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WOLF LÖSUNGEN AUS DEM NORDEN

User Guide

FIELDBUS User Guide

This document is the "original instructions" document. All non-English versions are translations of the "original instructions".

The contents of this document are believed to be correct at the time of printing. In the interest of a commitment to a policy of continuous improvement, the manufacturer reserves the right to change the specification of the product or its performance or the contents of the User Guide without notice.

Fieldbus Guide Issue 02 (10/21)

Invertek Drives Ltd adopts a policy of continuous improvement and whilst every effort has been made to provide accurate and up to date information, the information contained in this User Guide should be used for guidance purposes only and does not form the part of any contract.

1. About This Document

1.1. Compatibility

This Document is for use with the following firmware versions:

Optidrive E3: Version 3.11

Optidrive Compact 2 Basic: Version 2.07

This document provides information regarding parameters and programming for all Invertek Drives' Optidrive E3 product families including the Optidrive E3 based Compact 2 Basic units.

For information regarding installation and technical data, refer to the relevant Installation Guide document.

Invertek Drives Ltd adopts a policy of continuous improvement and whilst every effort has been made to provide accurate and up to date information, the information contained in this User Guide should be used for guidance purposes only and does not form the part of any contract.

The information in this user guide relates to the functionality of the firmware version as stated above. Prior versions of firmware may not fully support all functions as described. If necessary, firmware updates may be carried out using Optitools Studio PC software.

1.2. Intended Audience

This document provides an overview of the parameters and functions of the Optidrive product ranges and provides the necessary technical information to allow competent users to understand the functions of the parameters.

1.3. Additional Documentation

This document forms part of a package of documents intended to provide information about the Optidrive product range. Related documents are shown in the table below.

Product Range	Optidrive E3 ODE-3-...					Optidrive Compact 2-Basic OPC-2-...E
Enclosure	IP20	IP66				All
Version	All	A	B	C	D	All
Quick Start Guide	EN DE SP FR PT IT PO	EN DE SP FR PT IT PO				EN DE
Declaration of Conformity	EN					EN
Installation Guide	EN DE SP FR PT IT PO					EN DE
Parameter List	EN DE SP FR PT IT PO					
Fieldbus Guide	EN DE SP FR PT IT PO					

2. Fieldbus Connectivity

2.1. Overview

The following fieldbus networks are supported:

Fieldbus Network	Requires Option			Supported Communication Type	Refer to Section
	For Compact 2	For Optidrive E3 IP20	For Optidrive E3 IP66		
Modbus RTU	Built In			R/W Holding Registers	*4. Modbus RTU*
CAN	Built In			2 x PDO & SDO	*5. CAN*
Ethernet/IP	-	-	"-EIP"	Cyclic & Acyclic	*6. Ethernet Connection* and *8. Ethernet/IP Communication*
Modbus TCP	-	-	"-MTP"	R/W Holding Registers	*6. Ethernet Connection*
Profibus DP	OD-PROFB-IN			Cyclic Control Only	*10. Fieldbus Gateways*
DeviceNet	OD-DEVNET-IN			Cyclic Control Only	*10. Fieldbus Gateways*

3. Parameter Configuration for Fieldbus Operation

3.1. Overview

The following parameters are used to configure any fieldbus connection. Refer to the Programming Guide for further information. Parameters are explained more fully in the Programming Guide.

3.1.1. Parameter P-12: Control Source

The fieldbus interfaces may be used to monitor information from the drive regardless of where the control commands originate.

If it is required to control the drive through the fieldbus interface, the following parameter should be adjusted as shown.

Reference: P-12	**Function: Control Source Selection**

Setting	Function	Description
3	**Fieldbus Mode**	Control via Modbus RTU or Ethernet using the internal Accel / Decel ramp parameters. Recommended setting for all fieldbus except CAN.
4	**Fieldbus Mode**	Control via Modbus RTU or Ethernet with Accel / Decel ramps determined by the fieldbus.
7	**CAN open Control**	Control via CAN (RS485) using the internal Accel / Decel ramp parameters. Recommended setting.
8	**CAN open Control**	Control via CAN (RS485) interface with Accel / Decel ramps updated via CAN.

NOTE When P-12 = 3, 4, 7, or 8 an enable signal must still be provided at the control terminals, digital input 1.

3.1.2. P-36 Communication Configuration

Reference: P-36	**Function: Serial Interface Configuration**
Index 1	**Function: Address / Node ID**

For Modbus RTU: Defines the Node Address
For CAN: Defines the Node ID
For Ethernet: Setting 1 MUST be used

Index 2	**Function: Baud Rate**

Setting	Baud Rate	Fieldbus
0	9.6	Modbus RTU.
1	19.2	For Ethernet communication, 115,2kbps must be selected.
2	38.4	
3	57.6	
4	115.2	
5	125	CAN
6	250	
7	500	
8	1000	

Index 3	Function: Modbus RTU Communication Loss Detection

Communication loss protection for Modbus RTU is selected here. For CAN, refer to the Fieldbus Guide for information.

Setting	Display	Timeout	Action
0	0	Disabled	
1	t 30	30ms	Trip (Coast Stop)
2	t 100	100ms	
3	t 1000	1s	
4	t 3000	3s	
5	r 30	30ms	Ramp to Stop
6	r 100	100ms	
7	r 1000	1s	
8	r 3000	3s	
9	t 10000	10s	Trip (Coast Stop)
10	t 30000	30s	
11	t 60000	60s	
12	r 10000	10s	Ramp to Stop
13	r 30000	30s	
14	r 60000	60s	

Parameter P-36 is a compound parameter with multiple indices. The indices are displayed sequentially when accessing the parameter through a keypad or separately in Optitools Studio. The data from all indices is stored within the drive memory as a single WORD. When accessing this value through a fieldbus network, the data format is as follows:

Reference: P-63	Function: Modbus RTU Mode Selection			
E3 IP20, IP66NS	Minimum:	Maximum: 1	Default: 0	Scaling: 1 = 1
E3 IP66S				
Compact 2 Basic				
Fieldbus Information:	CAN Index: 20A3h	Modbus Register: 191	Format: UINT	Units: N/A

Description:

Setting	Function	Description
0	**Standard**	All Modbus RTU telegrams are valid regardless of the destination address. In this case, communication loss detection is only activated when no valid Modbus RTU data is present on the network for the time period selected in P-36 regardless of the intended destination address. This is intended for larger Modbus RTU networks with several noes where there may be some time delay between Modbus transactions specifically intended for the drive however transactions intended for other network devices will be present.
1	**Advanced**	Only Modbus RTU telegrams intended for the specific node address are valid. Communication loss protection will activate if no Modbus RTU message intended for the specific drive node address is received within the time limit set in P-36. This mode is intended for use in small networks and **must** be used with any other Fieldbus network type e.g. Modbus TCP, Ethernet/IP.

4. Modbus RTU

4.1. Overview

Modbus RTU communication is supported using Function Codes 03 Read Holding Registers and 06 Write Single Holding Register.

All internal registers are Holding registers. There are no other register types present within the drive.

Registers 1 to 4 only support Function Code 16 Write multiple Holding Registers.

Modbus RTU communication is enabled by default for Read access.

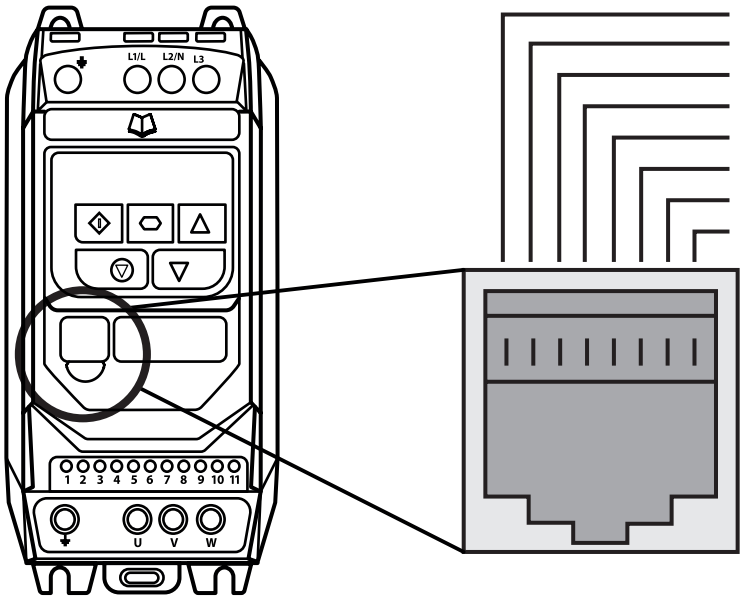
To control the drive through Modbus RTU, parameter P-12 should be set to 3 or 4. Refer to the programming guide for further information on the parameter settings.

When an external Modbus RTU device is used to control the drive, Digital Input 1 acts to provide a local enable / disable signal. The drive will not operate unless digital input 1 is ON. Additional functions may be assigned to other input terminals. Refer to the Installation guide for details of the digital Input function assignments that are possible.

4.2. Hardware Connection

4.2.1. Optidrive E3 IP20

Optidrive E3 IP20 models have a built in RJ45 connector which provides the interface for Modbus RTU connection.



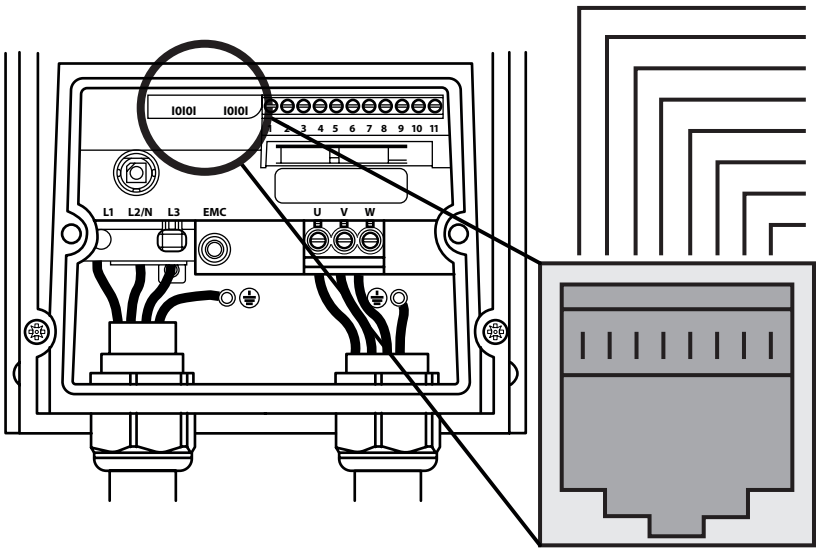
1	CAN-
2	CAN+
3	0 Volts
4	Optibus / Remote Keypad / PC Connection
5	Optibus / Remote Keypad / PC Connection +
6	+24 Volt
7	-RS485 (Modbus RTU)
8	+RS485 (Modbus RTU)

Warning:

This is not an Ethernet connection. Do not connect directly to an Ethernet port.

4.2.2. Optidrive E3 IP66

Optidrive E3 IP66 models have two RJ45 connectors fitted under the terminal cover as shown below. The connectors are parallel allowing simple connection between multiple drives.



1	CAN-
2	CAN+
3	0 Volts
4	Optibus / Remote Keypad / PC Connection
5	Optibus / Remote Keypad / PC Connection +
6	+24 Volt
7	-RS485 (Modbus RTU)
8	+RS485 (Modbus RTU)

Warning:

This is not an Ethernet connection. Do not connect directly to an Ethernet port.

4.2.3. Optidrive Compact 2 Basic

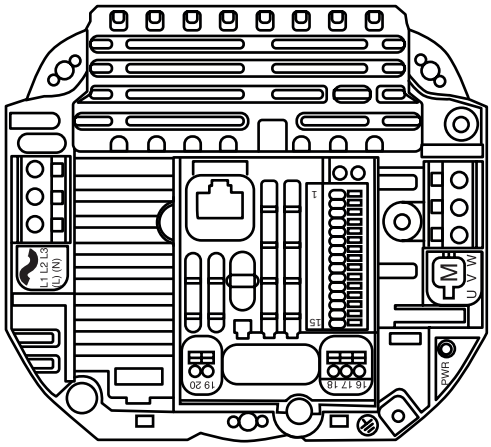
Suitable Motor Types

Optidrive Compact 2 Basic drives also include the RJ45 connector with the same layout as Optidrive E3 units shown above. Additionally, the Modbus RTU interface is also present on terminals as follows:

Terminal 7: 0V

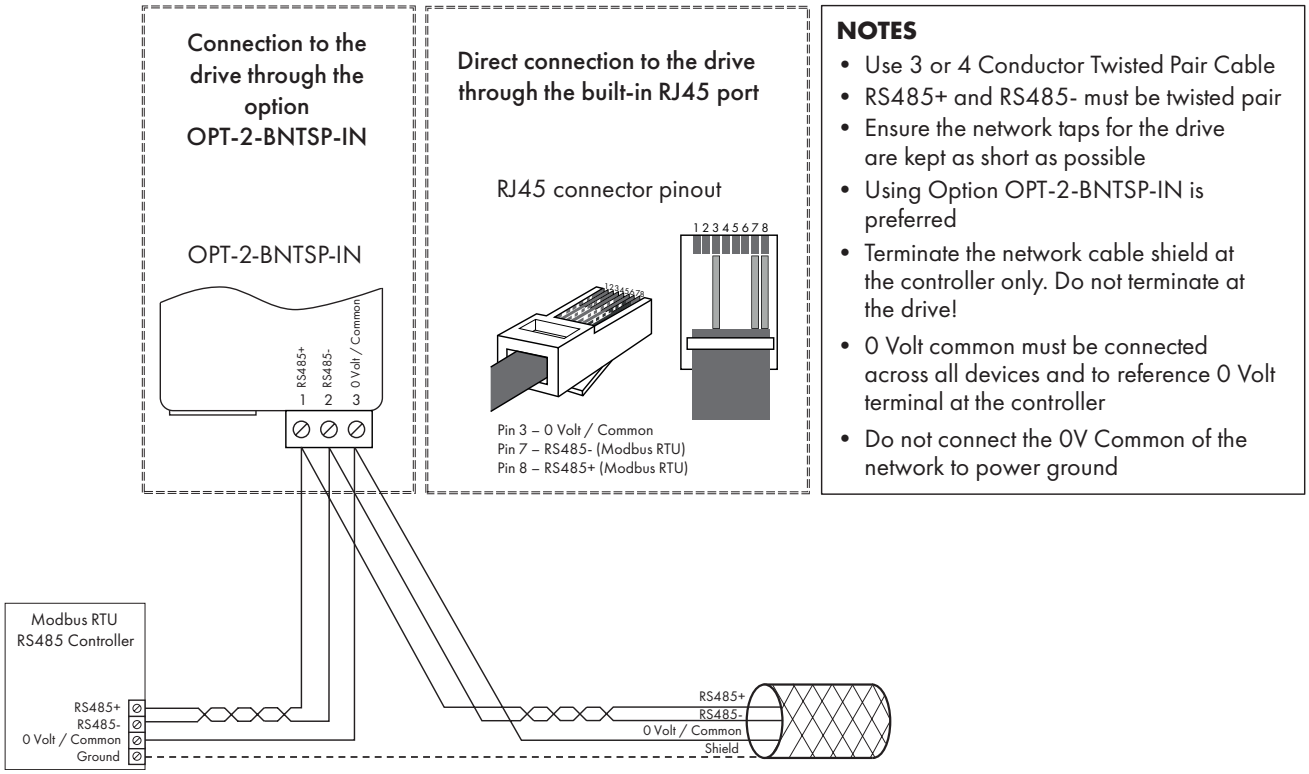
Terminal 10: Modbus RTU +

Terminal 11: Modbus RTU -

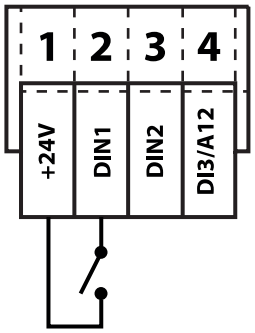


4.2.4. General

All Invertek drive's support the RS485 **3-wire** connection method for Modbus RTU according to the network specification. The three wires are essential to transfer data and maintain common potential between all nodes. For drives that have an RJ45 connector an optional interface connector providing terminals to connect to a Modbus RTU network is available, part number OPT-2-BNTSP-IN.



4.2.5. Control Terminal Connection



4.3. Modbus RTU Configuration Parameter

Refer to section *3. Parameter Configuration for Fieldbus Operation on page 6.*

4.4. Modbus RTU Status & Control Holding Registers

Modbus RTU status holding registers are shown in section *11. Control & Status Registers on page 54.*

Holding Register 1 – 4 are used for drive control.

Additional Holding registers provide status information which may be read from the drive.

Modbus Master devices differ between different manufacturers and so it may be necessary to review the documentation for the specific Master device being used to understand the correct addressing method to access Holding Registers, e.g.

- Some devices use zero based addressing
  - In this case the first Holding Register address is Holding Register 0
  - Subtract 1 from the Holding Register number shown in the documentation.
- Some devices recognise Holding Registers with a 40000 prefix
  - In this case the first Holding Register may be 40000 or 40001
  - Add the appropriate prefix and if necessary, subtract the offset.

4.5. Parameter Access

All User Adjustable parameters are accessible by Modbus RTU using the corresponding Holding Register. The register number associated to each parameter is shown in the Programming Guide document along with any specific information about how the value is scaled or stored.

Parameter values may be read from the drive or written to, depending on the operating mode of the drive – some parameters cannot be changed whilst the drive is enabled.

4.6. Modbus RTU Indirect Parameter Access

In addition to Direct Access, Indirect Read / Write access to all user adjustable parameters is supported using a simple method as detailed below. This is achieved using the following two Modbus registers.

4.6.1. Register 44: Drive Parameter Index

This index value will be used by register 45 to carry out parameter read and write function.

If the value is set to a parameter number that does not exist in the drive, an exception response will be received.

4.6.2. Register 45: Drive Parameter Value

When reading this register, the value represents the value of the parameter specified by register 44.

When writing to this register, the value will be written to the drive parameter number specified by register 44.

If the value written to a parameter is outside of the parameter range, an exception response will be received.

4.6.3. Parameter Read Method

To read a parameter, firstly write the parameter number to register 44, then read the value from register 45, e.g. to Read the Value of P-01.

- Write 1 to Register 44.
- Read the Value of Register 45.

4.6.4. Parameter Write Method

Writing parameter values can be achieved by the same method, however, register 45 is used to write the parameter value after the parameter number has been selected using Register 44, e.g. to Write a Value of 60.0Hz to parameter P-01.

- Write 1 to Register 44.
- Register 45 will return the present value of P-01, which can be Read if required.
- Referring to the Programming Guide, apply any scaling necessary
  - In this case, 60.0Hz = 3600.
- Write the scaled value to Register 45. P-01 now changes to 60.0Hz, or an exception code may be returned.

5. CAN

5.1. Overview

The CAN communication profile is implemented according to the specification DS301 version 4.02 of CAN in automation (www.can-cia.de). Specific device profiles such as DS402 are not supported.

CAN communication is enabled by default however to use any control functions parameter P-12 must be set to 7 or 8. Refer to the Programming Guide for further Information.

5.2. CAN Communication Configuration Parameter

The CAN communication baud rate can be set by using parameter P-36. Available baud rates are: 125kbps, 250kbps, 500kbps, 1Mbps. (with default settings as 500kbps).

The Node ID is set up through drive address parameter P-36 as well with the default value of 1.

5.3. CAN COB-ID

The following default COB-ID and functions are supported:

Type	COB-ID	Function
NMT	000h	Network management.
Sync	080h	Synchronous message. COB-ID can be configured to other value.
Emergency	080h + Node address	Emergency message.
PDO1 (TX)	180h + Node address	Process data object. PDO1 is pre-mapped and enabled by default. COB-ID can be configured to other value. PDO2 is pre-mapped and disabled by default. Transmission mode, COB-ID and mapping can be configured.
PDO1 (RX)	200h + Node address	
PDO2 (TX)	280h + Node address	
PDO2 (RX)	300h + Node address	
SDO (TX)	580h + Node address	SDO channel can be used for drive parameter access.
SDO (RX)	600h + Node address	
Error Control	700h + Node address	Guarding and Heartbeat function are supported. COB-ID can be configured to other value.

NOTE

- The SDO channel only supports expedited transmission.
- A maximum of 2 Process Data Objects (PDO) are supported.
  - All PDOs are pre-mapped; however, PDO2 is disabled by default
  - The table below gives the default PDO mapping information.
- Customer configuration (mapping) will **NOT** be saved during power down. This means that the CAN configuration will restore to its default condition each time the drive is powered up.

5.4. PDO Default Mapping

	Objects No.	Mapped Object	Length	Mapped Function	Transmission Type	For information on the values
RX PDO1	1	2000h	Unsigned 16	Control word	254 Valid immediately	Refer to section *11.1. Control Registers on page 54*
	2	2001h	Integer 16	Frequency setpoint		
	3	2003h	Unsigned 16	User ramp reference		
	4	0006h	Unsigned 16	Dummy		
TX PDO1	1	200Ah	Unsigned 16	Drive status register	254 Send after receiving RX PDO 1	Refer to section *11.1.1. Drive Control Word PDO0 on page 54*
	2	200Bh	Integer 16	Motor speed Hz		
	3	200Dh	Unsigned 16	Motor current		
	4	2010h	Integer 16	Drive temperature		
RX PDO2	1	0006h	Unsigned 16	Dummy	254	
	2	0006h	Unsigned 16	Dummy		
	3	0006h	Unsigned 16	Dummy		
	4	0006h	Unsigned 16	Dummy		
TX PDO2	1	2011h	Unsigned 16	DC bus voltage	254	
	2	2012h	Unsigned 16	Digital input status		
	3	2013h	Integer 16	Analog input 1 (%)		
	4	2014h	Integer 16	Analog input 2 (%)		

5.5. PDO Transmission Type

Various transmission modes can be selected for each PDO. For RX PDO, the following modes are supported:

Transmission Type	Mode	Description
0 – 240	Synchronous	The received data will be transferred to the drive active control register when the next sync message is received.
254, 255	Asynchronous	The received data will be transferred to the drive active control register immediately without delay.

For TX PDO, the following modes are supported:

Transmission Type	Mode	Description
0	Acyclic synchronous	TX PDO will only be sent out if the PDO data has changed and PDO will be transmitted on reception of SYNC object.
1-240	Cyclic synchronous	TX PDO will be transmitted synchronously and cyclically. The transmission type indicates the number of SYNC object that are.
254	Asynchronous	TX PDO will only be transferred once corresponding RX PDO has been received.
255	Asynchronous	TX PDO will only be transferred anytime if PDO data value has changed.

