APPLICATION NOTE

TITLE:	**Setup of Digispense® 4000 with PLCs and Gateways**	**AN-101**
		REV B
CATEGORY:	**Controller Interface**	

1. DESCRIPTION

This application note describes how to setup an IVEK Digispense® 4000 (DS4000) for use with PLCs and Gateways. Presently, EtherNet/IP™, PROFINET® and EtherCAT®[1] are the communication interfaces available on the DS4000PM controller. The DS4000BT controller has an HMI and discrete I/O in addition to optional interfaces (e.g., EtherNet/IP, PROFINET, EtherCAT, RS232, etc.). Controllers containing an ethernet-based interface module also contain an HTTP server and an FTP server.

Configuring the DS4000 for an application requires modifying parameters to match the physical system (pump motor type, pump size, etc.) and to create the desired fluidic movement profile (acceleration, discharge rate, etc.). Controlling the DS4000 also requires reading and writing parameters (e.g., to start operations, check status, etc.). The DS4000 has over 200 parameters, many of these require no modification (i.e., the default values are sufficient). Also, the DS4000 has non-volatile memory so changes to most parameters will remain across a power-cycle.

NOTE: Ivek uses the word "parameter(s)" for the data inside of the DS4000 that may be exchanged with other devices such as PLCs and PCs. Some PLC and fieldbus literature also refer to their own parameters. It is important to note that in this document "parameter(s)" almost always refers to a DS4000 parameter. All parameters are listed in the product manual.

There are several ways to modify parameters. On a DS4000BT, the simplest way is by using the HMI; on a DS4000PM, by using the web pages or fieldbus. When using a fieldbus, such as: EtherNet/IP, PROFINET, or EtherCAT; accessing the parameters is accomplished via cyclic (implicit) data exchange or acyclic (explicit) data exchange (e.g. MSG functions). Some PLC development systems provide an extra mechanism to modify parameters (e.g., the Parameter Tab of the Module Properties window in Studio 5000®). ***Not all parameters are available via cyclic data exchange; only those parameters that are important for real-time control (e.g., commands and status).***

There are trade-offs in choosing which method to use to modify parameters. The simpler methods (e.g., HMI, web pages) reduce development time, but make device replacement more difficult due to the need to manually configure a replacement controller. The more complex methods (e.g., acyclic exchange, MSG functions), require extra development time, but allow the PLC software to verify that parameters are configured to desired values before initiating pumping operations. Often, the simpler methods are used during the beginning stages of a project as the fluidic parameters are being determined and as the PLC engineer is getting familiar with the controller. The more complex methods are then employed as the PLC application matures and verification of parameters is desired.

[1] EtherCAT® is a registered trademark and patented technology, license by Beckhoff Automation GmbH, Germany.

2. ACCESSING THE DS4000 USING ROCKWELL STUDIO 5000

Studio 5000 is the development environment for Rockwell PLCs. Accessing the DS4000 requires installing it's EDS file into Studio 5000. The EDS file provides information for Studio 5000 to automatically create Module Defined Data Types and Controller Tags upon addition of a DS4000 to a project. ***This reduces the need to create custom User Defined Data Types (UDTs), Add-on Profiles (AOPs), and Tags for programming with the DS4000***.

The following instructions describe how to install the DS4000 in a Studio 5000 project and how to modify parameters via the Parameters tab, the MSG block and the Cyclical I/O Controller Tags. These instructions were generated using an Allen-Bradley CompactLogix™ 5380 (5069-L306ER), an IVEK Digispense 4000, and Rockwell Automation Studio 5000 Logix Designer (version 34.01.00). ***NOTE: the Customer Example was developed using DS4000PM v2.3. A newer version of DS4000PM or a DS4000BT may be used by updating/installing the proper EDS file.***

2.1. Adding the EDS File

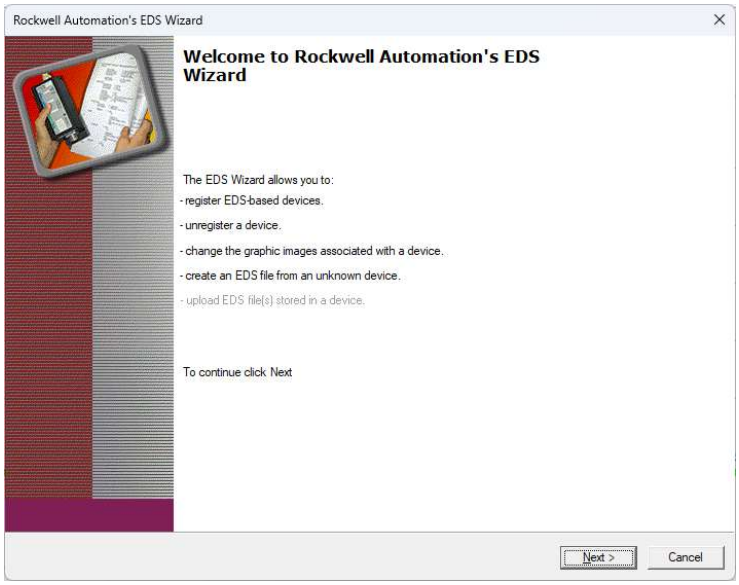
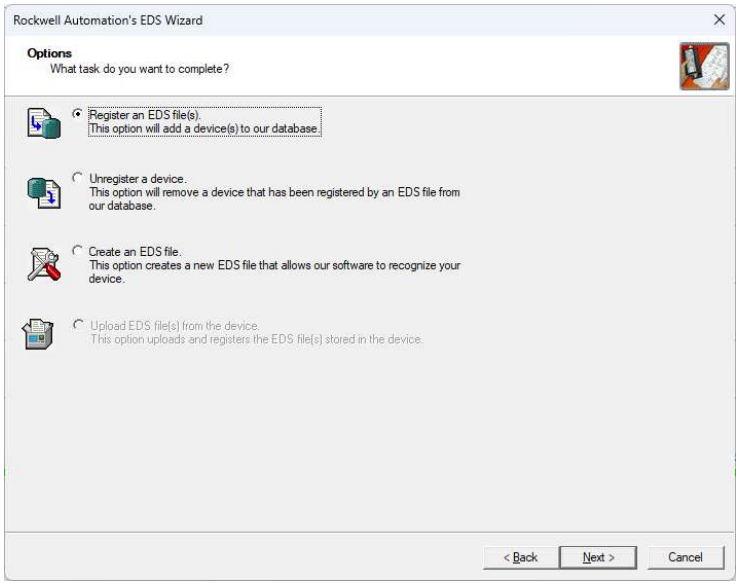
The EDS file and icon (Ivek.ico) for the DS4000 must be imported into Studio 5000 using the EDS import wizard. If upgrading the EDS file from a previous version, the previous version must first be uninstalled (see section 2.2).

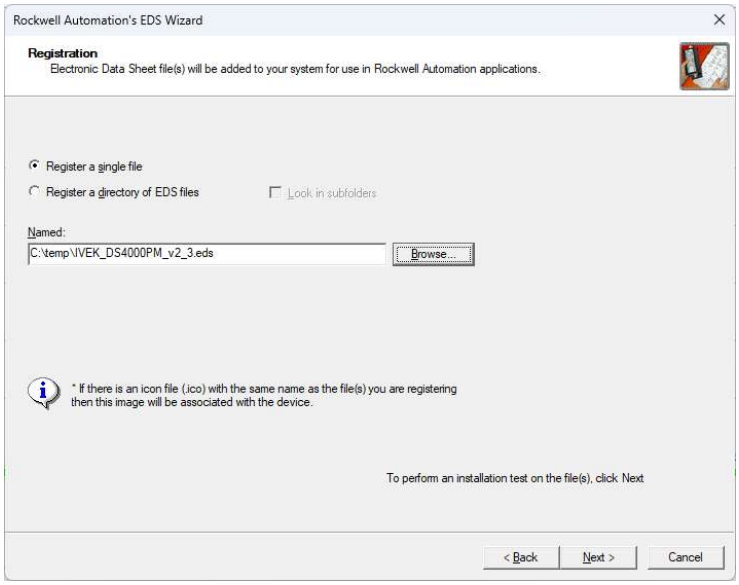
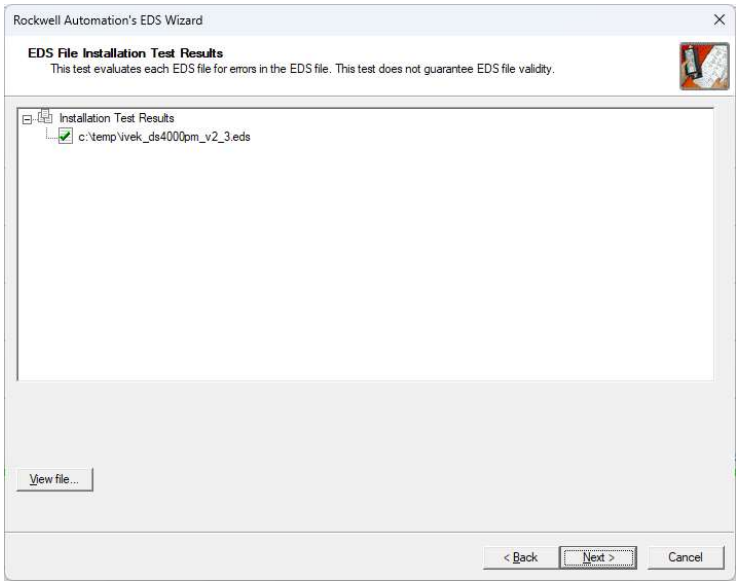
The EDS file is located on the file system of the DS4000 (a zipped file contains the EDS files and the IVEK icon file). A hyperlink to the file exists on the DS4000's web pages (Help->Manuals). Alternatively, FTP may be used to access the file (see section 5.3). The latest EDS file is also located on the IVEK website (https://www.ivek.com/manuals.html).

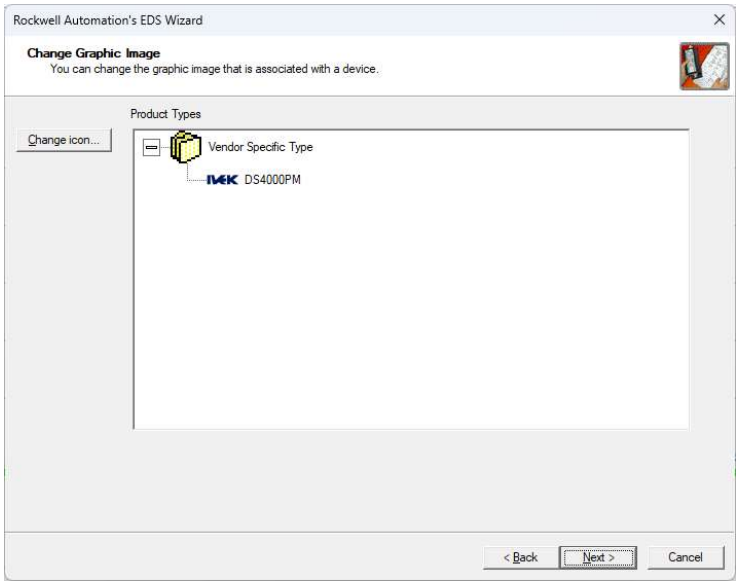
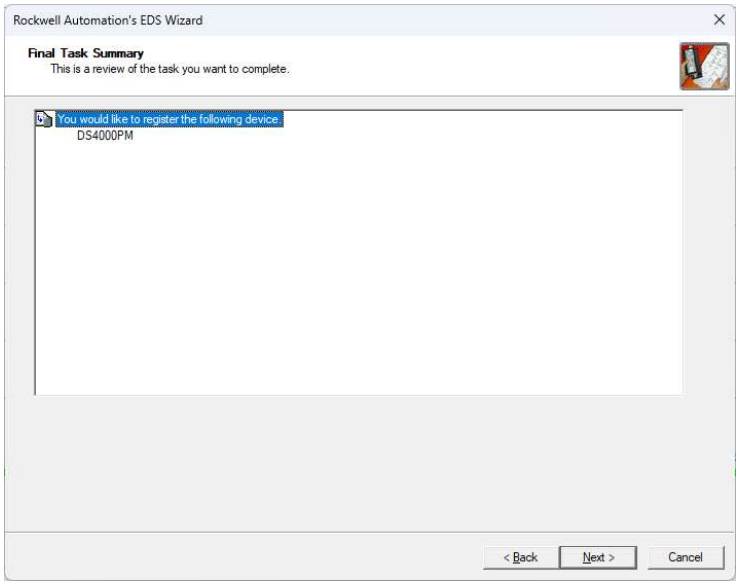
Make sure the installed EDS is the correct version for the specific DS4000 firmware version.

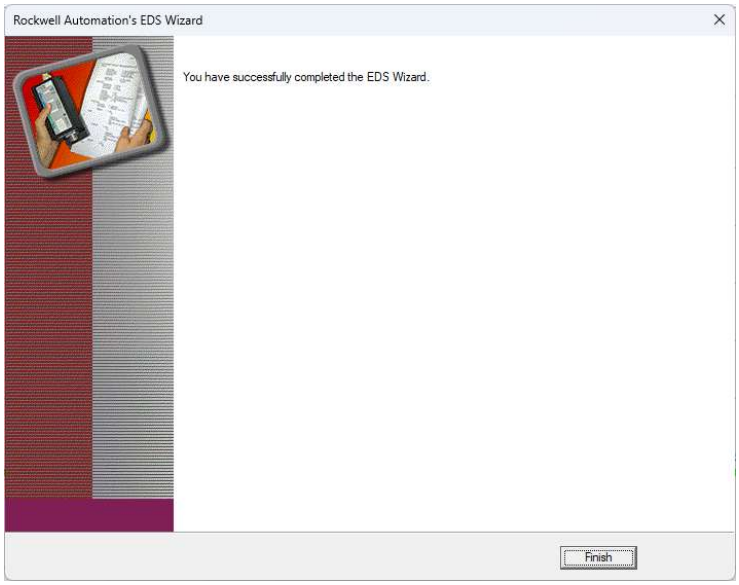
Firmware Version	EDS File
560010-0101	05F1002B00010103.eds, v1.03
560010-0102	05F1002B00010103.eds, v1.03
560010-0201	05F1002B00010201.eds, v2.01
560010-0202	05F1002B00010202.eds, v2.02
560010-0203	05F1002B00010203.eds, v2.03 (DS4000PM) or 05F1002B00030203.eds, v2.03 (DS4000BT)
560010-0204	05F1002B00010204.eds, v2.04 (DS4000PM) or 05F1002B00030204.eds, v2.04 (DS4000BT)

Note: ***if the DS4000 is in Bootloader mode, the DS4000 appears as a different device. Also, it is not certified as an EtherNet/IP device in this mode, so removal from an existing EtherNet/IP network is recommended. The EDS file, 05F1002B00040102.eds, is provided in case the PLC needs to connect to the DS4000 in bootloader mode. However, connection by a PLC is not necessary in order to access web pages and perform FTP transfers*.**

Instruction	Image
Start the EDS Wizard. Press the Next button.	
Select “Register an EDS file(s)” and press the Next button.	

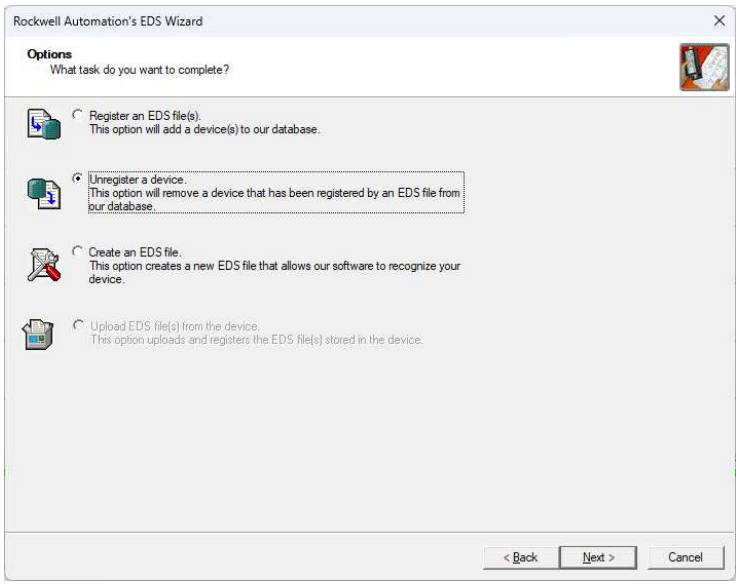
Select “Register a single file” and browse for the EDS file. Press the Next button to start installation of the EDS file.	
Verify that the EDS file was successfully installed. Press the Next button.	

