Ethernet/IP Expansion Card Tutorial
For HD2 Variable Speed Inverter Drives

IMO

Feature Tutorial

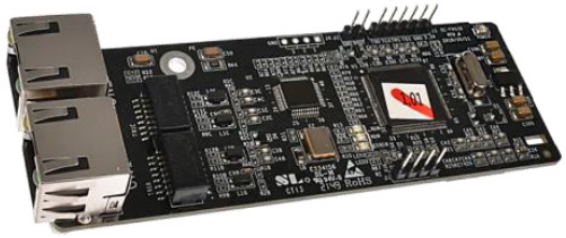
Introduction

This tutorial describes instructions to operate the HD2 EtherNet/IP™ communications card (HD2-E-EIP) and related commands.

The HD2 EtherNet/IP™ expansion communication card is defined as an EtherNet/IP™ server station communication card and is used exclusively with the HD2 family of variable speed drives.

IMO Ethernet/IP Expansion Card

Part Number	HD2-E-EIP
Family Series	HD2 Ethernet/IP Comms Card
Net Weight	0.3kg
Gross Weight	0.1kg



The communication card supports 32 inputs/outputs to read and write process data, read state data, and read and write function parameters of an inverter.

Supported Functions

- Supports the EtherNet/IP protocol, and supports EtherNet/IP devices.
- Provides two EtherNet/IP ports and supports the 10/100M full-duplex/half-duplex operation for daisy chaining.
- Supports the star, linear, and ring topologies.

Communication Ports

Standard RJ45 ports are used in EtherNet/IP communication. The communication card provides two RJ45 ports with no transmission direction defined, and therefore you can insert a cable into the port without regard to its direction.

The Ethernet IP communication card provides standard RJ45 ports and supports the linear, star, and ring topologies. It is recommended to use Ethernet cable that is defined as CAT5, CAT5e, or CAT6 and use high-quality network cables that meet the electrical standards.

State indicators

The EtherNet/IP communication card provides four LED indicators and four net port indicators to indicate its states. The following table describes the state indicators.

Net Port Indicator	Yellow	On	Link indicator, indicating successful Ethernet connection
		Off	Link indicator, indicating that Ethernet connection is not established
	Green	On	ACK indicator, indicating that data interchange being performed
		Off	ACK indicator, indicating that data interchange is not being performed

LED	Colour	State	Description
LED1	Green	On	The card is handshaking with the inverter
		Blinking (1Hz)	The card and inverter communicate normally
		Off	The card and inverter are not communicating
LED2	Green	On	The communication between the card and the PLC is online and data interchange is allowed
		Blinking (1Hz)	IP address conflict between the card and PLC
		Off	The communication between the card and PLC is offline
LED3	Red	On	Failed to setup I/O between the card and PLC
		Blinking (1Hz)	Incorrect PLC configuration
		Blinking (2Hz)	The card failed to send data to the PLC
		Blinking (4Hz)	The connection between the card and PLC timed out
		Off	No fault
LED4	Red	On	3.3V power indicator

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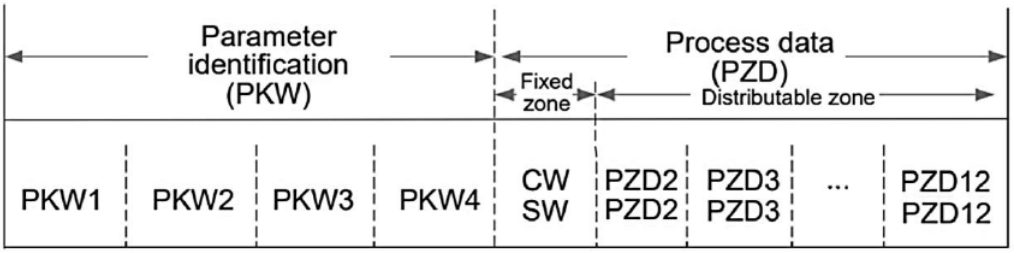
HD2-E-EIP Packet Structure & Mapping

The communication packet used includes a 32 word boundary that include:

Transmitted Data from the PLC / Received data in the HD2 drive: 16 words (O1 – O12)

Received Data / Transmitted data from the HD2 drive: 16 words (I1 – I12)



Mapping Output Data is as follows:

Name	Style	Data Type	Description
IMOHD2:O1		_005A:HD2_EthernetIP_Module	
IMOHD2:O1.Data	Decimal	INT(16)	
IMOHD2:O1.Data[0]	Decimal	INT	PKW1
IMOHD2:O1.Data[1]	Decimal	INT	PKW2
IMOHD2:O1.Data[2]	Decimal	INT	PKW3
IMOHD2:O1.Data[3]	Decimal	INT	PKW4
IMOHD2:O1.Data[4]	Decimal	INT	CW
IMOHD2:O1.Data[5]	Decimal	INT	PZD2
IMOHD2:O1.Data[6]	Decimal	INT	PZD3
IMOHD2:O1.Data[7]	Decimal	INT	PZD4
IMOHD2:O1.Data[8]	Decimal	INT	PZD5
IMOHD2:O1.Data[9]	Decimal	INT	PZD6
IMOHD2:O1.Data[10]	Decimal	INT	PZD7
IMOHD2:O1.Data[11]	Decimal	INT	PZD8
IMOHD2:O1.Data[12]	Decimal	INT	PZD9
IMOHD2:O1.Data[13]	Decimal	INT	PZD10
IMOHD2:O1.Data[14]	Decimal	INT	PZD11
IMOHD2:O1.Data[15]	Decimal	INT	PZD12