5.6. CAN Specific Object Table

Index	Sub Index	Function	Access	Type	PDO Map	Default Value
1000h	0	Device Type	RO	U32	N	0
1001h	0	Error Register	RO	U8	N	0
1002h	0	Manufacturer Status Register	RO	U16	N	0
1005h	0	COB-ID Sync	RW	U32	N	00000080h
1008h	0	Manufacturer Device Name	RO	String	N	ODE3
1009h	0	Manufacturer Hardware Version	RO	String	N	x.xx
100Ah	0	Manufacturer Software Version	RO	String	N	x.xx
100Ch	0	Guard Time (1ms)	RW	U16	N	0
100Dh	0	Lifetime Factor	RW	U8	N	0
1014h	0	COB-ID EMCY	RW	U32	N	00000080h+Node ID
1015h	0	Inhibit Time Emergency (100µs)	RW	U16	N	0

Index	Sub Index	Function	Access	Type	PDO Map	Default Value
1016h	0	Consumer Heartbeat Time No. of entries	RO	U8	N	1
	1	Consumer Heartbeat Master Node & Time	RW	U32	N	0
1017h	0	Producer Heartbeat Time (1ms)	RW	U16	N	0
1018h	0	Identity Object No. Of entries	RO	U8	N	4
	1	Vendor ID	RO	U32	N	0x0000031A
	2	Product Code	RO	U32	N	Drive Dependent
	3	Revision Number	RO	U32	N	x.xx
	4	Serial Number	RO	U32	N	Drive Dependent
1200h	0	SDO Parameter No. Of entries	RO	U8	N	2
	1	COB-ID Client -> Server (RX)	RO	U32	N	00000600h+Node ID
	2	COB-ID Server -> Client (TX)	RO	U32	N	00000580h+Node ID
1400h	0	RX PDO1 comms param. no. of entries	RO	U8	N	2
	1	RX PDO1 COB-ID	RW	U32	N	40000200h+Node ID
	2	RX PDO transmission type	RW	U32	N	254
1401h	0	RX PDO2 comms param. no. of entries	RO	U8	N	2
	1	RX PDO2 COB-ID	RW	U32	N	C0000300h+Node ID
	2	RX PDO2 transmission type	RW	U8	N	0
1600h	0	RX PDO1 1 mapping / no. of entries	RW	U8	N	4
	1	RX PDO1 1st mapped object	RW	U32	N	20000010h
	2	RX PDO1 2nd mapped object	RW	U32	N	20010010h
	3	RX PDO1 3rd mapped object	RW	U32	N	20030010h
	4	RX PDO1 4th mapped object	RW	U32	N	00060010h
1601h	0	RX PDO2 1 mapping / no. of entries	RW	U8	N	4
	1	RX PDO2 1st mapped object	RW	U32	N	00060010h
	2	RX PDO2 2nd mapped object	RW	U32	N	00060010h
	3	RX PDO2 3rd mapped object	RW	U32	N	00060010h
	4	RX PDO2 4th mapped object	RW	U32	N	00060010h
1800h	0	TX PDO1 comms parameter number of entries	RO	U8	N	3
	1	TX PDO1 COB-ID	RW	U32	N	40000180h+Node ID
	2	TX PDO1 transmission type	RW	U8	N	254
	3	TX PDO1 Inhibit time (100µs)	RW	U16	N	0
1801h	0	TX PDO2 comms param no. of entries	RO	U8	N	3
	1	TX PDO2 COB-ID	RW	U32	N	C0000280h+Node ID
	2	TX PDO2 transmission type	RW	U8	N	0
	3	TX PDO2 Inhibit time (100µs)	RW	U16	N	0
1A00h	0	TX PDO1 mapping / no. of entries	RW	U8	N	4
	1	TX PDO1 1st mapped object	RW	U32	N	200A0010h
	2	TX PDO1 2nd mapped object	RW	U32	N	200B0010h
	3	TX PDO1 3rd mapped object	RW	U32	N	200D0010h
	4	TX PDO1 4th mapped object	RW	U32	N	20100010h
1A01h	0	TX PDO2 mapping / no. of entries	RW	U8	N	4
	1	TX PDO2 1st mapped object	RW	U32	N	20110010h
	2	TX PDO2 2nd mapped object	RW	U32	N	20120010h
	3	TX PDO2 3rd mapped object	RW	U32	N	20130010h
	4	TX PDO2 4th mapped object	RW	U32	N	20140010h

5.7. Parameter Access

All user adjustable parameters are accessible through the CAN communication interface. The Programming Guide document provides the Index for each parameter along with any scaling or information how the data for each parameter is stored.

5.8. Additional Status Indices

Further additional status Indices are present in the drive. These are described in section *11. Control & Status Registers on page 54.*

6. Ethernet Connection

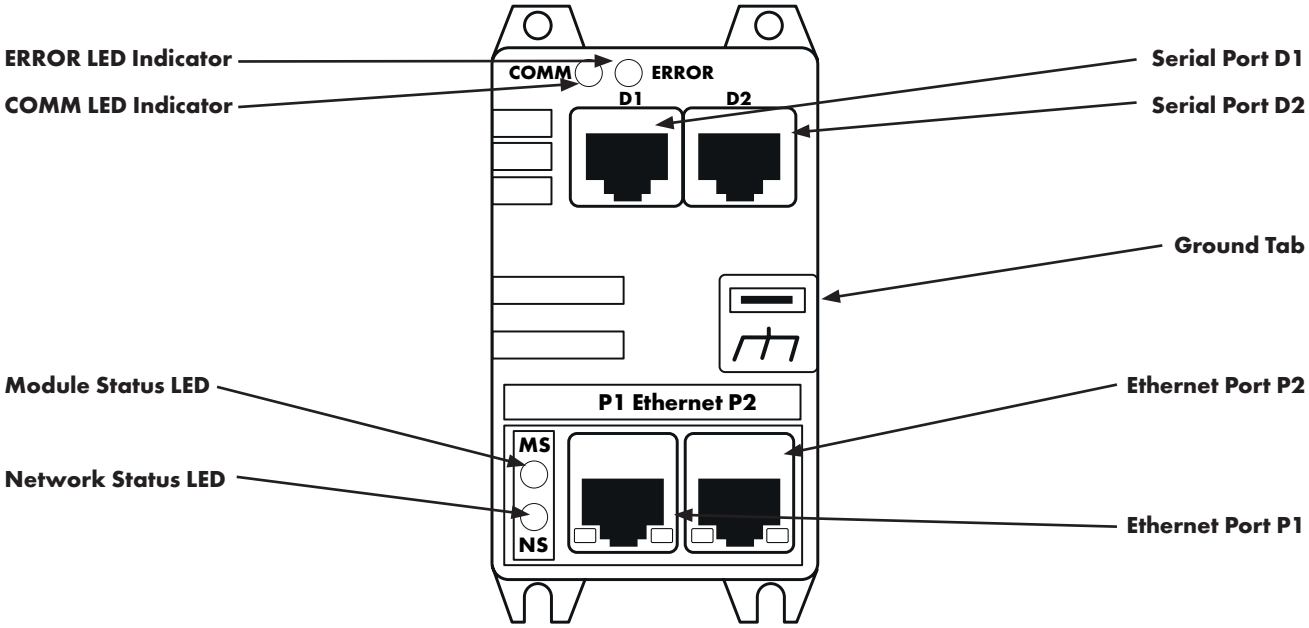
6.1. Available Interface Options

Ethernet interfaces are optionally available for Optidrive E3 and Optidrive Compact 2 products which support either Ethernet/IP protocol or Modbus TCP protocol. Part numbers for these interfaces are shown in the table below. The correct interface should be selected according to the drive type.

Drive Family	Interface Type	Ethernet/IP Interface Model Code	Modbus TCP Interface Model Code
Optidrive E3 IP20	External Option	OPT-2-ETHEG-IN	OPT-3-MTPEG-IN
Optidrive E3 IP66	Internal Option	Drive Model Code + "-EIP"	Drive Model Code + "-MTP"
Optidrive Compact 2	Plug in Option	OPT-2-ETHIG-IN	OPT-2-MTPEG-IN

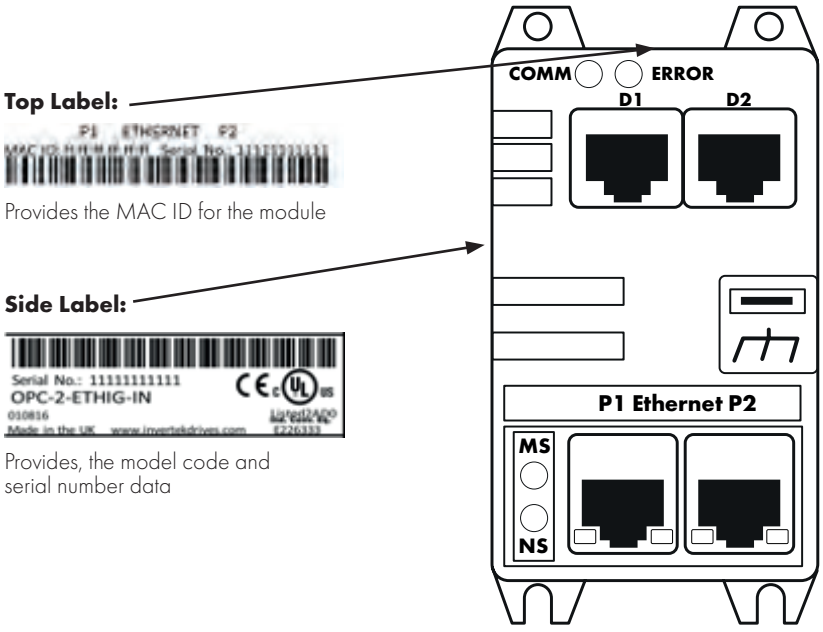
6.2. External Interface

6.2.1. Layout



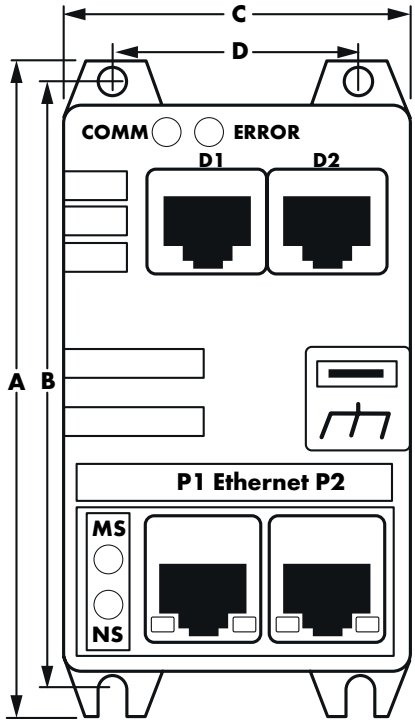
6.2.2. Labelling

There are two labels:



6.2.3. Mechanical Installation

- The Ethernet IP interface is intended for mounting inside a control cabinet adjacent to the drive.
- The unit should be mounted in a vertical position only, on a flat, flame resistant, vibration free mounting.
- The unit must be installed in a pollution degree 1 or 2 environment only.
- Use the module as a template to mark the locations for drilling the mounting screws.
- Drill and tap the holes as required.
- Secure the unit to the backplate using suitable screws, 1Nm.



A		B		C		D		Weight	
mm	in	mm	in	mm	in	mm	in	g	oz
89	3.50	76	2.99	47	1.85	31	1.22	65	2.29

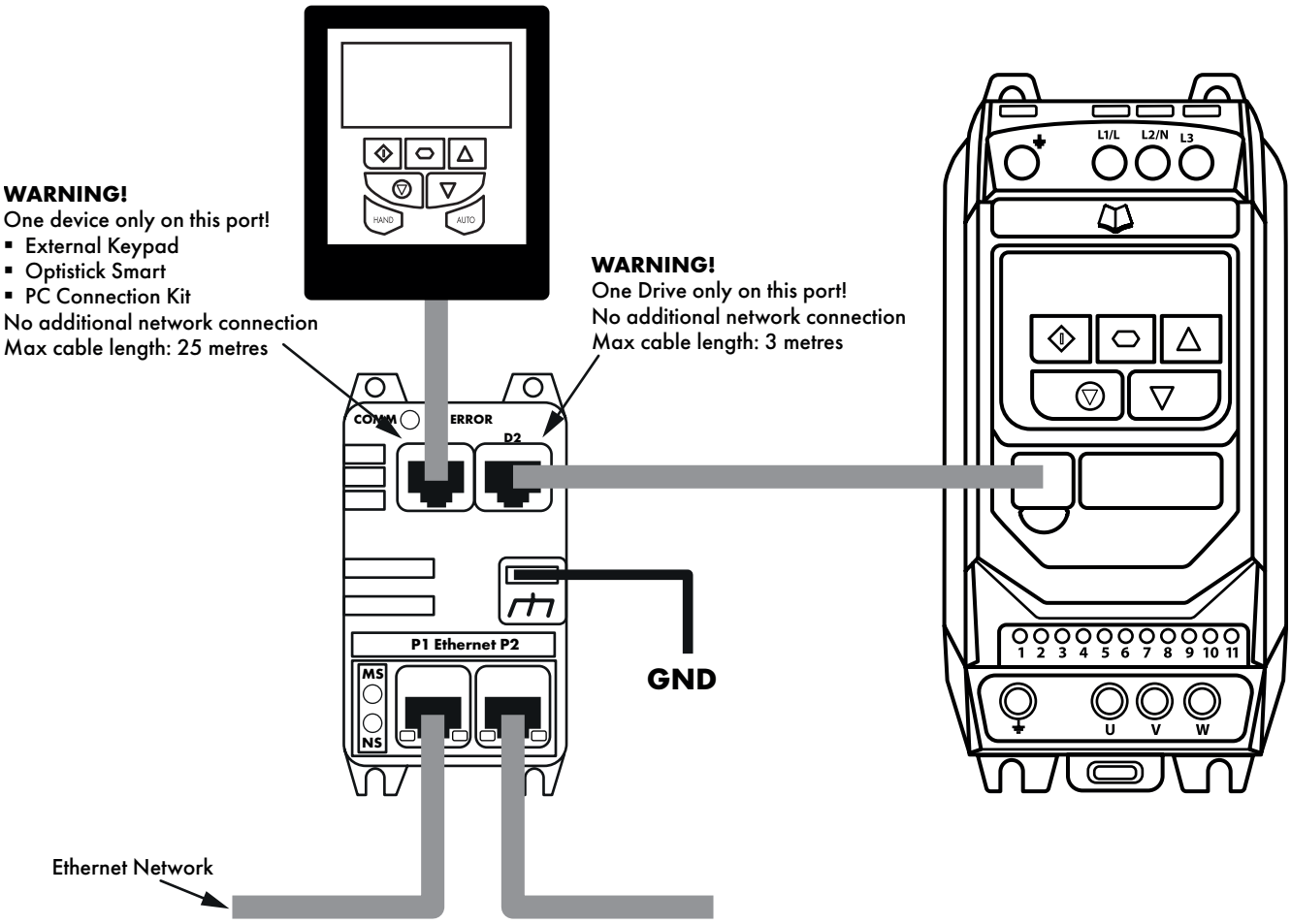
Mounting Bolts	
Metric	UNF
M4	#8

6.2.4. Electrical Installation

WARNING! Do not connect Ethernet devices to ports D1 or D2. They may be damaged!

Power supply to the module is provided from the connected drive via the RJ45 connection.

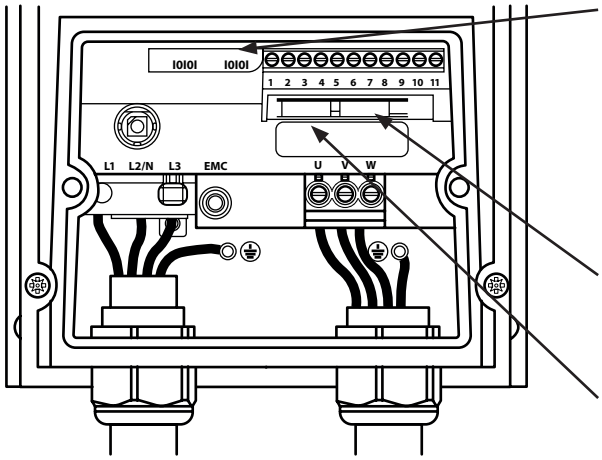
WARNING! Do not use cross over cables! Cables must be pin to pin connected!



Ground tab – Observe the recommended grounding procedure for the fieldbus network and if necessary, connect this tab to ground where required.

6.3. Internal Interface for IP66 Drives

6.3.1. Layout – Internal Interface



IOIOI: Dual serial ports.

WARNING! Do not connect Ethernet devices here!

These ports are for external serial connection of remote keypad and PC connection only!

Port P1: Primary Ethernet port

Port P2: Secondary Ethernet Port

6.3.2. Labelling – Internal Interface

The MAC address of the device is shown below the ports.

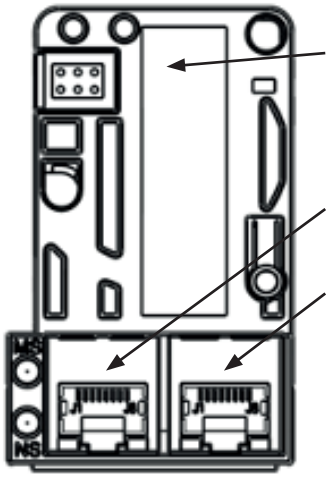
6.4. Optional Interface for Compact 2 Basic Drives

6.4.1. Installation

The Ethernet/IP interface is mounted underneath the control pod.

- Remove the control pod as described in the Compact 2 installation guide.
- Locate the Ethernet/IP interface in the slot below the control pod.
- Refit the control pod.

6.4.2. Layout



WARNING! Do not connect Ethernet cables to the RJ45 port on the control Pod!

6.5. Drive Parameter Settings

6.5.1. Overview

The following parameter settings are required in the drive. For further description of the drive parameters, refer to the drive user guide.

Drive Type	Optidrive E3 (ODE-3-...)	Setting
Parameter		
Drive Address	P-36 Index 1	1
Modbus RTU Baud Rate	P-36 Index 2	115.2kbps
Modbus RTU Data Format	N/A	N-1
Communication Loss Reaction	P-36 Index 3	As required
Command Source Selection	P-12	Select for Fieldbus Control if control of the drive operation is required

7. Internal Webserver

7.1. Overview

A web server interface is present in all Ethernet based fieldbus interfaces and can be accessed using the IP address or host name.

- Default IP address: 192.168.1.253.
- Hostname: OPCxxxxxxxxxx, where xxxxxxxxxx = 'PR ID' value shown on the top product label as described in section 6.2.2. *Labelling on page 14* or 6.3.2. *Labelling – Internal Interface on page 16.*

The IP address and Host Name may be reconfigured by the user via the Web Server or Ethernet/IP Class 0xF4.

7.2. Default Login

To access to the web server:

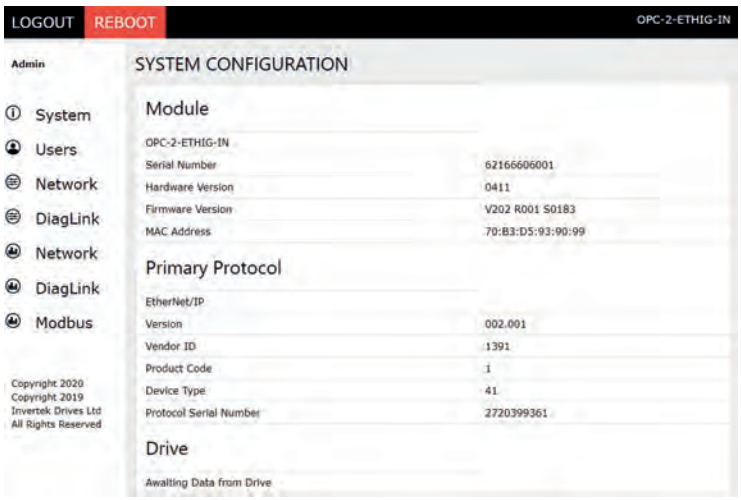
- Open a web browser on your connected PC.
- Enter the module IP address in the address bar.
- Default admin login details:
  - Username: **Admin**
- Password: **Serial Number** of the module (see product label as described in section 6.2.2. *Labelling on page 14* or 6.3.2. *Labelling – Internal Interface on page 16.*)

7.3. Web Server Contents

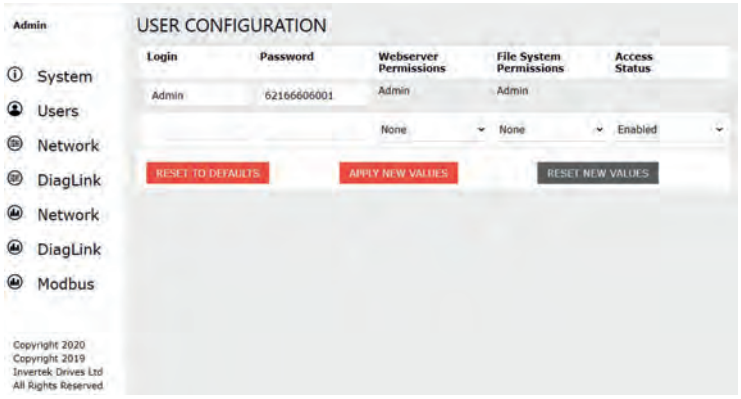
The web server contains 7 pages as described below.

7.3.1. System

Information about the Module and Primary Protocol is displayed. This information is Read Only.



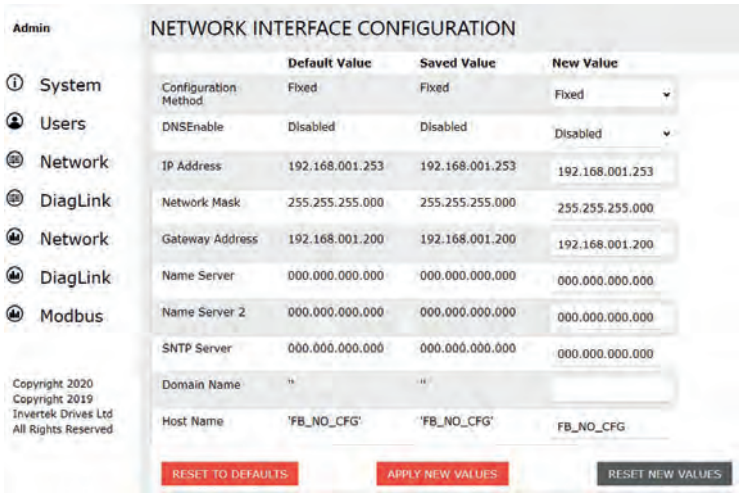
7.3.2. Users



Information about user's accounts is displayed.

7.3.3. Network (IP Address and Network Settings)

Information about network adapter configuration is displayed.

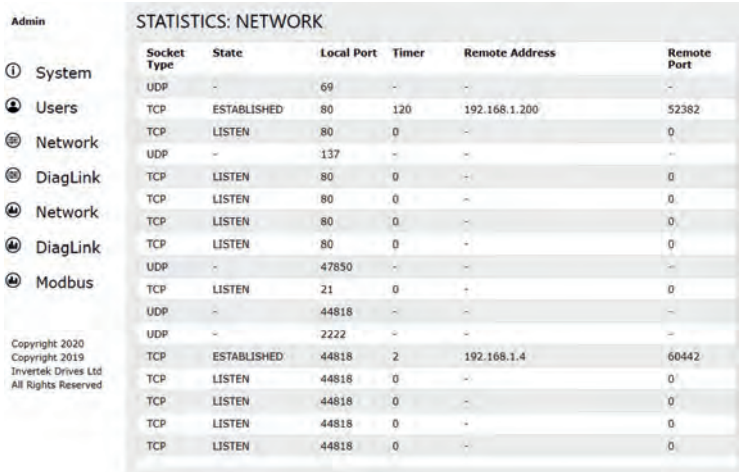


7.3.4. DiagLink (Ethernet Configuration Message)

Information about the serial communication settings to the drive are displayed.