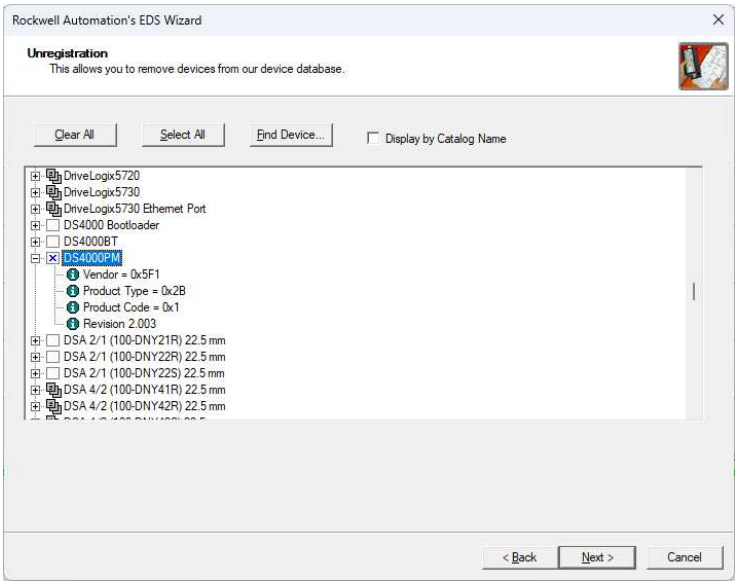
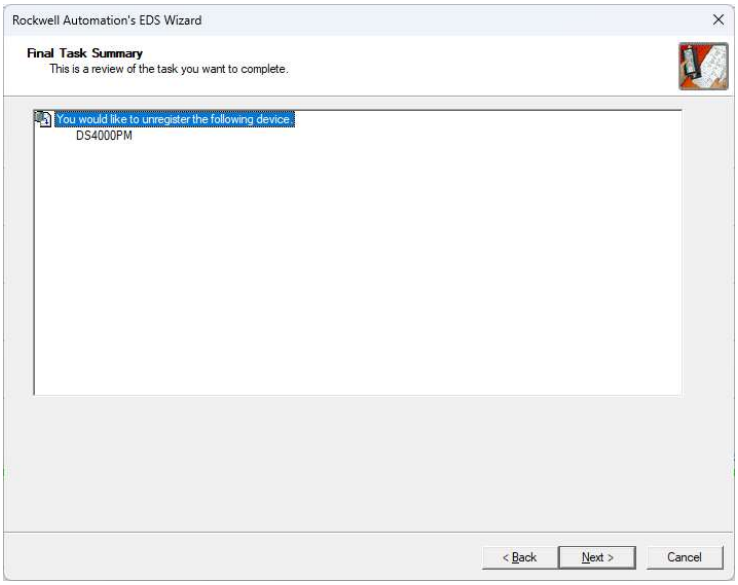
Verify that the IVEK icon is shown and then press the Next button.	
Verify that the DS4000 is the device to register and press the Next button to register the device.	

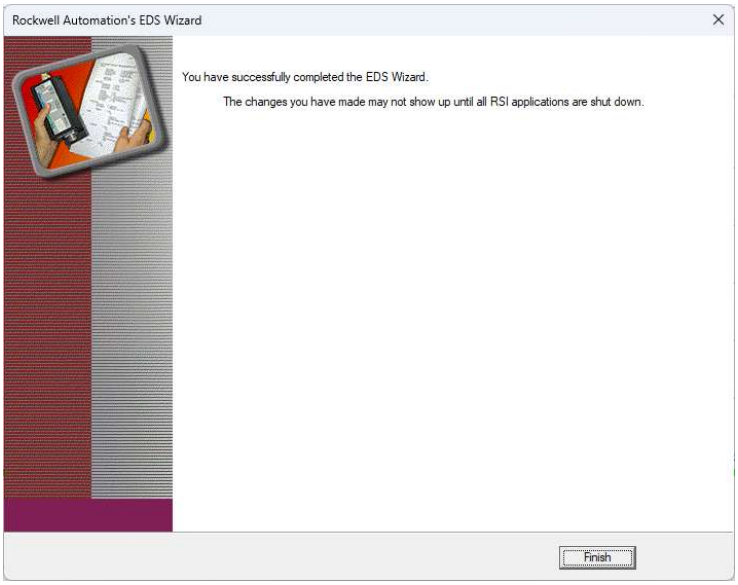
Verify that the EDS Wizard completed successfully. Press the Finish button.	

2.2. Removing an EDS file (for upgrading purposes)

When upgrading an EDS file, it is best to first remove the previous EDS file from Studio 5000 using the EDS Wizard. After removing the previous version of the EDS file using the instructions listed below, install the new version using the instructions per section 2.1.

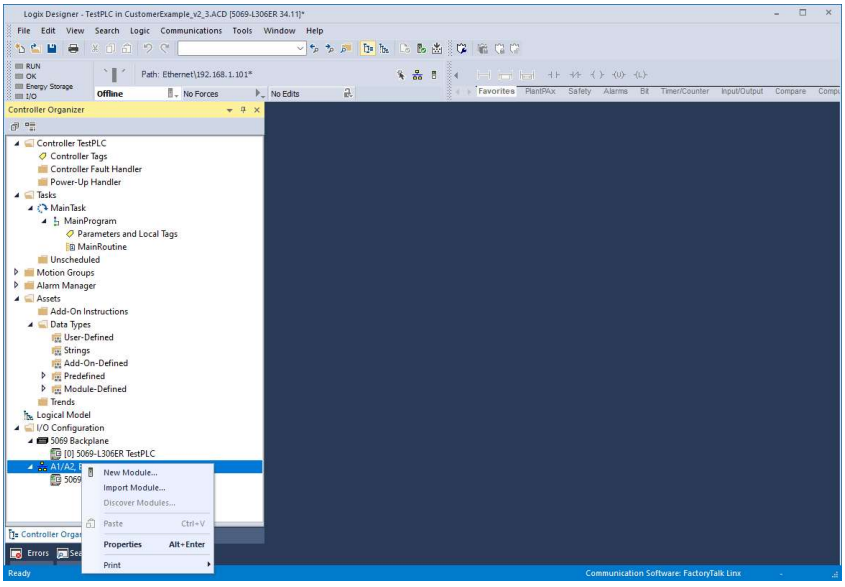
Instruction	Image
Start the EDS Wizard. Select "Unregister a device" and press the Next button.	

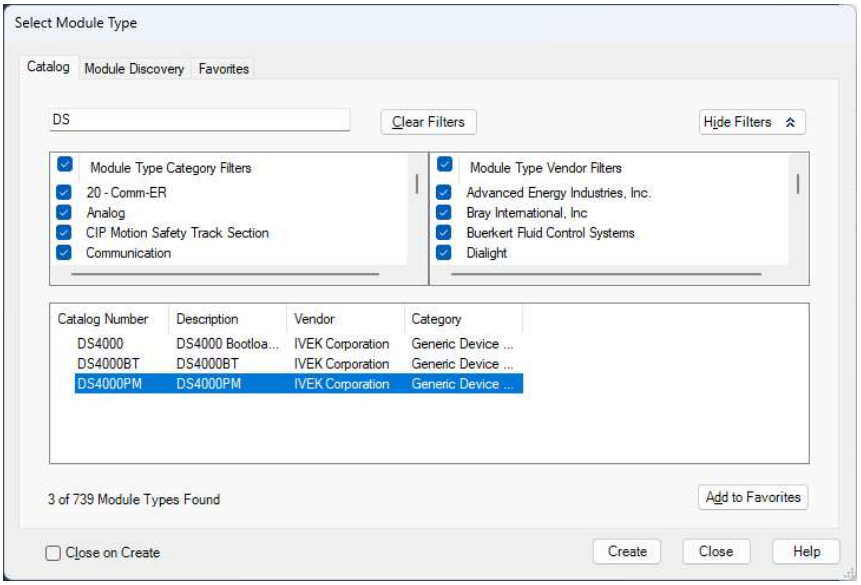
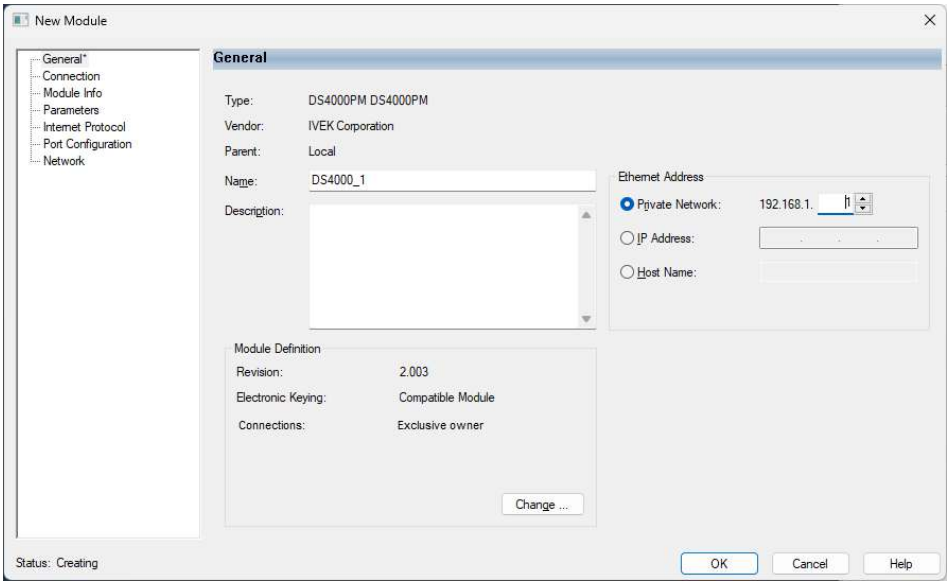
Search through the list of devices and select “DS4000”. Press the Next button.	
Verify the DS4000 is the device to be unregistered. Press the Next button.	

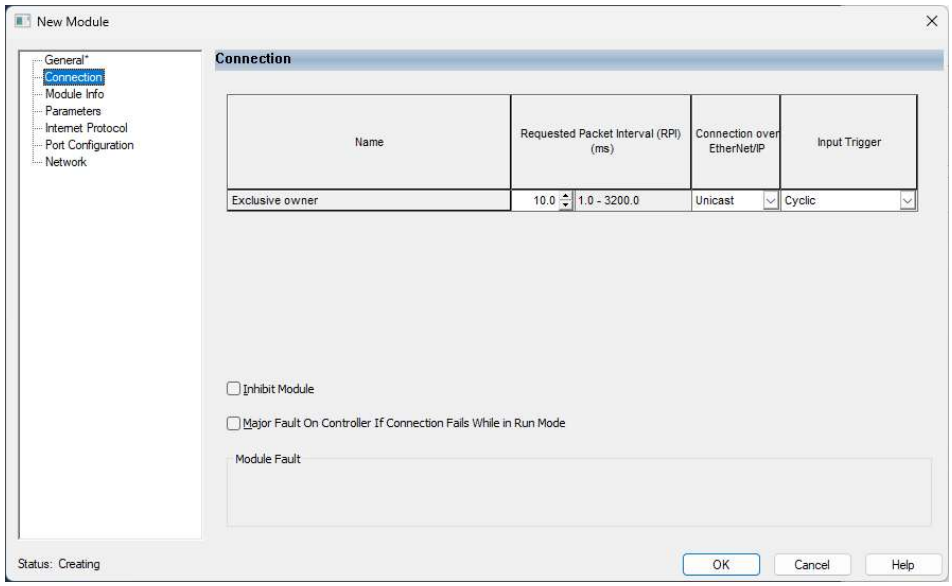
Verify the removal of the DS4000 EDS file was successful. Press the Finish button.	

2.3. Adding the DS4000 to a Project

After installing the EDS file of the DS4000 using the EDS Wizard, the DS4000 is available for addition to a project in Studio 5000. The following instructions show how to add a DS4000.

Instruction	**Image**
Select the Ethernet port to which the DS4000 is connected. Select the “New Module” option from the popup menu.	

Select “DS4000PM” or “DS4000BT” from the catalog and press the Create button. The Module Properties window should open automatically.	
Select the General tab and provide a Name for the DS4000. Configure the Ethernet address for the device. **NOTE: the DS4000 is configured from the factory to have DHCP enabled so you may need to use IPConfig (see section 5.1) to disable DHCP and configure a static IP address.**	

Select the Connection tab and verify the settings. Adjust any settings for the specific application. Press the OK button, then press the Close button on the Select Module Type window. Verify the DS4000 module appears in the project.	

2.4. Using Cyclical I/O Controller Tags

Controller Tags and Module-Defined Data Types for the I/O data are automatically created when the DS4000 is added to the project (i.e., it is not necessary to manually map the number of bytes to exchange – though that information is contained in section 6). The Controller Tags contain several parameters that are useful for real-time control of the pumping operations. There are Tags available in the Input direction, and separate Tags available in the Output direction. Detailed information about each of the parameters contained in the I/O Controller Tags is available in the DS4000 product manual.

Not all parameters are available as I/O Controller Tags, only the subset necessary for real-time control of the pumping operations. The Cyclical I/O Controller Tags are exchanged between the PLC and the DS4000 using implicit messages on the EtherNet/IP network.

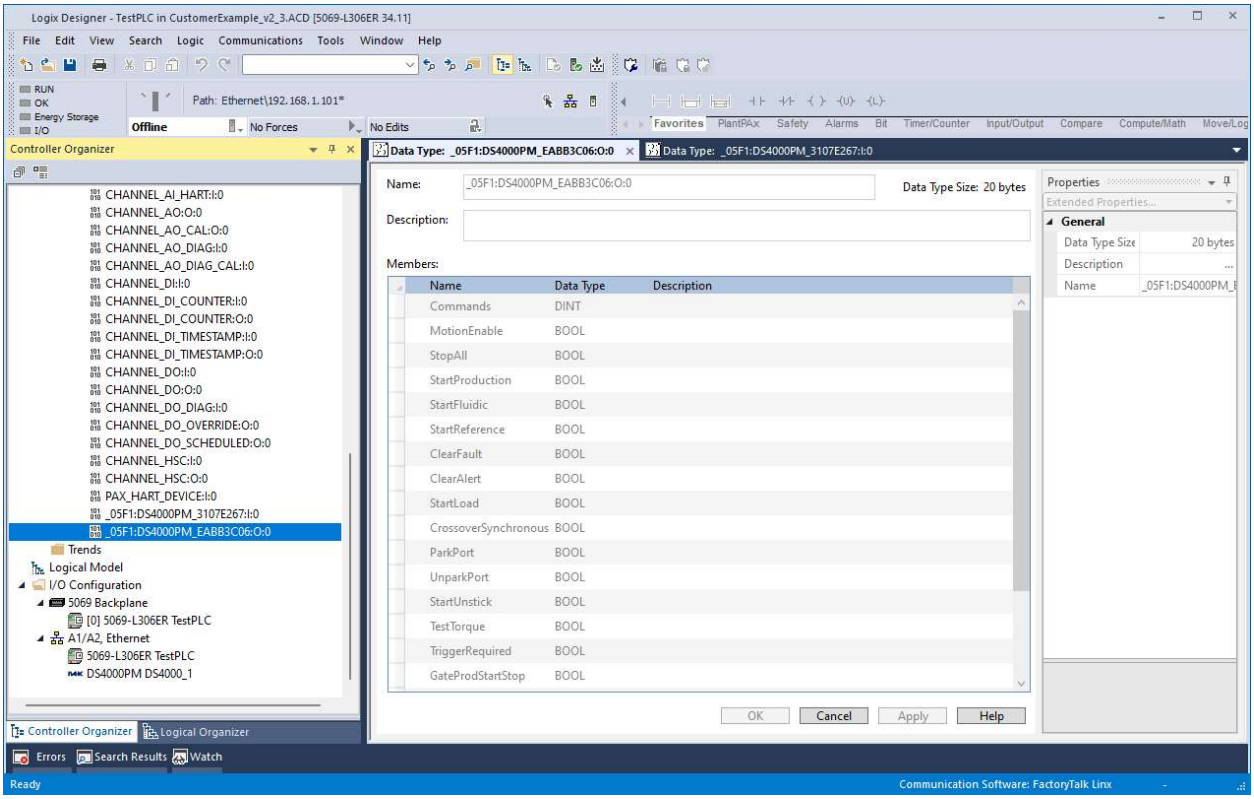


Figure 1, Module-Defined Data Type created automatically when EDS installed (Output)

