<br>1: Rectifier AI1<br>2: Rectifier AI2<br>101: Expansion card 1 AI1<br>102: Expansion card 1 AI2<br>201: Expansion card 2 AI1 | Select the source of the analog quantity/temperature input. |

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| | | 202: Expansion card 2 AI2 | |
| F4-31 | AI curve 1 minimum input | -10.00V~10.00V | When the main frequency is set through the analog input, the AI terminal is used as the frequency source setting, and 5 different AI curves can be selected for each AI terminal.<br>AI curve is the relationship between the analog input voltage (or analog input current) and the percentage relative to the maximum frequency (F0-10). AI song<br>The x-axis of the line represents the analog input voltage (or analog input current), and the y-axis represents the set value corresponding to the analog input, that is, the relative maximum frequency<br>(F0-10) percentage.<br>There are 5 types of AI curves, among which curve 1, curve 2, and curve 3 are all 2-point curves, and the relevant parameters are F4-31~F4-42; curve 4 and curve 5 are both<br>It is a 4-point curve, and the relevant parameters are A6-00 ~ A6-15.<br>There are 2 points on AI curve 1~3, namely the minimum input point and the maximum input point. F4-31 corresponds to the x-axis of the minimum input point of AI curve 1, that is, the minimum modulus<br>Analog input voltage (or minimum analog input current). |
| F4-32 | AI curve 1 minimum input corresponding setting | -100.0%~100.0% | The y-axis corresponding to the minimum input point of AI curve 1, that is, the set value corresponding to the minimum analog input. |
| F4-33 | AI curve 1 maximum input | -10.00V~10.00V | The x axis corresponding to the maximum input point of AI curve 1, that is, the maximum analog input voltage (or the maximum analog input current). |
| F4-34 | AI curve 1 maximum input corresponding setting | -100.0%~100.0% | The y-axis corresponding to the maximum input point of AI curve 1, that is, the set value corresponding to the maximum analog input. |
| F4-35 | AI curve 2 minimum input | -10.00V~10.00V | The x axis corresponding to the minimum input point of AI curve 2 is the minimum analog input voltage (or minimum analog input current). |
| F4-36 | AI curve 2 minimum input | -100.0%~100.0% | The y-axis corresponding to the minimum input point of AI curve 2 is |

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| | corresponding setting | | the set value corresponding to the minimum analog input. |
| F4-37 | AI curve 2 maximum input | -10.00V~10.00V | The x axis corresponding to the maximum input point of AI curve 2, that is, the maximum analog input voltage (or the maximum analog input current). |
| F4-38 | AI curve 2 maximum input corresponding setting | -100.0%~100.0% | The y-axis corresponding to the maximum input point of AI curve 2 is the set value corresponding to the maximum analog input. |
| F4-39 | AI curve 3 minimum input | -10.00V~10.00V | The x axis corresponding to the minimum input point of AI curve 3 is the minimum analog input voltage (or minimum analog input current). |
| F4-40 | AI curve 3 minimum input corresponding setting | -100.0%~100.0% | The y-axis corresponding to the minimum input point of AI curve 3 is the set value corresponding to the minimum analog input. |
| F4-41 | AI curve 3 maximum input | -10.00V~10.00V | The x axis corresponding to the maximum input point of AI curve 3, that is, the maximum analog input voltage (or the maximum analog input current). |
| F4-42 | AI curve 3 maximum input corresponding setting | -100.0%~100.0% | The y-axis corresponding to the maximum input point of AI curve 3 is the set value corresponding to the maximum analog input. |
| F4-48 | AI curve selection | Ones place:<br>1: Curve 1 (2 points)<br>2: Curve 2 (2 points)<br>3: Curve 3 (2 points)<br>4: Curve 4 (4 points)<br>5: Curve 5 (4 points)<br>Ten:<br>1: Curve 1 (2 points)<br>2: Curve 2 (2 points)<br>3: Curve 3 (2 points)<br>4: Curve 4 (4 points)<br>5: Curve 5 (4 points)<br>hundreds:<br>1: Curve 1 (2 points)<br>2: Curve 2 (2 points)<br>3: Curve 3 (2 points)<br>4: Curve 4 (4 points)<br>5: Curve 5 (4 points) | Set the curve corresponding to AI1~AI3 through the ones, tens, and hundreds of this parameter, and each AI can select any AI curve.<br>1: Curve 1 (2 points)<br>Two-point curve, the corresponding relationship between voltage and frequency is set by F4-31~F4-34.<br>2: Curve 2 (2 points)<br>Two-point curve, the corresponding relationship between voltage and frequency is set by F4-35~F4-38.<br>3: Curve 3 (2 points)<br>Two-point curve, the corresponding relationship between voltage and frequency is set by F4-39~F4-42.<br>4: Curve 4 (4 points)<br>4-point curve, the corresponding relationship between voltage and frequency is set by A6-00~A6-07.<br>5: Curve 5 (4 points)<br>4-point curve, the corresponding relationship between voltage and frequency is set by A6-08~A6-15. |