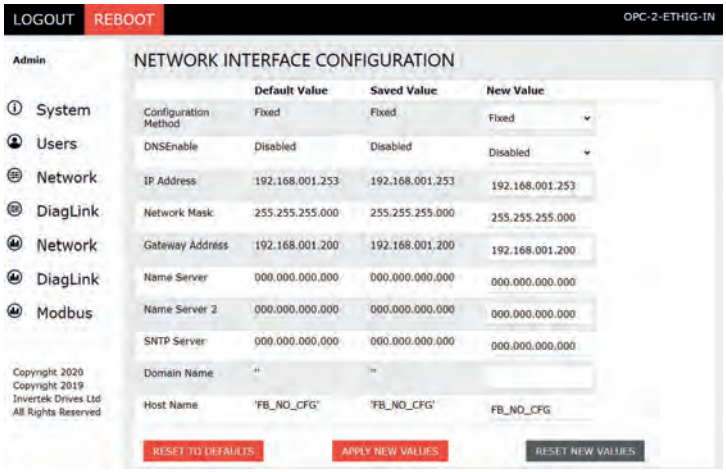
7.3.5. Network (Ethernet Network Statistics)

Statistic information about the ethernet connections is displayed.



7.4. Changing the IP Address

Go to **Network** settings screen:

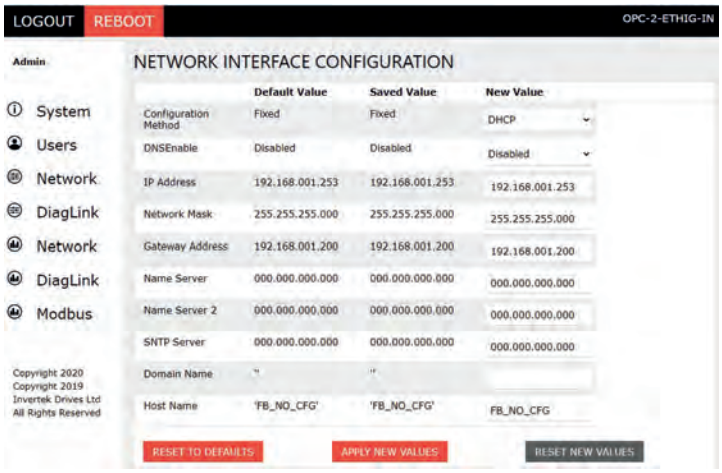


The IP address can be assigned to the module manually by the User (Fixed or Static IP Address) or automatically by the DHCP Server. The default configuration method is Fixed IP address.

7.4.1. Automatically (DHCP) Assigned IP Address

To automatically (DHCP) assign an IP address to the module please select **DHCP** mode in the **Configuration Method** and confirm changes by clicking **APPLY NEW VALUES**.

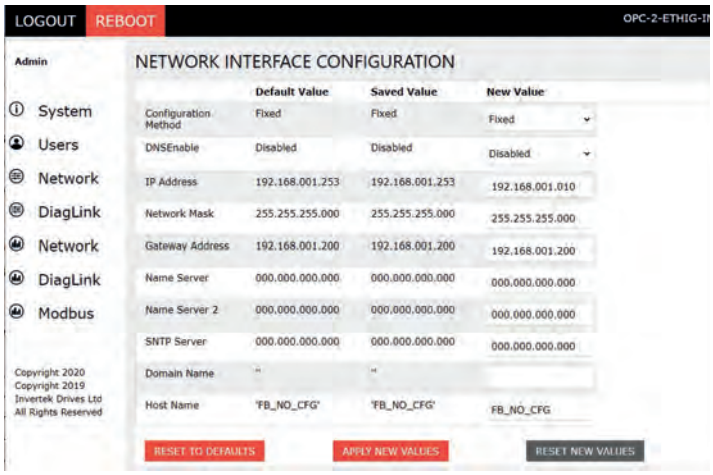
NOTE A power cycle is necessary after changing the network settings. Please click REBOOT button at the top left corner or power cycle the module!



7.4.2. Manually Assigned IP Address

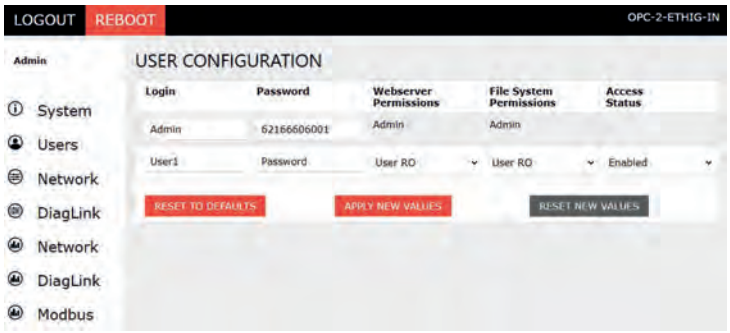
To manually set up the module IP address, please select **Fixed** mode in the **Configuration Method**, type new values in required fields in column New Value as shown below and confirm changes by clicking **APPLY NEW VALUES**.

NOTE A power cycle is necessary after changing the network settings. Please click REBOOT button at the top left corner or power cycle the module!

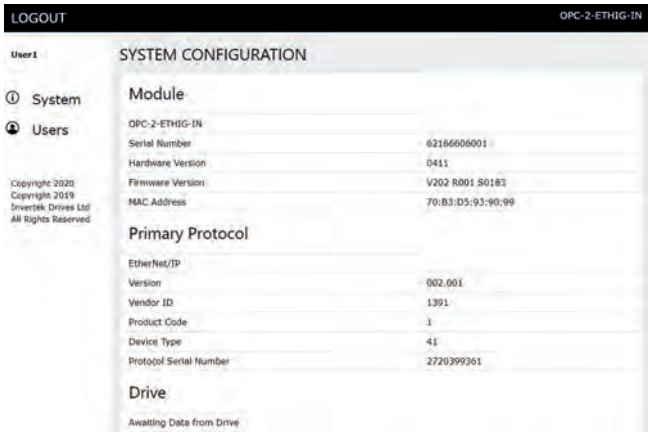


7.5. Creating an Additional User Account for Limited Access

It is possible to change admin password and create second User with its own login, password, permissions, and limited access if required. To create new user, you need to add new login details (login and password) and defined the access levels (permissions) for this user.



User with permissions like above, will have a limited access to the module data and settings as shown below.



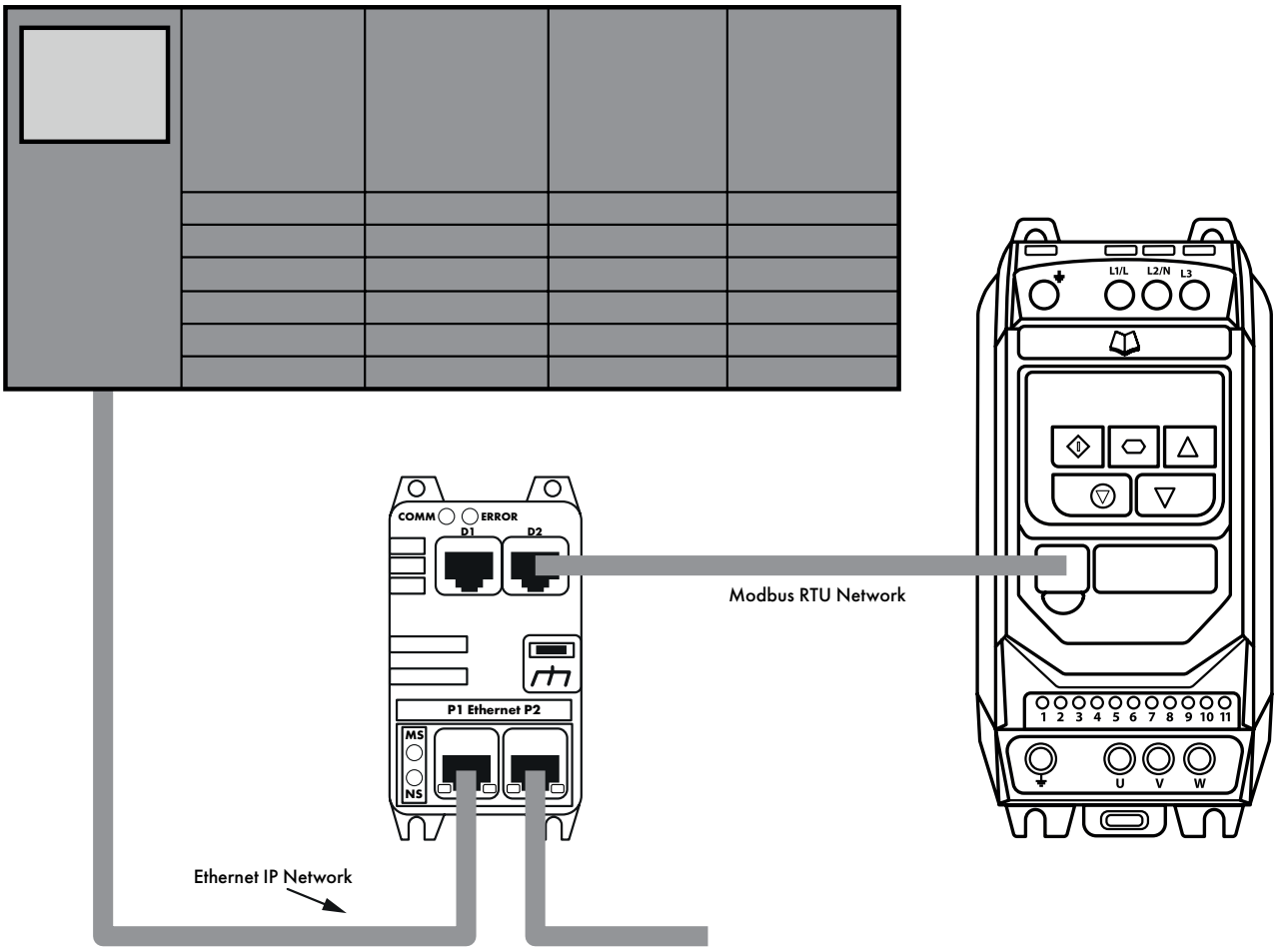
NOTE Default user account is still valid in addition to the second user account!

8. Ethernet/IP Communication

8.1. Overview

The Ethernet/IP interface is a CIP Modbus Translator Device (CIP Type 29) providing access to a virtual Modbus device (CIP Type 28h) defined according to CIP Volume 7 specification.

8.2. Operation



Messages are not sent to the Ethernet Interface, rather they are sent to the drive through the interface. The interface provides a translation from the Ethernet/IP network to the Modbus sub network and therefore to the drive. In order for this to operate successfully, the PLC needs to send the message along with the necessary routing information. This procedure is detailed in the following sections.

8.3. Usage Requirement

- To fully use the functionality of the Ethernet/IP Modbus translator requires a compatible Network Master device that supports use with a Modbus Translator Device (CIP Type 29) defined according to CIP Specification.
  - o Alternatively, the device may be support as a Generic CIP Bridge Device which supports cyclic communication only.
  - o Consult your PLC / Control Device vendor to determine compatibility.
- When using the device to control the drive it is necessary to ensure that the amount of data and frequency of data exchange does not exceed the amount of data which can be successfully exchanged on the Modbus sub-network within the permitted time.
  - o Recommended minimum RPI is 100ms.
  - o When Acyclic telegrams are exchanged, Cyclic telegrams should be paused.
- Whilst the Optitools Studio PC software supports communication through the Ethernet network for device commissioning, it is not recommended to use this continuously during operation of the drive as the additional communication load may exceed the limit resulting in loss of Cyclic communication.
  - o In this case, connect the PC software to the drive serial port using the USB / RS485 adaptor.
    - Use port D1 or D2 of the external Ethernet adaptor.
    - Use port D1 or D2 of the Compact 2 Ethernet adaptor.
    - Use one of the available ports labelled "IOIOI".
  - o Do not connect via Ethernet if data logging is required.

8.4. Operation

Cyclic control and monitoring of the drive is achieved by a Class 1 connection to the mapped Modbus PDI and PDO parameters. This can be achieved using one of the following methods.

8.4.1. Configuration

The interface supports the following Ethernet/IP classes:

- 0x01 Identity
- 0x02 Message Router
- 0x06 Connection manager
- 0x45 Modbus Serial
- 0xF4 Port
- 0xF5 TCP/IP
- 0xF6 Ethernet Link

8.4.2. IP Address

The default IP address is 192.168.1.253, Subnet Mask 255.255.255.0

IP configuration can be changed using:

- The TCP/IP Class 0xF5. Values will not be applied until an Identity Class 0x01 reset is executed
- Via the internal webserver interface. Please refer to section *7.4. Changing the IP Address on page 20* for more information..

8.5. Process Data Exchange (cyclic communication)

For simple connection and control it is recommended to use the 4-word input, 4-word output process data exchange to allow control and monitoring of the drive.

In this case the 4 Control Words transferred to the drive correspond to Modbus Register addresses 1 – 4. Refer to section *11.1. Control Registers on page 54* for further information.

The 4 Status Words returned from the drive correspond to Modbus Registers 6 – 9. Refer to section *11.2. Standard Status Registers on page 55* for further information.

An optional Extended Status Information is also possible and defined within the EDS file which supports 16 Words of Status information. Refer to section *11.3. Extended Status Registers on page 56* for further information.

8.6. Configuring the Scanner

This section explains how to configure a communication exchange between the drive with Ethernet/IP interface (built-in or external one) and compatible controller with Ethernet/IP.

8.6.1. EDS File

EDS files are available from the Invertek website, www.invertekdrives.com/variable-frequency-drives/options/communication-interfaces.

Multiple EDS files are included to support a variety of Master network devices, e.g., Rockwell Automation, Codesys. The EDS files contain the necessary path information to establish a connection as described below in further detail and may be used directly with compatible master systems.

8.6.1.1. OPT-2-ETHEG-IN and Compact 2 Ethernet/IP

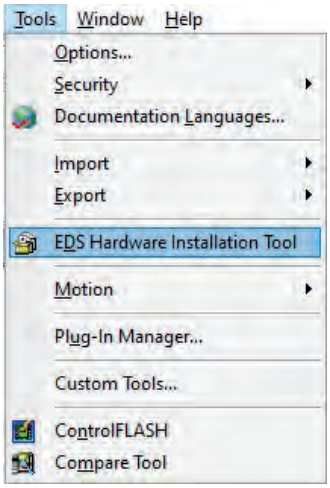
OPC-2-ETIG-IN V2.xx EDS file is dedicated for use with standalone Ethernet/IP Interface (OPT-2-ETHEG-IN) and the Compact 2 Ethernet/IP interface.

8.6.1.2. ODE-3 IP66 Outdoor with built-in Ethernet/IP interface

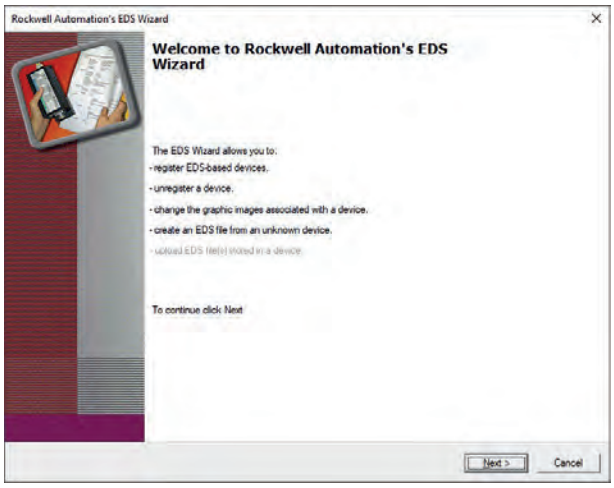
OPT-3-ETIG-IN V2.xx EDS file is dedicated for use with Optidrive E3 IP66 Outdoor with built-in Ethernet/IP interface.

8.6.2. Installing EDS files using Allen Bradley (Rockwell) Studio 5000 Logix Design

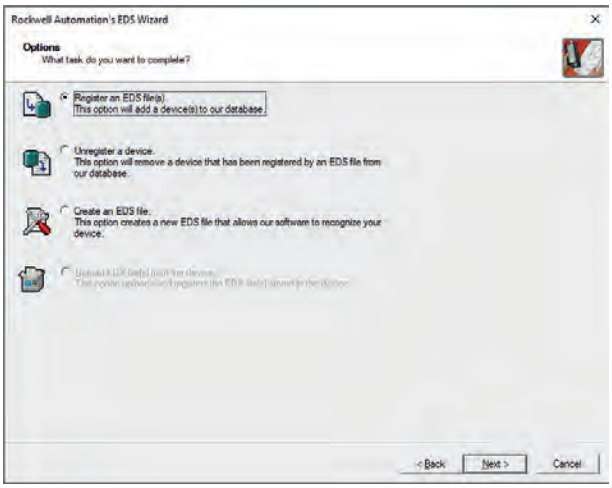
Step 1.
Open the EDS Hardware Installation Tool from Tools Tab



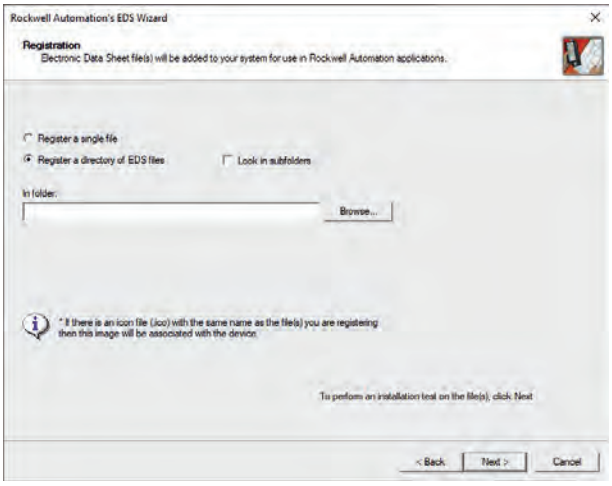
Step 2.
Starting the EDS Wizard



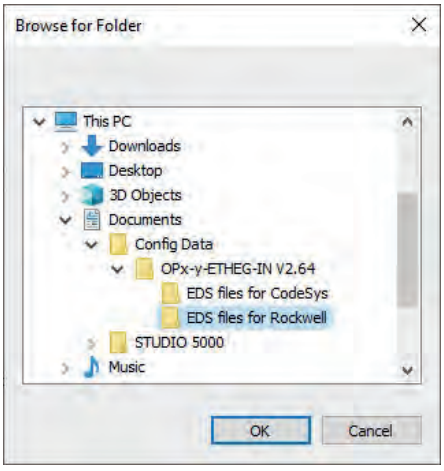
Step 3.
Select 'Register EDS file(s)' option



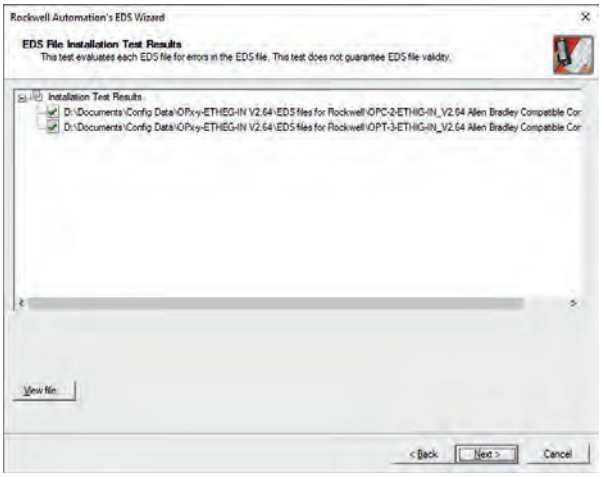
Step 4.
Select 'Register a directory of EDS files'



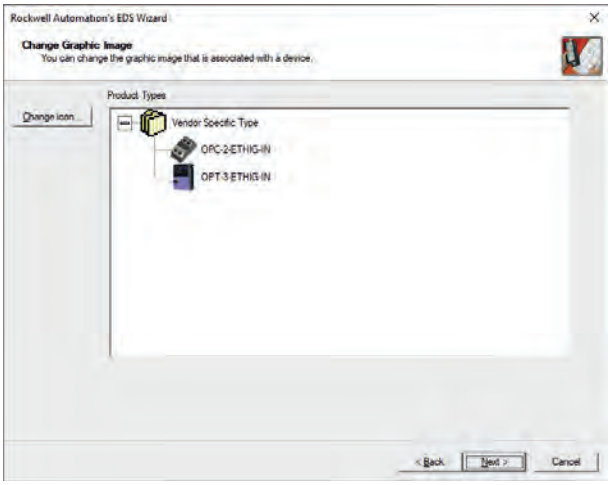
Step 5.
Select folder 'EDS files for Rockwell'



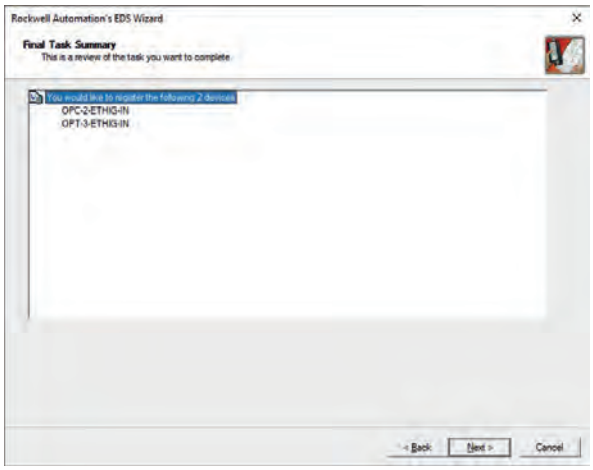
Step 6.
Confirm EDS File Installation Test Result



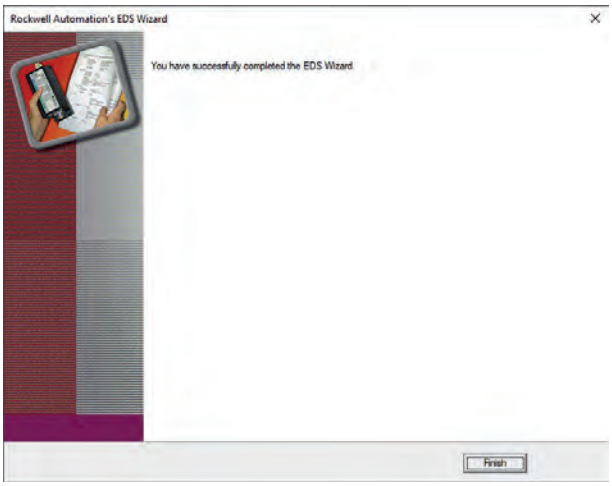
Step 7.
Confirm the Graphic Images



Step 8.
Confirm the Final Task Summary



Step 9.
Finish the EDS Wizard

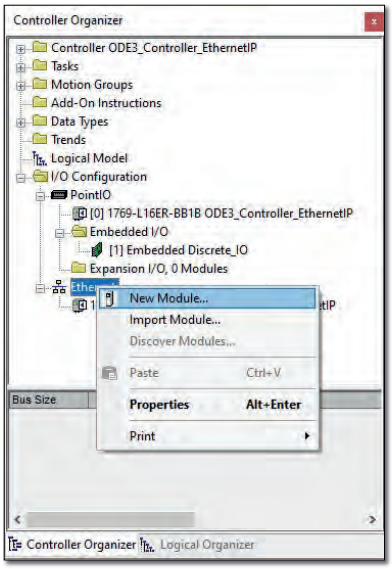


8.6.3. *Setting up the communication between the Rockwell Master and the Drive with Ethernet/IP Interface*