Mapping Input Data is as follows:

Name	Style	Data Type	Description
IMOHD2:I1		_005A:HD2_EthernetIP_Module	
IMOHD2:I1.Data	Decimal	INT(16)	
IMOHD2:I1.Data[0]	Decimal	INT	PKW1
IMOHD2:I1.Data[1]	Decimal	INT	PKW2
IMOHD2:I1.Data[2]	Decimal	INT	PKW3
IMOHD2:I1.Data[3]	Decimal	INT	PKW4
IMOHD2:I1.Data[4]	Decimal	INT	SW
IMOHD2:I1.Data[5]	Decimal	INT	PZD2
IMOHD2:I1.Data[6]	Decimal	INT	PZD3
IMOHD2:I1.Data[7]	Decimal	INT	PZD4
IMOHD2:I1.Data[8]	Decimal	INT	PZD5
IMOHD2:I1.Data[9]	Decimal	INT	PZD6
IMOHD2:I1.Data[10]	Decimal	INT	PZD7
IMOHD2:I1.Data[11]	Decimal	INT	PZD8
IMOHD2:I1.Data[12]	Decimal	INT	PZD9
IMOHD2:I1.Data[13]	Decimal	INT	PZD10
IMOHD2:I1.Data[14]	Decimal	INT	PZD11
IMOHD2:I1.Data[15]	Decimal	INT	PZD12

For illustration purposes and to map out the drive's memory, the descriptions we altered to show the addresses within the drive. These descriptions can be changed at any time to fit the application. Note to change the memory location boundary from INT(8) to INT(16)

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HD2-E-EIP Address definitions

PKW1-PKW4 : Parameter identification, Array index, and two paramter values. This is generally reserved for special functions not found in the PZD options. For more infromation, please contact IMO

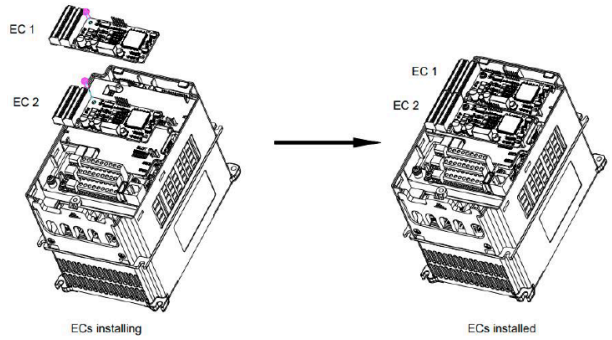
CW / SW : Control and Status Word - These occupy the PZD0 location and the address cannot be changed or altered.

PZD1-PZD12 : Programmable data areas. Within the HD2 program, select what what data type you wish to set by a PLC, or read from into a PLC. (see HD2-E-EIP Setup for details)

HD2 Expansion Card Installation

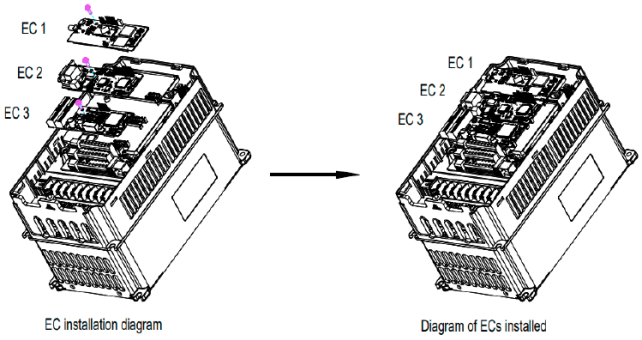
The HD2 is equipped with two expansion ports for drive up to and including 5.5 kW and three ports for HD2 drives that are 7.5 kW or higher. Remove the keypad/HMI and both the wiring cover and top-cover reveals the expansion port sockets.

Two expansion ports available on drive up to and including 5.5kW



ECs installing ECs installed

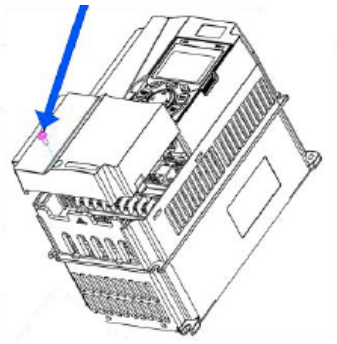
Three expansion ports available on drives 7.5kW and higher.