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| F4-49 | AI is lower than the minimum input setting selection | Ones place:<br>0: Corresponding to the minimum input setting 1:0.0%<br>Ten:<br>0: Corresponding to the minimum input setting 1:0.0%<br>hundreds:<br>0: Corresponding to the minimum input setting 1:0.0% | Set the processing mode that AI1~AI3 are lower than the minimum input setting through the ones place, tens place and hundreds place of this parameter.<br>0: Corresponding to the minimum input setting<br>When the input AI is lower than the minimum setting value, the frequency corresponding relationship is the minimum input setting.<br>1:0.0%<br>When the input AI is lower than the minimum setting value, the frequency corresponding relationship is 0.0%. |

| DI Function code | Description |
|---|---|
| 1 | **Forward run (FWD) or run command** |
| | When two-wire type 1 (F4-17=0), it is forward running; when two-wire type 2 (F4-17=1), it is running command. |
| 2 | **Reverse running (REV) or forward and reverse running direction** |
| | Three-wire type 1 (F4-17=2) is reverse running; two-wire type 2 (F4-17=3) is forward and reverse running direction. |
| 3 | **Three-wire operation control** |
| | Make sure that the inverter operation mode is three-wire control mode. If you want to set the run command through the terminal, set the parameter F4-17 (terminal command mode) to 2 (Three-wire type 1) or 3 (Three-wire type 2), the terminal function should be set to this function. |
| 4 | **Forward jog (FJOG)** |
| | The operation mode of the inverter is forward jog operation. Description of jog running frequency and jog acceleration/deceleration time parameters F8-00, F8-01, F8-02. |
| 5 | **Reverse Jog (RJOG)** |
| | The operation mode of the inverter is reverse jog operation. Description of jog running frequency and jog acceleration/deceleration time parameters F8-00, F8-01, F8-02. |
| 6 | **Terminal UP** |
| | When the frequency is given through the terminal, it is an increasing command to modify the frequency. The effective terminal is equivalent to being pressed all the time. |
| 7 | **Terminal DOWN** |
| | When the frequency is given through the terminal, it is the decrement command to modify the frequency. The effective terminal is equivalent to keep pressing |
| 8 | **UP/DOWN setting clear (terminal, keyboard)** |
| | When the main frequency is set through the panel, the terminal selects this function to clear the |
| 9 | **Fault reset (RESET)** |
| | Reset the fault of the inverter. Use this function to realize remote fault reset. |
| 10 | **External fault normally open input** |
| | When the external signal is sent to the inverter, the inverter reports fault E15.01. |
| 11 | **External fault normally closed input** |
| | When the external signal is sent to the inverter, the inverter reports fault E15.02. |
| 12 | **User-defined fault 1** |

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| | When the inverter alarms E27.00, the inverter will process according to the set value of F9-51 (fault protection action selection). |
| 13 | **User-defined fault 2** |
| | When the inverter alarms E28.00, the inverter will process according to the set value of F9-51 (fault protection action selection). |
| 14-17 | **Multi-segment command terminal 1~4** |
| | Through 16 states of these four terminals, 16 speeds or 16 other commands can be set. |
| 18-19 | **Acceleration/deceleration selection terminal 1~2** |
| | Through the 4 states of the two terminals, 4 kinds of acceleration and deceleration time can be selected. |
| 20 | **Prohibition of acceleration and deceleration** |
| | The inverter maintains the current running frequency (except for the stop command), and is not affected by changes in the external input frequency. |
| 21 | **Command source switching terminal 1** |
| | When the run command is set through the terminal (F0-02=1), the terminal selects this function to switch between terminal control and keyboard control;<br>When setting the running command (F0-02=2), the terminal selects this function to switch between communication control and keyboard control. |
| 22 | **Command source switching terminal 2** |
| | It is used to switch between the terminal and the communication setting operation command. If the terminal is used to control the running command, the system will switch off when the terminal of this function is selected.<br>Change to communication control; if the communication control operation command is used, the system will switch to terminal control when the terminal that selects this function is valid. |
| 23 | **Frequency command switching** |
| | Used to switch between different frequency command input methods. According to the setting of F0-07 (frequency command superposition selection), the<br>Switch. |
| 24 | **Frequency source X and preset frequency switch** |
| | The main frequency is switched to the preset frequency (F0-08). |
| 25 | **Frequency source Y and preset frequency switch** |
| | The auxiliary frequency is switched to the preset frequency (F0-08). |
| 26 | **Frequency modification enable** |
| | If the terminal is valid, it is allowed to modify the frequency; if the terminal is invalid, it is forbidden to modify the frequency. |
| 27 | **Counter input** |
| | In the counting technology function, the terminal selects this function to input counting pulse. |
| 28 | **Counter reset** |
| | In the counting technology function, the terminal selects this function to clear the counter status. |
| 29 | **Length count input** |
| | In the fixed-length technology function, the terminal selects this function to input the length count. |
| 30 | **Length reset** |
| | Use this terminal function in the fixed-length technology function to clear the length. |
| 31 | **PID pause** |
| | PID is temporarily invalid, the inverter maintains the current output frequency and no longer performs PID adjustment of the frequency source. |
| 32 | **PID integration suspended** |
| | The integral adjustment function of PID is suspended, but the proportional adjustment and differential adjustment functions of PID are still valid. |