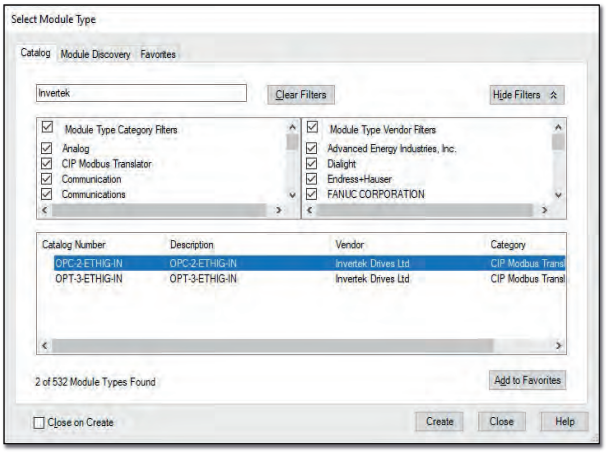
8.6.3.1. Invertek's Standard Telegram (4 Words In / 4 Words Out)

8.6.3.1.1. For use with OPT-2-ETHEG-IN (ODE-3 IP20 & IP66 Outdoor without Ethernet/IP interface) & OPT-2-ETHIG-IN plug in option for Compact 2

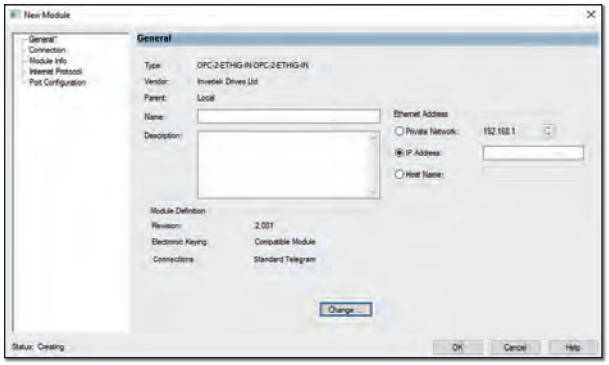
Step 1.
Add the New Module to the Ethernet/IP network
Click the right button on the Ethernet (under the I/O Configuration) and add the New Module



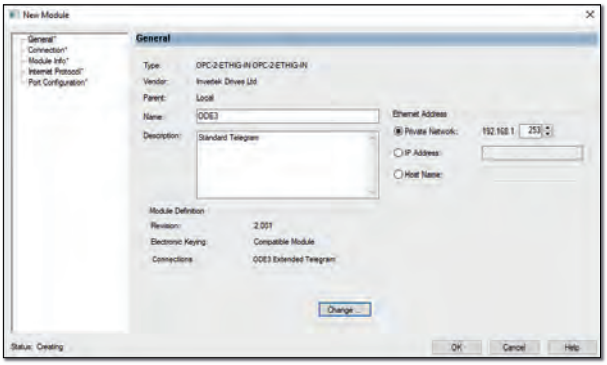
Step 2.
Search for Invertek devices in the Catalog View
Select the OPC-2-ETHIG-IN device from the list



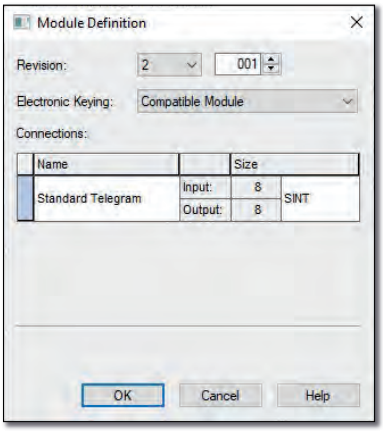
Step 3.
Assign the device Name and the IP Address to the Drive
(Default IP Address of the module is 192.168.1.253)



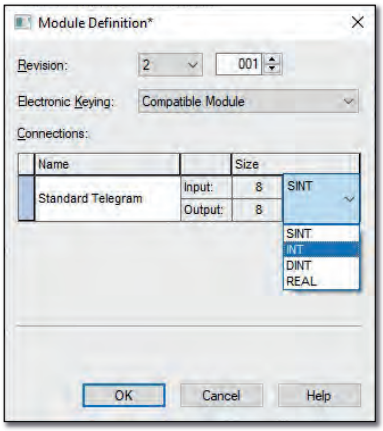
Step 4.
Click the *'Change...'* button in the Module Definition



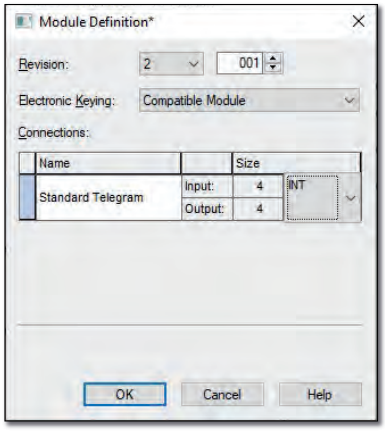
Step 5.
Change the data type
Click the left button on the SINT field under the Size Tab



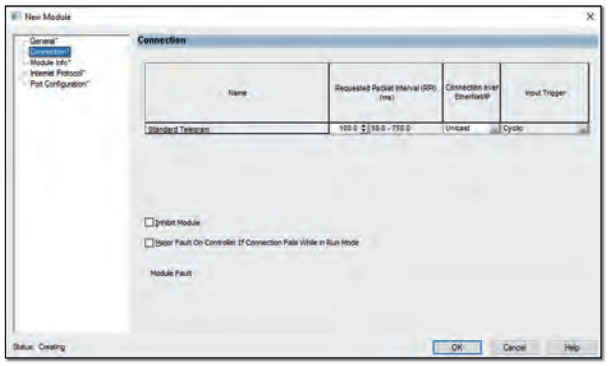
Step 6.
Select INT data type from the drop list



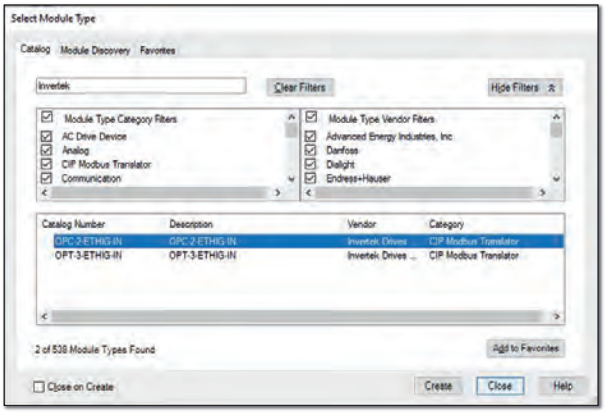
Step 7.
Confirm INT as the selected data type



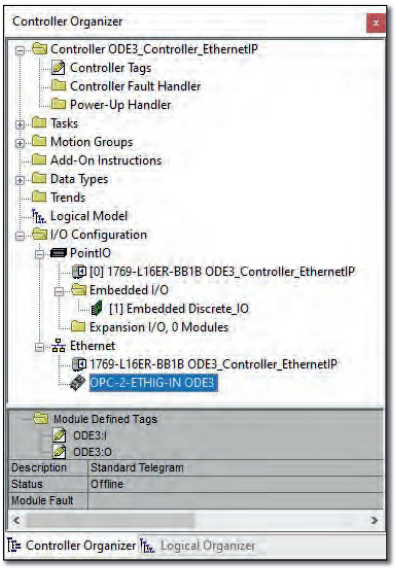
Step 8.
(Optional) Adjust the RPI time in the Connection tab
Click OK button to save your settings



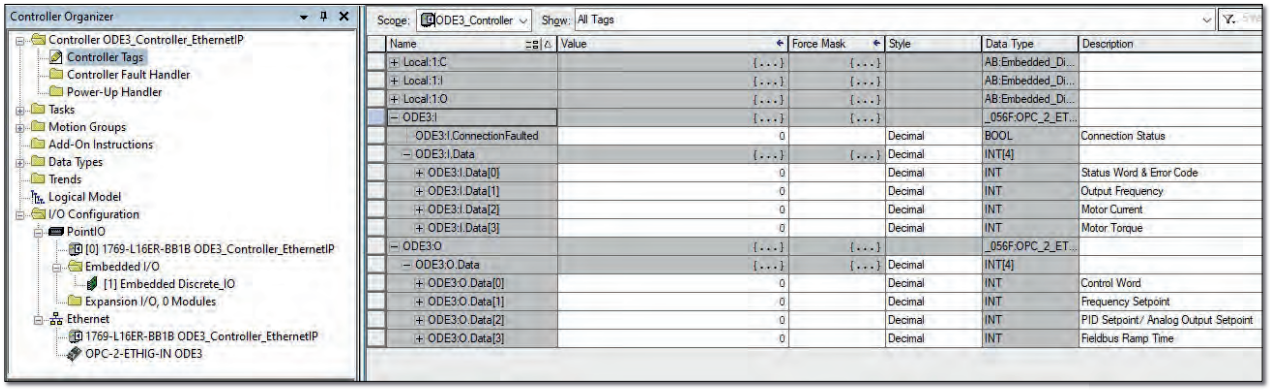
Step 9.
Close the Select Module Type Window



Step 10.
OPC-2-ETHIG-IN device will be added to the project

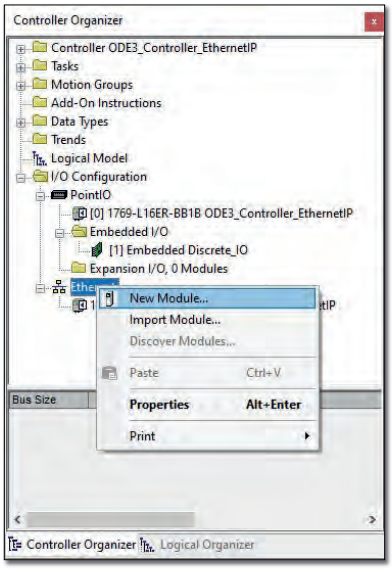


Step 11.
Drive tags created in the Controller Tags Window

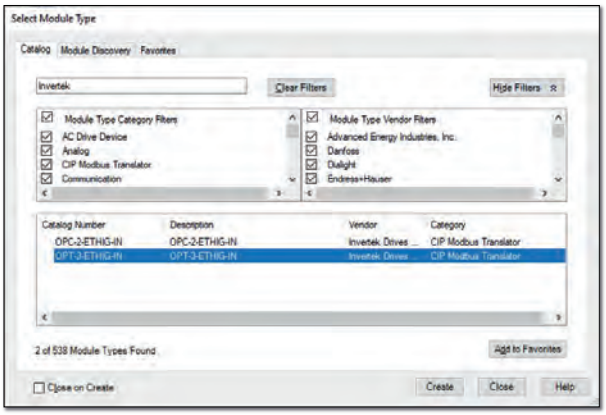


8.6.3.1.2. For use with ODE-3 IP66 Outdoor drives with built-in Ethernet/IP interface (Drive model code +"EiP").

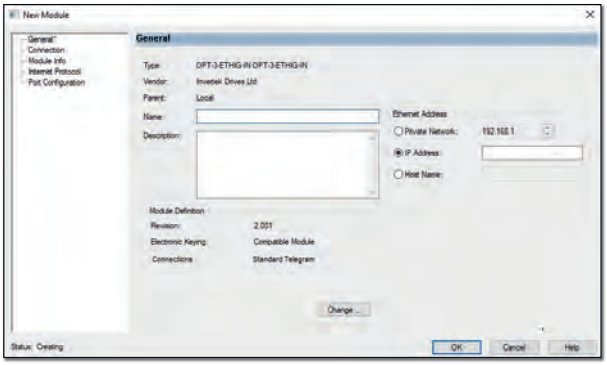
Step 1.
Add the New Module to the Ethernet/IP network
Click the right button on the Ethernet (under the I/O Configuration) and add the New Module



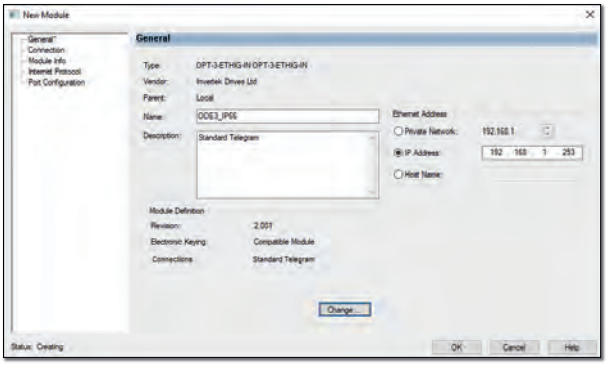
Step 2.
Search for Invertek devices in the Catalog View
Select the OPT-3-ETHIG-IN device from the list



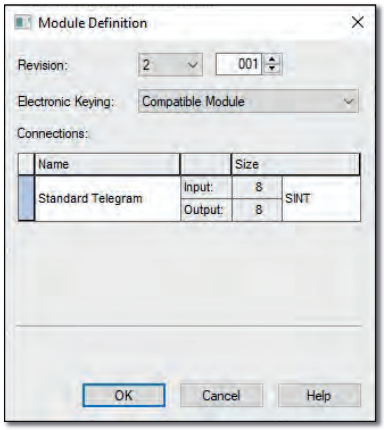
Step 3.
Assign the device Name and the IP Address to the Drive
(Default IP Address of the module is 192.168.1.253)



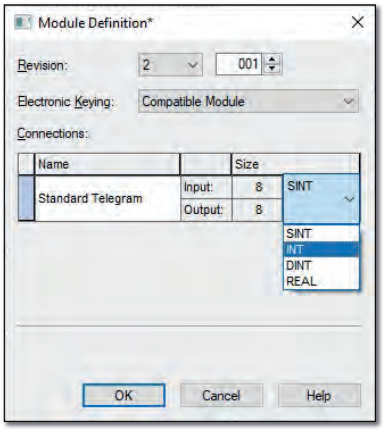
Step 4.
Click the *'Change...'* button in the Module Definition.



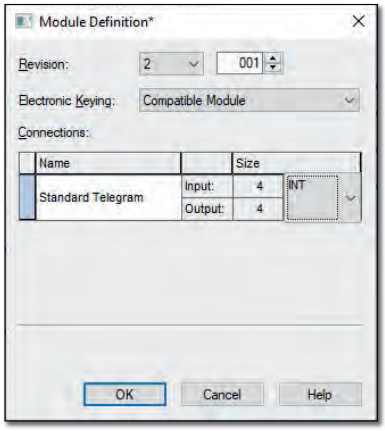
Step 5.
Change the data type
Click the left button on the SINT field under the Size Tab



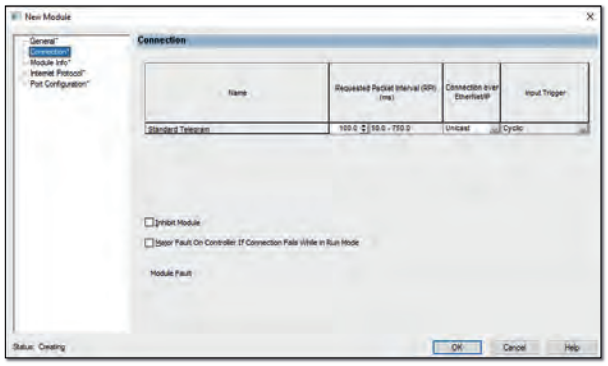
Step 6.
Select INT data type from the drop list



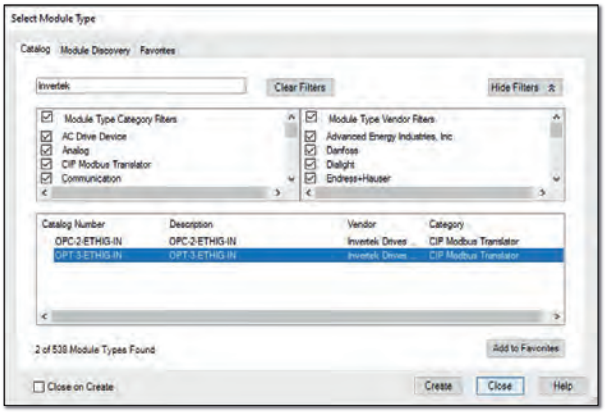
Step 7.
Confirm INT as the selected data type



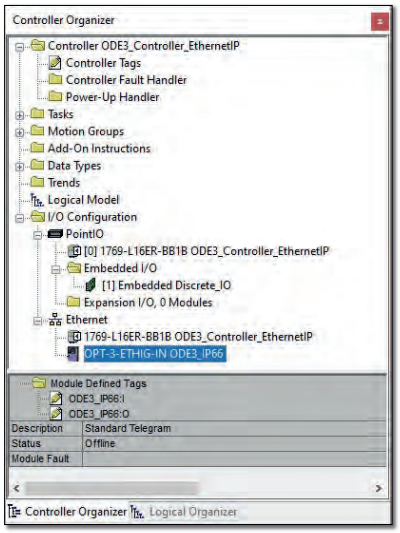
Step 8.
(Optional) Adjust the RPI time in the Connection tab
Click OK button to save your settings



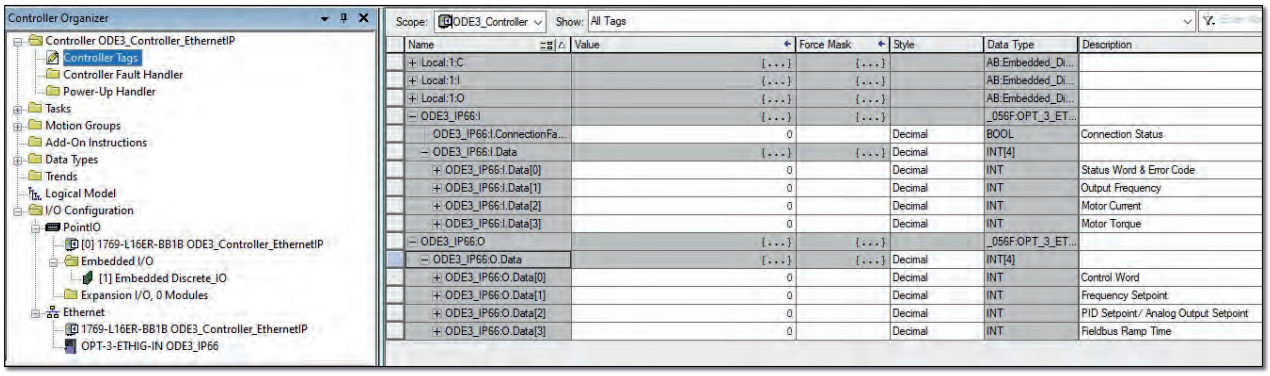
Step 9.
Close the Select Module Type Window



Step 10.
OPT-3-ETHIG-IN device will be added to the project



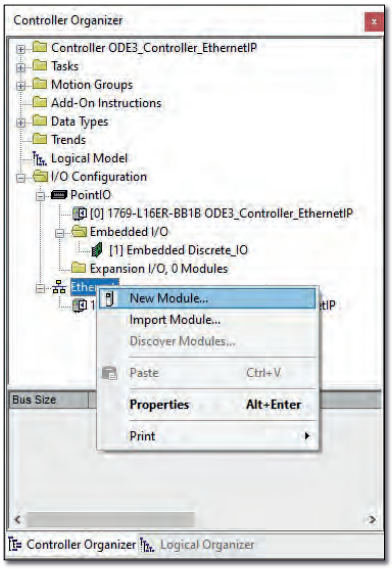
Step 11.
Drive tags created in the Controller Tags Window



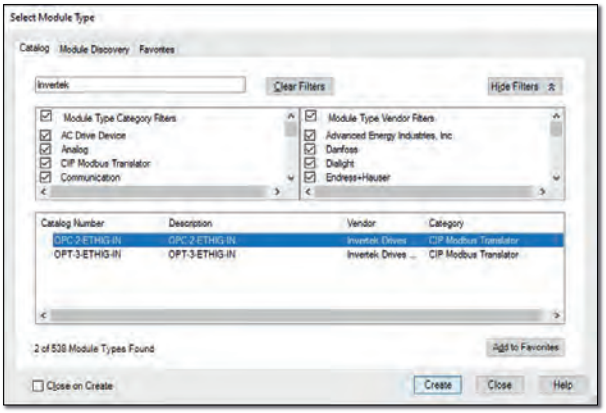
8.6.3.2. ODE-3 Extended Status Information (4 Words In / 16 Words Out)

8.6.3.2.1. For use with OPT-2-ETHEG-IN (ODE-3 IP20 & IP66 Outdoor without Ethernet/IP interface) & OPT-2-ETHIG-IN plug in option for Compact 2.