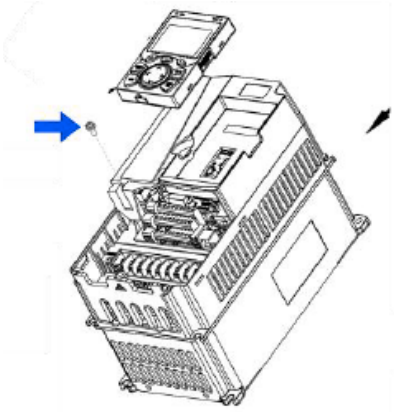
EC installation diagram Diagram of ECs installed

Recommended installation steps are as follows:

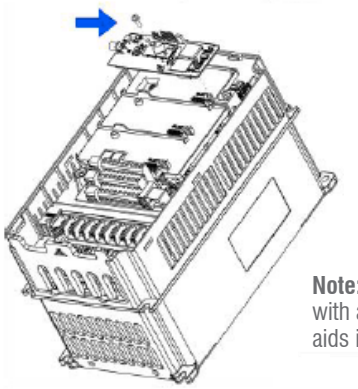
STEP 1: Remove bottom cover



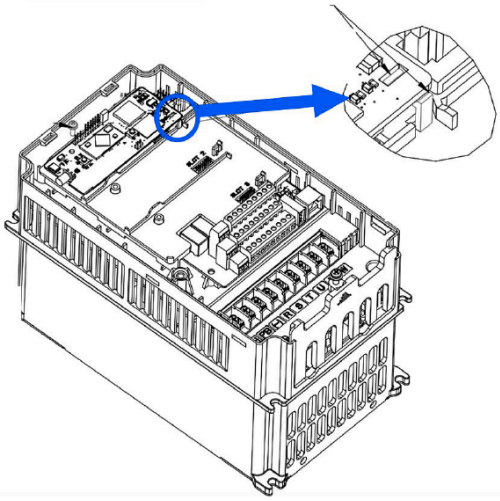
STEP 2: Remove Keypad and top-cover set screw
Note: detatch the RJ45 connection cable from the rear of the keypad



STEP 3: Place expansion card over any of the expansion ports – line up the data pins on the drive to the card's plug.



Note: Look for a hole in the expansion card – this lines up with a plastic " tooth " on the drive's expansion slot – this aids in lining up the data pins to the socket.



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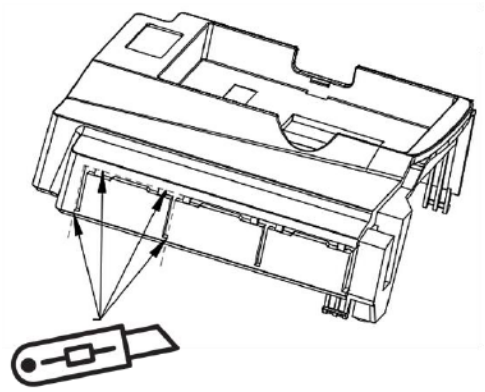
STEP 4: Press firmly in a downward movement to securely set the expansion card. A “click “ sound to be heard when the expansion card is securely in place.



Before replacing the top cover, cut out the plastic door pertaining to the expansion card installed. These plastic doors have four tabs that can be easily severed with a sharp knife or saw.

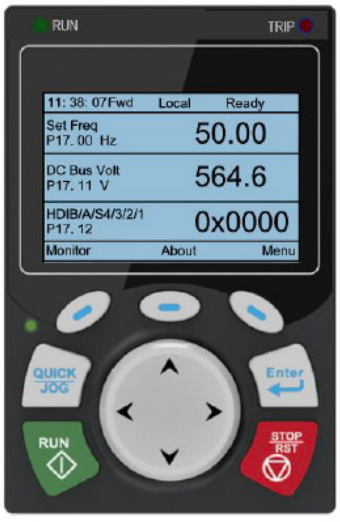
STEP: 5 Replace the top cover and bottom covers. Plug the RJ45 cable back into the keypad and insert keypad into holder.

HD2-E-EIP Setup

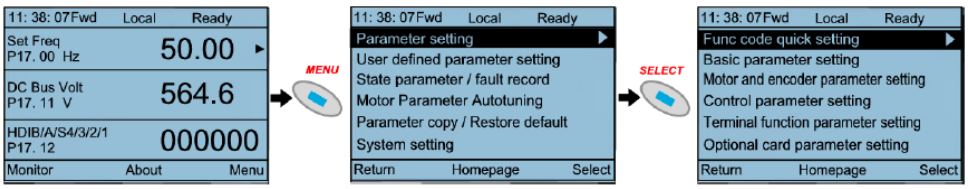
After plugging the card into the drive, power it using either the input power supply (R, S, T terminals) or the 24V power supply card (HD2-E-APS). No motor connected to the drive is required to setup the initial parameters and can be done alongside setting up the motor parameters.