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| 33 | **PID parameter switch**<br>When the PID parameter switching condition selection (FA-18) is set to 1 (switched by the terminal) and the terminal is invalid, the PID parameter uses FA-05~FA-07;<br>When the sub is valid, FA-15~FA-17 are used. |
| 34 | **The direction of PID action is reversed**<br>PID action direction is opposite to the direction set by FA-03 (PID action direction). |
| 35 | **Torque control prohibited**<br>In the torque control mode, the torque control is switched to the speed control. After the terminal is invalid, it returns to the torque control mode. |
| 36 | **Speed control/torque control switch**<br>The inverter switches between torque control and speed control modes.<br>A0-00 (speed/torque control mode) is set to 0, when the terminal is valid, the control mode is torque mode; when the terminal is invalid, the control mode is speed mode formula.<br>A0-00 (speed/torque control mode) is set to 1, when the terminal is valid, the control mode is speed mode; when the terminal is invalid, the control mode is torque mode formula. |
| 38 | **Speed tracking start**<br>When DI is valid, speed tracking starts. |
| 39 | **Immediate DC braking**<br>The inverter directly switches to the DC braking state. |
| 40 | **Deceleration DC braking**<br>The inverter decelerates to the start frequency of stop DC braking (F6-11), and then enters the DC braking state. |
| 41 | **External parking terminal 1**<br>When "running command selection" is the operation panel (F0-02=0), the inverter will stop. |
| 42 | **42: External parking terminal 2**<br>In any running command mode (panel control, terminal control, communication control), the inverter decelerates to stop. At this time, the deceleration time is fixed at deceleration time Room 4 (F8-08). |
| 43 | **Running pause**<br>The inverter decelerates to stop. When the terminal is valid, all operating parameters are memorized (such as PLC parameters, swing frequency parameters, PID parameters). After the terminal is invalid,<br>The inverter restores the previously memorized operating state. |
| 44 | **Free parking**<br>The inverter stops and the motor stops according to inertia. |
| 45 | **Emergency stop**<br>When the system is in an emergency state, the inverter will decelerate according to the emergency stop deceleration time of terminal F8-59. When the emergency stop deceleration time of V/f mode is 0s, follow the minimum unit<br>Time to decelerate. The input terminal does not need to be in the closed state continuously, even if the time in the closed state is only an instant, it will be stopped urgently.<br>only.<br>Different from the general deceleration time, the emergency stop input terminal is disconnected after the emergency stop deceleration time, if the inverter terminal runs signal at this time<br>If it is still in the closed state, the inverter will not start. The inverter will restart only after disconnecting the running terminal first and then inputting the terminal running command again. |
| 46 | **Motor selection terminal**<br>Select the motor parameters. When the terminal is valid, select motor 2; when the terminal is invalid, select motor 1. |

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| 47 | **This running time is cleared** |
| | The running time of the inverter is cleared to zero.<br>If the current running time is less than the set value (greater than 0) of F8-57 (this running arrival time), the terminal is valid during this process, and the current running counts Time is cleared.<br>If the current running time is greater than the set value of F8-57 (greater than 0), the terminal is valid at this time, and the current running time will not be cleared. |
| 48 | **Two-wire/three-wire switch** |
| | Used to switch between two-wire and three-wire control.<br>If F4-17 is set to 0 (two-wire type 1), when the terminal of this function is valid, switch to three-wire type 1.<br>If F4-17 is set to 1 (two-wire type 2), when the terminal of this function is valid, switch to three-wire type 2.<br>If F4-17 is set to 2 (three-wire type 1), when the terminal of this function is valid, switch to two-wire type 1.<br>If F4-17 is set to 3 (three-wire type 2), when the terminal of this function is valid, switch to two-wire type 2. |
| 49 | **PLC status reset** |
| | Restore the inverter to the initial state of the simple PLC. |
| 50 | **Swing frequency pause** |
| | In the swing frequency technology function, the terminal selects this function to pause the swing frequency function (the inverter outputs at the center frequency). |
| 54-63 | **reserved** |

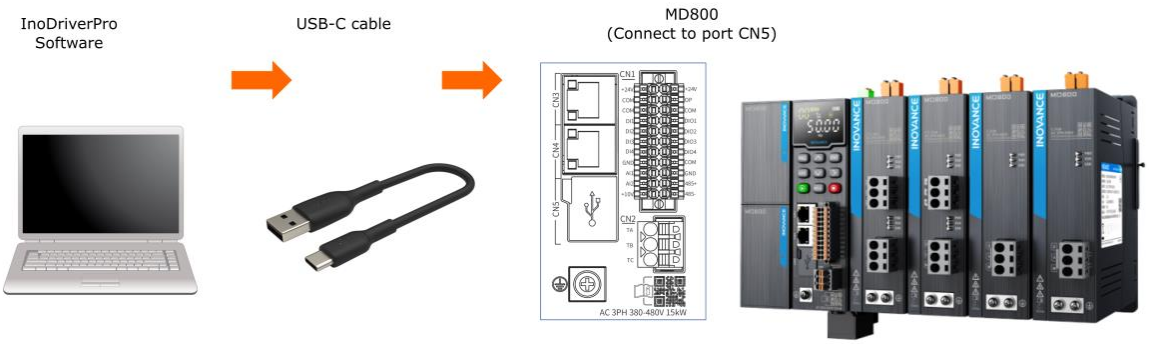
# 10 PC TOOLS

This section explains the different tools available for diagnosis, monitoring and updating. It is divided into two main sections: communication with the InoDriverShop diagnostic and monitoring software and firmware update.