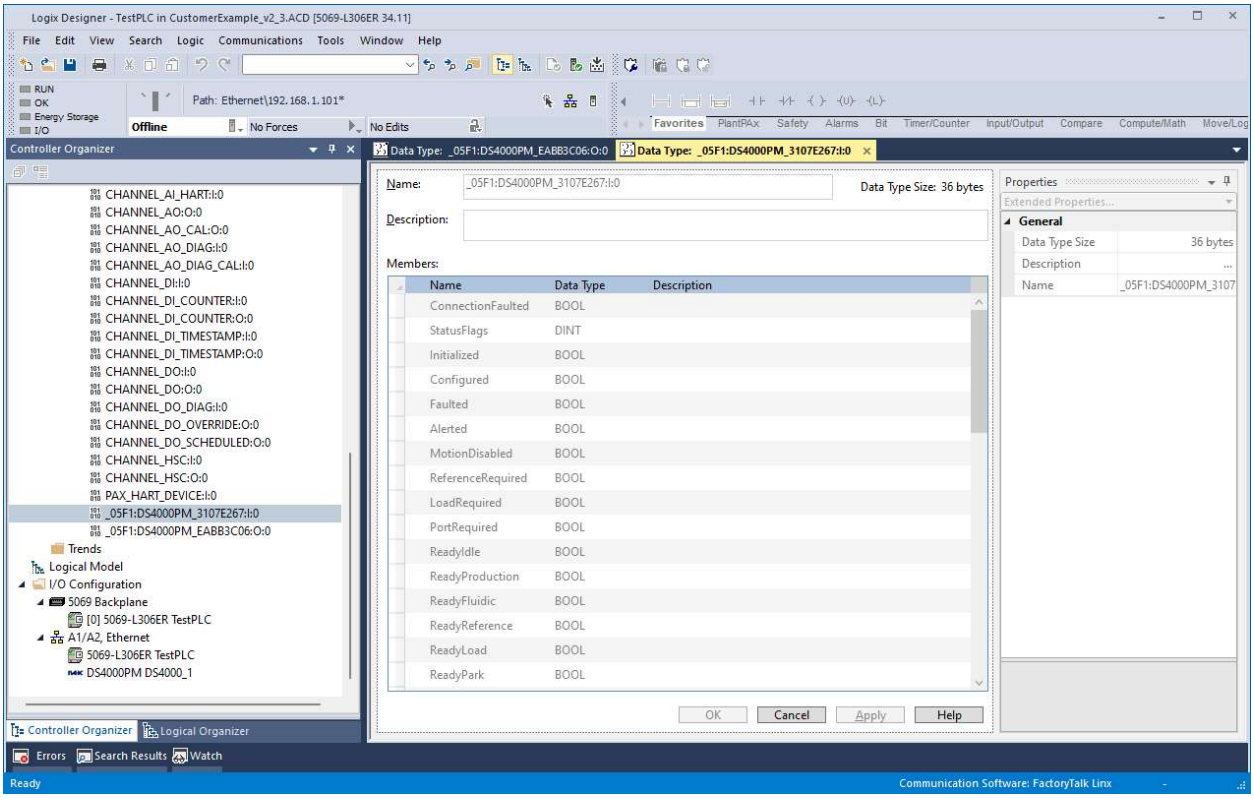


Figure 2, Module-Defined Data Type created automatically when EDS installed (Input)

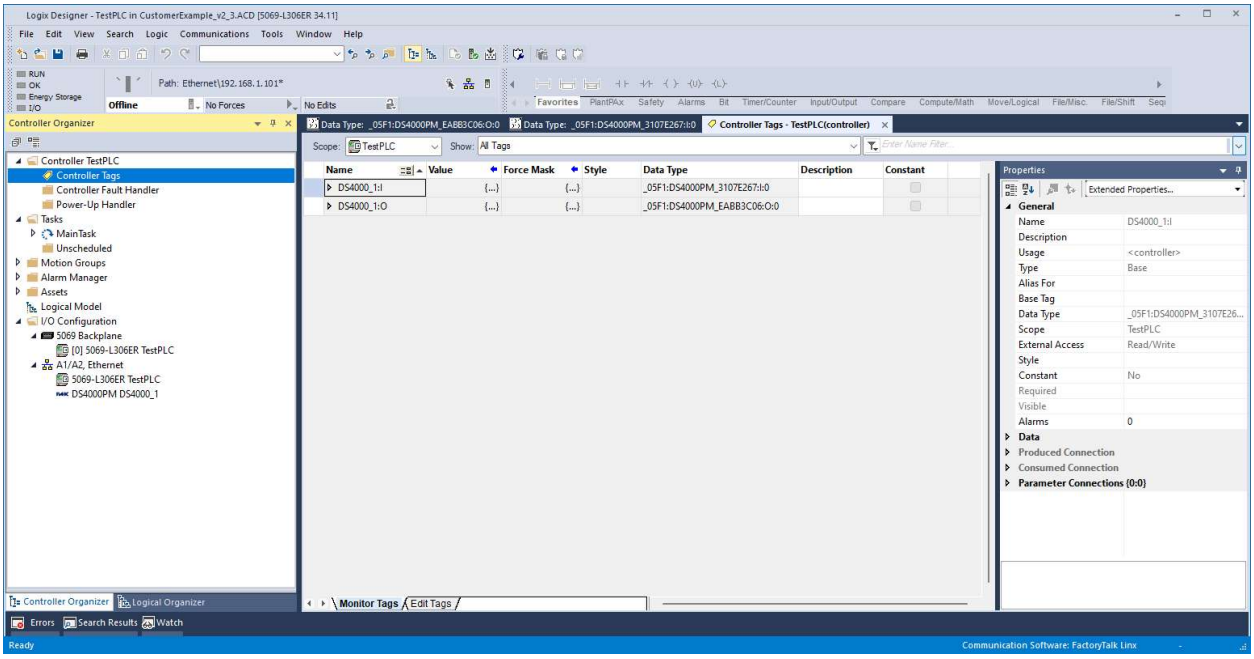


Figure 3, Cyclical I/O Controller Tags created automatically when EDS installed

2.5. Viewing Module Parameters

Though only a some of the parameters are available in the Cyclical I/O Controller Tags, all DS4000 parameters are available in the Parameters tab of the Module Properties window. When connected online to the PLC, the values are displayed and are modifiable.

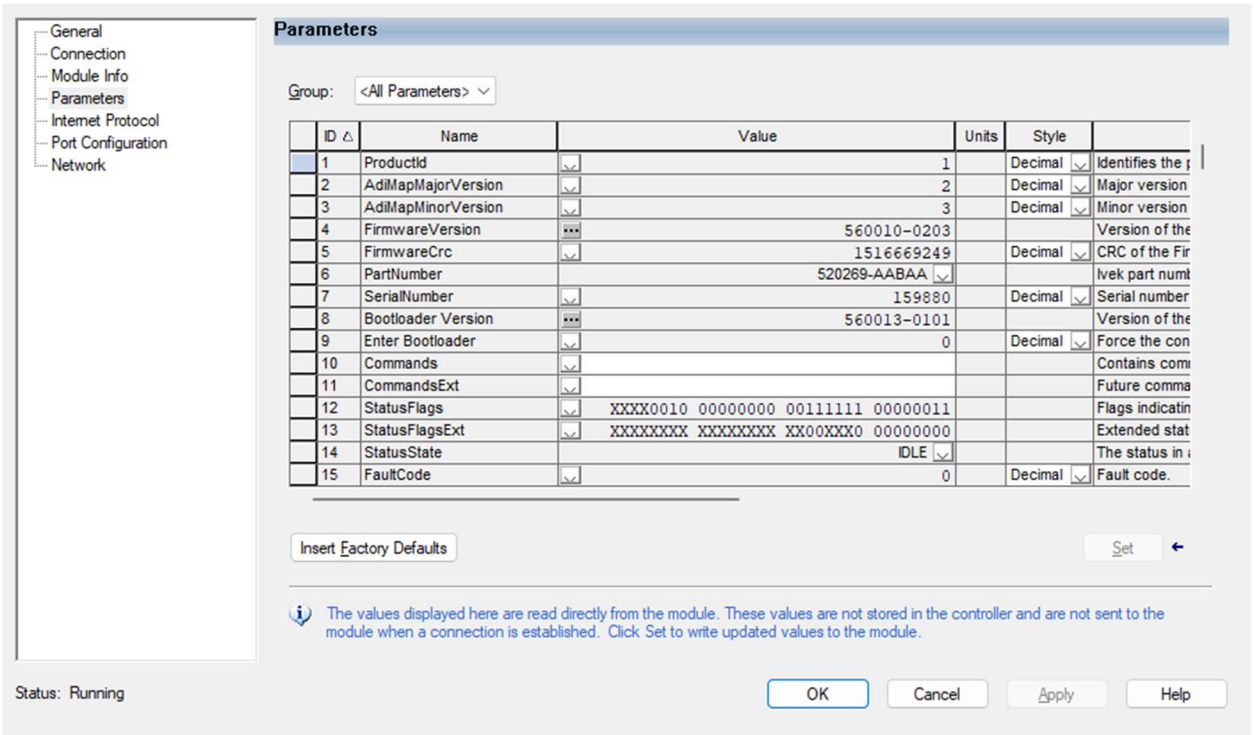
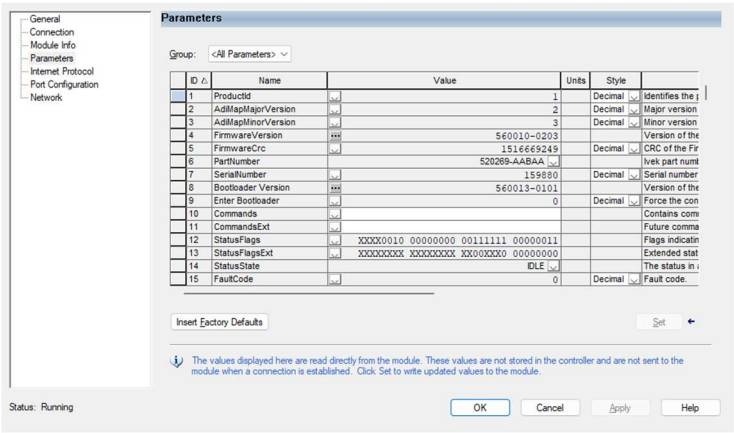
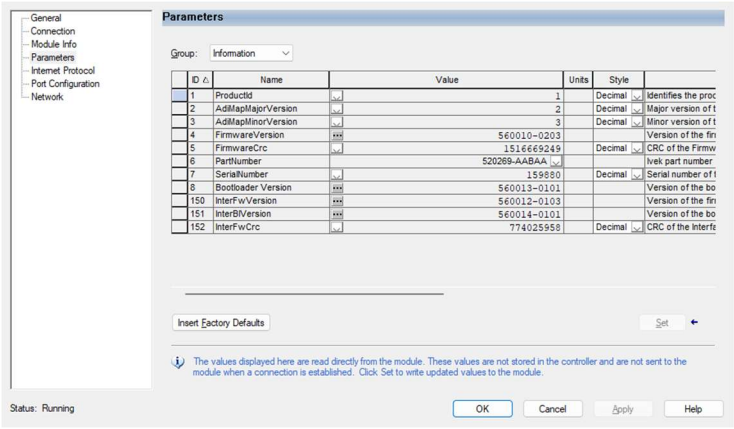


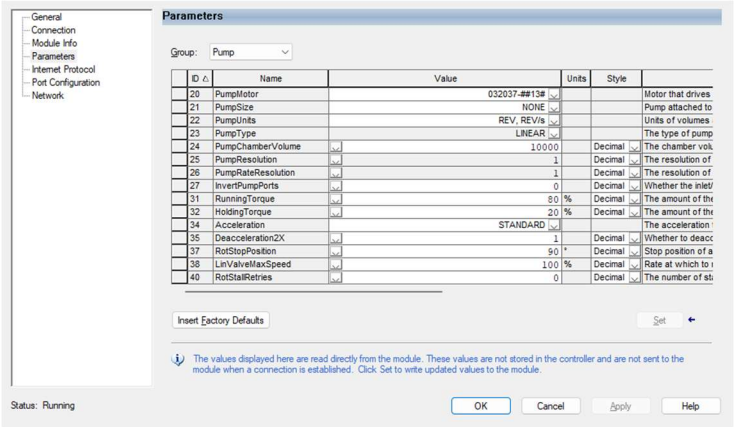
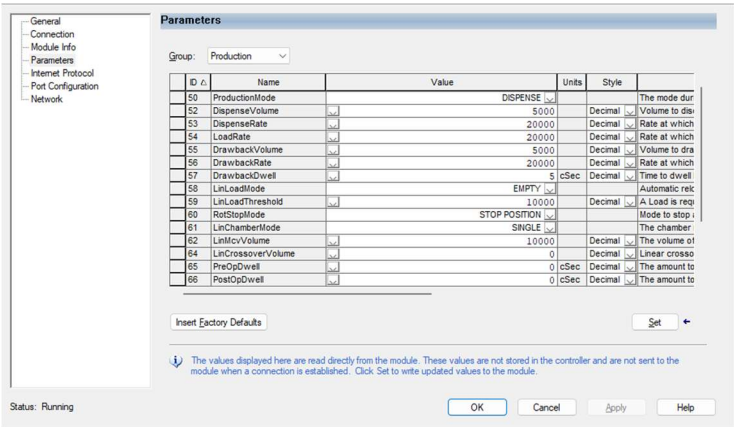
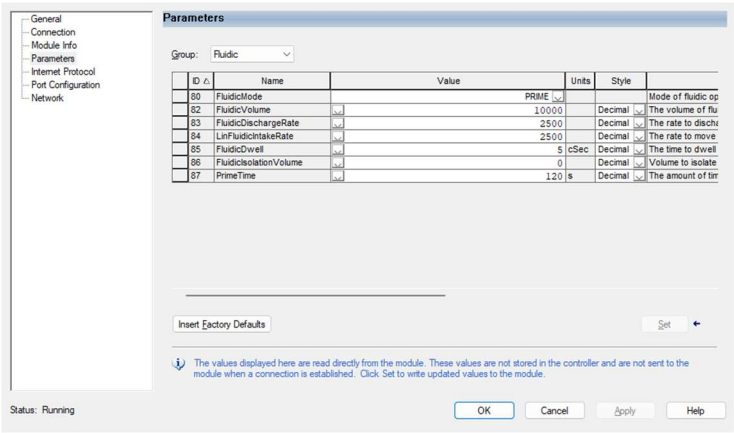
Figure 4, Accessing parameters using the Parameter tab within Studio 5000

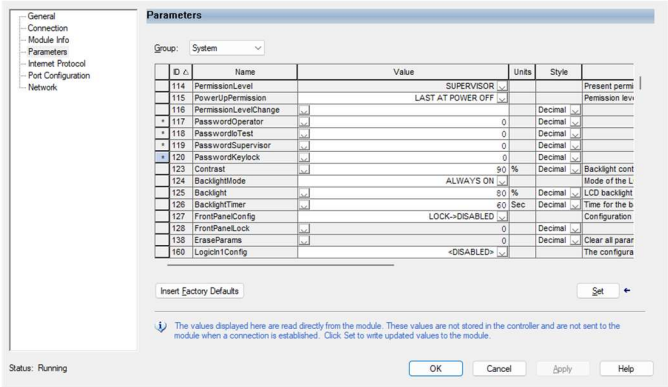
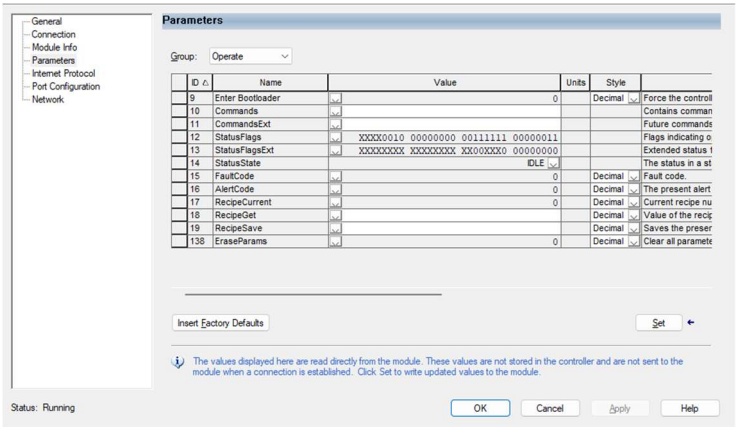
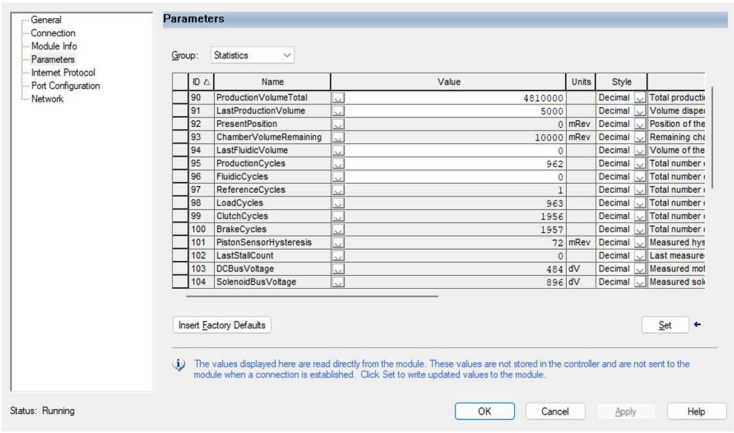
Modifying values using the Parameters tab will modify the parameter value in the controller immediately. Due to the non-volatile nature of most parameters, modifications made to the parameters will be retained by the controller, even through a power-cycle. There are a few exceptions to this as some parameters are volatile (e.g., command and status parameters).