Step 1.
Add the New Module to the Ethernet/IP network
Click the right button on the Ethernet (under the I/O Configuration) and add the New Module

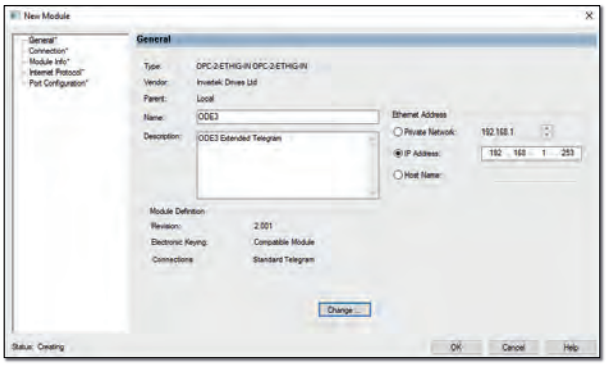


Step 2.
Search for Invertek devices in the Catalog View
Select the OPC-2-ETHIG-IN device from the list

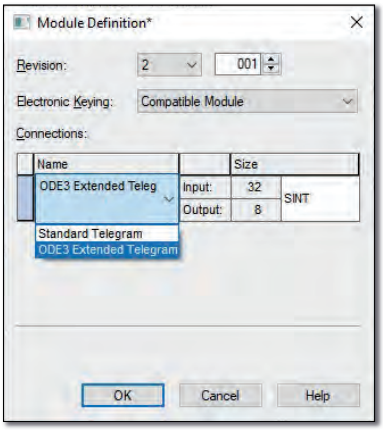


Step 3.
Assign the device Name and the IP Address to the Drive
(Default IP Address of the module is 192.168.1.253)

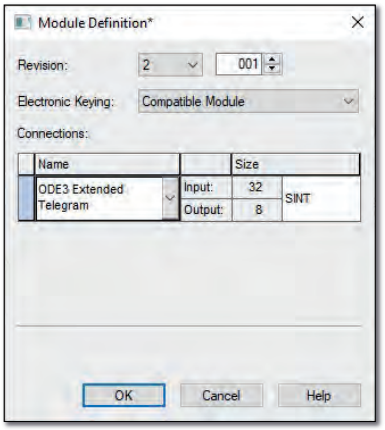
Step 4.
Click the *'Change...'* button in the Module Definition



Step 5.
Chang the Connection type
Click the left button under the Name tab on the Standard Telegram field

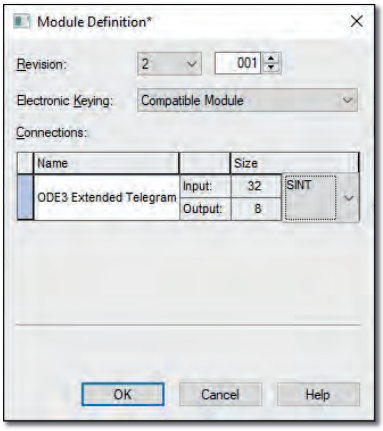


Step 6.
Select ODE3 Extended Telegram form the drop list as the Connection

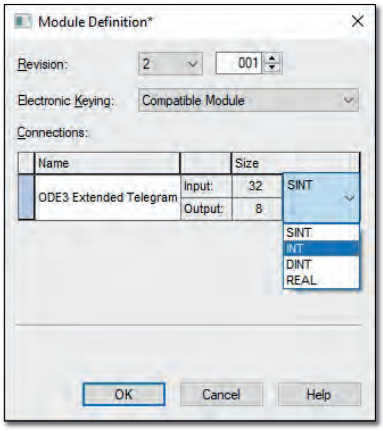


Step 7.
Change the data type

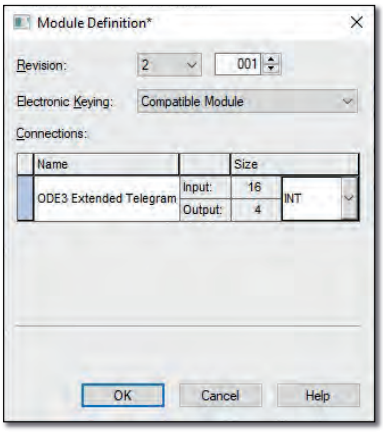
Click the left button on the SINT field under the Size Tab



Step 8.
Select INT data type from the drop list

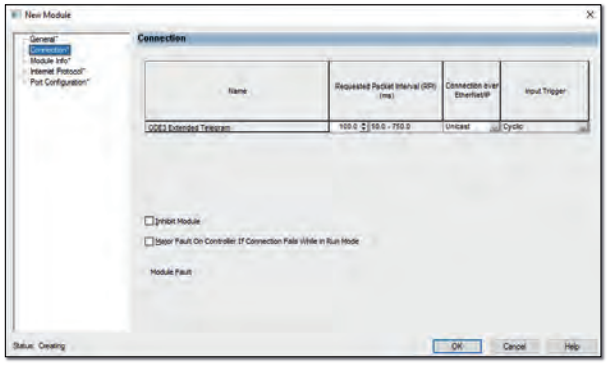


Step 9.
Confirm INT as the selected data type

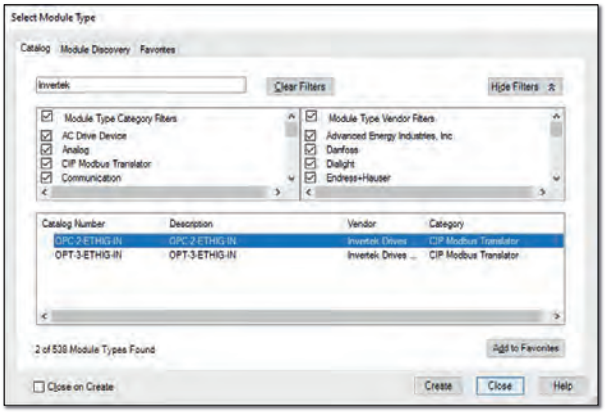


Step 10.
(Optional) Adjust the RPI time in the Connection tab.

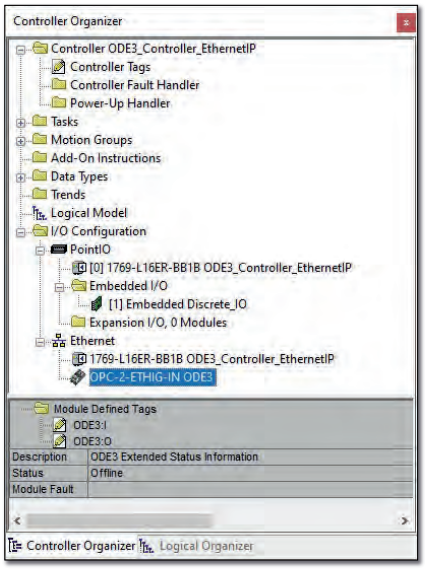
Click OK button to save your settings.



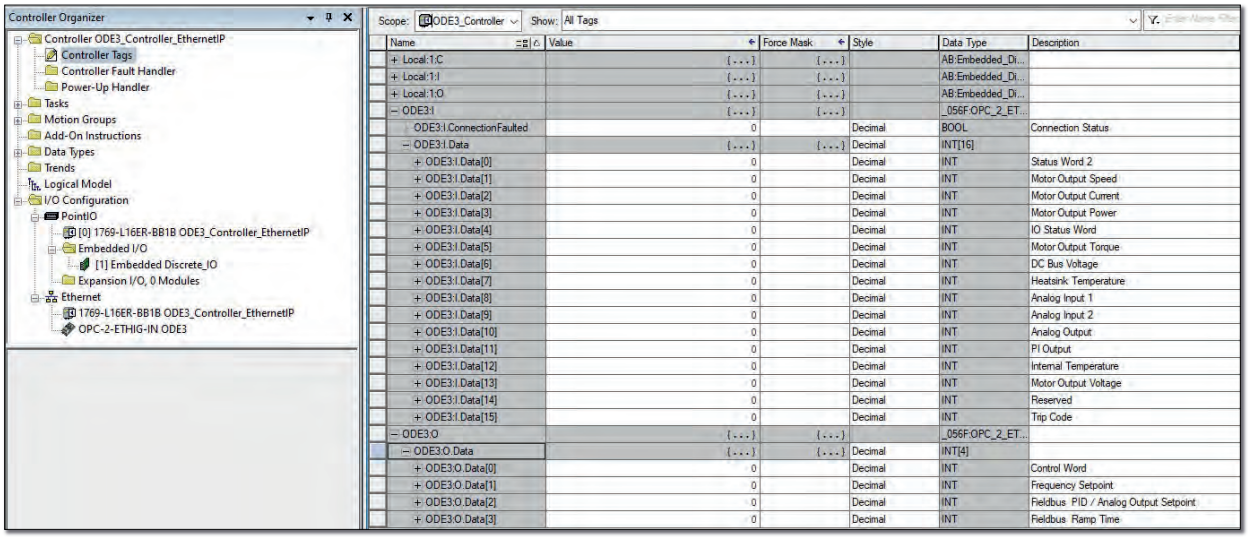
Step 11.
Close the Select Module Type Window



Step 12.
OPC-2-ETHIG-IN device will be added to the project

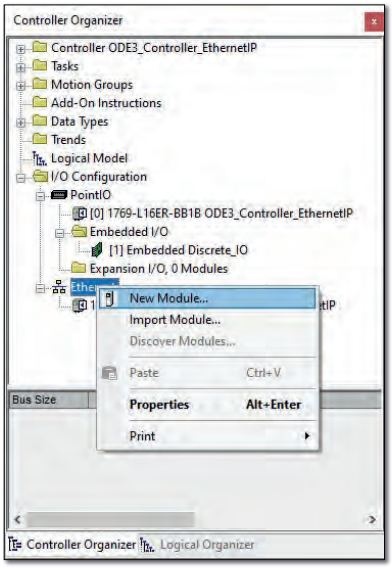


Step 13.
Drive tags created in the Controller Tags Window

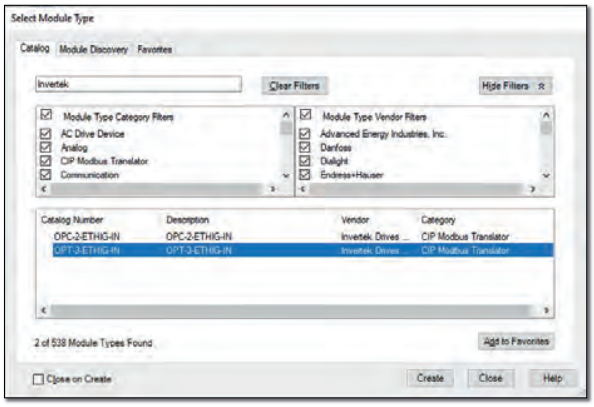


8.6.3.2.2. For use with ODE-3 IP66 Outdoor drives with built-in Ethernet/IP interface (Drive model code +"EiP")

Step 1.
Add the New Module to the Ethernet/IP network
Click the right button on the Ethernet (under the I/O Configuration) and add the New Module

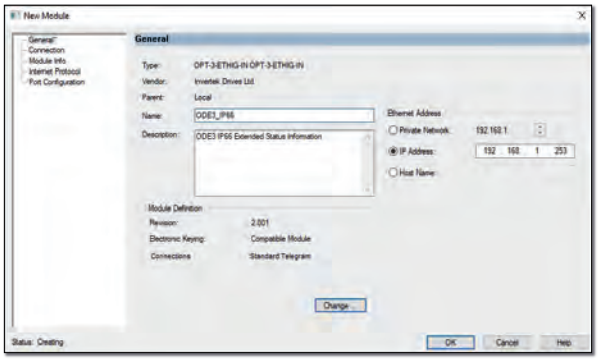


Step 2.
Search for Invertek devices in the Catalog View
Select the OPT-3-ETHIG-IN device from the list



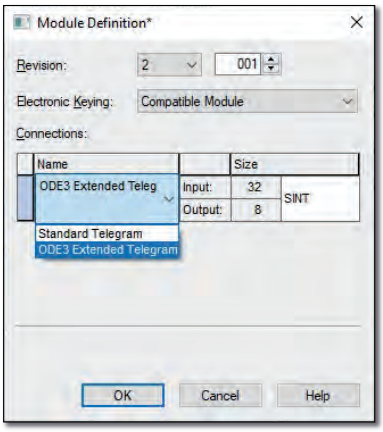
Step 3.
Assign the device Name and the IP Address to the Drive
(Default IP Address of the module is 192.168.1.253)

Step 4.
Click the *'Change...'* button in the Module Definition

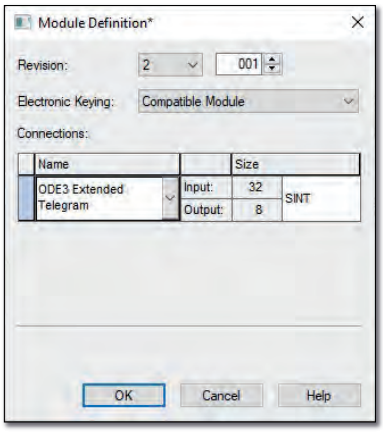


Step 5.
Change the Connection type

Click the left button under the Name tab on the Standard Telegram field

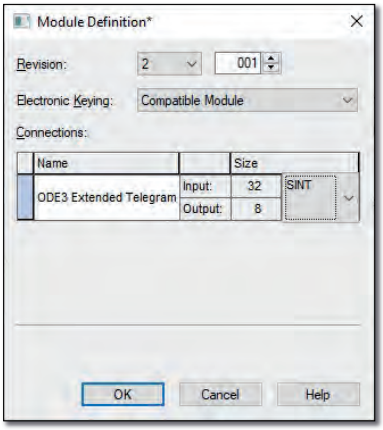


Step 6.
Select ODE3 Extended Telegram form the drop list as the Connection

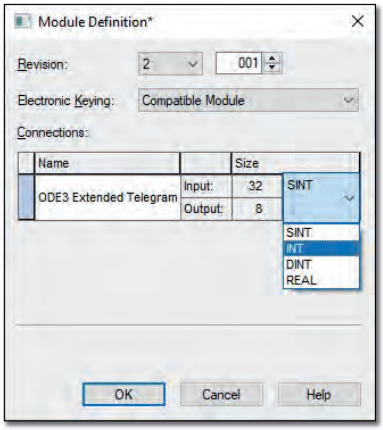


Step 7.
Change the data type

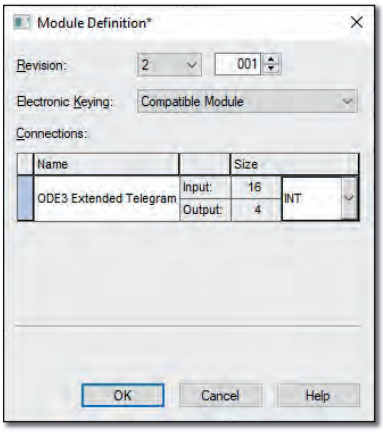
Click the left button on the SINT field under the Size Tab



Step 8.
Select INT data type from the drop list

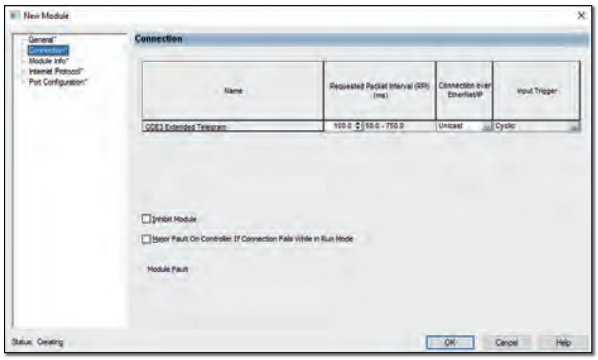


Step 9.
Confirm INT as the selected data type

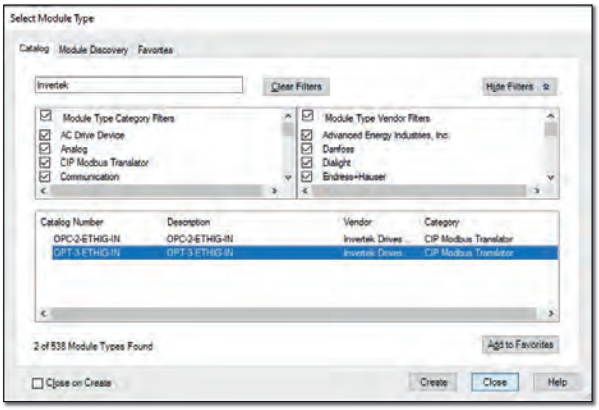


Step 10.
(Optional) Adjust the RPI time in the Connection tab

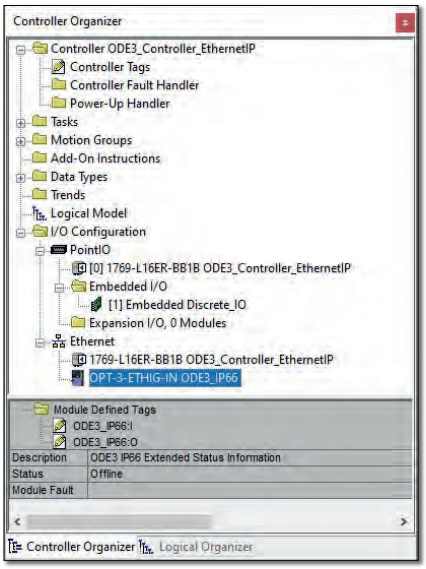
Click OK button to save your settings



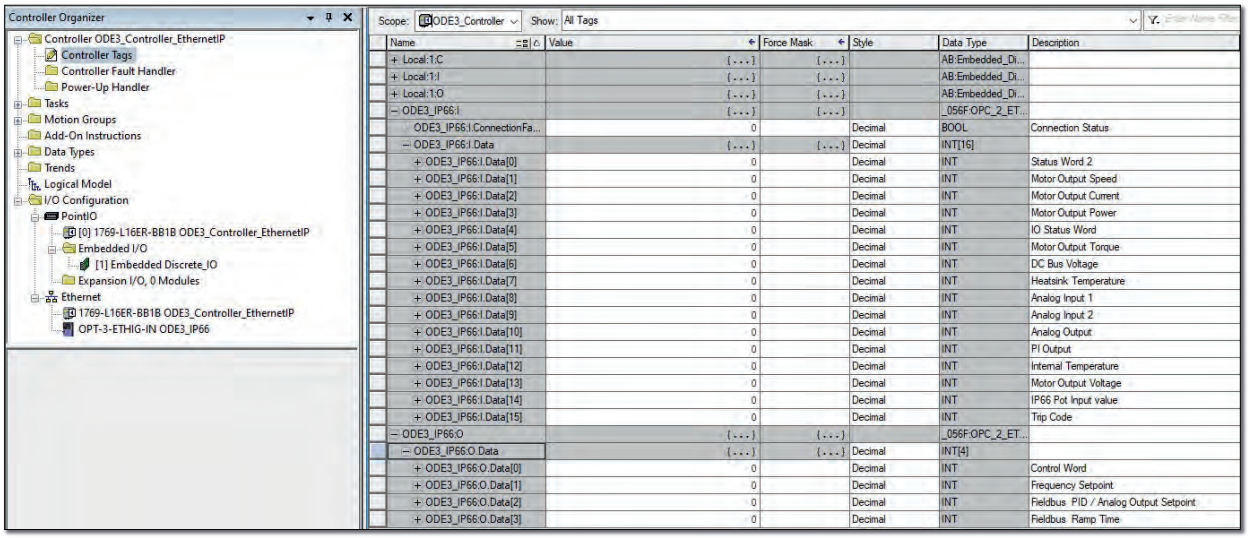
Step 11.
Close the Select Module Type Window



Step 12.
OPT-3-ETHIG-IN device will be added to the project



Step 13.
Drive tags created in the Controller Tags Window



8.6.4. *Generic device configuration*

NOTE This method of connection and operation without using the EDS file is only possible when working with PLC's which support message routing through a Modbus Translator device. Consult your PLC supplier for confirmation.

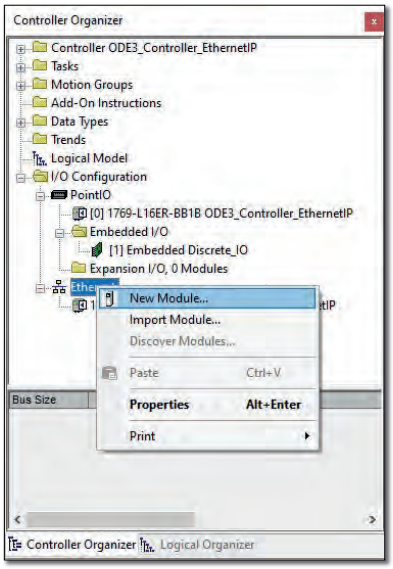
8.6.4.1. Configuration example based on Allen Bradley Studio 5000 Logix Design

8.6.4.1.1. Configuration example for Standard Telegram (4 Words in, 4 Words Out)

Step 1.

Add the New Module to the Ethernet/IP network

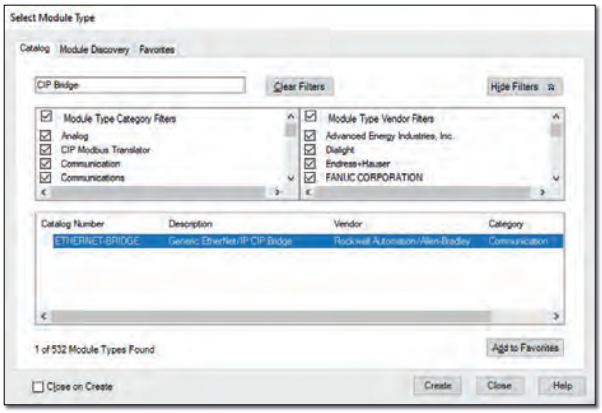
Click the right button on the Ethernet (under the I/O Configuration) and add the New Module



Step 2.

Search for Invertek devices in the Catalog View

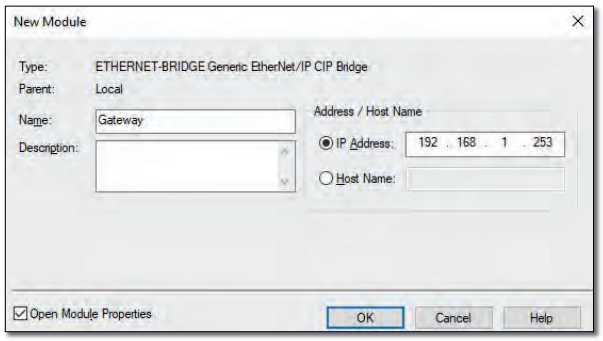
Please type 'CIP Bridge' in the search box and select ETHERNET-BRIDGE



Step 3.

Assign the device Name and the IP Address to the Drive

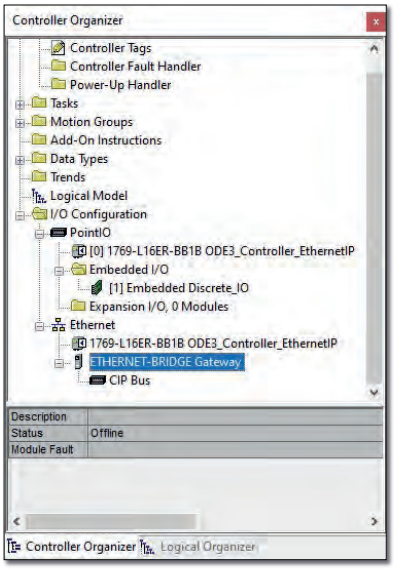
(Default IP Address of the module is 192.168.1.253)



Step 4.