Step 1: Setup IP address of the HD2-E-EIP network card

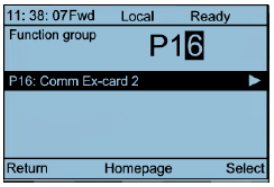
With the drive powered on, the keypad will power on and the home screen appears:



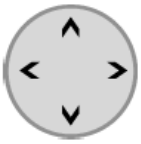
Press the key below the MENU prompt on the HMI and follow the keypress in the following sequence:



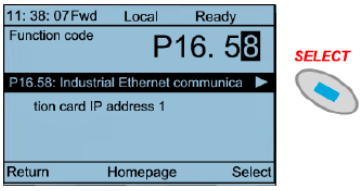
Enter the Parameter Group Selection:



Use the navigation paddle to index the cursor and increase or decrease values or selections.

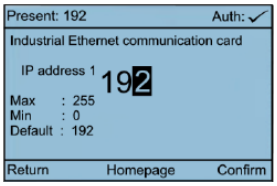


Navigate and change the address P16.58



Press “SELECT “to navigate and enter the first octet.

Use the paddle to index the cursor and set the IP address.



Enter the IP address in the sequential addresses after P16.58
For example:

IP Address: **192.168.254.50**
Submask: **255.255.255.0**
Gateway: **192.168.254.10**

The address will be in the following registers:

IP Address		Submask		Gateway	
P16.58	192	P16.62	255	P16.66	192
P16.59	168	P16.63	255	P16.67	168
P16.60	254	P16.64	255	P16.68	254
P16.61	50	P16.65	255	P16.69	10

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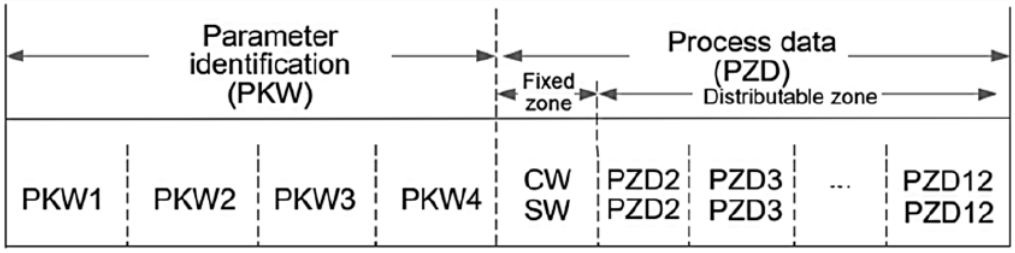
Step 2: Setup Data Registers in the HD2

As explained before the data register transmitted and received between a PLC and a HD2-E-EIP over EtherNet/IP™ consists of a total of 32, 16-bit words (16 transmitted and 16 received data registers)



PKW1 – PKW4 registers are four special addressing purposes.

The CW (control word) and SW (status word) are a set address, however addresses: PZD2 to PZD12 are fully selectable to a number of control or status registers inside the HD2 drive.

If you are getting a code (72) E-EIP – Ethernet/IP timeout to temporarily stop this from appearing in the keypad – go to parameter: P16.54 and set to " 0 " – **NOTE: this disables monitoring of the Ethernet/IP protocol – it is recommended to return this to 3-5 seconds after programming is complete and the drive is in operation.**

Each PZD memory location within the HD2 has data that can be transmitted from the HD2 drive, or received from a connected PLC.

The table illustrates the Function Code for receiving data to the HD2 drive from a PLC, and the corresponding functions types related to each PZD memory locations:

Function code	Word	Value range	Default value
P16.32	Received PZD2	0: Invalid 1: Set frequency (0–Fmax, unit: 0.01 Hz)	0
P16.33	Received PZD3	2: PID reference (0–1000, in which 1000 corresponds to 100.0%)	0
P16.34	Received PZD4	3: PID feedback (0–1000, in which 1000 corresponds to 100.0%)	0
P16.35	Received PZD5	4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the rated current of the motor)	0
P16.36	Received PZD6	5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz)	0
P16.37	Received PZD7	6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz)	0
P16.38	Received PZD8	7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor)	0
P16.39	Received PZD9	8: Upper limit of the brake torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor)	0
P16.40	Received PZD10	9: Virtual input terminal command, 0x000–0x3FF (corresponding to S8, S7, S6, S5, HDIB, HDIA, S4, S3, S2, and S1 in sequence)	0
P16.41	Received PZD11	10: Virtual output terminal command, 0x00–0x0F (corresponding to RO2, RO1, HDO, and Y1 in sequence)	0
P16.42	Received PZD12	11: Voltage setting (for V/F separation) (0–1000, in which 1000 corresponds to 100.0% of the rated voltage of the motor) 12: AO output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: MSB of position reference (signed number) 15: LSB of position reference (unsigned number) 16: MSB of position feedback (signed number) 17: LSB of position feedback (unsigned number) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)	0

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The table illustrates the Function Code to transmit data from the HD2 to a networked PLC, and the corresponding function types related to each PZD memory locations:

Function code	Word	Value range	Default value
P16.43	Transmitted PZD2	0: Invalid	0
P16.44	Transmitted PZD3	1: Running frequency (×100, Hz)	0
P16.45	Transmitted PZD4	2: Set frequency (×100, Hz)	0
P16.46	Transmitted PZD5	3: Bus voltage (×10, V)	0
P16.47	Transmitted PZD6	4: Output voltage (×1, V)	0
P16.48	Transmitted PZD7	5: Output current (×10, A)	0
P16.49	Transmitted PZD8	6: Actual output torque (×10, %)	0
P16.50	Transmitted PZD9	7: Actual output power (×10, %)	0
P16.51	Transmitted PZD10	8: Rotating speed of the running (×1, RPM) 9: Linear speed of the running (×1, m/s) 10: Ramp frequency reference	0
P16.52	Transmitted PZD11	11: Fault code 12: AI1 value (×100, V)	0
P16.53	Transmitted PZD12	13: AI2 value (×100, V) 14: AI3 value (×100, V) 15: HDIA frequency (×100, kHz) 16: Terminal input state 17: Terminal output state 18: PID reference (×100, %) 19: PID feedback (×100, %) 20: Rated torque of the motor 21: MSB of position reference (signed number)	0
		22: LSB of position reference (unsigned number) 23: MSB of position feedback (signed number) 24: LSB of position feedback (unsigned number) 25: Status word 26: HDIB frequency value (×100, kHz)	

After setting the IP address and PZD parameters – it is recommended to cycle power to the drive to ensure the parameters are set. It is also a good idea to do a command prompt and ping to the card with your PC or laptop to ensure the IP address is valid.

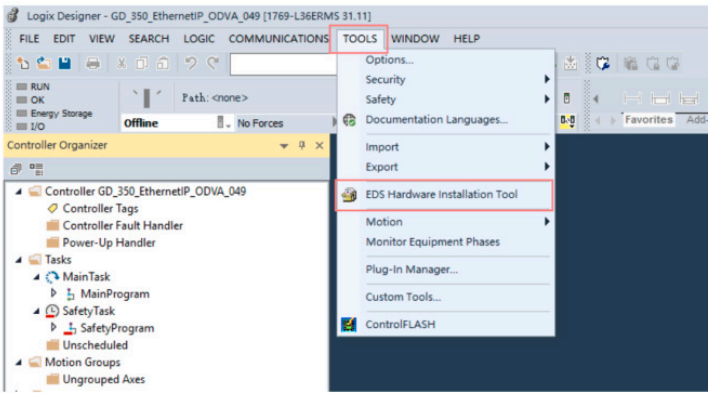
PLC Program

Install EDS file (https://downloads.imopc.com/imo_hd2_ethernetip_v1.20.eds)

The EDS file is used to specify device attributes for Ethernet IP client. The client identifies the device through product code, device type, and major version attributes.

Open Allen Bradley Studio5000 and start a new project.

Ensure you have a latest copy of the EDS file from IMO. Latest version is 1.20



Open the EDS Hardware Installation Tool. The Device Wizard will appear.