## 10.1 INODRIVERSHOP

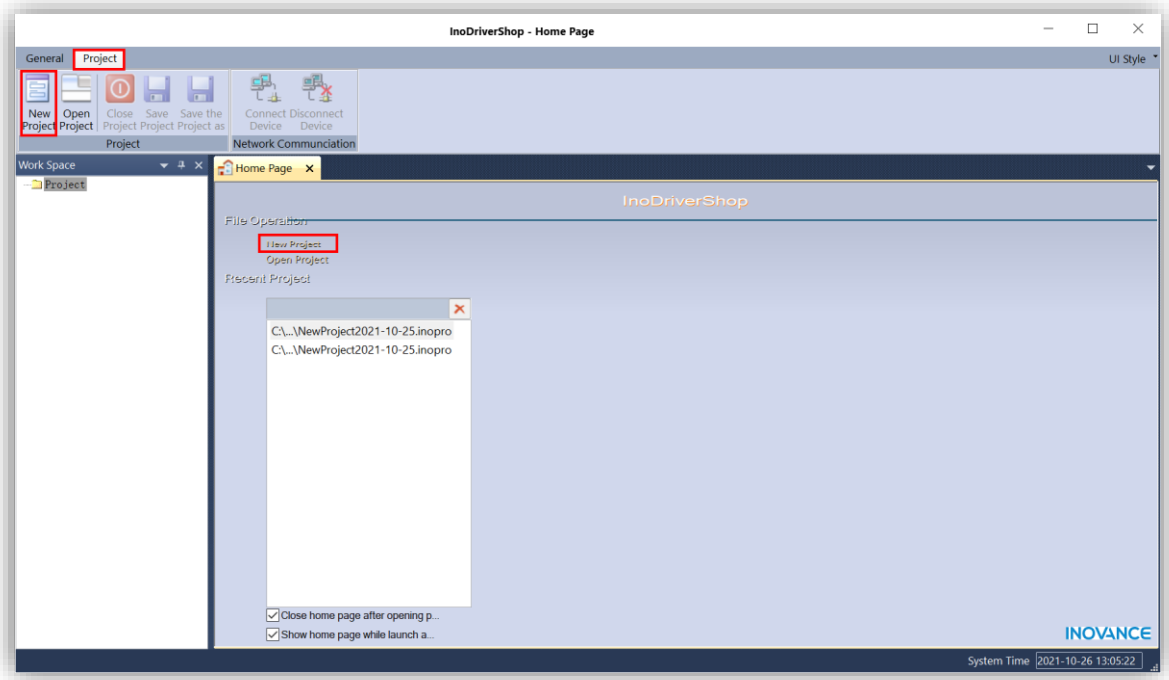
InoDriverShop is the software for windows platforms that allows diagnosis and monitoring of MD800 drives.

Only a standard USB-C cable is needed to connect to the sMD800 drives.