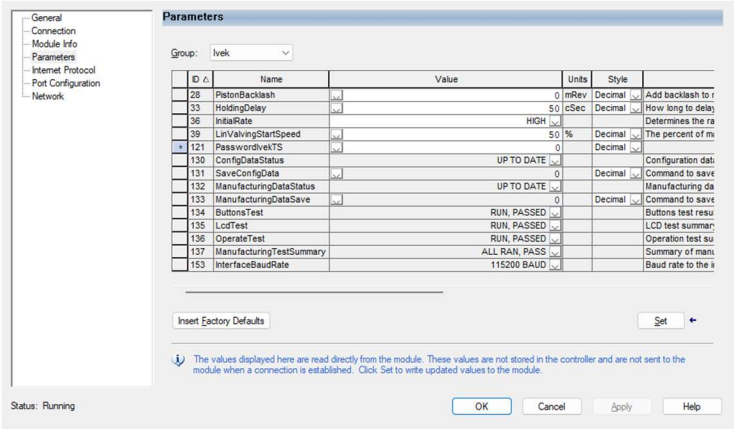
The Parameter tab contains a “Group” setting that allows groups of Parameters to be shown together according to categories defined by IVEK. The categories attempt to organize parameters in a way that indicate the way in which their values influence the system. The IVEK defined groups include: Information, Pump, Production, Fluidic, System, Operate, Statistics, and IVEK. Note that the entire list of parameters available on the DS4000 is available by selecting the “<All Parameters>” group.

The groups of parameters are listed in the table below.

Group	**Example**
<All Parameters> This is the default setting when opening the Parameters tab. All of the IVEK defined Parameters are available. **NOTE: when the DS4000 is offline, the “Value” fields will not be available.**	
Information General information pertaining to the DS4000. These parameters are generally read-only.	

<u>Pump</u> Parameters that relate to the Pump attached to the DS4000. Generally, these are only modified when the pump attached to the unit is changed. Some of these parameters do impact the fluidic profile of pumping operations (e.g., acceleration).	
<u>Production</u> Parameters that relate to the Production Mode pumping operations.	
<u>Fluidic</u> Parameters that relate to the Fluidic Setup Mode pumping operations.	

<u>System</u> Parameters that relate to the overall system settings of the controller. These are not typically related to pumping operations but rather things like I/O and security.	
<u>Operate</u> Parameters that relate to initiating pumping operations and monitoring operational status. Most of these parameters are also available as Cyclic I/O Tag data.	
<u>Statistics</u> Statistics that relate both to pumping operations and also the overall system/controller.	

IVEK These are for use by IVEK during factory setup or Technical Service troubleshooting.	

2.6. Accessing Parameters using MSG Function Block

The MSG function block may be used by the PLC software to access parameters that need to be modified or read during runtime, if they are not available in the cyclic I/O Tags. All parameters reside in the CIP Parameter Object class which is a standard object in the CIP specification.

The MSG function must contain the following:

- Message Type: select CIP Generic.
- Service Type: for reading parameters select “Parameter Read; for writing parameters select “Parameter Write”. Selecting one of these Service Types will automatically populate Service Code, Class, and Attributes with the proper values.
- Service Code: “e” hex for Get Attribute Single, “10” hex for Set Attribute Single (populated automatically went Parameter Read or Parameter Write selected for Service Type).
- Class: “f” hex which is the value for the CIP Parameter Object class (populated automatically when Parameter Read or Parameter Write selected for Service Type).
- Instance: enter the parameter ID (decimal) for the desired parameter (see DS4000 product manual or the web pages for the parameter ID for each parameter).
- Attribute: “1” decimal for the Value attribute (populated automatically when Paramater Read or Parameter Write selected for Service Type). Other attributes are available as “A” hex for Minimum Value, “B” hex for Maximum Value, and “C” hex for Default Value – see the CIP specification for more information.

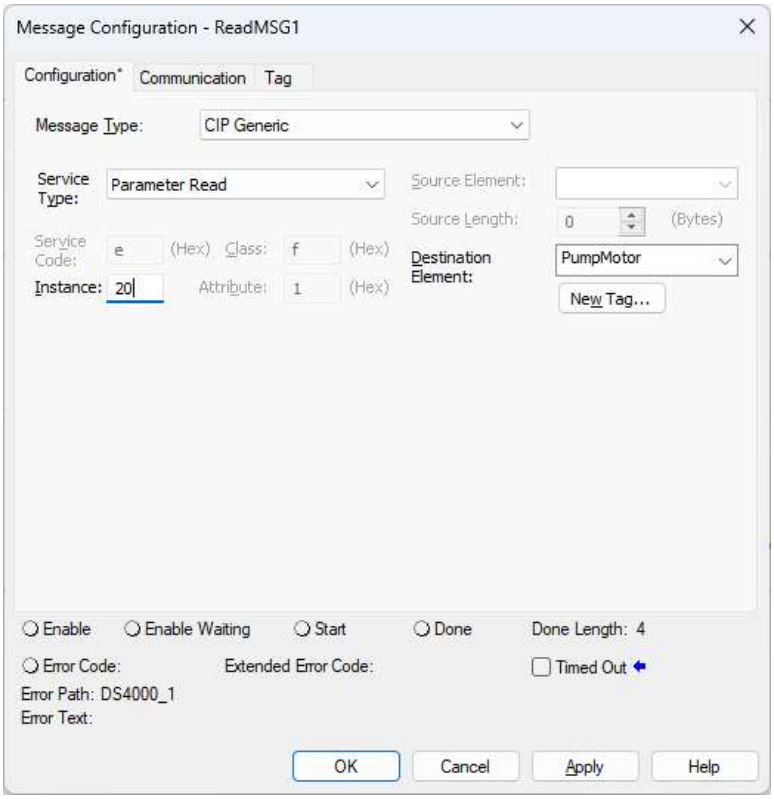


Figure 5, Parameter Read command

2.7. Starting with the Example Project

An example project, using Ladder Logic, is located on the on the IVEK website (https://www.ivek.com/manuals.html).

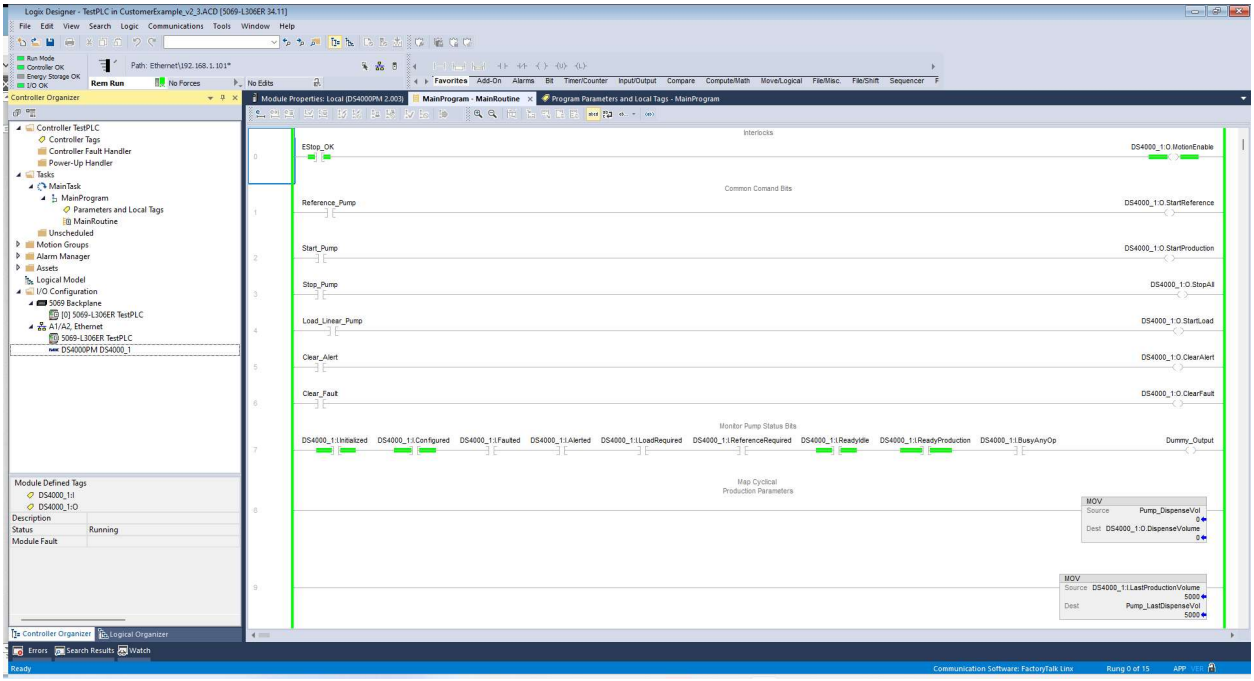


Figure 6, Example Ladder Logic program

3. ACCESSING THE DS4000 USING SIEMENS TIA PORTAL

TIA Portal® is a development environment for Siemens PLCs. Accessing the DS4000 requires installing a GSD (GSDML) file into the workspace. The GSD file provides TIA Portal with the information needed to communicate with the DS4000 device.

The following instructions describe how to install the DS4000 in a TIA Portal project and how to read and modify parameters via cyclic I/O data exchange, and also via acyclic Read Data Record and Write Data Record services. These instructions were generated using an IVEK Digispense 4000, TIA Portal V19 and a SIMATIC S7-1200 PLC.

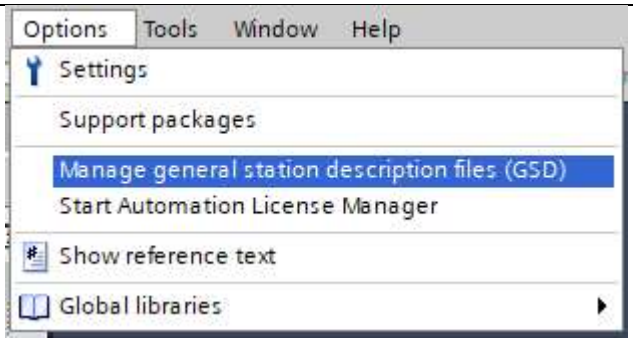
3.1. Adding the GSD file

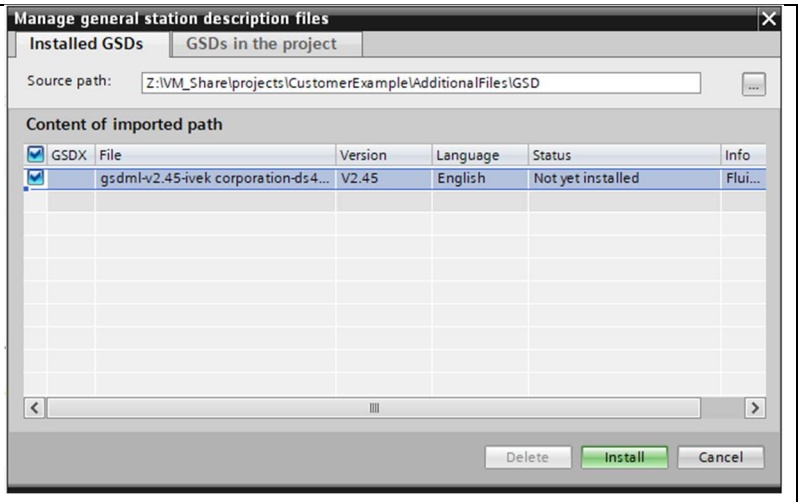
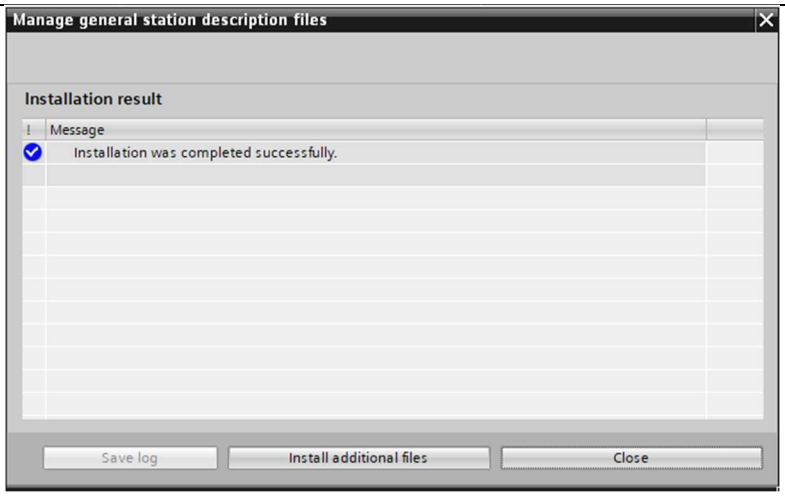
The GSD file (e.g., GSDML-V2.45-IVEK Corporation-DS4000PM-20241107.xml) for the DS4000 must be imported into TIA Portal. The GSD file is located on the IVEK website (https://ivek.com/manuals.html).

Make sure the installed GSD is the correct version for the specific DS4000 firmware version.