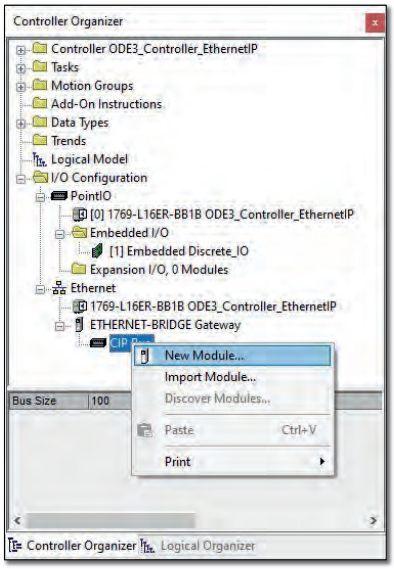
Ethernet-Bridge device will be added to your project

The Modbus Translator will be added to your Ethernet/IP network represented as an "ETHERNET-BRIDGE"

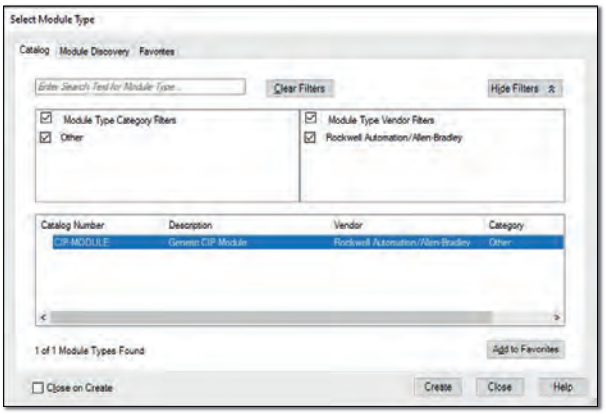


Step 5.
Add the 'New Module' under the 'CIP Bus'

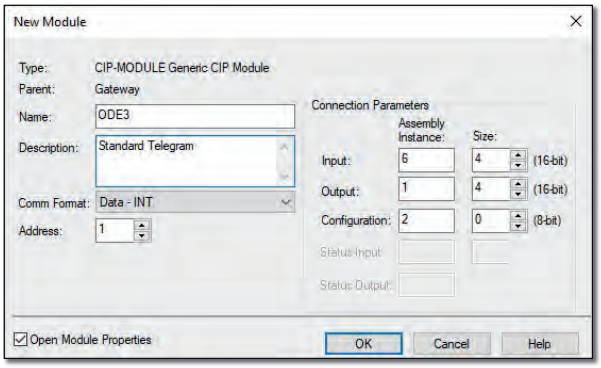
Click the right button on the CIP Bus (under the ETHERNET-BRDIGE) and add the New Module



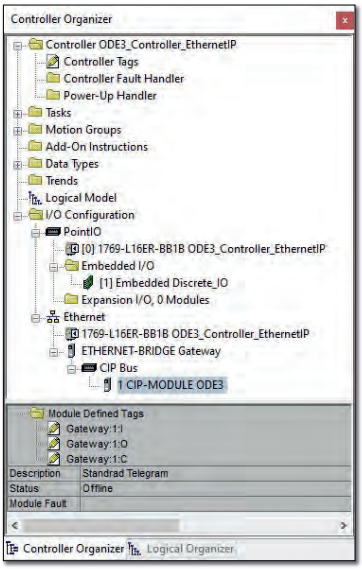
Step 6.
Select the 'CIP-Module' from the list



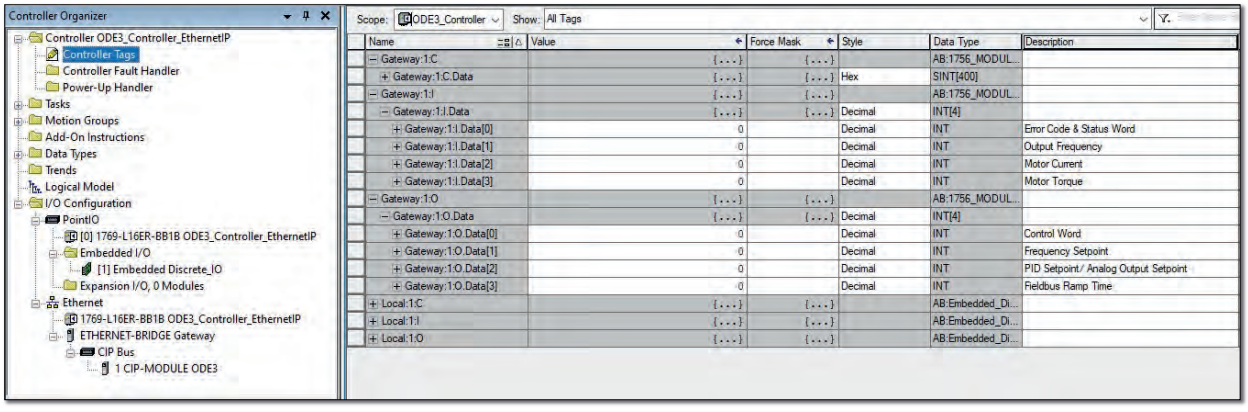
Step 7.
Assign the drive name, configure the Assembly Instances and sizes for Standard Telegram



Step 8.
Device should be added under the CIP Bus



Step 8.
Tags for the ODE3 drive are created int the Controller Tags window



Configuration for Assembly Instances and Size for Standard Telegram (4 Words In & 4 Words Out) are as below:

Device Settings		
Data Type	INT	16-bit
Address	1	-

Connection Parameters		
	Assembly Instance	**Size**
Input	6	4
Output	1	4
Configuration	2	0

NOTE

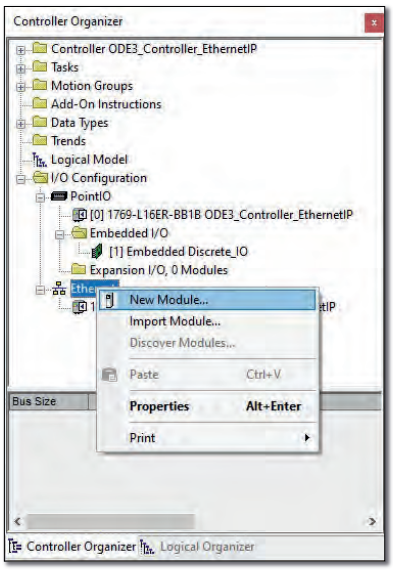
1. Assembly Instance is the Modbus Register number which can be found in the drive Parameter List / Programming guide document.
2. Device Address must be set to 1 and be equal to the drive local address.

8.6.4.1.2. Configuration example for ODE3 Extended Telegram (4 Words In / 16 Words Out)

Step 1.

Add the New Module to the Ethernet/IP network

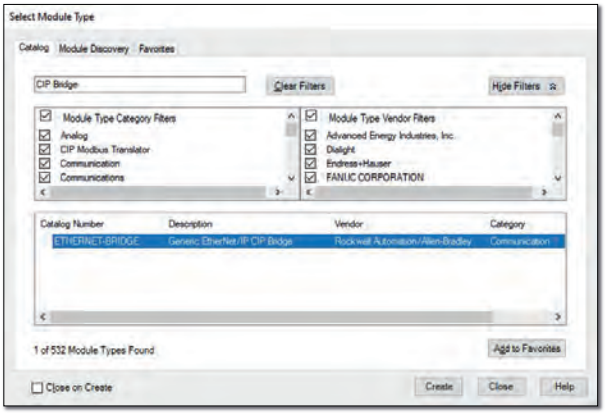
Click the right button on the Ethernet (under the I/O Configuration) and add the New Module



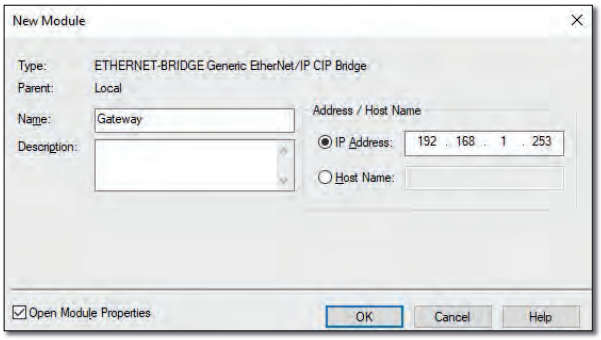
Step 2.

Search for Invertek devices in the Catalog View

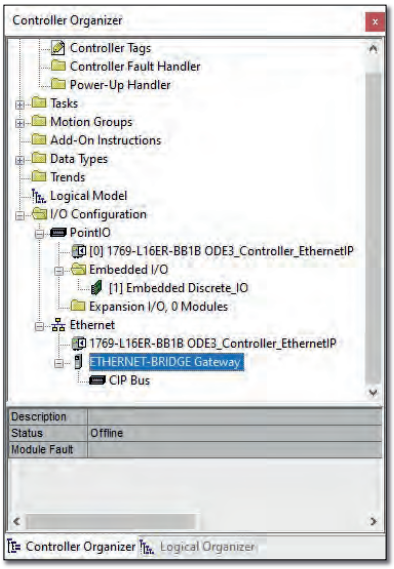
Please type 'CIP Bridge' in the search box and select ETHERNET-BRIDGE



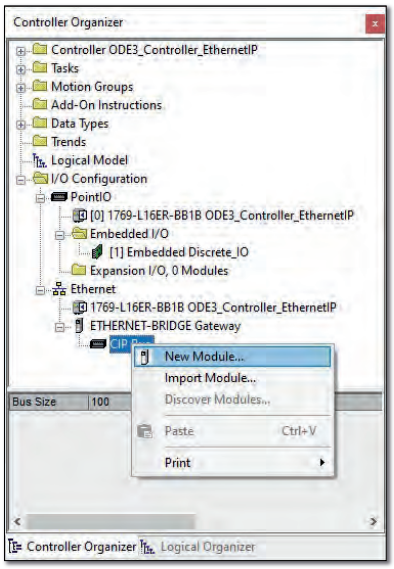
Step 3.
Assign the device Name and the IP Address to the Drive
(Default IP Address of the module is 192.168.1.253)



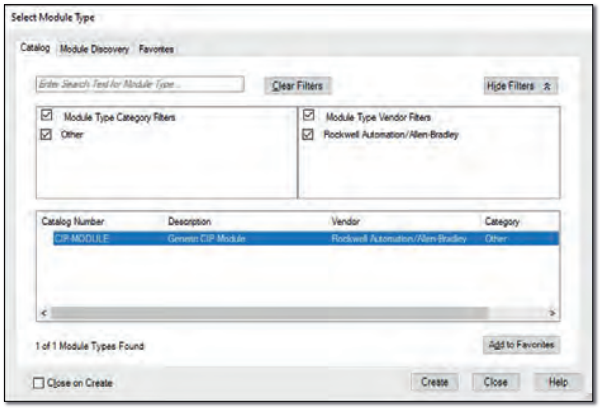
Step 4.
Ethernet-Bridge device will be added to your project
The Modbus Translator will be added to your Ethernet/IP network represented as an "ETHERNET-BRIDGE"



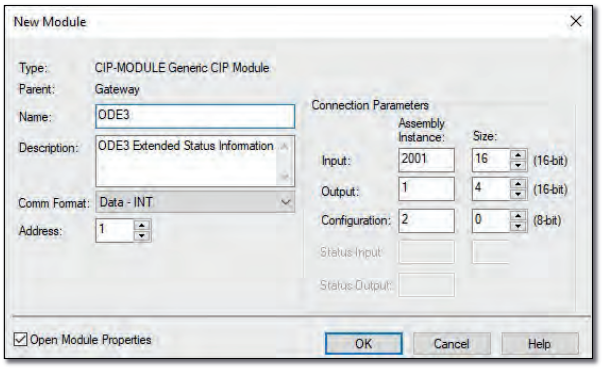
Step 5.
Add the 'New Module' under the 'CIP Bus'
Click the right button on the CIP Bus (under the ETHERNET-BRDIGE) and add the New Module



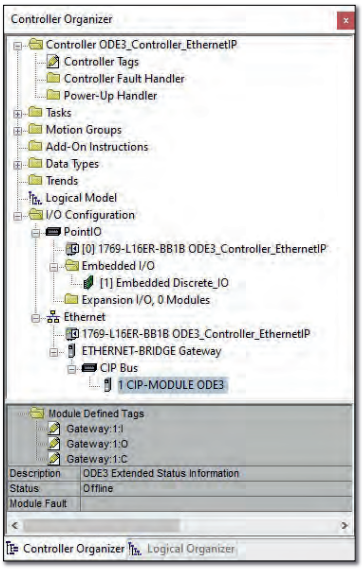
Step 6.
Select the 'CIP-Module' from the list



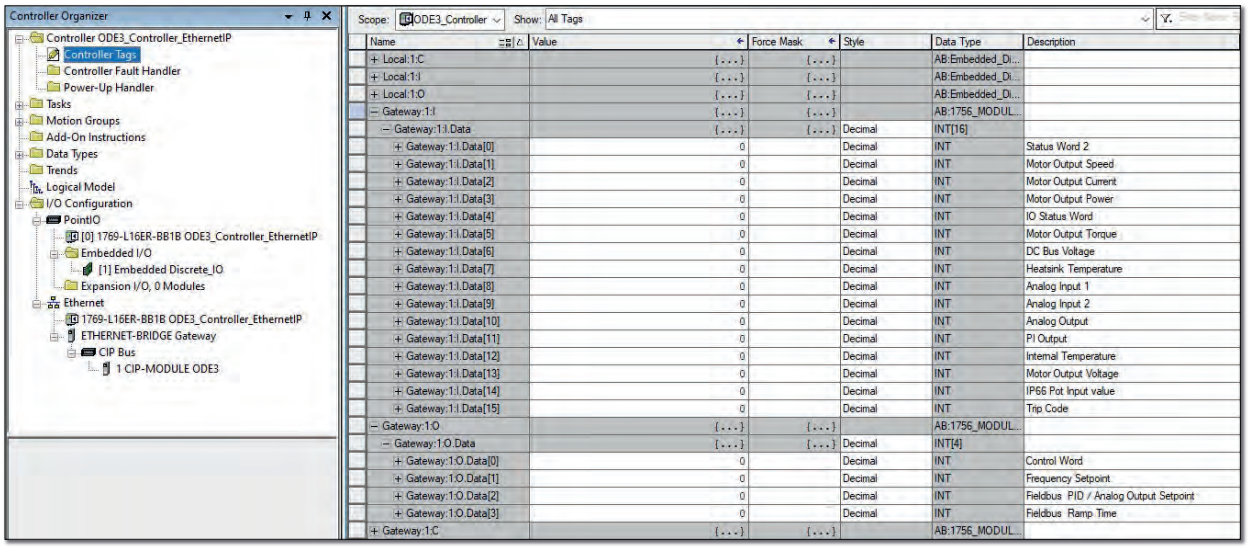
Step 7.
Assign the drive name, configure the Assembly Instances and sizes for ODE3 Extended Telegram



Step 8.
Device should be added under the CIP Bus



Step 9.
Tags for the ODE3 drive are created int the Controller Tags window



Configuration for Assembly Instances and Size for ODE3 Extended Telegram (4 Words In & 16 Words Out) are as below:

Device Settings		
Data Type	INT	16-bit
Address	1	-

Connection Parameters		
	Assembly Instance	**Size**
Input	2001	16
Output	1	4
Configuration	2	0

NOTE

1. Assembly Instance is the Modbus Register number which can be found in the drive Parameter List / Programming guide document.
2. Device Address must be set to 1 and be equal to the drive local address.

8.6.4.2. Generic device configuration with Enabled Routing (Other PLC type)

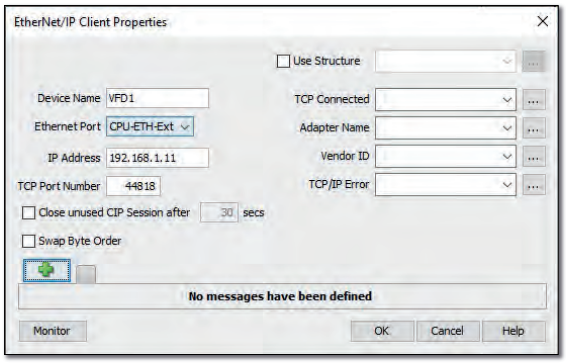
Communication as a Generic deice is also possible with PLC's that support routing through a CIP Modbus Translator.

For detailed information please refer to the programming documentation of the PLC.

A typical example configuration is shown below.

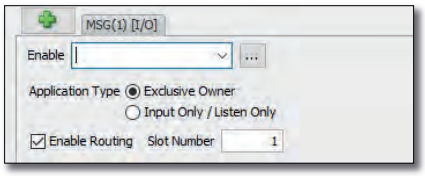
Network configuration

Add a Generic Device to the EtherNet/IP network, assign the device name and IP address



Message configuration

Please add the I/O Message and configure it as below

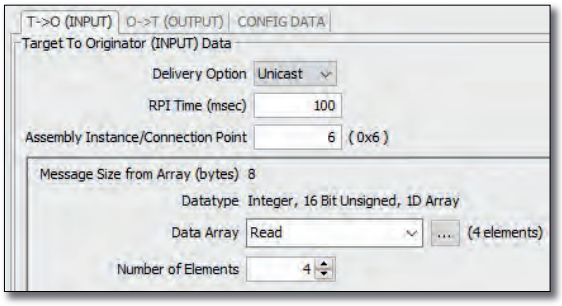


NOTE

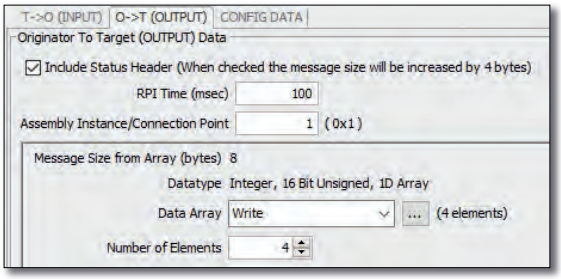
Slot number must be set to 1 and be equal to the drive local network address (Parameter P-36).

Device configuration for Standard Telegram (4 Words In/ 4 Words Out)

Target to Originator:

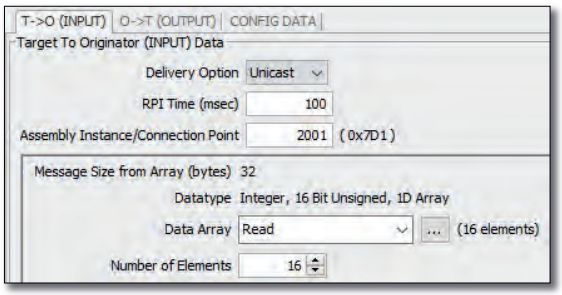


Originator to Target:

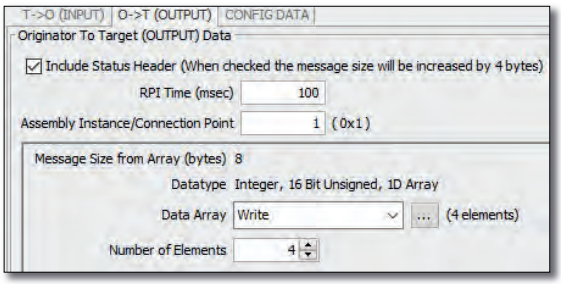


Device configuration for Extended Status Information (Advanced Telegram with 4 Words In/ 16 Words Out)

Target to Originator:



Originator to Target:



8.7. Advanced connection methods

Communication to the drive may also be possible using one of the two methods shown below. This allows process data to be cyclically exchanged between the Ethernet/IP master and a connected Optidrive.

Both of the following methods are pre-defined within the available EDS files.

8.7.1. Method 1: Class 1 connection to Drive Assembly object

Drive control can be achieved via Class1 connections to the Assembly Object (0x04).

The controller must implement the forward open request (routing) to the OPT-2-ETHEG-IN Port 3, address 1.

For Drive specific allocation refer to Drive Manual and/or Ethernet/IP EDS file.

For Drive specific read/write limitations refer to Drive Manual and/or Ethernet/IP EDS file.

The following connection setting will establish a Class 1 connection to transfer Drive PDI/PDO Modbus registers

Connection setting		Value
Path		20 04 24 01 2C 01 2C 06
RPI		Min 50ms
Timeout Multiplier		Recommend x32
Trigger		Cyclic
Transport type		Exclusive owner
O->T	Size	8
	Connection Type	Point to Point
	Length	Fixed
	Transfer Format	32bit Run/Idle
T->O Standard Telegram 4 Word	Size	8
	Connection Type	Point to Point
	Length	Fixed
	Transfer Format	Pure data

8.7.2. Method 2: Class 1 connection via OPC-2-ETHIG-IN 'Forward Open Assembly' object

The OPC-2-ETHIG-IN provides the Vendor Class 'Forward Open Assembly (0x0300)' which negates the need for the control to provide the forward open mapping.

For Drive specific allocation refer to Drive Manual and/or Ethernet/IP EDS file.

For Drive specific read/write limitations refer to Drive Manual and/or Ethernet/IP EDS file.

The following connection setting will establish a Class 1 connection to transfer Drive PDI/PDO registers.

Connection setting		Value
Path		21 00 00 03 24 01 2C 01 2C 06
RPI		Min 50ms
Timeout Multiplier		Recommend x32
Trigger		Cyclic
Transport type		Exclusive owner
O->T (4 Words)	Size	8
	Instance	1
	Connection Type	Point to Point
	Length	Fixed
	Transfer Format	32bit Run/Idle
T->O Standard Telegram (4 Words)	Size (bytes)	8
	Instance	1
	Connection Type	Point to Point
	Length	Fixed
	Transfer Format	Pure data
T->O Extended Status Telegram (16 Words) **Valid also for Method 1**	Size (bytes)	32
	Instance	2001
	Connection Type	Point to Point
	Length	Fixed
	Transfer Format	Pure data

8.8. Parameter data transfer

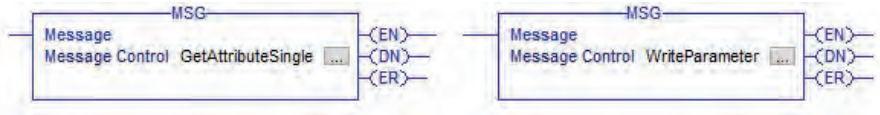
8.8.1. Overview

The OPT-2-ETHEG-IN/ OPT-3-ETIG-IN are Modbus Translator Devices. This means that all data accessible from the drives Modbus RTU interface may also be accessed via the Ethernet/IP interface. For details of the relevant Modbus registers available for each drive, refer to the drive Parameter List / Programming Guide.

The interface module supports acyclic access to all drive parameters. This type of communication is typically used for low priority and occasional access to drive settings and data. For this purpose, the module supports explicit messaging.

8.8.2. *Explicit Messaging*

Explicit messaging can be used to read or write a parameter setting.



All drives parameter variables have the data type INT (16 bit, 2-byte objects). The device parameters and the PLC program variables must have the same data lengths.

Accessing drive parameters

Explicit messaging must be configured using the settings shown below.

Explicit Message Read Request Configuration		
Read Message Type	**Single Parameter Read**	**Multiple Parameters Read**
Service ID	14 (0x0E)	78 (0x4E)
Class ID	15 (0x0F)	68 (0x44)
Attribute ID	1 (0x01)	-
Instance ID	Modbus Register assigned to the Parameter Number	
Data Type	INT (16-bit)	
Data Size	16-bit	16-bit x Number of Requested Elements

Explicit Message Write Request Configuration		
Read Message Type	**Single Parameter Write**	**Multiple Parameters Write**
Service ID	16 (0x10)	Not supported
Class ID	15 (0x0F)	Not supported
Attribute ID	1 (0x01)	Not supported
Instance ID	Modbus Register assigned to the Parameter Number	
Data Type	INT (16-bit)	
Data Size	16-bit	-

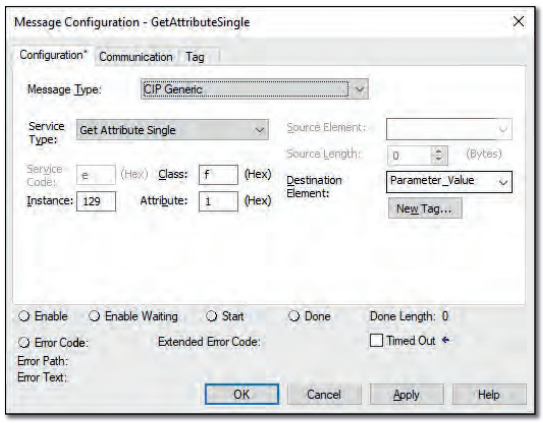
8.8.2.1. Parameter data transfer - configuration example based on Allen Bradley Studio 5000 Logix Designer

8.8.2.1.1. Read Parameter Value

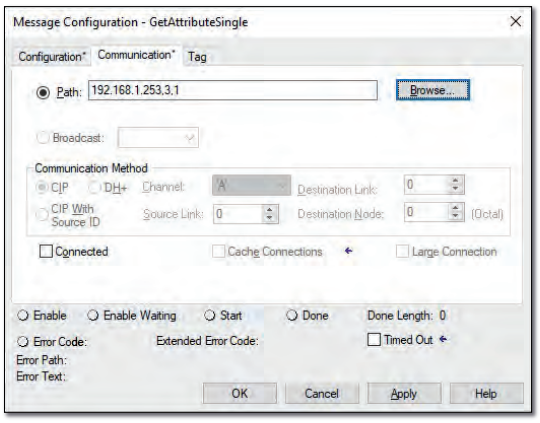
Please add the MSG function to the program.