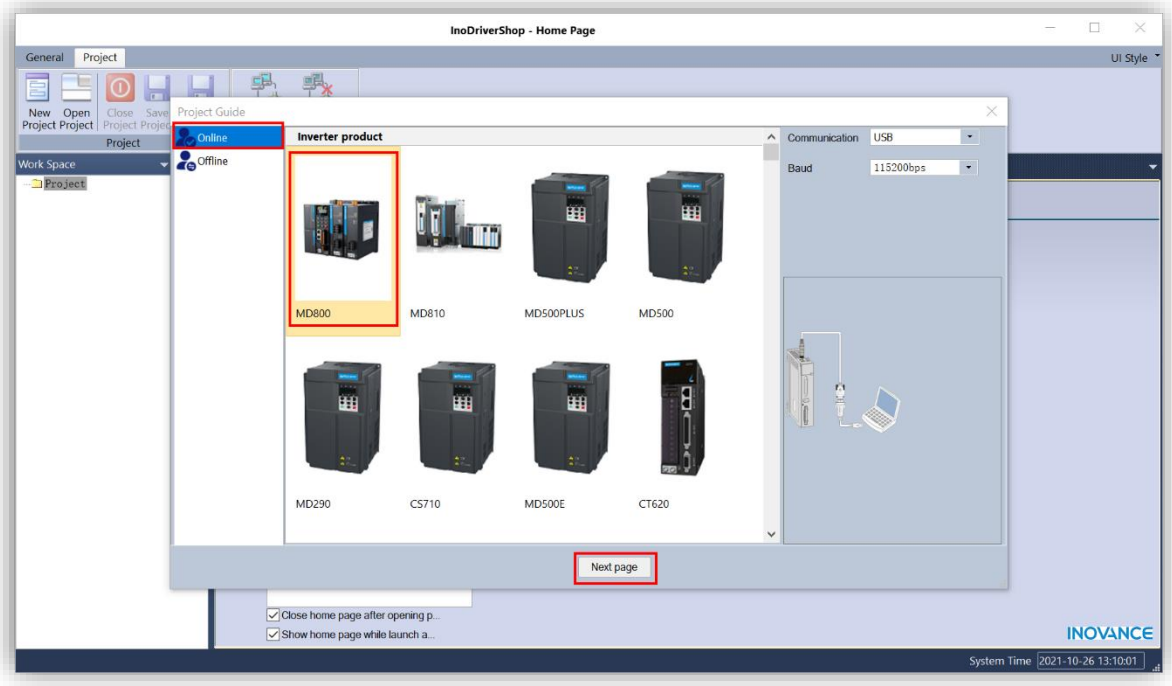



Follow the below procedure to connect InoDriverShop to the MD800 drive:

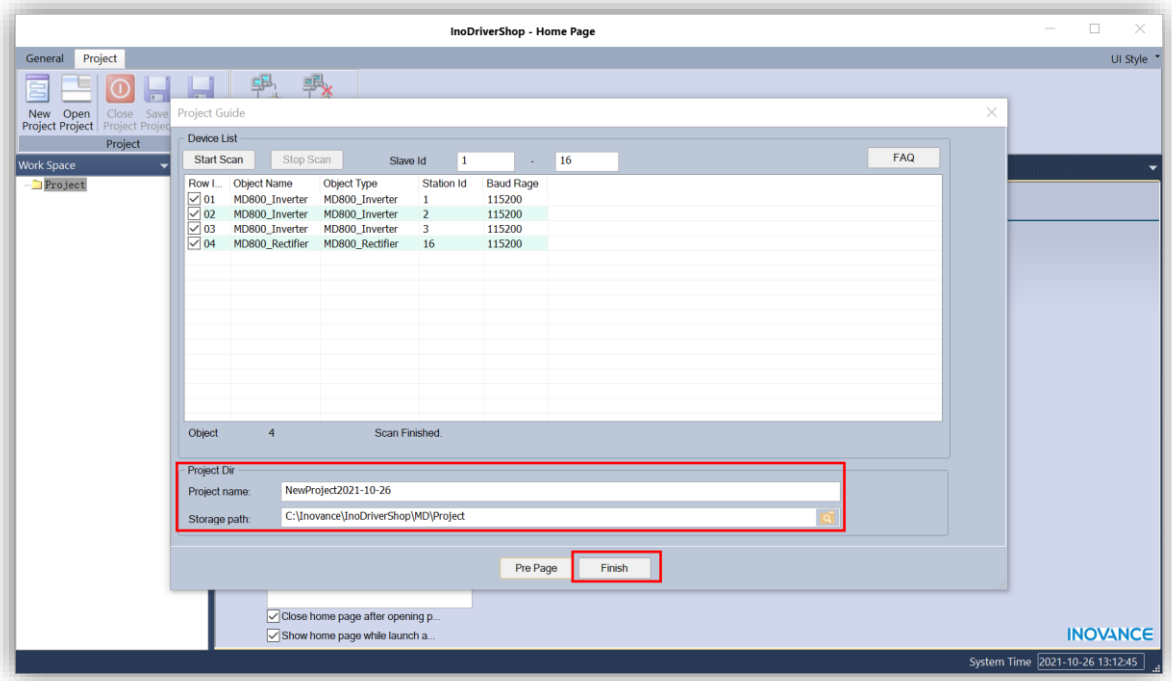
1. Open the InoDriverShop and click in the “new project” button.