Firmware Version	GSD File
560010-0101	Not supported
560010-0102	Not supported
560010-0201	Not supported
560010-0202	Not supported
560010-0203	Not supported
560010-0204	GSDML-V2.45-IVEK Corporation-DS4000-20241206.xml

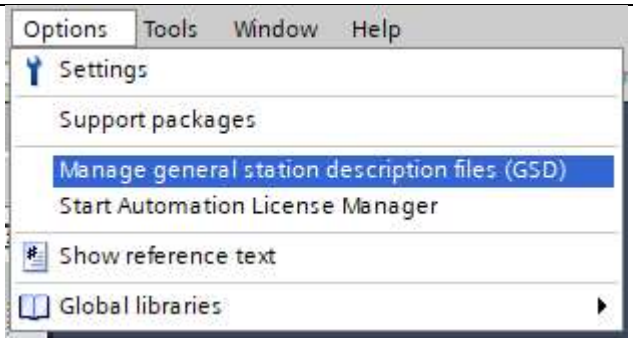
Note: ***if the DS4000 is in Bootloader mode, the DS4000 appears as a different device. Also, it is not certified as a PROFINET device in this mode, so removal from an existing PROFINET network is recommended. The GSD file does not contain the information necessary to connect a PLC to the DS4000 in bootloader mode. However, connection by a PLC is not necessary in order to access web pages and perform FTP transfers*.**

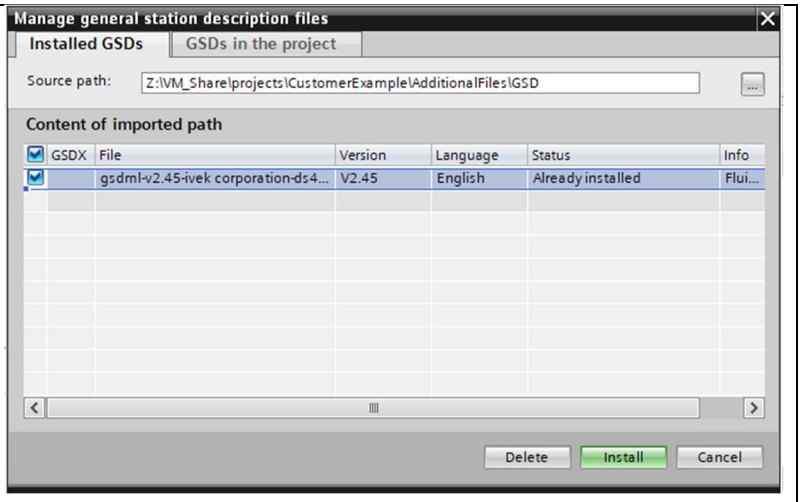
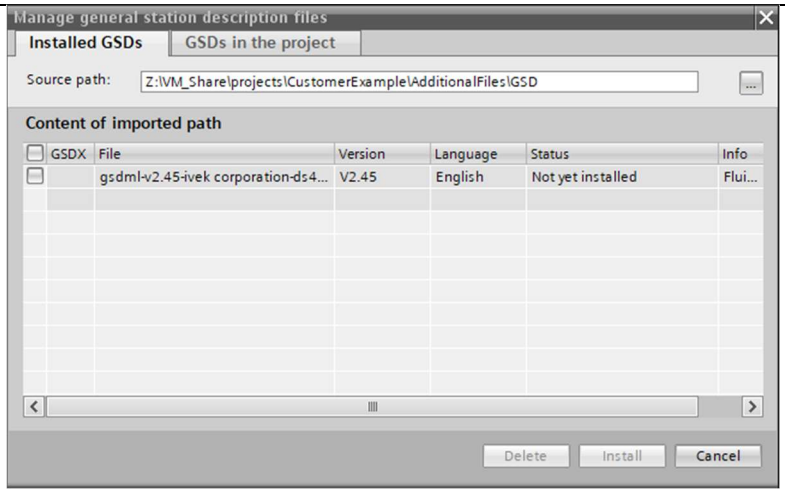
Instruction	Image
In the project view, from the Menu select Options->Manage general station description files (GSD).	

In the pop-up window, use the "…" button to browse to the directory containing the GSD file(s). The files available in the directory appear in the Content of Imported path section. Select the GSD file(s) to install and press the Install button.	
Verify that the GSD was installed successfully.	

3.2. Removing a GSD file

Sometimes it is necessary to remove an older version of a GSD.

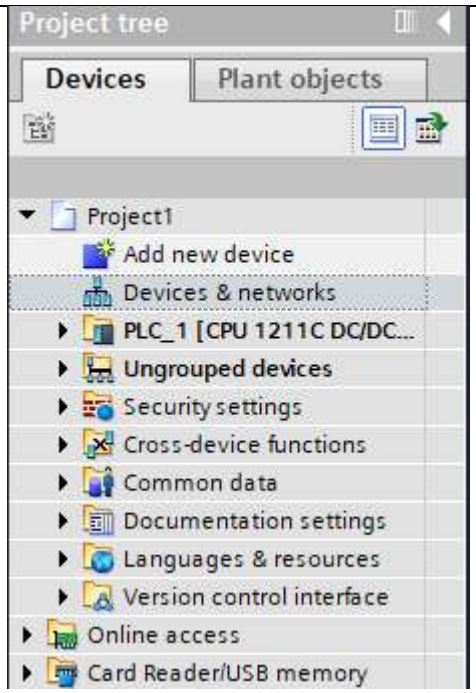
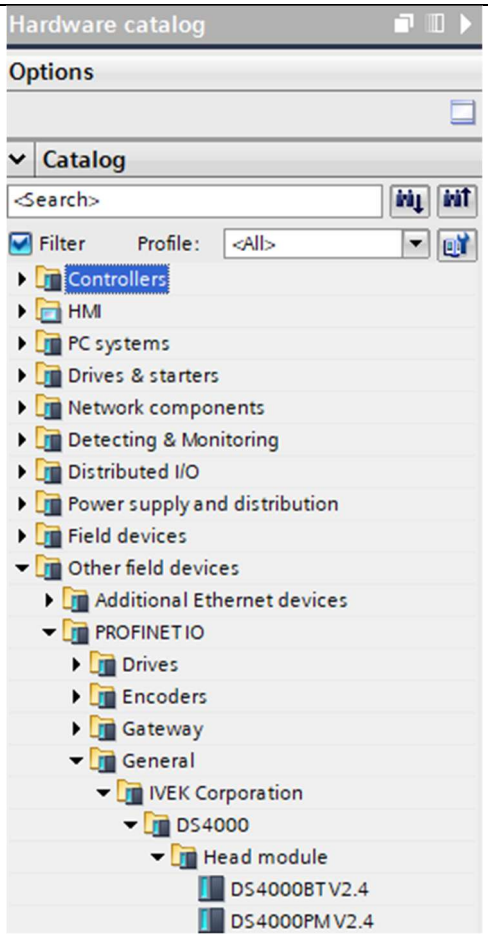
Instruction	Image
In the project view, from the Menu select Options->Manage general station description files (GSD)	

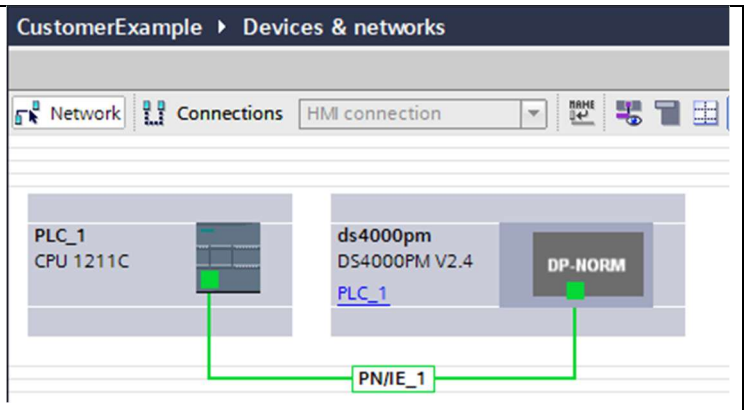
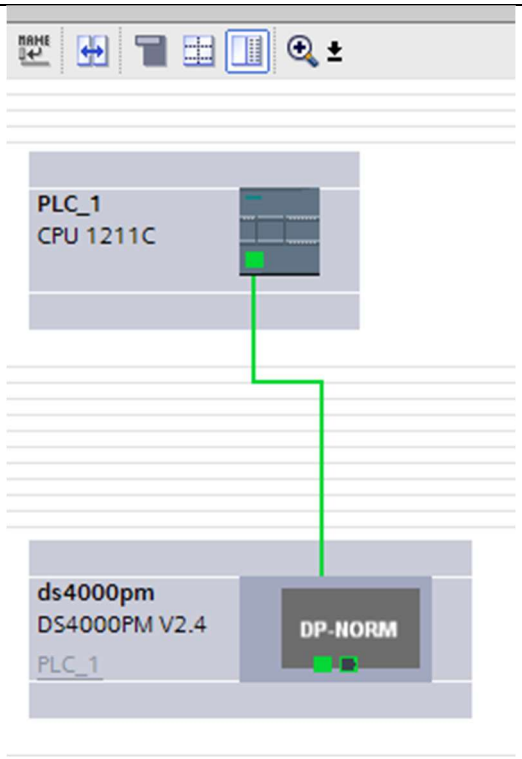
The pop-up window lists the GSD files that are already installed. Select the GSD that is being removed and press the Delete button. TIA Portal will indicate that the catalog is being updated.	
The pop-up window will now show the GSD as “Not yet installed”.	

3.3. Adding the DS4000 to a Project

After installing the GSD file of the DS4000 to TIA Portal, the DS4000 is available for addition to a project. The following instructions show how to add a DS4000.

Instruction	Image

In the Project view, click on Devices & networks.	
Choose the Network view tab, and browse for the desired IVEK controller. E.g., Hardware catalog: Other field devices->PROFINET IO->General->IVEK Corporation->DS4000->DS4000PM V2.4.	

Connect the PLC to the DS4000PM.	
Select the Tab for the Topology View. Connect the PLC port to a DS4000 port. The DS4000 is now a part of the project and ready for communication.	

3.4. Using Cyclical I/O Controller Tags

After the DS4000 is installed in the project, there are several modules available to exchange cyclic I/O data between the DS4000 and PLC. The modules are automatically fixed in specific slots. Each module represents a Parameter that is available for cyclic exchange. These Parameters are useful for real-time control of the pump operations. There are modules/parameters in both the Input and Output directions. Detailed information about each of the parameters contained in the module mapping is available in the DS4000 product manual.

Not all parameters are available as modules, only the subset necessary for real-time control of the pumping operations.

To use these parameters in the PLC, each module needs to be mapped to either I addresses or Q addresses. TIA Portal automatically fills in the I addresses and Q addresses when the DS4000 is inserted into the project.

If the I addresses and Q addresses are chosen to traverse the modules in order, it is possible to overlay tags to better identify each parameter. An example of this is shown in Figure 7, Figure 8, and Figure 9.

Device overview

Module	Rack	Slot	I address	Q address	Type
ds4000bt1	0	0			DS4000BTV2.3
Interface	0	0 X1			ds4000bt
P10_1	0	1		100...103	P10
P11_1	0	2		104...107	P11
P18_1	0	3		108	P18
P143_1	0	4		109	P143
P144_1	0	5		110...111	P144
P52_1	0	6		112...115	P52
P76_1	0	7		116...119	P76
P12_1	0	8	100...103		P12
P13_1	0	9	104...107		P13
P14_1	0	10	108		P14
P139_1	0	11	109		P139
P140_1	0	12	110...111		P140
P17_1	0	13	112		P17
P141_1	0	14	113		P141
P142_1	0	15	114...115		P142
P15_1	0	16	116...119		P15
P16_1	0	17	120...123		P16
P91_1	0	18	124...127		P91
P75_1	0	19	128...131		P75

Figure 7, I and Q addresses in order

CustomerExample ▸ PLC_1 [CPU 1211C DC/DC/DC] ▸ PLC tags ▸ DS4000 [2]

DS4000

	Name	Data type	Address	Retain	Acces...	Writa...	Visibl...	Comment
1	DS4000_PD_In	"DS4000_PD...	%I100.0		☑	☑	☑	
2	statusFlags	Status_T	%I100.0		☑	☑	☑	
3	statusFlagsExt	StatusFlagsExt_T	%I104.0		☑	☑	☑	
4	statusState	USInt	%IB108		☑	☑	☑	
5	reserved139	USInt	%IB109		☑	☑	☑	
6	reserved140	UInt	%IW110		☑	☑	☑	
7	currentRecipe	USInt	%IB112		☑	☑	☑	
8	reserved141	USInt	%IB113		☑	☑	☑	
9	reserved142	UInt	%IW114		☑	☑	☑	
10	codeFault	UDInt	%ID116		☑	☑	☑	
11	codeAlert	UDInt	%ID120		☑	☑	☑	
12	volumeLastProduction	UDInt	%ID124		☑	☑	☑	
13	rateActual	UDInt	%ID128		☑	☑	☑	
14	DS4000_PD_Out	"DS4000_PD_O...	%Q100.0	☐	☑	☑	☑	
15	<Add new>			☐	☑	☑	☑	

Figure 8, Tags for Input Parameters

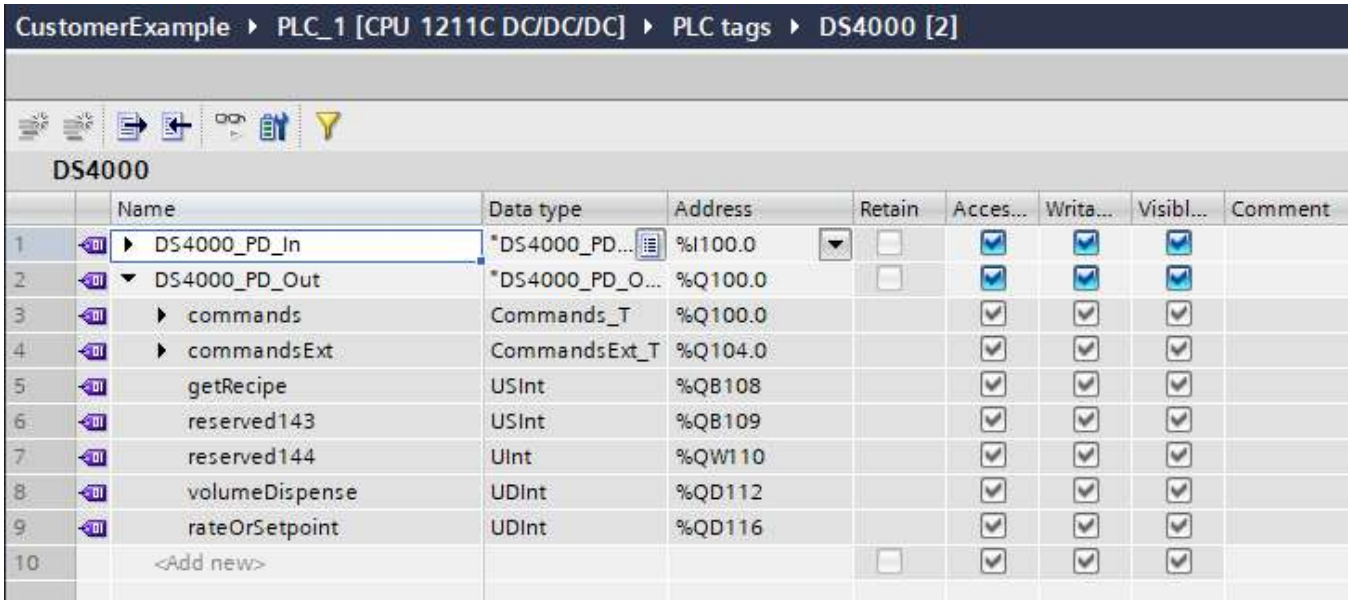


Figure 9, Tags for Output Parameters

Once there are tags overlayed with the I addresses and Q addresses, the data still requires some transformation due to endianness of bit arrays. In particular, statusFlags, statusFlagsExt, commands, and commandsExt require byte swapping so that the bit locations will match the locations in the DS4000 product manual. Examples of how to swap these parameters are shown in Figure 10 and Figure 11.

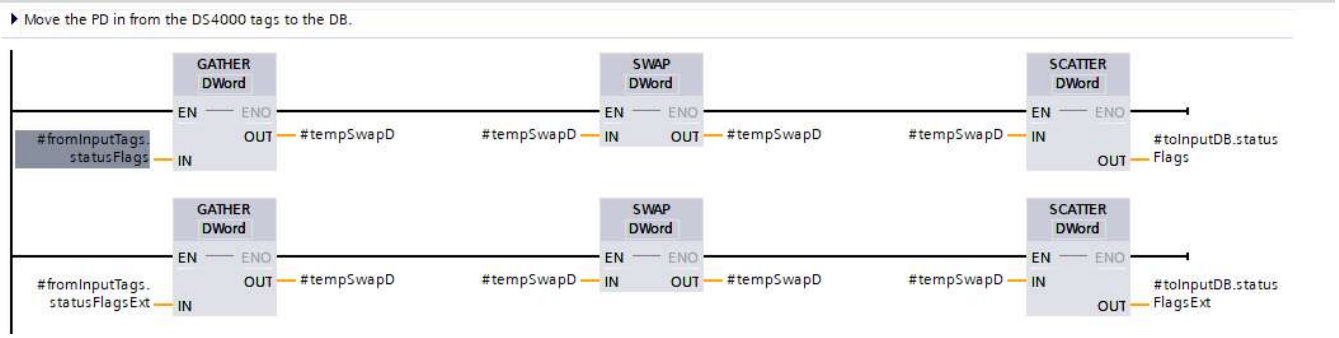


Figure 10, Swapping Status Bits

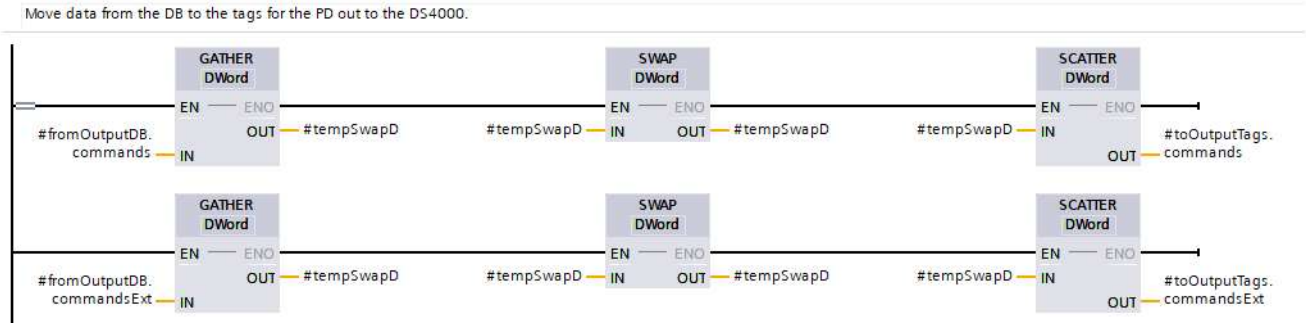


Figure 11, Swapping Command Bits

These examples may be part of a Function Block that executes before any of the data is used by the PLC program. Figure 12 and Figure 13 show examples of function blocks performing these functions.