Massage Configuration – Parameter Read

Configuration Tab:



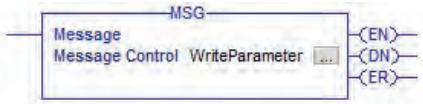
Communication Tab:



Cofiguration Settings	
Message Type	CIP Generic
Service Type	Get Attribute Single (0x0E)
Class ID	0x0F
Instance	The relevant Modbus RTU Register Number (For ODE-3 i.e.: P-01 = 129 [128+01], P-02 = 130 [128+02])
Attribute	1
Source Length	2 Bytes
Destination Element	Must be a 16-bit data type
Path	**'Device Name or IP Address, 3, 1'**

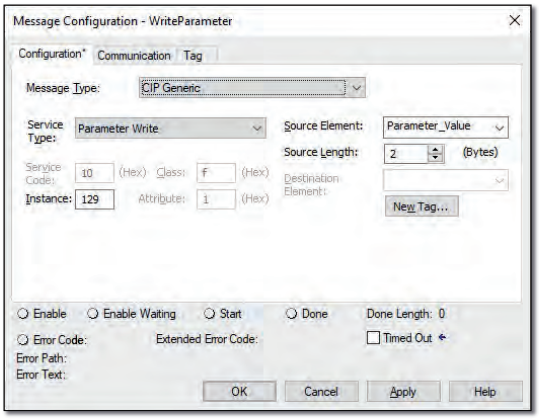
8.8.2.1.2. Write Parameter Value

Please add the MSG function to the program.

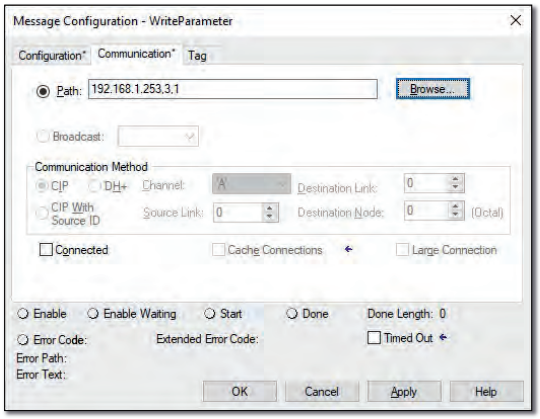


Massage Configuration – Parameter Write

Configuration Tab:



Communication Tab:



Cofiguration Settings	
Message Type	CIP Generic
Service Type	Parameter Write (0x10)
Class ID	0x0F
Instance	The relevant Modbus RTU Register Number (For ODE-3 i.e.: P-01 = 129 [128+01], P-02 = 130 [128+02])
Attribute	1
Source Length	2 Bytes
Destination Element	Must be a 16-bit data type
Path	**'Device Name or IP Address, 3, 1'**

8.9. Trouble Shooting

8.9.1. *Status Indicator LEDs*

Refer to *6. Ethernet Connection on page 14* for status LED location information.

Status LED	Function
NS	Ethernet Network Status Indicator
MS	MS: Ethernet/IP Network Status Indicator
COMM	COMM: Modbus Communication Indicator (OPC-2-ETHIG-IN <-> Drive)
ERROR	Modbus Error Indicator (OPC-2-ETHIG-IN <-> Drive)

Network Status (NS) Indicator	
State	**Ethernet/IP**
Steady Off	Not powered No IP address
Steady Green	Online One or more connections active or message received
Flashing Green	Online No connections active or no messages received
Flashing Red	Connection timeout
Steady Red	Duplicate IP
Flashing Green and Red	Self-test

Module Status (MS) Indicator	
State	**Indication**
Steady Off	No power
Steady Green	Operating in normal condition
Flashing Green	Drive not configured
Flashing Red	Minor fault - Recoverable fault
Steady Red	Major fault - Unrecoverable fault
Flashing Green / Red	Self-test

COMM	
State	**Indication**
Steady Off	Modbus protocol TX/RX inactive
Steady/flashing Yellow	Modbus protocol TX/RX active

ERROR	
State	**Indication**
Steady Off	Modbus protocol TX/RX Status OK
Steady Red	Non-recoverable internal fault – Modbus communications circuit fault
Flashing Red	Recoverable Communication fault or configuration error

Link Activity LEDs (P1/P2)		
State	**State**	**Indication**
P1 Speed	Steady Yellow	100Mbps link active
	Steady Off	10Mbps or No link
P1 Link Activity	Steady Green	Valid Link
	Steady Off	No Link
	Flash	TX/RX
P2 Speed	Steady Yellow	100Mbps link active
	Steady Off	10Mbps or No link
P2 Link Activity	Steady Green	Valid Link
	Steady Off	No Link
	Flash	TX/RX

9. Modbus TCP

9.1. Overview

The OPT-3-MTPEG-IN device operates as a Modbus TCP to Modbus RTU converter and communicates to the drive using the Modbus RTU protocol. For drives with factory fitted interface, the operating principle remains the same.

9.2. Usage Requirement

- When using the Modbus TCP to control the drive it is necessary to ensure that the amount of data and frequency of data exchange does not exceed the amount of data which can be successfully exchanged on the Modbus sub-network within the permitted time.
- Whilst the Optitools Studio PC software supports communication through the Ethernet network for device commissioning, it is not recommended to use this continuously during operation of the drive as the additional communication load may exceed the limit resulting in loss of Cyclic communication.
  - In this case, connect the PC software to the drive serial port using the USB / RS485 adaptor.
    - Use port D1 or D2 of the external Ethernet adaptor.
    - Use port D1 or D2 of the Compact 2 Ethernet adaptor.
    - Use one of the available ports labelled "IOIOI".
  - Do not connect via Ethernet if data logging is required.

9.3. Operation

9.3.1. Supported Commands

Modbus TCP supported commands and registers are the same as those for Modbus RTU. Refer to sections *4.3. Modbus RTU Configuration Parameter on page 10* to *4.6. Modbus RTU Indirect Parameter Access on page 10* for further information.

9.3.2. IP Address

The default IP address is 192.168.1.253, Subnet Mask 255.255.255.0

IP configuration can be changed using the internal webserver interface.

9.4. Trouble Shooting

9.4.1. Status Indicator LEDs

Refer to *6. Ethernet Connection on page 14* for status LED location information.

Status LED	Function
NS	Ethernet Network Status Indicator
MS	MS: Ethernet/IP Network Status Indicator
COMM	COMM: Modbus Communication Indicator (OPC-2-ETHIG-IN <-> Drive)
ERROR	Modbus Error Indicator (OPC-2-ETHIG-IN <-> Drive)

Network Status (NS) Indicator		
State	**Ethernet/IP**	**Modbus TCP**
Steady Off	Not powered No IP address	Not powered No IP address In EXCEPTION state
Steady Green	Online One or more connections active or message received	At least one Modbus TCP message received
Flashing Green	Online No connections active or no messages received	Online Waiting for first Modbus TCP message
Flashing Red	Connection timeout	Connection timeout No valid Modbus TCP message have been received with in the configures "process active timeout"
Steady Red	Duplicate IP	Duplicate IP Fatal Error
Flashing Green and Red	Self-test	

Module Status (MS) Indicator	
State	**Indication**
Steady Off	No power
Steady Green	Operating in normal condition
Flashing Green	Drive not configured
Flashing Red	Minor fault - Recoverable fault
Steady Red	Major fault - Unrecoverable fault
Flashing Green / Red	Self-test

COMM	
State	**Indication**
Steady Off	Modbus protocol TX/RX inactive
Steady/flashing Yellow	Modbus protocol TX/RX active

ERROR	
State	**Indication**
Steady Off	Modbus protocol TX/RX Status OK
Steady Red	Non-recoverable internal fault – Modbus communications circuit fault
Flashing Red	Recoverable Communication fault or configuration error

Link Activity LEDs (P1/P2)		
State	**State**	**Indication**
P1 Speed	Steady Yellow	100Mbps link active
	Steady Off	10Mbps or No link
P1 Link Activity	Steady Green	Valid Link
	Steady Off	No Link
	Flash	TX/RX
P2 Speed	Steady Yellow	100Mbps link active
	Steady Off	10Mbps or No link
P2 Link Activity	Steady Green	Valid Link
	Steady Off	No Link
	Flash	TX/RX

10. Fieldbus Gateways

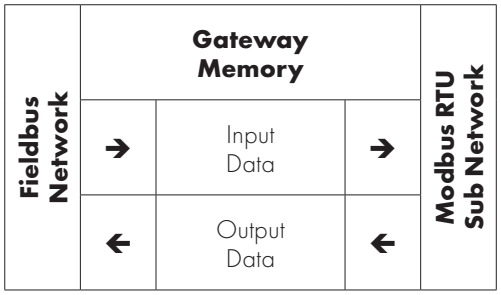
10.1. Gateway Concept

The fieldbus gateway acts as an interface between the Modbus RTU interface and a high-level fieldbus network such as Profibus DP or DeviceNet.

The gateway supports up to 8 drives connected as slaves.

NOTE When ordering the gateway, the number of slaves must be specified to ensure the correct configuration is loaded.

The gateway internally consists of two segments of memory. Data transferred from the fieldbus Master System is written to the first memory area, and the fieldbus Master may Read data from the second memory area.



The fieldbus Master can normally be configured to Read and Write the entire gateway memory area in a single transaction, or separate transaction per drive may be configured. The gateway is the pre-configured by Invertek to carry out the necessary individual Modbus RTU transactions to communicate with the Sub Network of connected drives.

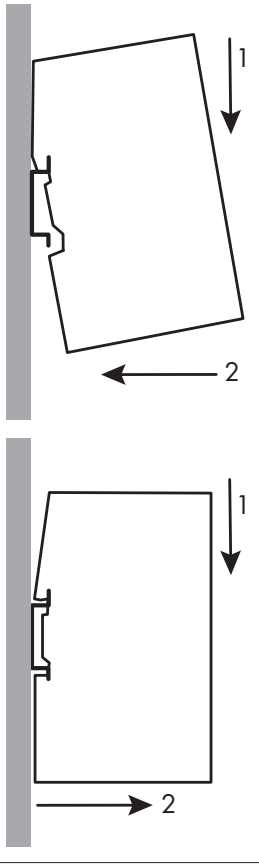
10.2. Gateway Included Components

Each gateway is supplied with the following:

- Anybus Communicator Profibus AB7000 OR Anybus Communicator DeviceNet AB7001.
- Male DB9-RJ45 Blue Subnetwork Connection Cable.

NOTE PROFIBUS / DeviceNet network cable and connector are **not** included.

10.3. Gateway Installation



- Mount the gateway on to the DIN-rail.
- The DIN-rail mechanism works as follows:
  - To snap the gateway on, first press it downwards (1) to compress the spring in the DIN-rail mechanism, then push it against the DIN-rail as to make it snap on (2).
  - To snap the gateway off, push it downwards (1) and pull it out from the DIN-rail (2), as to make it snap off from the DIN-rail.
- Connect the Anybus Communicator to the PROFIBUS-DP / DeviceNet network.
- For Profibus, set the PROFIBUS node ID (see section *10.7.1. Installation on page 51*).
- Connect the gateway to the serial subnetwork using the supplied Blue Male DB9-RJ45 Subnetwork Connection Cable.
- For a network with multiple drives, refer to *10.4.2. Multi Drive Network Example on page 48*.
- Gateways supplied by Invertek drives are pre-configured to operate with 4 connected E3 drives, unless an alternative number is specified when ordering.
- If an alternative number of slaves are required, configuration files to suit between one and 4 slaves may be downloaded from the Invertek Drives website. The user may then load the desired slave configuration to the gateway as follows:
  - Connect the gateway to the PC via the configuration cable.
  - Connect the power cable and apply power.
  - Start the Anybus Configuration Manager program on the PC.
    (The Anybus Configuration Manager software attempts to detect the serial port automatically. If not successful, select the correct port manually in the "Port"-menu).
  - Configure the gateway using the Anybus Configuration Manager and download the relevant configuration to suit the number of connected slave drives.
  - Set up the PROFIBUS communication in accordance with the configuration.

10.4. Subnetwork Connection

The drive sub network connects to the connector on the bottom of the gateway, using the supplied DB9-RJ45 cable. For a single drive installation, the cable can be connected directly from the gateway to the Optidrive. For a network of multiple drives, the network can be easily constructed using suitable RJ45 cables and splitters available from your Invertek Drives Sales Partner.

10.4.1. Single Drive Network Example

The gateway is connected to the drive using the supplied Blue Male DB9-RJ45 Subnetwork Connection Cable.

10.4.2. Multi Drive Network Example

The network can be constructed using firstly the supplied Blue Male DB9-RJ45 Subnetwork Connection Cable, and in addition, RJ45 Splitters (OPT-2-J45SP-IN) and RJ45 cables (0.5m – OPT-2J4505-IN, 1m – OPT-J4510-IN, 3m – OPT-2-J4530-IN). Alternative cables may be used; Invertek recommend using Cat 6 shielded twisted pair cables with pin-to-pin construction.

10.5. Gateway Memory Mapping

The PLC programmer can read/write the PLC memory mapping to gateway memory to monitor/control drives in the sub network.

10.5.1. Input Memory

This part of the memory contains the real-time drive information that can be read by the PLC.

Drive Modbus RTU Address	Data	Start Address	Data Length	Modbus Register (Refer to section 11 for further information)
1	Trip code	0x0000	8 bits	6
	Drive status	0x0001	8 bits	
	Motor speed in Hz	0x0002	16 bits	7
	Motor current	0x0004	16 bits	8
	Not Used	0x0006	16 bits	
2	Trip code	0x0008	8 bits	6
	Drive status	0x0009	8 bits	
	Motor speed in Hz	0x000A	16 bits	7
	Motor current	0x000C	16 bits	8
	Not Used	0x000E	16 bits	
3	Trip code	0x0010	8 bits	6
	Drive status	0x0011	8bits	
	Motor speed in Hz	0x0012	16 bits	7
	Motor current	0x0014	16 bits	8
	Not Used	0x0016	16 bits	
4	Trip code	0x0018	8 bits	6
	Drive status	0x0019	8 bits	
	Motor speed in Hz	0x001A	16 bits	7
	Motor current	0x001C	16 bits	8
	Not Used	0x001E	16 bits	
5	Trip code	0x0020	8 bits	6
	Drive status	0x0021	8 bits	
	Motor speed in Hz	0x0022	16 bits	7
	Motor current	0x0024	16 bits	8
	Not Used	0x0026	16 bits	
6	Trip code	0x0028	8 bits	6
	Drive status	0x0029	8 bits	
	Motor speed in Hz	0x002A	16 bits	7
	Motor current	0x002C	16 bits	8
	Not Used	0x002E	16 bits	
7	Trip code	0x0030	8 bits	6
	Drive status	0x0031	8 bits	
	Motor speed in Hz	0x0032	16 bits	7
	Motor current	0x0034	16 bits	8
	Not Used	0x0036	16 bits	
8	Trip code	0x0038	8 bits	6
	Drive status	0x0039	8 bits	
	Motor speed in Hz	0x003A	16 bits	7
	Motor current	0x003C	16 bits	8
	Not Used	0x003E	16 bits	

10.5.2. Output Memory

This part of the memory contains the real-time drive information that can be read by the PLC.

Drive Modbus RTU Address	Data	Start Address	Data Length	Modbus Register (Refer to section 11 for further information)
1	Control command	0x0200	16 bits	1
	Speed reference in HZ	0x0202	16 bits	2
	No Function	0x0204	16 bits	-
	Ramp Time	0x0206	16 bits	4
2	Control command	0x0208	16 bits	1
	Speed reference in HZ	0x020A	16 bits	2
	No Function	0x020C	16 bits	-
	Ramp Time	0x020E	16 bits	4
3	Control command	0x0210	16 bits	1
	Speed reference in HZ	0x0212	16 bits	2
	No Function	0x0214	16 bits	-
	Ramp Time	0x0216	16 bits	4
4	Control command	0x0210	16 bits	1
	Speed reference in HZ	0x0212	16 bits	2
	No Function	0x0214	16 bits	-
	Ramp Time	0x0216	16 bits	4
5	Control command	0x0220	16 bits	1
	Speed reference in HZ	0x0222	16 bits	2
	No Function	0x0224	16 bits	-
	Ramp Time	0x0226	16 bits	4
6	Control command	0x0228	16 bits	1
	Speed reference in HZ	0x022A	16 bits	2
	No Function	0x022C	16 bits	-
	Ramp Time	0x022E	16 bits	4
7	Control command	0x0230	16 bits	1
	Speed reference in HZ	0x0232	16 bits	2
	No Function	0x0234	16 bits	-
	Ramp Time	0x0236	16 bits	4
8	Control command	0x0230	16 bits	1
	Speed reference in HZ	0x0232	16 bits	2
	No Function	0x0234	16 bits	-
	Ramp Time	0x0236	16 bits	4

10.6. Controlling the Optidrive(s)

The following points should be noted when attempting to control the Optidrive(s):

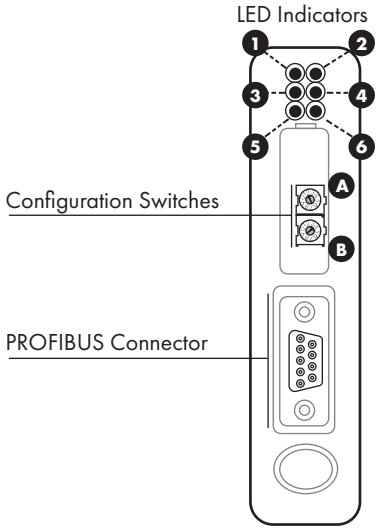
- The drive must be set for Modbus RTU control using P-12.
- Digital Input 1 which acts as a hardware enable must be ON for the drive to start, otherwise the drive will not enable, and the Sub Network Status LED will illuminate Red when the user tries to start the drive.
- The Enable / Run signal is Edge triggered, and so the drive must receive a control word with Bit 0 = 0, followed by a control word with Bit 0 = 1 to start.
- If P-12 = 3 and the user writes any data to the Ramp Time memory area, the gateway will indicate a Sub Network Status error (red flash), as the drive rejects the data which cannot be used.

10.7. Profibus DP Gateway Features – OD-PROFB-IN

- Complete PROFIBUS-DP slave functionality according to IEC 61158.
- Supports all common baud rates up to 12 Mbit (detected automatically).
- Up to 64 bytes of I/O data in each direction, allowing up to 8 Optidrives to be connected to a single gateway.
- Galvanically isolated bus electronics.

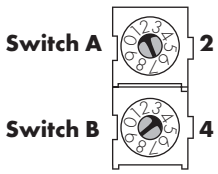
10.7.1. Installation

10.7.1.1. Overview - Module Front



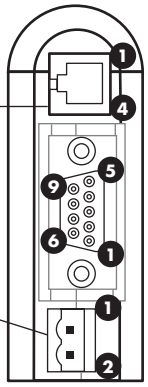
1	Online	Green	Online
		Off	Not Online
2	Offline	Red	Offline
		Off	Not Offline
3	Not Used	-	-
4	Fieldbus Diagnostics	Off	No diagnostics present
		Red, Flashing 1Hz	Configuration Error
		Red, Flashing 2Hz	User parameter data error
		Red, Flashing 4Hz	Initialisation Error
5	Subnet Status	Flashing Green	Running, but one or more transaction errors
		Green	Running
		Red	Transaction error / subnet stopped
6	Device Status	Off	Power Off
		Alternating Red / Green	Invalid / missing configuration
		Green	Initialising
		Flashing Green	Running
		Red	Bootloader Mode
		Flashing Red	Diagnostic Code
A	Set the PROFIBUS node address by using the switches as follows:		
B	Node address = (switch B * 10) + (switch A * 1)		

Example:
Setting node address 42



Bottom View
PC Connector:
1. GND
2. GND
3. RS232 Rx
4. RS232 Tx

Power:
1. +24 V DC
2. GND



DB9	
1	+5V
2	RS232 Rx (Not Used)
3	RS232 Tx (Not Used)
4	NC
5	Signal 0V
6	RS422 Rx+ (Not Used)
7	RS422 Rx- (Not Used)
8	RS485+ Modbus RTU
9	RS485- Modbus RTU

Power	
1	+24VDC, 300mA
2	0V

Profibus Connector	Pin no	Description
5 Female 1 9 6	**1**	Shield
	3	B-line
	4	RTS
	5	GND bus
	6	+5V bus out
	8	A-line
	2, 7, 9	NC

10.7.2. Profibus Master Configuration

The latest applicable GSD file may be downloaded from the HMS website, www.anybus.com.

The actual configuration process will differ for different Profibus Master Systems and is not possible to explain in this document. Example configurations for Siemens PLC are provided on the HMS website.

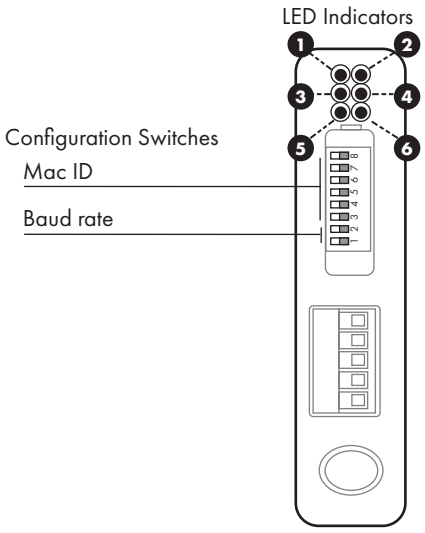
When configuring the communication between the Master System and the gateway, 4 words of Input Process Data and 4 words of Output Process Data should be allocated per drive connected the gateway, up to a maximum of 32 Input and Output words. If necessary, a configuration may be chosen in the Profibus Master which supports more than the connected number of drives, e.g. if 3 drives are connected to the gateway, the Master System can be configured for 12, 16 or even 32 words of Input and Output process data. The additional words will simply not contain any data.

10.8. DeviceNet Gateway Features – OD-DEVNT-IN

- Communications Adapter, profile no. 12
- Group two server
- Mac ID and baud rate configuration via on-board switches
- Polled, Change-of-state and Bit strobed I/O

10.8.1. Installation

10.8.1.1. Overview - Module Front



1	Network Status	Off	Not online
		Green	Link ok, online, connected
		Flashing Green	Online, not connected
		Red	Critical link failure
		Flashing Red	Connection timeout
2	Module Status	Off	No power
		Green	Device operational
		Flashing Green	Data size bigger than configured
		Red	Unrecoverable fault
		Flashing Red	Minor fault
3	Not Used	-	-
4	Not Used	-	-
5	Fieldbus Diagnostics	Flashing Green	Running, but one or more transaction errors
		Green	Running
		Red	Transaction error / subnet stopped
6	Device Status	Off	Power Off
		Alternating Red / Green	Invalid / missing configuration
		Green	Initialising
		Flashing Green	Running
		Red	Bootloader Mode
		Flashing Red	Diagnostic Code

10.8.1.2. Configuration Switches – Baud Rate

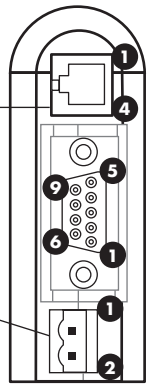
Switch 1	Switch 2	Baud Rate
OFF	OFF	125k
OFF	ON	250k
ON	OFF	500k
ON	ON	N/A

10.8.1.3. Configuration Switches – MAC ID

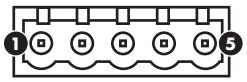
MAC ID	Switch 3	Switch 4	Switch 5	Switch 6	Switch 7	Switch 8
0	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3-62	...	...	...	...	...	...
63	ON	ON	ON	ON	ON	ON

Bottom View
PC Connector:
1. GND
2. GND
3. RS232 Rx
4. RS232 Tx

Power:
1. +24 V DC
2. GND



DB9	
1	+5V
2	RS232 Rx (Not Used)
3	RS232 Tx (Not Used)
4	NC
5	Signal 0V
8	RS485+ Modbus RTU
9	RS485- Modbus RTU
Power	
1	+24VDC, 300mA
2	0V

DeviceNet Connector	Pin no	Description
	**1**	V-
	2	CAN L
	3	Shield
	4	CAN H
	5	V+

10.8.2. DeviceNet Master Configuration

The latest version of the EDS file may be downloaded from the HMS website, www.anybus.com.