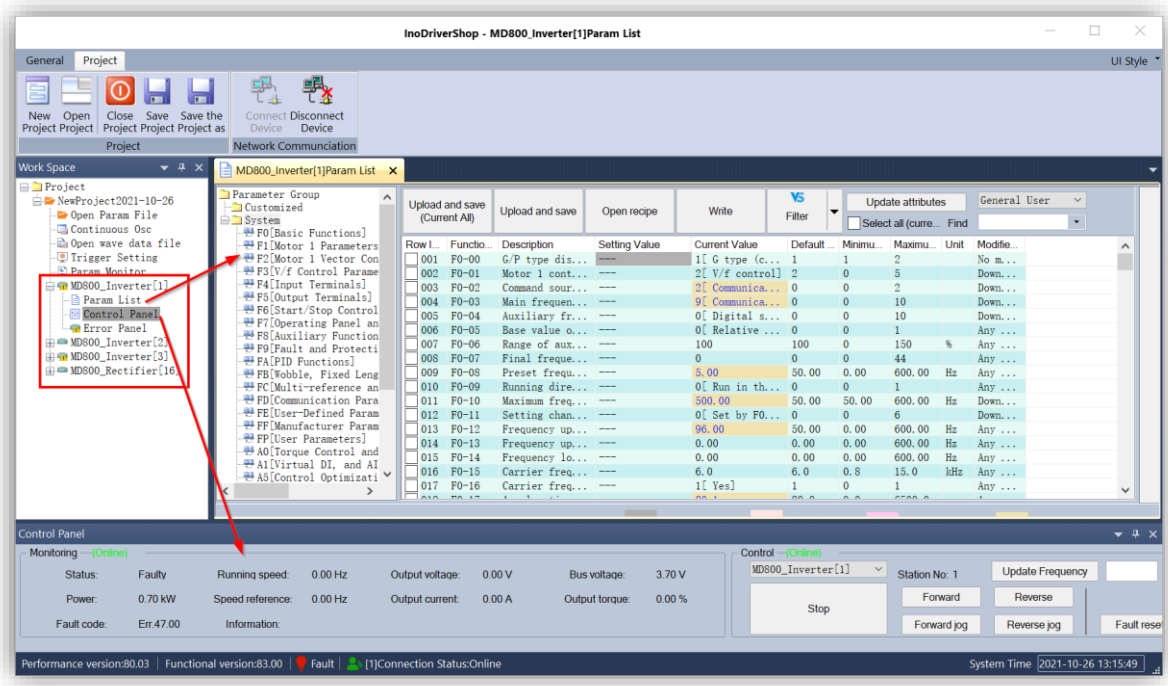
2. Select “Online”, the MD800 drive, and click on the “next” button




3. The software will detect the connected modules and shows a list. The software detects the different modules and displays them in a list. Select the location where you want to save the project and click on the "Finish" button.



4. The detected modules are shown in the project tree from where you can access the list of parameters or the control panel of each module.



## 10.2 MD800 FIRMWARE UPDATE

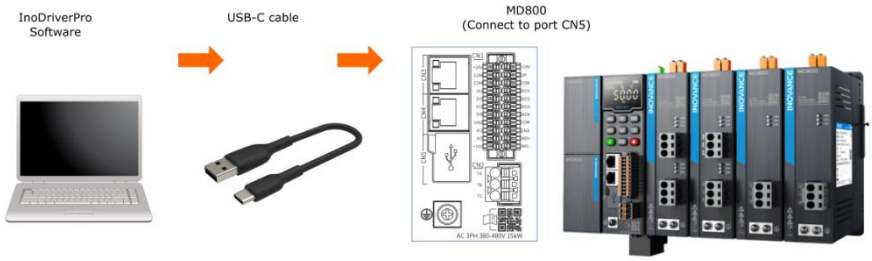
In some cases it is necessary to update the firmware of the rectifier, the inverters or the optional communication modules. This section explains the procedure and the different methods to carry out this task.

The following table shows the parameters that indicate the firmware version of each module:

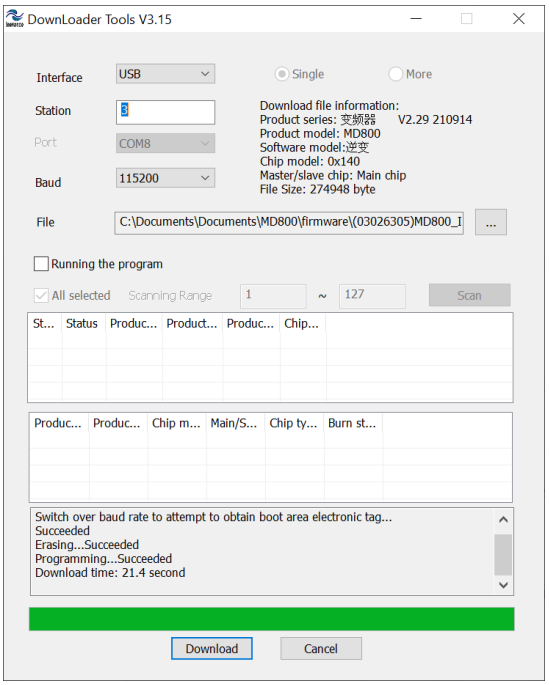
| Parameter | Parameter description |
|---|---|
| | |
| **Rectifier** | |
| **F0-02** | Rectifier software version |
| **FD-91** | Optional communication card firmware version |
| **Inverter** | |
| **F7-10** | Performance software version |
| **F7-11** | Function software version |

### 10.2.1 USING INOLOADER SOFTWARE

To update the firmware with the InoLoader software it is necessary a USB-C cable, and a computer to run the software.



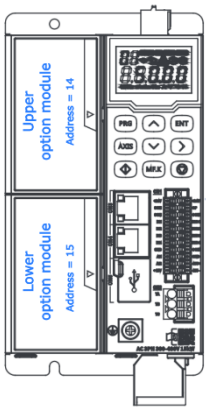

Connect the USB-C cable to the laptop and the MD800 and follow the below procedure:




Start the InoLoader software and select the USB interface as the communication port.