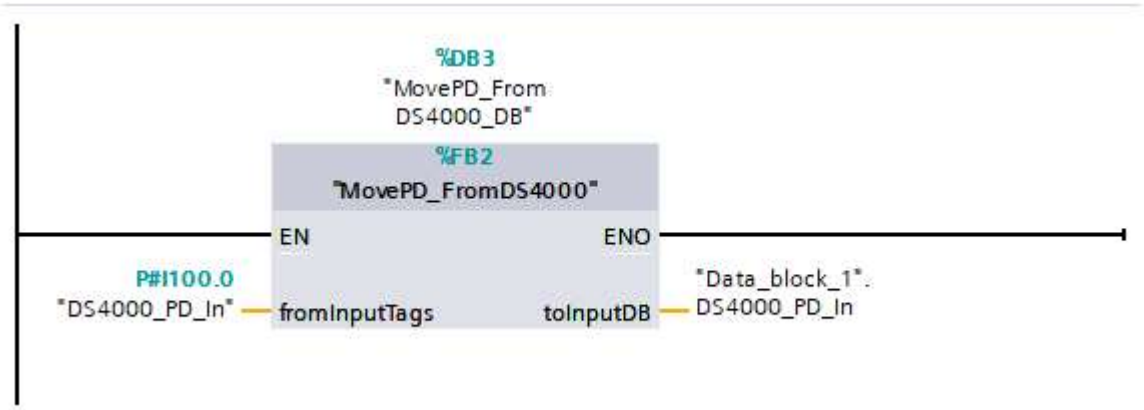


Figure 12, FB to Move from DS4000 to PLC

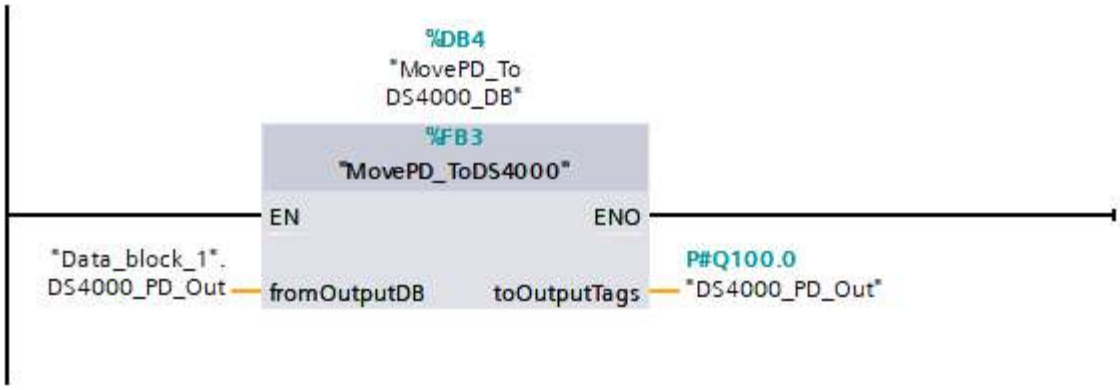


Figure 13, FB to Move from PLC to DS4000

3.5. Modifying DS4000 Parameters

Though some of the DS4000 parameters are available via cyclic I/O data, all of the parameters are available using Read Data Record and Write Data Record services (acyclic). These services are available using the RDREC and WRREC function blocks.

The RDREC function block contains the following inputs:

- EN – the enable bit for the function block.
- REQ – a trigger to request the read of the data record.
- ID – the address of the head module in the DS4000 (e.g., ds4000pm1~Head). This is a System constant automatically generated by TIA Portal and visible in the Device view ->System Constants tab, for the DS4000.
- INDEX – this is the Parameter ID of the desired parameter to read. The DS4000 product manual lists every available parameter including its ID. (For example, the Dispense Volume parameter ID is 52).
- MLEN – this is the length of the desired parameter to read. The DS4000 product manual lists every available parameter including its data type, and a length for each data type. (For example, the Dispense Volume type is VOL, which is equivalent to a DINT, which is 4 bytes).
- RECORD – this is a location to place the parameter upon a successful read.

The WRREC function block contains the following inputs:

- EN – the enable bit for the function block.
- REQ – a trigger to request the write of the data record.
- ID – the address of the head module in the DS4000 (e.g., ds4000pm1~Head). This is a System constant automatically generated by TIA Portal and visible in the Device view ->System Constants tab, for the DS4000.
- INDEX – this is the Parameter ID of the desired parameter to write. The DS4000 product manual lists every available parameter including its ID. (For example, the Dispense Volume parameter ID is 52).
- MLEN – this is the length of the desired parameter to write. The DS4000 product manual lists every available parameter including its data type, and a length for each data type. (For example, the Dispense Volume type is VOL, which is equivalent to a DINT, which is 4 bytes).
- RECORD – this is a location to place the parameter upon a successful read.

3.6. Starting with an example project

An example project, using Ladder Logic, is located on the on the IVEK website (https://www.ivek.com/manuals.html).

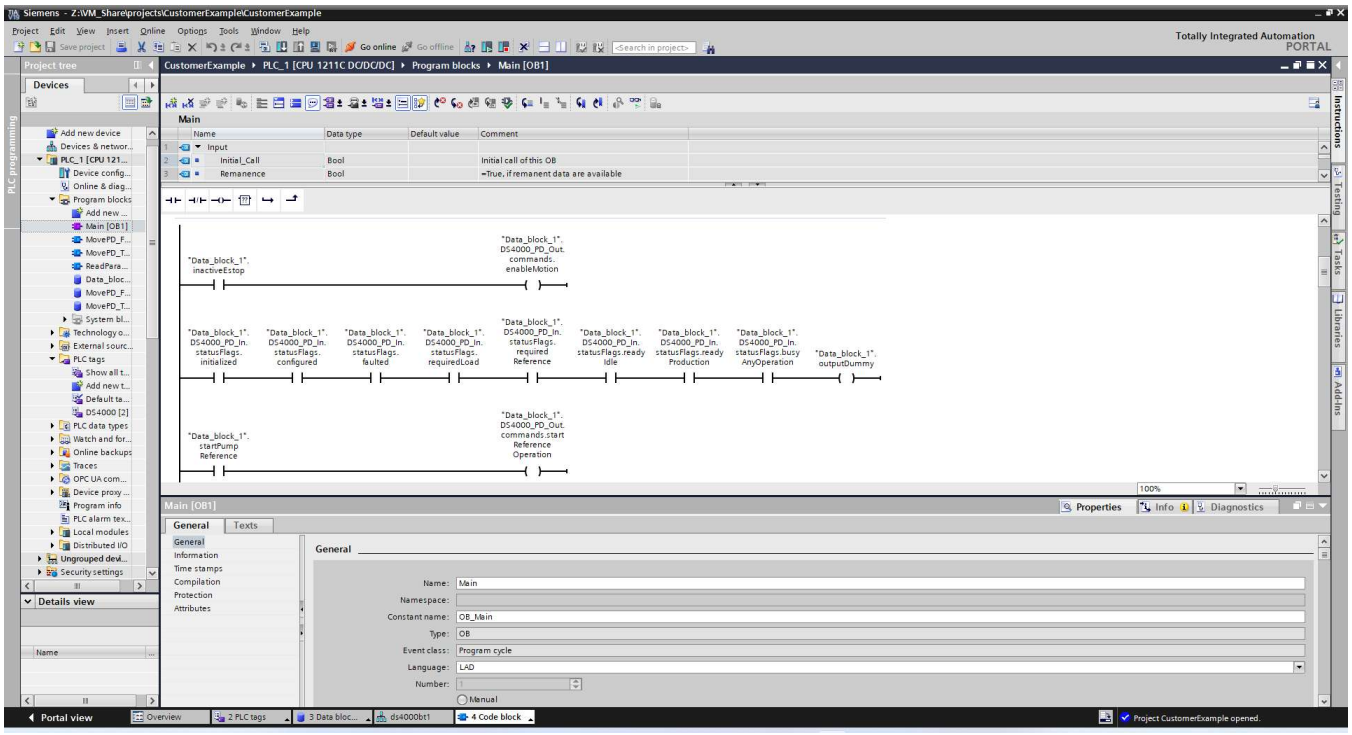


Figure 14, Example Ladder Logic Program

3.7. Accessing DS4000 EtherNet/IP version using TIA Portal

While PROFINET is the recommended fieldbus for use with Siemens' PLCs, it is possible to communicate between a Siemens' PLC and an DS4000 EtherNet/IP version. TIA Portal offers a "LCCF_EnetScanner" function block that may be used for this purpose. Please refer to the Siemens' document, "EtherNet/IP Scanner for SIMATIC".

4. ACCESSING THE DS4000 USING BECKHOFF TWINCAT 3

TwinCAT® 3 is a development environment for Beckhoff PLCs. Accessing the DS4000 requires placing an ESI file into the appropriate directory so that TwinCAT may access it. The ESI file provides information for TwinCAT to access the CANopen Dictionary upon addition of a DS4000 to a project.

The following instructions describe how to install the DS4000 in a TwinCAT 3 project and how to read and modify parameters via the CoE – Online data, the FB_EcCoESdoRead() and FB_EcCoESdoWrite() function blocks, and the Cyclical I/O Controller Tags. These instructions were generated using and IVEK Digispense 4000, TwinCAT 3 and a PC.

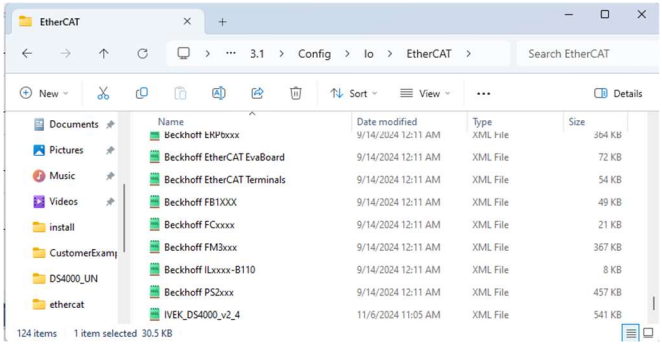
4.1. Adding the ESI File

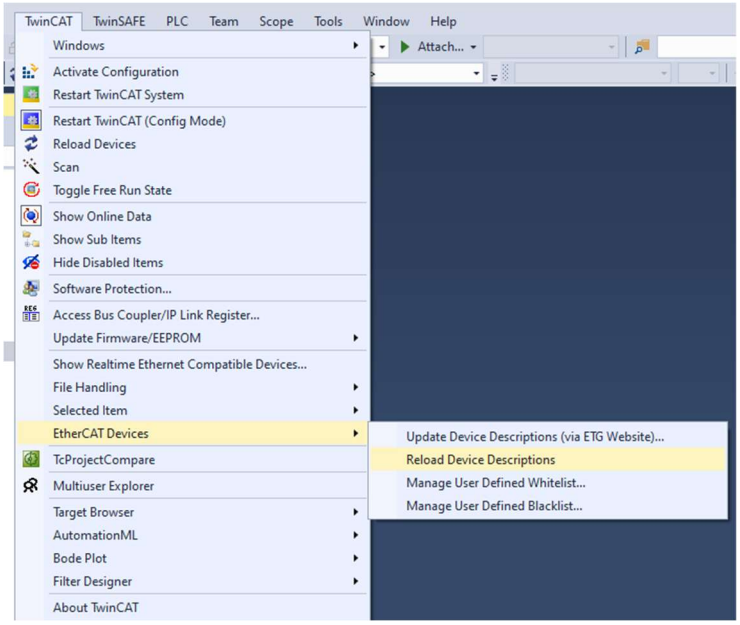
The ESI file (e.g., Ivek_DS4000_v2_4.xml) for the DS4000 must be imported into TwinCAT 3. The ESI file is located on the IVEK website (https://ivek.com/manuals.html).

Make sure the installed ESI is the correct version for the specific DS4000 firmware version.

Firmware Version	ESI File
560010-0101	Not supported
560010-0102	Not supported
560010-0201	Not supported
560010-0202	Not supported
560010-0203	IVEK_DS4000_v2_3.xml
560010-0204	IVEK_DS4000_v2_4.xml

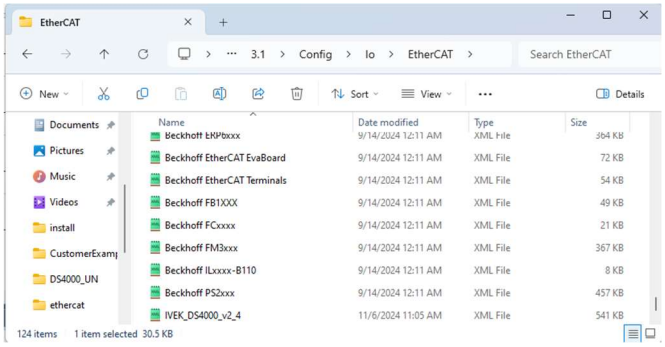
Note: ***if the DS4000 is in Bootloader mode, the DS4000 appears as a different device. Also, it is not verified as an EtherCAT device in this mode, so removal from an existing EtherCAT network is recommended. The ESI file, IVEK_DS4000_v2_4.xml, contains the information necessary to connect a PLC to the DS4000 in bootloader mode. This is necessary in order to order to access web pages and perform FTP transfers (EtherCAT over Ethernet (EoE) must be enabled).***

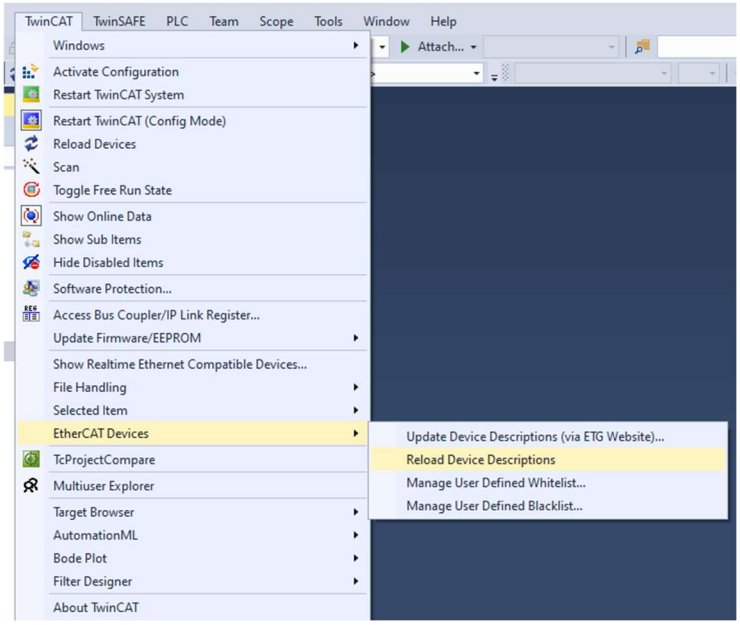
Instruction	Image
Add the IVEK ESI (e.g., IVEK_DS4000_v2_4.xml) to the TwinCAT directory (e.g., “c:\TwinCAT\3.1\Config\Io\EtherCAT”)	

TwinCAT reads the ESI upon opening a new System Manager window. If a System Manager window is already open, the ESI read may be initiated by the user. From the Menu, select TwinCAT->EtherCAT Devices->Reload Device Descriptions.	