The actual configuration process will differ for different DeviceNet Master Systems and is not possible to explain in this document. Example configurations for Rockwell PLC are provided on the HMS website.

When configuring the communication between the Master System and the gateway, 4 words of Input Process Data and 4 words of Output Process Data should be allocated per drive connected the gateway, up to a maximum of 32 Input and Output words. If necessary, a configuration may be chosen in the Master which supports more than the connected number of drives, e.g. if 3 drives are connected to the gateway, the Master System can be configured for 12, 16 or even 32 words of Input and Output process data. The additional words will simply not contain any data.

10.9. Diagnostics and Troubleshooting

Symptom	Suggested Actions
No Communication, Master > Gateway	Check all network cables Check correct bus termination Check correct node address on gateway Check GSD / EDS file is recognised and used by the Master Check the Status LEDs 1 and 2
Profibus Communication OK, Not possible to control the Optidrive(s)	Check the subnetwork Status LED Check all sub network connections Check correct baud rate set in drives Check drives are addressed sequentially from 1 Check that data is written to the correct memory area(s)

11. Control & Status Registers

11.1. Control Registers

When controlling the drive through any fieldbus network it is recommended to use the registers below. These registers support the Modbus RTU Function Code Write Multiple Registers and so all registers can be set in a single transaction greatly speeding up the drive control.

These registers are pre-mapped to the CAN RX PDO1 and are also used in the EDS file for Ethernet/IP communication.

The functions are described more fully in section *11.2. Standard Status Registers on page 55.*

Name	Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper Byte	Lower Byte	Format	Type	Scaling
PDO0	1	2000h	0	Y	-	Control Word		WORD	R/W	See Below
PDO1	2	2001h	0	Y	-	Frequency Setpoint		S16	R/W	1dp, e.g. 100 = 10.0Hz
PDO2	3	2002h	0	Y	-	PID Setpoint, Analog Output		-	R/W	0 – 4096 = 0 – 100%
PDO3	4	2003h	0	Y	-	Ramp Time		U16	R/W	2dp, e.g. 500 = 5.00s

11.1.1. Drive Control Word PDO0

Bit	Function When "0"	Function When "1"
15	No Function Assigned	
14		
13		
12		
11		
10		
9	Digital output OFF	Digital Output ON
8	Relay Output OFF	Relay Output ON
7	No Function Assigned	
6		
5		
4		
3	Operation Permitted	Coast Stop
2	No Action	Reset Active Fault
1	Operation Permitted	Fast Stop
0	Stop	Run

For normal operation, Bit 3 has the highest priority, bit 0 has the lowest priority (bit 3>bit 1>bit 0).

Note that the Run / Stop (bit 0), Fast Stop (bit 1) and Coast Stop (bit 3) only operate under the following conditions:

- Fieldbus control (or CAN) is selected in P-12
- P-31 = 0 or 1

Otherwise, Run / Stop function is controlled by drive control terminals.

Reset function (bit 2) is always active when the drive operates in Fieldbus or CAN mode.

Bits 8 and 9 may optionally be used to control the state of the built in Analog Output in Digital Mode and the Output relay. This function is activated if selected by the relevant parameter:

- Relay Output P-18
- Digital Output, P-25

Refer to the programming Guide for further information.

11.1.2. Frequency Setpoint PDO1

Frequency Setpoint value is transferred with one decimal place (200 = 20.0Hz).

The maximum value is limited by P-01.

Sending a value that exceeds P-01 will result in an Exception error.

11.1.3. PID Setpoint, Analog Output Control PDO2

This word may optionally be used for the following functions:

- To set the setpoint to the PID controller
  - Requires P-44 = 2
  - The value range is 0 – 4096 = 0 – 100.0
  - Values > 4096 are treated as 100.0%
- To directly control the analog output in analog mode
  - Requires P-25 = 13
  - The value range is 0 – 4096 = 0 – 10Volts Output
  - Values > 4096 are treated as 100.0%

11.1.4. Ramp Time PDO3

Active only when P-12 = 8 (CAN) or 4 (All other fieldbus).

This register specifies the drive acceleration and deceleration ramp time. The same value is applied simultaneously to the acceleration and deceleration ramp times.

The value has two decimal places, e.g., 500 = 5.00 seconds.

11.2. Standard Status Registers

When controlling the drive through any fieldbus network the registers below can be used to provide a simple status feedback from the drive.

Registers 6, 7 and 8 are pre-mapped to the first CAN PDO and are also used in the EDS file for Ethernet/IP communication.

The functions are described more fully in section *11.2. Standard Status Registers on page 55.*

Name	Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Type	Scaling
PDI0	6	200Ah	0	Y	-	Error code	Drive status	WORD	R	See Below
PDI1	7	200Bh	0	Y	-	Output Frequency		S16	R	1dp, e.g. 100 = 10.0Hz
PDI2	8	200Dh	0	Y	-	Motor Current		U16	R	1dp, e.g. 100 = 10.0A
PDI3	9	200Eh	0	Y	-	Motor Torque		S16	R	4096 = 100%

11.2.1. Drive status and error code Word PDI0

Bit	Function When "0"	Function When "1"
15	In the event of a trip, the associated code is shown in this byte	
14		
13		
12		
11		
10		
9		
8		
7		
6	Not Ready	Drive Ready
5		
4		
3		
2	-	Drive In Standby Mode
1	Drive OK	Drive Tripped
0	Drive Stopped	Drive Running

Bit 6: Drive Ready to Run is defined as:

- Not tripped.
- Hardware enable signal present (DI1 ON).
- No mains loss condition.

11.3. Extended Status Registers

Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Type	Scaling
2001	-	-	-	-	Status Word 2		WORD	R	See Below
2002	-	-	-	-	Motor Output Speed		S16	R	1dp, e.g. 100 = 10.0Hz
2003	-	-	-	-	Motor Output Current		U16	R	1dp, e.g. 100 = 10.0A
2004	-	-	-	-	Motor Output Power		U16	R	2dp, e.g. 100 = 1.00kW
2005	-	-	-	-	IO Status Word		WORD	R	See Below
2006	-	-	-	-	Motor Output Torque		U16	R	4096 = 100%
2007	-	-	-	P0-08	DC Bus Voltage		U16	R	600 = 600 Volts
2008	-	-	-	P0-09	Heatsink Temperature		S16	R	50 = 50°C
2009	-	-	-	P0-01	Analog Input 1		S16	R	1dp, e.g. 500 = 50.0%
2010	-	-	-	P0-02	Analog Input 2		U16	R	1dp, e.g. 500 = 50.0%
2011	-	-	-	-	Analog Output		U16	R	1dp, e.g. 500 = 50.0%
2012	-	-	-	P0-05	PI Output		U16	R	1dp, e.g. 500 = 50.0%
2013	-	-	-	P0-20	Internal Temperature		S16	R	50 = 50°C
2014	-	-	-	P0-07	Motor Output Voltage		U16	R	200 = 200 Volts RMS
2015	-	-	-	-	IP66 Pot Input value		U16	R	1dp, e.g. 500 = 50.0%
2016	-	-	-	-	Trip Code		U16	R	See Below

11.3.1. Status Word 2 - Register 2001

Status Word 2 provides an optional additional status word which may be used in additional or as an alternative to the status word in register 6. This status word is the first word in a block of 16 registers which may be read using a single "Read Multiple Registers" command enabling an efficient method to transfer important status information.

Bit	Definition	Bit is HIGH under the following conditions:
0	Ready	No trip / fault No mains loss Hardware enable input is present
1	Running	Drive running
2	Tripped	Drive tripped
3	Standby	In Standby Mode
4	Fire Mode	Fire mode is active
5	Reserved	N/A
6	Speed Set-point Reached (At Speed)	Drive is enabled Output Frequency = Set point
7	Below Minimum Speed	Drive is enabled Output Frequency / Speed < P-02
8	Overload	Output current > P-08
9	Mains Loss	Mains power not detected
10	Heatsink > 85°C	Heatsink temperature > 85°C
11	Control Board > 80°C	Control PCB temperature > 80°C
12	Switching Frequency Reduction	PWM switching frequency is reduced from set value
13	Reverse Rotation	Motor rotates is in reverse direction
14	Reserved	N/A
15	Live Toggle Bit	This bit will toggle each time this register is read

11.3.2. IO Status Word - Register 2005

This register provides an extended status indication of drive input and output signal status.

Bit	Definition	Bit is HIGH under the following conditions:
0	DI1 Status	DI1 ON
1	DI2 Status	DI2 ON
2	DI3 Status	DI3 ON
3	DI4 Status	DI4 ON
4, 5	Reserved	N/A
6	IP66 Switch FWD	IP66 FWD Switch FWD (IP66 Switched Drives only)
7	IP66 Switch REV	IP66 FWD Switch REV (IP66 Switched Drives only)
8	Digital Output Status	DO HIGH OR AO > 0 (Terminals 8 & 9)
9	Relay Output Status	Output Relay Closed
10,11	Reserved	N/A
12	Analog Input 1 Signal Lost (4-20mA)	AI1 Signal < 3mA (only with 4 – 20mA signal type selected)
13	Analog Input 2 signal Lost (4-20mA)	AI2 Signal < 3mA (only with 4 – 20mA signal type selected)
13	Reserved	N/A
14	IP66 Pot Input > 50%	IP66 integrated pot > 50% (IP66 Switched Units Only)

11.3.3. Trip Code Register 2016

In the event of a trip, this register returns the trip code number associated. Refer to the parameter list for a list of trip codes.

11.4. Additional Modbus RTU Registers / CAN Index Data – Control & Monitoring

Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Type	Scaling
5	2004h	0	Y	-	High Resolution Frequency Setpoint		S16	R	See Below
10	200Fh	0	Y	-	Motor Power		U16	R	2dp, e.g. 100 = 1.00kW
11	2012h	0	Y	P0-04	Digital Input Status		WORD	R	See Below
12	-	-		P0-20	Rating ID		U16	R	Internal Value
13	-	-		P0-20	Power rating		U16	R	2dp, e.g. 37 = 0.37kW / HP
14	-	-		P0-20	Voltage rating		U16	R	See Below
15	27E8h	0	N	P0-18	IO processor software version		U16	R	2dp, e.g. 300 = 3.00
16	27EAh	0	N	P0-18	Motor control processor software version		U16	R	2dp, e.g. 300 = 3.00
17	-	-		P0-20	Drive type		U16	R	Internal Value
18	201Ch	0	Y	P0-48	Scope Channel 1 Data		S16	R	Internal Format
19	201Dh	0	Y	P0-48	Scope Channel 2 Data		S16	R	Internal Format
-	201Eh	0	Y	P0-49	Scope Channel 3 Data		S16	R	Internal Format
-	201Fh	0	Y	P0-49	Scope Channel 4 Data		S16	R	Internal Format
20	2013h	0	Y	P0-01	Analog 1 input result		U16	R	1dp, e.g. 500 = 50.0%
21	2014h	0	Y	P0-02	Analog 2 input result		U16	R	1dp, e.g. 500 = 50.0%
-	2015h	0	Y	-	Analog Output %		U16	R	1dp, e.g. 500 = 50.0%
22	-	-		P0-03	Pre-Ramp Speed Reference Value		S16	R	1dp, e.g. 500 = 50.0Hz
23	2011h	0	Y	P0-08	DC Bus Voltage		U16	R	600 = 600 Volts
24	-			P0-09	Drive Power Stage Temperature		S16	R	50 = 50°C
-	2043h	0	Y	-	Control board temperature		S16	R	50 = 50°C

Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Type	Scaling
25	-	-		P0-30	Drive Serial Number 4		U16	R	See Below
26	-	-		P0-30	Drive Serial Number 3		U16	R	
27	-	-		P0-30	Drive Serial Number 2		U16	R	
28	-	-		P0-30	Drive Serial Number 1		U16	R	
29	2017h	0	Y	-	Relay Output Status		WORD	R	Bit 0 Indicates Relay Status 1 = Relay Contacts Closed
30	-	-		-	Reserved		-	R	No Function
31	-	-		-	Reserved		-	R	No Function
32	203Ch	0	Y	P0-26	kWh Meter		U16	R	1dp, e.g. 100 = 10.0kWh
33	203Dh	0	Y	P0-26	MWh Meter		U16	R	10 = 10MWh
34	203Eh	0	Y	P0-10	Running Time – Hours		U16	R	1 = 1 Hour
35	203Fh	0	Y	P0-10	Running Time – Minutes & Seconds		U16	R	100 = 100 Seconds
36	2040h	0	Y	P0-14	Run time since last enable – Hours		U16	R	1 = 1 Hour
37	2041h	0	Y	P0-14	Run time since last enable – Minutes & seconds		U16	R	100 = 100 Seconds
38	-	-		-	Reserved		U16	R	No Function
39	2010h	0	Y	P0-20	Internal Drive Temperature		S16	R	20 = 20C
40	2044h	0	Y	-	Speed Reference (Internal Format)		U16	R	3000 = 50Hz
41	-	-		-	Reserved		-	R	No Function
42	2046h	0	Y		Digital Pot / Keypad Reference		U16	R	3000 = 50Hz
43	2048h	0	Y	P0-07	Output Voltage		U16	R	100 = 100 Volts AC RMS
44	-	-		-	Parameter Access Index		U16	R	See Below
45	-	-		-	Parameter Access Value		S16	R	See Below
46	-	-	N	-	Parameter Checksum		U16	R	See Below
-	2049h	0	Y	P0-05	PI Output		U16	R	1000 = 100.0%
-	23E8h	0	N	-	Scope Index 12		RW		
-	23E9h	0	N	-	Scope Index 34		RW		
-	27D0h	0	N	P0-11	Run Time Since Last Trip 1 – Hours		U16	R	1 = 1 Hour
-	27D1h	0	N	P0-11	Run Time Since Last Trip 1 - Seconds		U16	R	100 = 100 Seconds
-	27D2h	0	N	P0-12	Run Time Since Last Trip 2 – Hours		U16	R	1 = 1 Hour
-	27D3h	0	N	P0-12	Run Time Since Last Trip 2 - Seconds		U16	R	100 = 100 Seconds
-	27D4h	0	N	P0-13	Trip Log 2 & 1		WORD	R	
-	27D5h	0	N	P0-13	Trip Log 4 & 3		WORD	R	
-	27D6h	0	N	P0-13	Trip 1 Time – Hours		U16	R	1 = 1 Hour
-	26D7h	0	N	P0-13	Trip 1 Time - Seconds		U16	R	100 = 100 Seconds
-	27D8h	0	N	P0-13	Trip 2 Time – Hours		U16	R	1 = 1 Hour
-	27D9h	0	N	P0-13	Trip 2 Time - Seconds		U16	R	100 = 100 Seconds
-	27DAh	0	N	P0-13	Trip 3 Time – Hours		U16	R	1 = 1 Hour
-	27DBh	0	N	P0-13	Trip 3 Time - Seconds		U16	R	100 = 100 Seconds
-	27DCh	0	N	P0-13	Trip 4 Time – Hours		U16	R	1 = 1 Hour
-	27DDh	0	N	P0-13	Trip 4 Time - Seconds		U16	R	100 = 100 Seconds

Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Type	Scaling
-	27DEh	0	N	P0-23	Time Heatsink > 85℃ – Hours		U16	R	1 = 1 Hour
-	27DFh	0	N	P0-23	Time Heatsink > 85℃ - Seconds		U16	R	100 = 100 Seconds
-	27E0h	0	N	P0-24	Time Internal > 80℃ – Hours		U16	R	1 = 1 Hour
-	27E1h	0	N	P0-24	Time Internal > 80℃ - Seconds		U16	R	100 = 100 Seconds
-	27E2h	0	N	P0-27	Fan Run Time – Hours		U16	R	1 = 1 Hour
-	27E3h	0	N	P0-27	Fan Run Time - Seconds		U16	R	100 = 100 Seconds
-	27E4h	0	N	-	Fire Mode Active Time – Hours		U16	R	1 = 1 Hour
-	27E5h	0	N	-	Fire Mode Active Time - Seconds		U16	R	100 = 100 Seconds
-	27E6h	0	N	-	Power on Time – Hours		U16	R	1 = 1 Hour
-	27E7h	0	N	-	Power on Time - Seconds		U16	R	100 = 100 Seconds
-	27E9h	0	N	P0-28	IO Checksum		WORD	R	
-	27EBh	0	N	P0-28	DSP Checksum		WORD	R	
-	27ECh	0	N	P0-19	Ambient Temperature Log 1		S16	R	50 = 50°C
-	27Edh	0	N	P0-19	Ambient Temperature Log 2		S16	R	50 = 50°C
-	27EEh	0	N	P0-19	Ambient Temperature Log 3		S16	R	50 = 50°C
-	27EFh	0	N	P0-19	Ambient Temperature Log 4		S16	R	50 = 50°C
-	27F0h	0	N	P0-19	Ambient Temperature Log 5		S16	R	50 = 50°C
-	27F1h	0	N	P0-19	Ambient Temperature Log 6		S16	R	50 = 50°C
-	27F2h	0	N	P0-19	Ambient Temperature Log 7		S16	R	50 = 50°C
-	27F3h	0	N	P0-19	Ambient Temperature Log 8		S16	R	50 = 50°C
-	27F4h	0	N	P0-15	DC Bus Voltage Log 1		U16	R	600 = 600 Volts
-	27F5h	0	N	P0-15	DC Bus Voltage Log 2		U16	R	600 = 600 Volts
-	27F6h	0	N	P0-15	DC Bus Voltage Log 3		U16	R	600 = 600 Volts
-	27F7h	0	N	P0-15	DC Bus Voltage Log 4		U16	R	600 = 600 Volts
-	27F8h	0	N	P0-15	DC Bus Voltage Log 5		U16	R	600 = 600 Volts
-	27F9h	0	N	P0-15	DC Bus Voltage Log 6		U16	R	600 = 600 Volts
-	27FAh	0	N	P0-15	DC Bus Voltage Log 7		U16	R	600 = 600 Volts
-	27FBh	0	N	P0-15	DC Bus Voltage Log 8		U16	R	600 = 600 Volts
-	27FCh	0	N	P0-16	Heatsink Temperature Log 1		S16	R	50 = 50°C
-	27FDh	0	N	P0-16	Heatsink Temperature Log 2		S16	R	50 = 50°C
-	27FEh	0	N	P0-16	Heatsink Temperature Log 3		S16	R	50 = 50°C
-	27FFh	0	N	P0-16	Heatsink Temperature Log 4		S16	R	50 = 50°C
-	2800h	0	N	P0-16	Heatsink Temperature Log 5		S16	R	50 = 50°C
-	2801h	0	N	P0-16	Heatsink Temperature Log 6		S16	R	50 = 50°C
-	2802h	0	N	P0-16	Heatsink Temperature Log 7		S16	R	50 = 50°C
-	2803h	0	N	P0-16	Heatsink Temperature Log 8		S16	R	50 = 50°C
-	2804h	0	N	P0-17	Motor Current Log 1		U16	R	1dp, e.g. 100 = 10.0A
-	2805h	0	N	P0-17	Motor Current Log 2		U16	R	1dp, e.g. 100 = 10.0A
-	2806h	0	N	P0-17	Motor Current Log 3		U16	R	1dp, e.g. 100 = 10.0A
-	2807h	0	N	P0-17	Motor Current Log 4		U16	R	1dp, e.g. 100 = 10.0A
-	2808h	0	N	P0-17	Motor Current Log 5		U16	R	1dp, e.g. 100 = 10.0A
-	2809h	0	N	P0-17	Motor Current Log 6		U16	R	1dp, e.g. 100 = 10.0A
-	280Ah	0	N	P0-17	Motor Current Log 7		U16	R	1dp, e.g. 100 = 10.0A
-	280Bh	0	N	P0-17	Motor Current Log 8		U16	R	1dp, e.g. 100 = 10.0A

Modbus RTU Register	CAN Open Index	Sub Index	PDO Map	Parameter Number	Upper byte	Lower Byte	Format	Type	Scaling
-	280Ch	0	N	P0-18	DC Ripple Log 1		U16	R	1 = 1 Volt
-	280Dh	0	N	P0-18	DC Ripple Log 2		U16	R	1 = 1 Volt
	280Eh	0	N	P0-18	DC Ripple Log 3		U16	R	1 = 1 Volt
-	280Fh	0	N	P0-18	DC Ripple Log 4		U16	R	1 = 1 Volt
-	2810h	0	N	P0-18	DC Ripple Log 5		U16	R	1 = 1 Volt
-	2811h	0	N	P0-18	DC Ripple Log 6		U16	R	1 = 1 Volt
-	2812h	0	N	P0-18	DC Ripple Log 7		U16	R	1 = 1 Volt
-	2813h	0	N	P0-18	DC Ripple Log 8		U16	R	1 = 1 Volt
-	2814h	0	N	P0-25	Estimated Rotor Speed		S16	R	
-	2815h	0	N	P0-32	Actual PWM Frequency		U16	R	
-	2816h	0	N	P0-31	Motor Current iD		U16	R	
-	2817h	0	N	P0-31	Motor Current iQ		U16	R	
-	2818h	0	N	P0-33	O-I Trip Counter		U16	R	
-	2819h	0	N	P0-34	O-V Trip Counter		U16	R	
-	281Ah	0	N	P0-35	U-V Trip Counter		U16	R	
-	281Bh	0	N	P0-36	O-T Trip Counter		U16	R	
-	281Ch	0	N	P0-37	bO-I Trip Counter		U16	R	
-	281Dh	0	N	P0-38	O-Heat Trip Counter		U16	R	

11.4.1. High Resolution Speed Reference

This register allows the user to set the speed reference value in the internal format, e.g. 3000 = 50.0Hz. This allows control resolution to 1 RPM with a 2-pole motor. The maximum allowed value is limited by P-01.

Either register 2 or register 5 can be used for speed reference control, however only one reference should be used in any control system, otherwise unexpected behaviour can result.

11.4.2. Scope Channel Data Values

These registers show the scope present data sample value for the first two scope channels. The channel data source selection is carried out through Optitools Studio.

11.4.3. Modbus RTU Registers 25 - 28: Drive Serial Number

The drive serial number may be read using these four registers. The serial number has 11 digits, stored as follows:

Register 28		Register 27				Register 26		Register 25		
x	x	x	x	x	x	x	x	x	x	x

e.g.

Register 25			1								
Register 26			1								
Register 27			8745								
Register 28			57								
Drive Serial Number	5	7	8	7	4	5	0	1	0	0	1

11.4.4. Parameter Checksum Modbus Register 46

A checksum is calculated based on the present value of all user adjustable parameters and stored in Modbus Register 46. This may be read to determine if parameter settings have been adjusted.

12. Technical Data (External Interface)

12.1. Environmental

Ambient Temperature	Storage and Transportation	-40 ... 60°C / -40 ... 140°F	
	Operating	-10 ... 50°C / 14 ... 122°F	UL approved
		40 ... 50°C / 104 ... 122°F	Without UL approval
Altitude	Operating	=<1000m	UL approved
		=<4000m	Without UL approval
Relative Humidity	Operating	< 95%	Non-condensing, frost and moisture free

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