Set the Station number:

- Rectifier = 16
- Axis 1 = 1
- Axis 2 = 2
- ....
- Axis 8 = 8
- Upper option module = 14
- Lower option module = 15



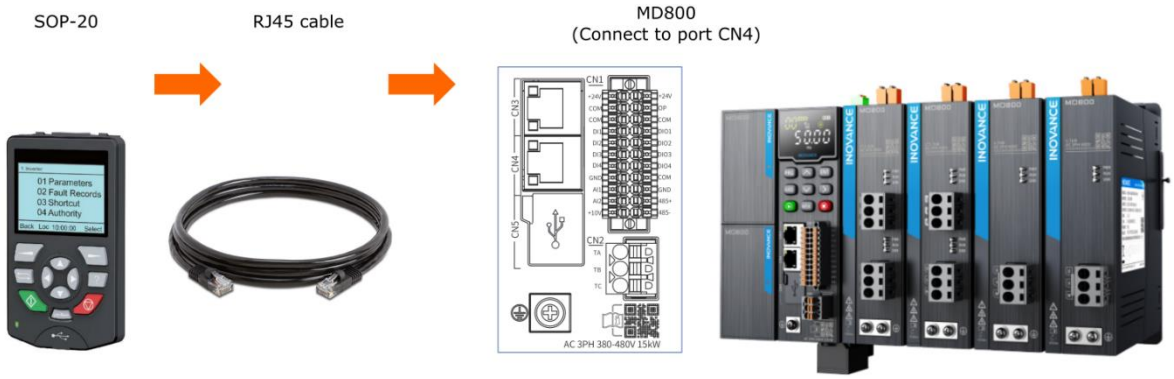

Select the firmware file and click on the download button to download it to the device.

### 10.2.2 USING SOP-20 KEYPAD


SOP-20 could be used to update the MD800 firmware. The SOP-20 is the remote keyboard that allows access to the parameterization of the MD800 in a simpler way and offers a series of tools that facilitate the start-up of the drive.

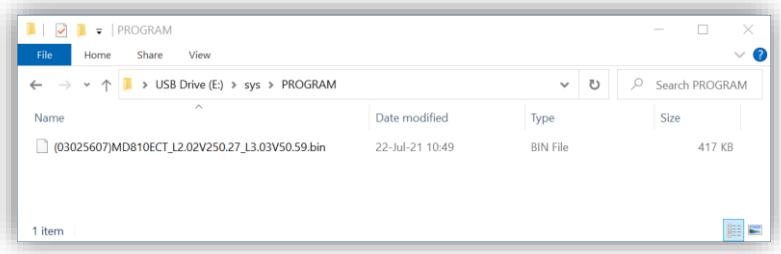
One of the functions of the SOP-20 is to update the MD800 firmware.

To update the firmware with the SOP-20 keypad it is necessary a USB Mini b and RJ45 cable. The USB cable is for copy the firmware file to the SOP-20 memory. The RJ45 cable is for communicate SOP-20 with the MD800 drive port.

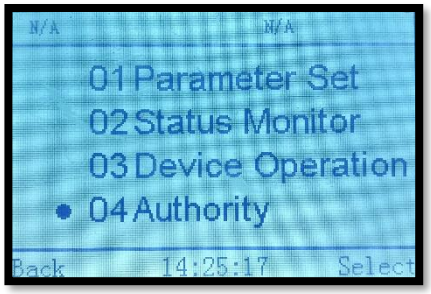



To update the firmware, follow these steps:

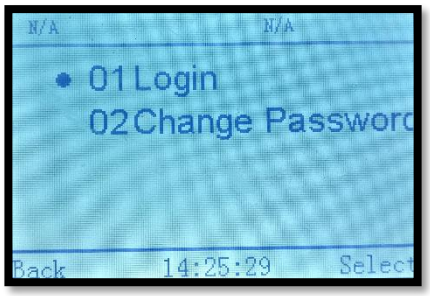
- The first step is to copy the firmware file onto the SOP-20's SD card.
    - Connect the SOP-20 to the USB port of a computer and activate the "USB Disk" mode of the SOP-20. A new drive will appear on the computer.
    - Copy the firmware file to this path “X:\SYS\PROGRAM”



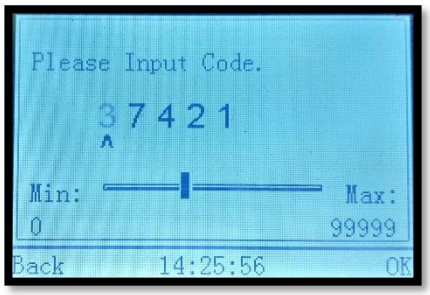

- Disconnect the SOP-20 from laptop
- Connect the SOP-20 to the RJ45B port of the MD800. The SOP-20 turns on and shows an initial screen. Press the button “Menu” and the below screen appears:
-