4.2. Removing an ESI file

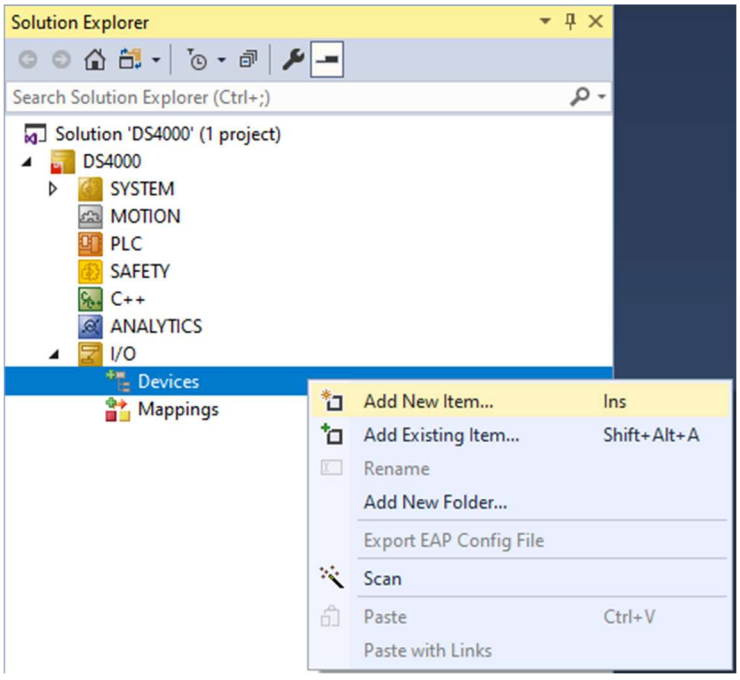
When removing an ESI file, simply remove it from the TwinCAT directory.

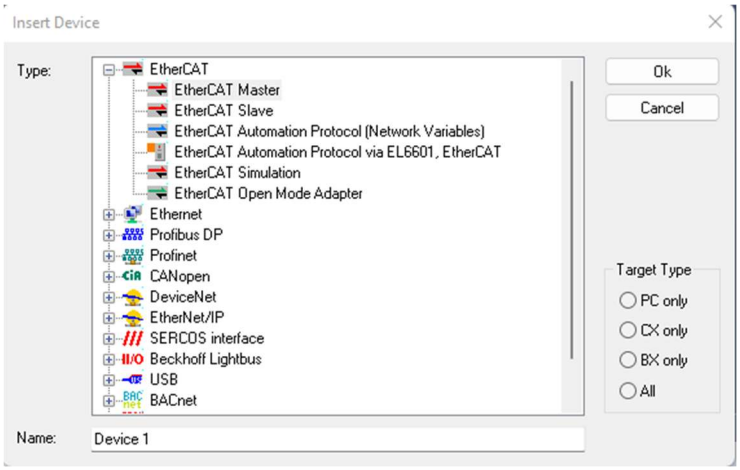
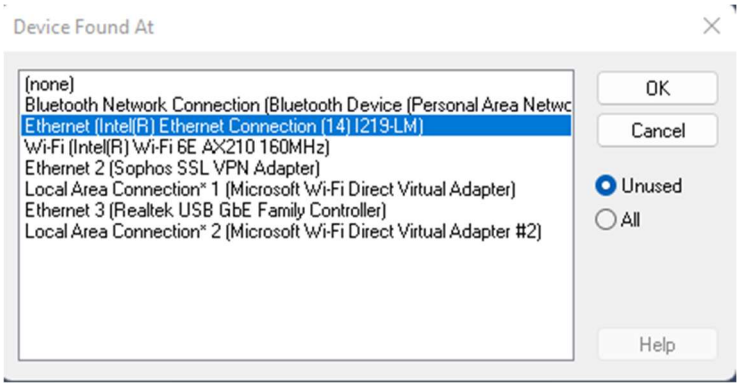
Instruction	**Image**
Delete the IVEK ESI (e.g., IVEK_DS4000_v2_3.xml) from the TwinCAT directory (c:\TwinCAT\3.1\Config\Io\EtherCAT)	

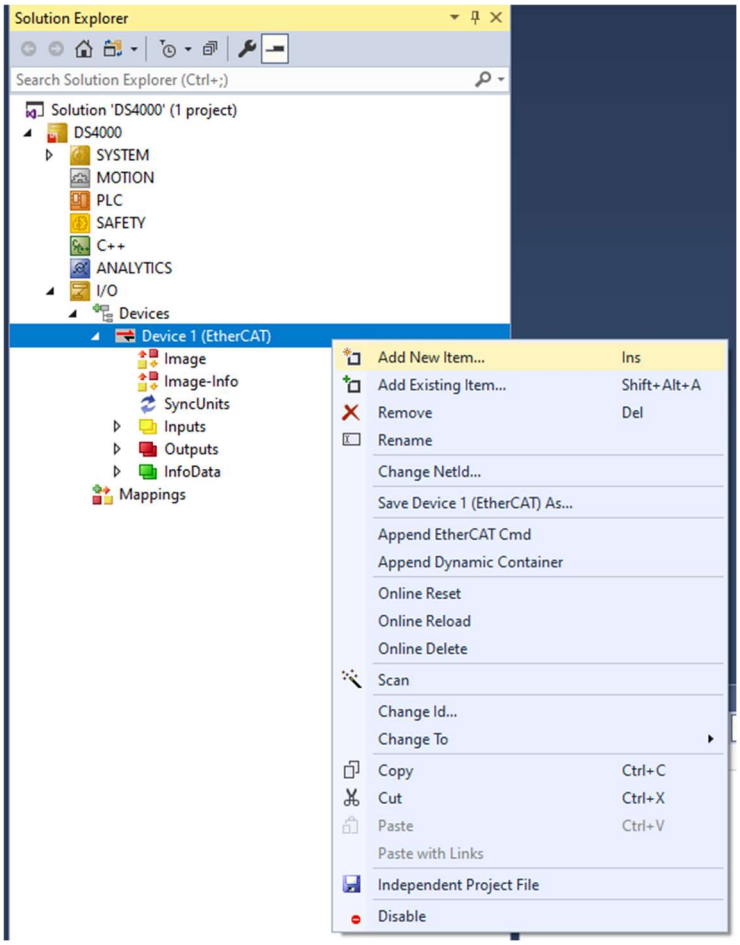
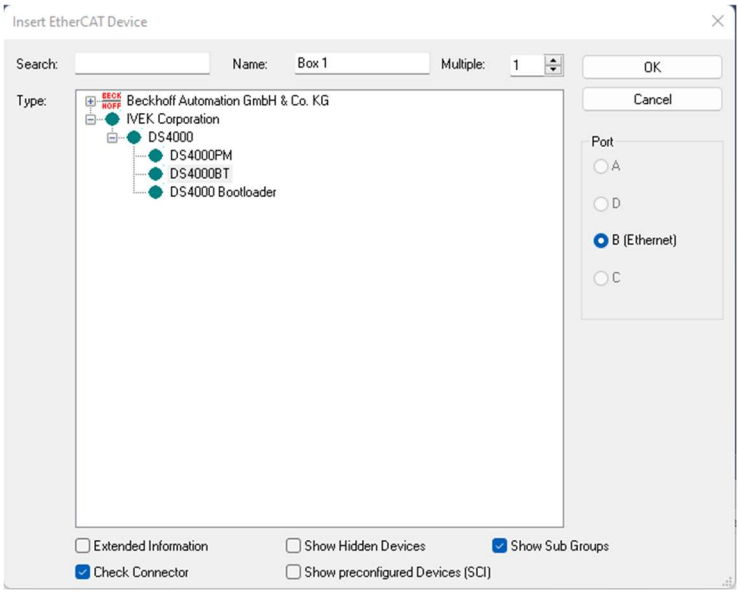
From the Menu, select TwinCAT->EtherCAT Devices->Reload Device Descriptions.	

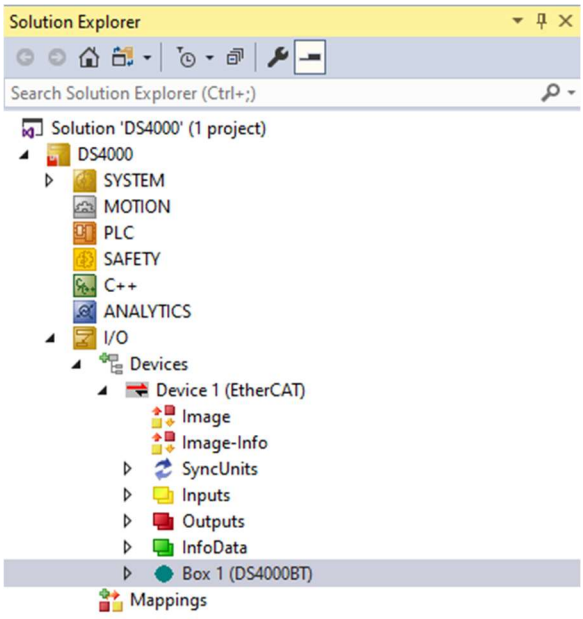
4.3. Adding the DS4000 to a Project

After installing the ESI file of the DS4000 to TwinCAT 3, the DS4000 is available for addition to a project. The following instructions show how to add a DS4000. Note that there is an alternative way to add a DS4000 by scanning the network for devices; those instructions are not provided.

Instruction	**Image**
Add a new I/O Device to the project by selecting I/O->Devices and opening the context menu. Select Add New Item.	

The project needs an EtherCAT Master to communicate with the DS4000 Slave. Select an EtherCAT Master, provide a name for the device, and press the Ok button.	
Select the Network interface that is connected to the DS4000 and press the Ok button.	

Highlight the newly added EtherCAT Master, open the context menu, and select Add New Item.	
If the ESI is properly installed, there will be an icon for IVEK Corporation. Expand the icon to see the devices available. Select the device that matches the DS4000 attached to the network. A name for the device is automatically created by TwinCAT (e.g., Box 1). Change the name if desired. Highlight the desired device and press the Ok button.	

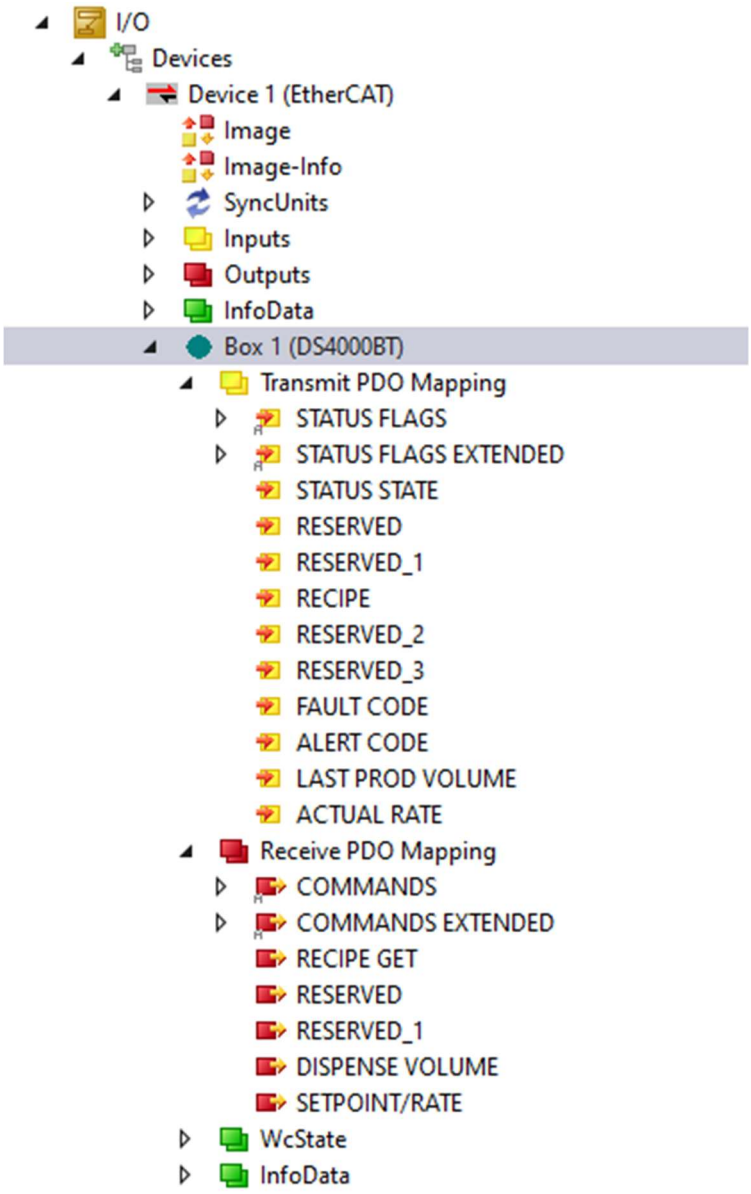
The DS4000 is now a part of the project and available for communication.	

4.4. Using Cyclical I/O Controller Tags

The cyclical I/O data available are shown in the PDO Mappings of the DS4000 device (e.g., Box 1). To see the PDO Mappings, expand the arrow next to the DS4000. This data contains several parameters that are useful for real-time control of the pumping operations. There are PDOs available in both the Transmit and Receive directions. Detailed information about each of the parameters contained in the PDO mappings is available in the DS4000 product manual.

Not all parameters are available as PDO mappings, only the subset necessary for real-time control of the pumping operations. The PDO mappings are exchanged between the PLC and the DS4000 using the EtherCAT network when the DS4000 is in the OP state.

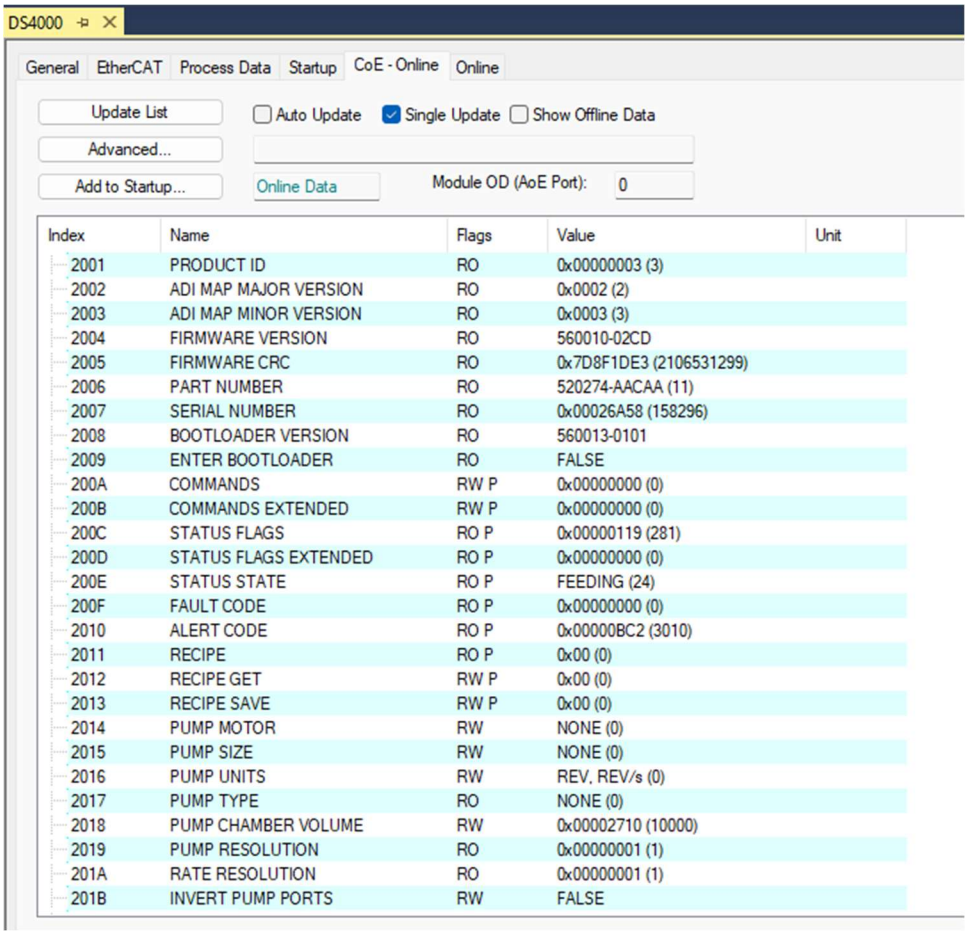
To use the PDO fields in a program, the PDO fields need to be mapped to Tags.