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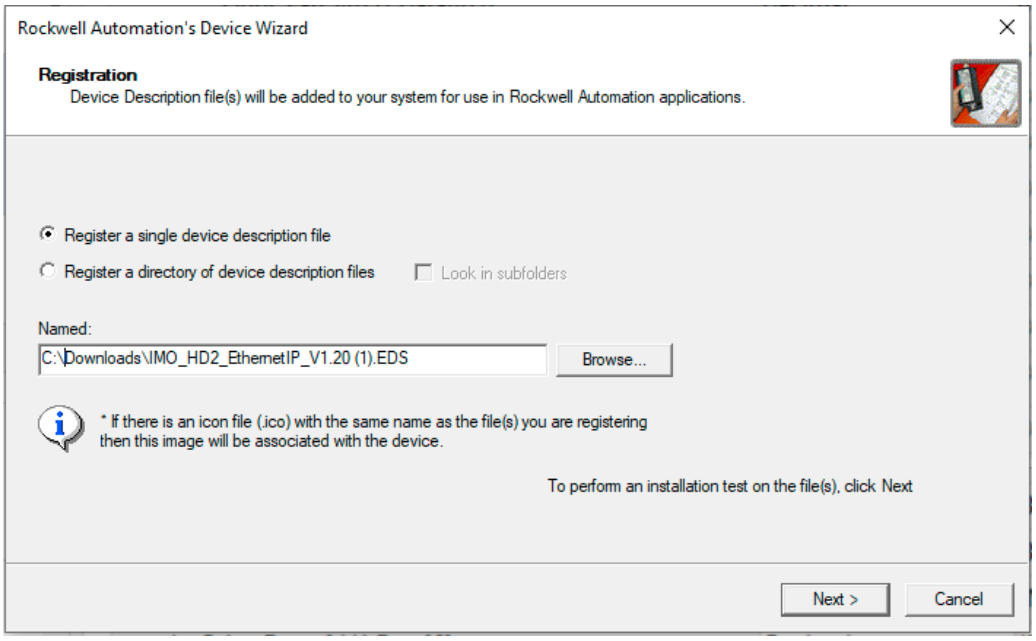
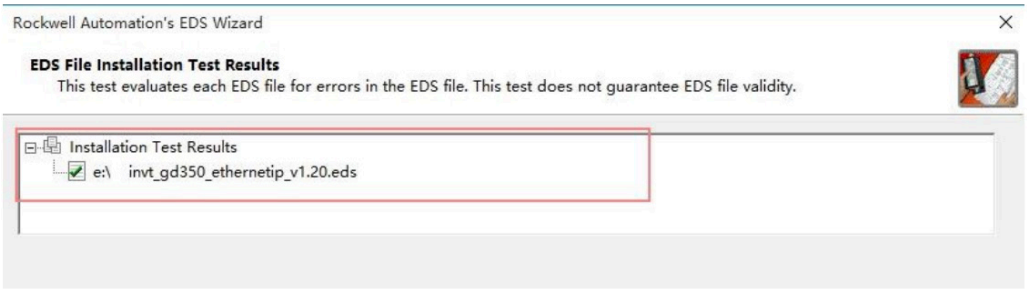
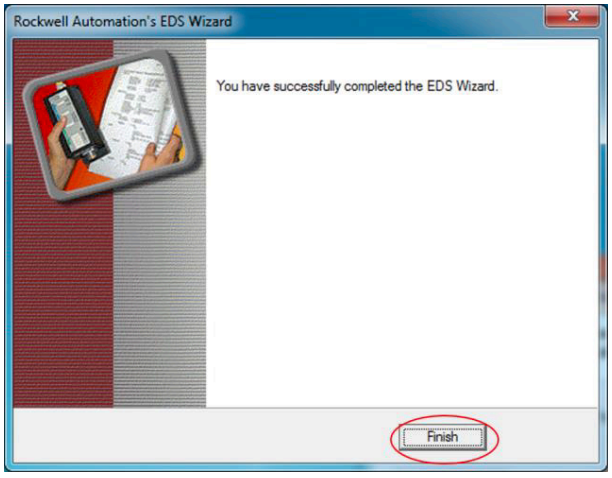
Register the EDS file within the wizard by locating and inserting the filepath of the EDS file in the Named dialog box:



Press NEXT



If the test is successful, press NEXT to finish the setup.



Press FINISH to complete

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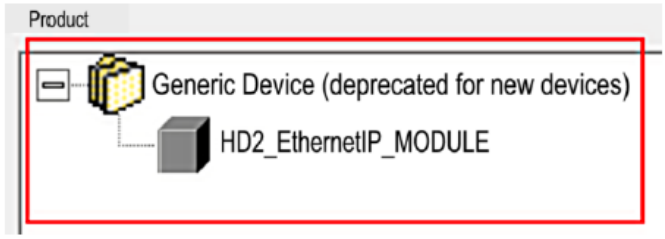
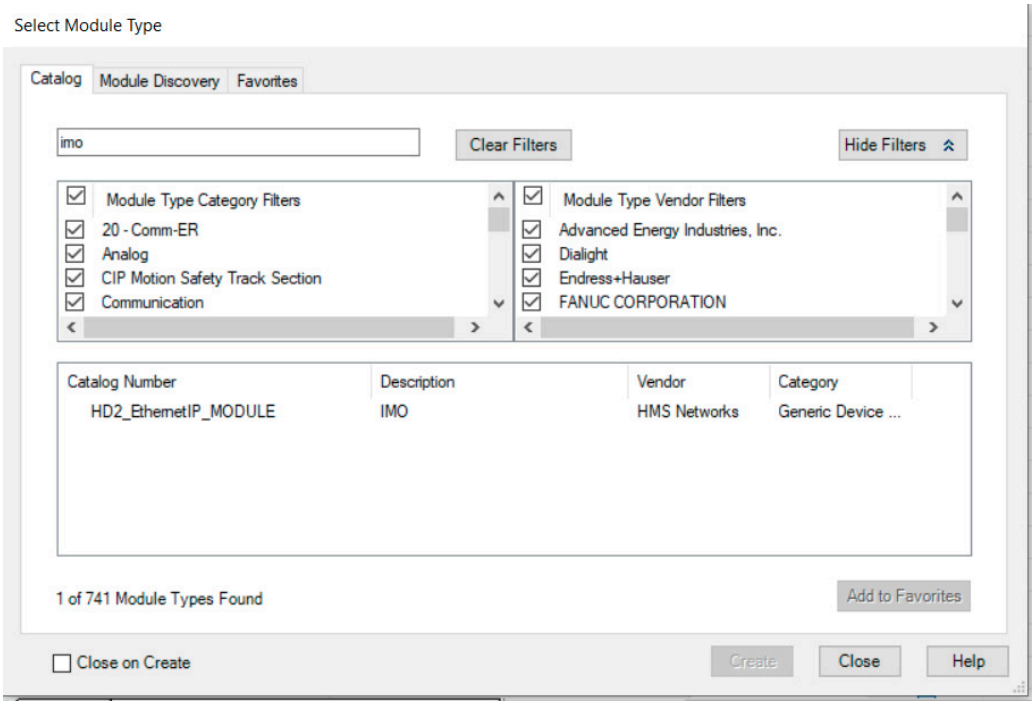
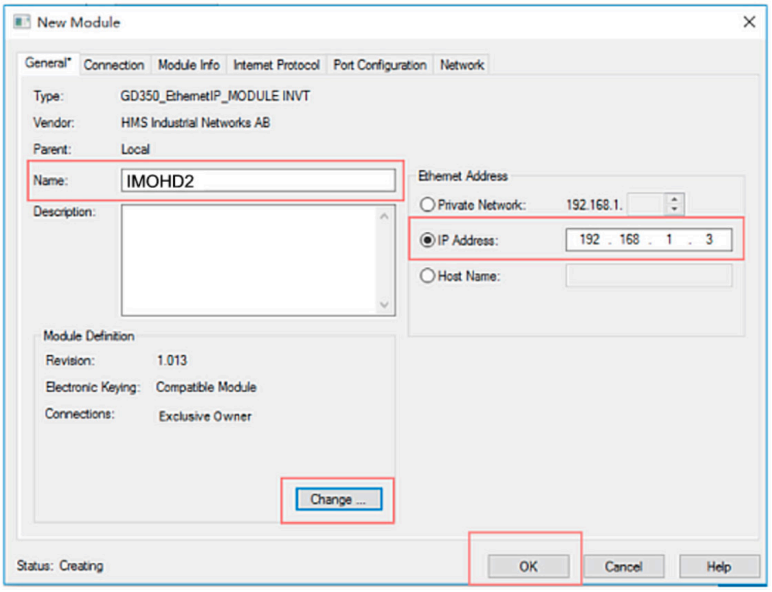
An optional icon change window will appear – confiming the HD2-E-EIP profile:





Add a New Module



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Ensure the following is complete:

- Unique Name (This will be the tag name)
- Set the IP address set in the HD2 (see HD2-E-EIP Setup for details)
- Set the Module Definition by pressing CHANGE

Under the Module Definition ensure:

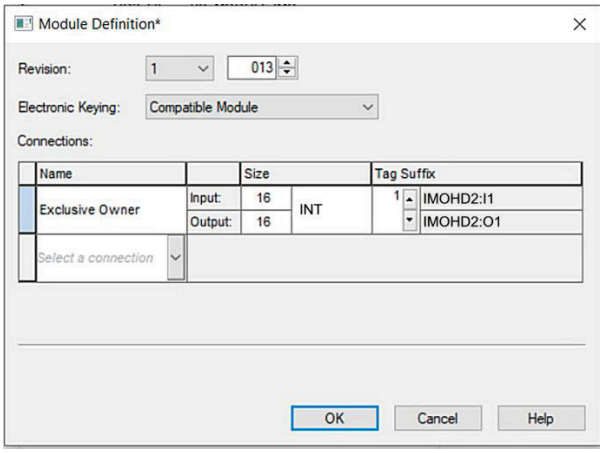
Electronic Keying: Compatible Module

Name: Exclusive Owner

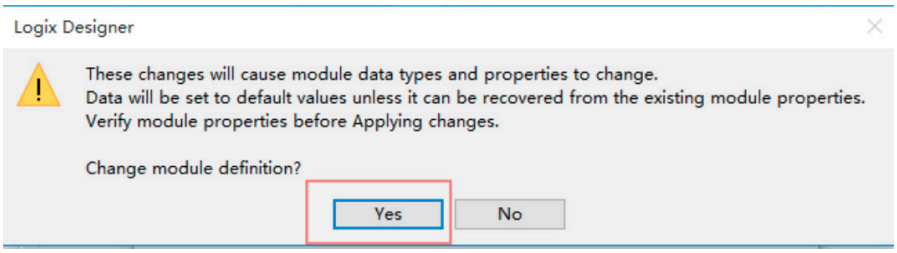
Size Input: 16

Size Output: 16
Ensure the word type is “INT”

The Tag Suffix will show the input and output tag file formats.



A prompt will ask if you would like to change the module definition – press YES to continue.



Configure EtherNet IP parameters in the inverter:

Parameter	Value	Description
P00.01	2	RUN Command Channel: Communication
P00.02	3	Communication: Ethernet IP
P00.06	13	Frequency Command: Ethernet IP
P16.58~P16.61	192.168.0.20	IP Address
P16.62~P16.65	255.255.255.0	Subnet Mask
P1§6.32	1	Received PZD2: Set Frequency
P16.43	1	Sent PZD2: Running Frequency
P16.44	11	Sent PZD3: Fault Code

PLC Settings - Parameters and Local Tags

Name	Usage	Value	Data Type	Class	Description
CW	Input	0	INT	Standard	Control Word
SetFrequency	Input	0	INT	Standard	Set Frequency
RunningFrequency	Local	0	INT	Standard	Running Frequency
FaultCode	Local	0	INT	Standard	Fault Code