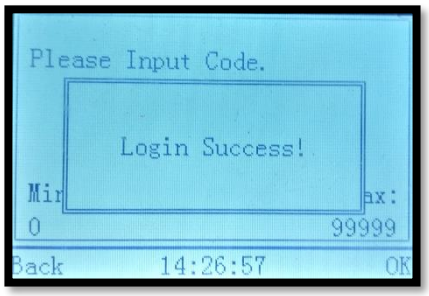

Select Authority



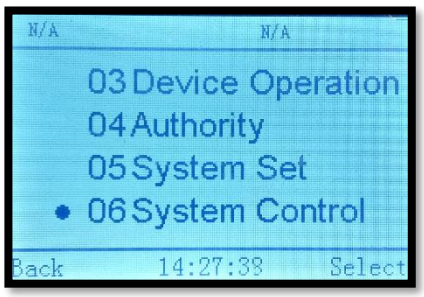

Select Login



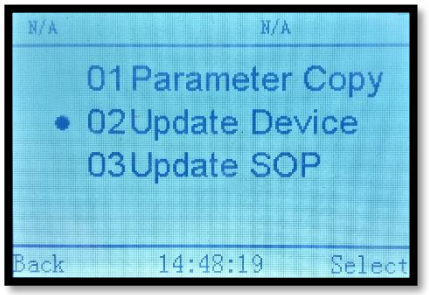

Enter administrator password: 37421



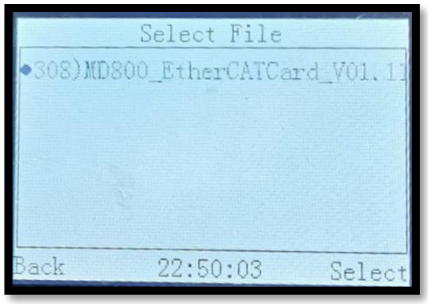

Click button back to return to main menu



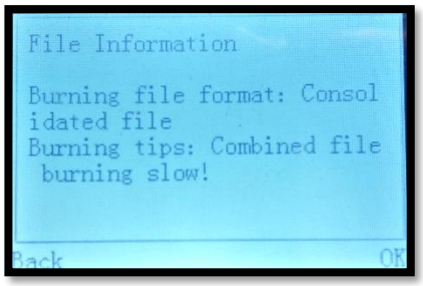

Select “System control”



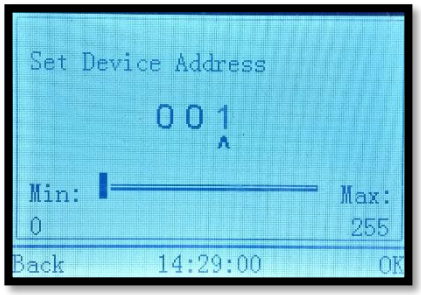

Select “Update Device”




Select firmware file

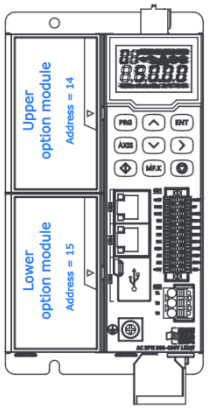


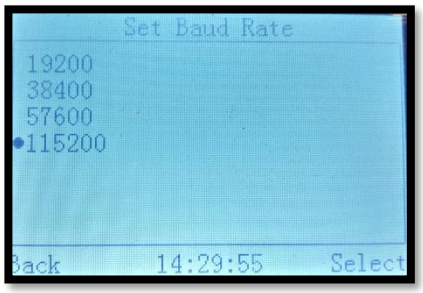

Click OK



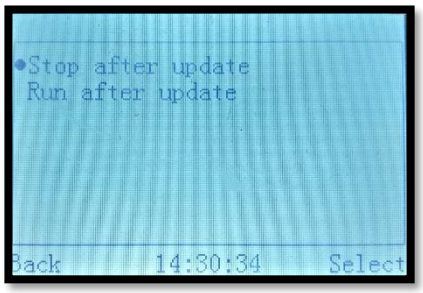

Select device address:

- Rectifier = 16
- Axis 1 = 1
- Axis 2 = 2
- ….
- Axis 8 = 8
- Upper option module = 14
- Lower option module = 15

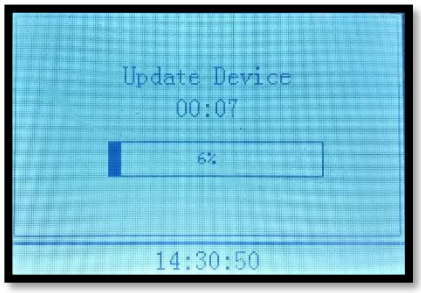


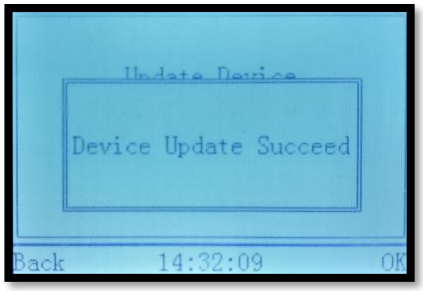

Select baud rate (parameter ***FD-00 Modbus baud rate***) and click OK




Select option “Stop after update”




Update starts…




If the process finish without any problem this message appears

## 11 NOTES

If FD-10 <> 3 the RUN/ERR led flashes quickly and the rectifier gets trip E16.77. Change the parameter FD-10 to 3 to establish communication between the optional card and the rectifier.