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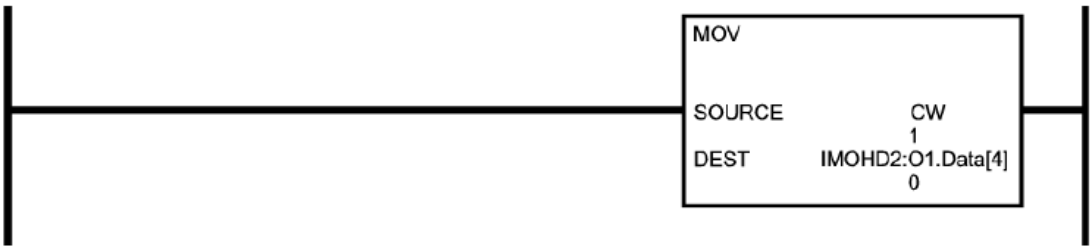
To command the Control Word a move function with the correcsponding decimal value will need to be sent – The value format of the control word is shown in the table below.

Bit	Name	Value	Description
0-7	Communication-based control command	1	Forward running
		2	Reverse running
		3	Forward jogging
		4	Reverse jogging
		5	Stop
		6	Coast to stop (emergency stop)
		7	Fault reset
		8	Jogging to stop
		9	Decelerate to stop
8	Enabling writing	1	Enable writing (mainly through PKW1 to PKW4)
9-10	Motor group setting	00	Motor 1
		01	Motor 2
11	Control mode switching	1	Enable torque/speed control switching
		0	Disable switching
12	Resetting power consumption to zero	1	Enable
		0	Disable
13	Pre-excitation	1	Enable
		0	Disable
14	DC braking	1	Enable
		0	Disable
15	Heartbeat reference	1	Enable
		0	Disable

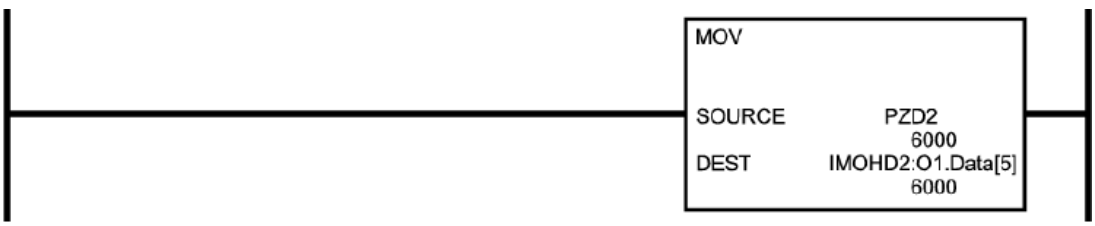
Unless you need the other parameters attached to bits 8-15, you only need to move a decimal value to the first byte of the Control Word.

NOTE – Moving a value of " 0 " will not do anything in the drive – any values that do not coincide with the value in the above-mentioned table, will be ignored.

A Ladder programming example of running the drive forward is as follows:



An example of setting the frequency (P16.32 to " 1 " Received PZD2: Set Frequency) – this sets 60HZ.



An example of reading the running frequency of the drive – assuming parameter P16.43 is set to " 1 " (Transmitting PZD2: Running Frequency)

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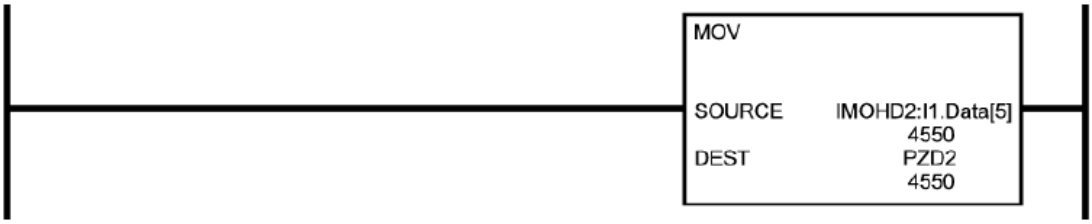

In this example, the PLC is seeing a running frequency of 45.5Hz from the drive.

If you wish to command the Control Word at a bit-level logic– adjust parameter P15.43 to " 1 ". The binary format is as follows:

Bit	Name	Description	Priority
0	Forward running	0: Decelerate to stop 1: Forward running	1
1	Reverse running	0: Decelerate to stop 1: Reverse running	2
2	Fault reset	0: Disable 1: Enable	3
3	Coast to stop	0: Disable 1: Enable	4
4	Forward jogging	0: Disable 1: Enable	5
5	Reverse jogging	0: Disable 1: Enable	6
6	Jogging to stop	0: Disable 1: Enable	7
7	/	Reserved	
8	Enable reading and writing (PKW1-PKW4)	0: Disable 1: Enable	
9	/	Reserved	
10	Decelerate to stop	0: Disable 1: Enable	0: Top priority
11-15	/	Reserved	

TECHNICAL SUPPORT

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