PDO Mappings of the DS4000 shown in a TwinCAT project

4.5. Viewing Module Parameters

Though only some of the parameters are available in the PDO mappings, all DS4000 parameters are available in the “CoE – Online” tab of the DS4000 window (to see this window, double click on the DS4000 device). When connected to the PLC, and in either the PRE-OP, SAFE-OP, or OP state, the values are displayed and are modifiable.



Index	Name	Flags	Value	Unit
2001	PRODUCT ID	RO	0x00000003 (3)	
2002	ADI MAP MAJOR VERSION	RO	0x0002 (2)	
2003	ADI MAP MINOR VERSION	RO	0x0003 (3)	
2004	FIRMWARE VERSION	RO	560010-02CD	
2005	FIRMWARE CRC	RO	0x7D8F1DE3 (2106531299)	
2006	PART NUMBER	RO	520274-AACAA (11)	
2007	SERIAL NUMBER	RO	0x00026A58 (158296)	
2008	BOOTLOADER VERSION	RO	560013-0101	
2009	ENTER BOOTLOADER	RO	FALSE	
200A	COMMANDS	RW P	0x00000000 (0)	
200B	COMMANDS EXTENDED	RW P	0x00000000 (0)	
200C	STATUS FLAGS	RO P	0x00000119 (281)	
200D	STATUS FLAGS EXTENDED	RO P	0x00000000 (0)	
200E	STATUS STATE	RO P	FEEDING (24)	
200F	FAULT CODE	RO P	0x00000000 (0)	
2010	ALERT CODE	RO P	0x00000BC2 (3010)	
2011	RECIPE	RO P	0x00 (0)	
2012	RECIPE GET	RW P	0x00 (0)	
2013	RECIPE SAVE	RW P	0x00 (0)	
2014	PUMP MOTOR	RW	NONE (0)	
2015	PUMP SIZE	RW	NONE (0)	
2016	PUMP UNITS	RW	REV, REV/s (0)	
2017	PUMP TYPE	RO	NONE (0)	
2018	PUMP CHAMBER VOLUME	RW	0x00002710 (10000)	
2019	PUMP RESOLUTION	RO	0x00000001 (1)	
201A	RATE RESOLUTION	RO	0x00000001 (1)	
201B	INVERT PUMP PORTS	RW	FALSE	

Example of accessing parameters using the “CoE – Online” tab within TwinCAT 3

Modifying values using the “CoE – Online” tab will modify the parameter value in the controller immediately. Due to the non-volatile nature of most parameters, modifications made to the parameters will be retained by the controller, even through a power-cycle. There are a few exceptions to this as some parameters are volatile (e.g., command and status parameters).

4.6. Accessing the parameter via Sdo functions

The FB_EcCoESdoRead and FB_EcCoESdoWrite function blocks may be used by the PLC software to access parameters that need to be modified or read during runtime, if they are not available in the cyclic I/O Tags. All parameters reside in the CANopen dictionary.

The functions must contain the following:

- sNetId: the network ID of the EtherCAT master.
- nSlaveAddr: the address of the DS4000.

- nSubIndex: a subindex of the object, typically 0 for the IVEK parameters.
- nIndex: the address of the parameter (see section 4.5 for one way to view the index of the parameters).
- pSrcBuf: a pointer to the variable to read/write.
- cbBufLen: the length of the variable to read/write. This length must match the length of the parameter (see Ivek manual for length of each parameter).

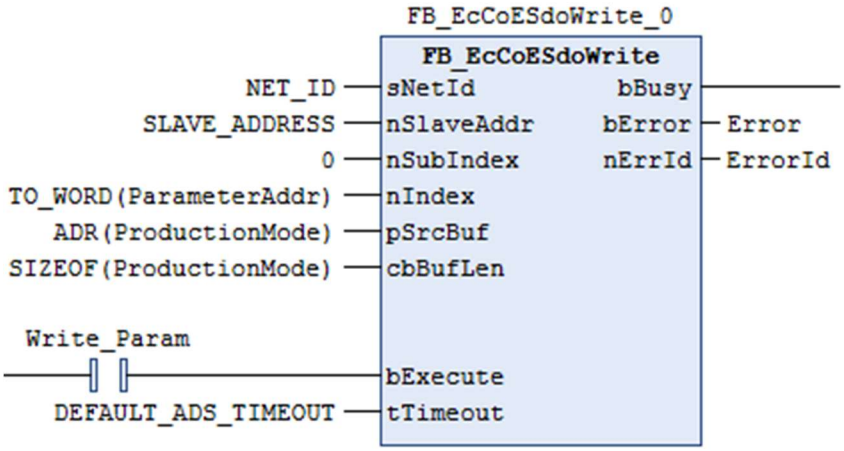


Figure 15, Parameter Write command

4.7. Starting with the example project

An example project, using Ladder Logic, is located on the on the IVEK website (https://www.ivek.com/manuals.html).

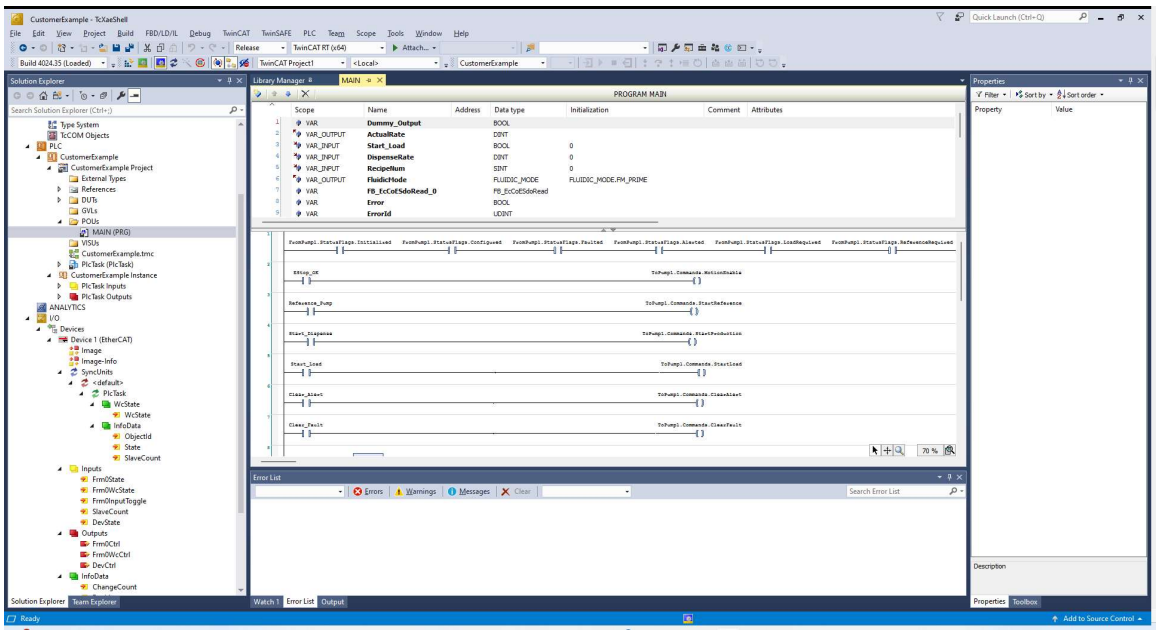


Figure 16, Example Ladder Logic program

4.8. Accessing DS4000 EtherNet/IP version using TwinCAT

While EtherCAT is the recommended fieldbus for use with Beckhoff PLCs, it is possible to communicate between a Beckhoff PLC and an DS4000 EtherNet/IP version. TwinCAT offers an EtherNet/IP Scanner software device that may be used for this purpose. Please refer to the Beckhoff document, “EtherNet/IP Scanner for SIMATIC”.

5. CONNECTING TO THE CONTROLLER WITH HTTP AND/OR FTP

DS4000 controllers that contain either an EtherNet/IP, PROFINET, or an EtherCAT interface module, also contain an HTTP server and an FTP server. The HTTP server delivers web pages to a browser for reading and writing the parameters of the controller. The FTP server provides services to transfer documentation files from the controller (e.g., EDS file).

In order to access these servers, the controller needs to be connected to the same network as the browsing device (e.g., computer) and the controller needs to be configured with a valid IP address.

For EtherCAT devices, the device must be online and in either the Pre-Op, Safe-Op, or Op state. Also, EoE must be enabled by the EtherCAT Master. The Customer Example project may be used as a starting point. After opening the project, use TwinCAT to place the EtherCAT Master and DS4000 into either Pre-Op, Safe-Op, or Op.

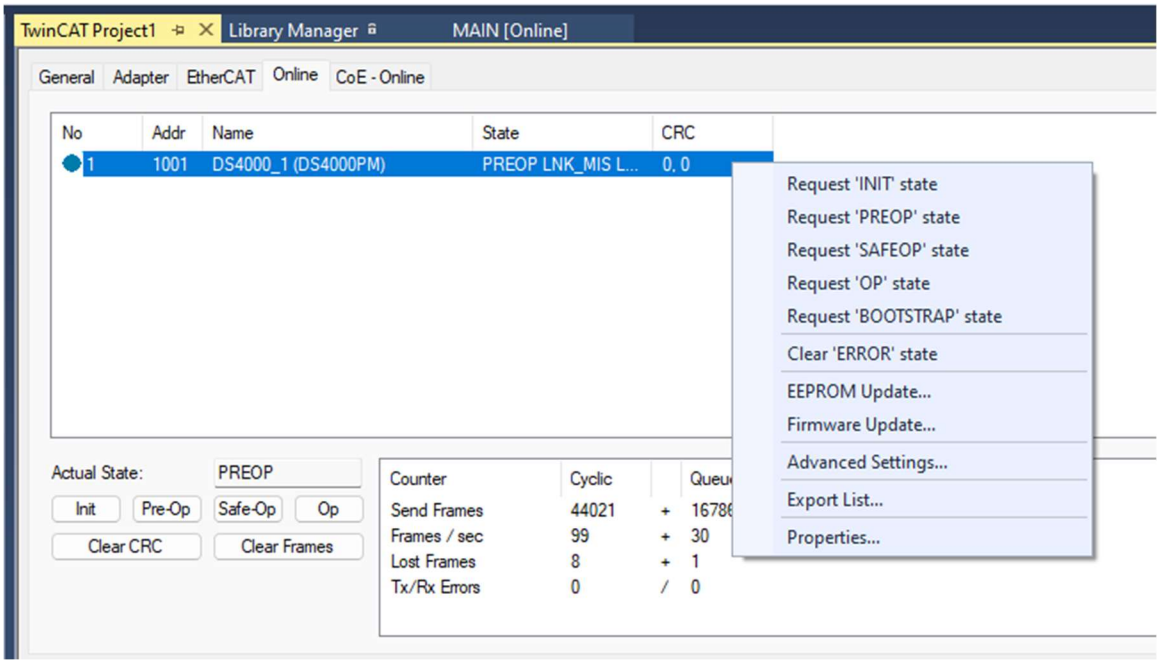


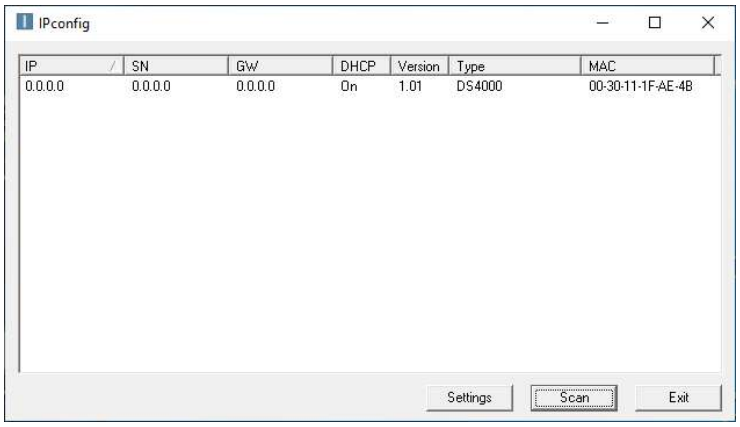
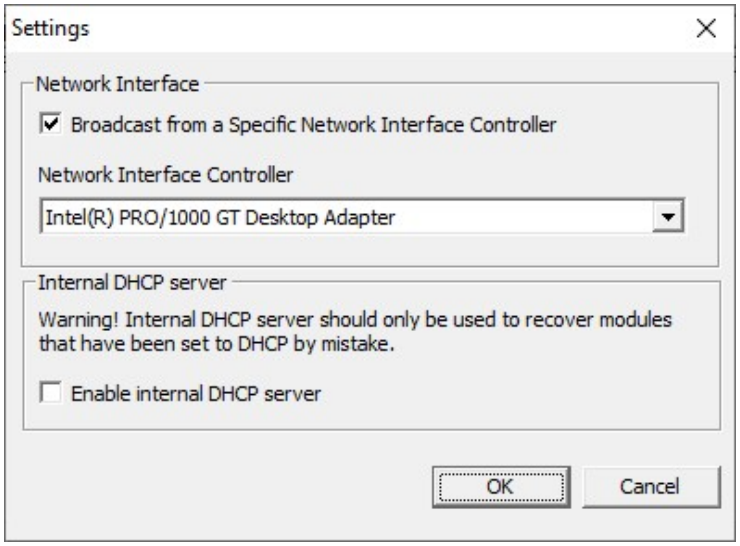
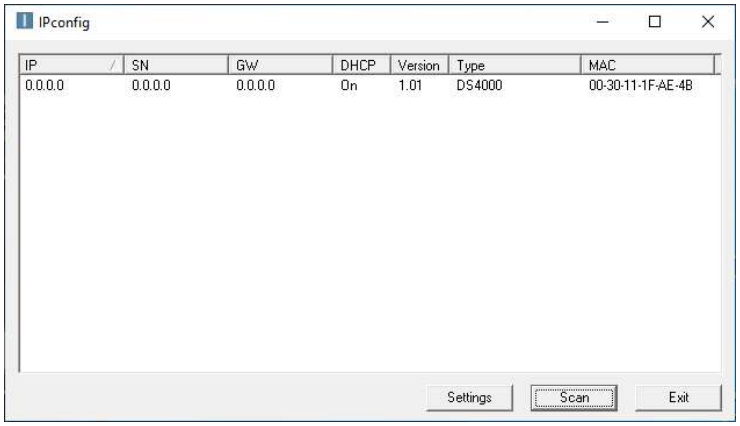
Figure 17, Requesting EtherCAT operating modes

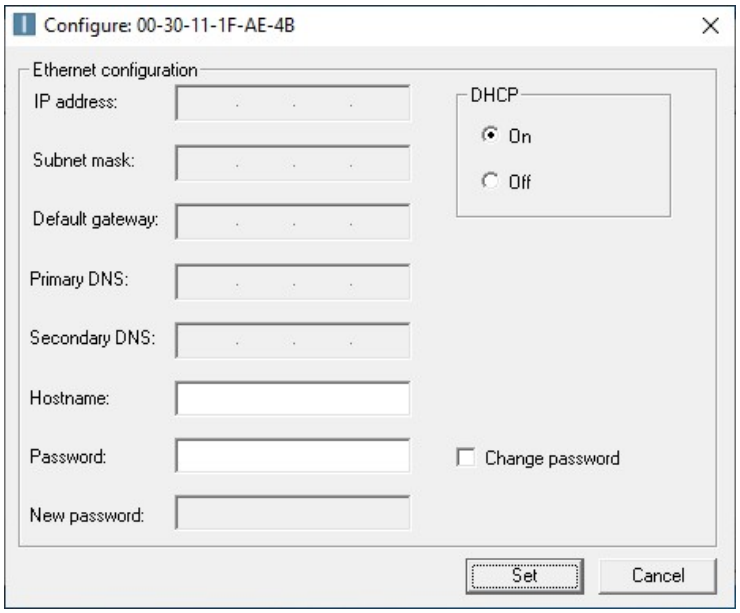
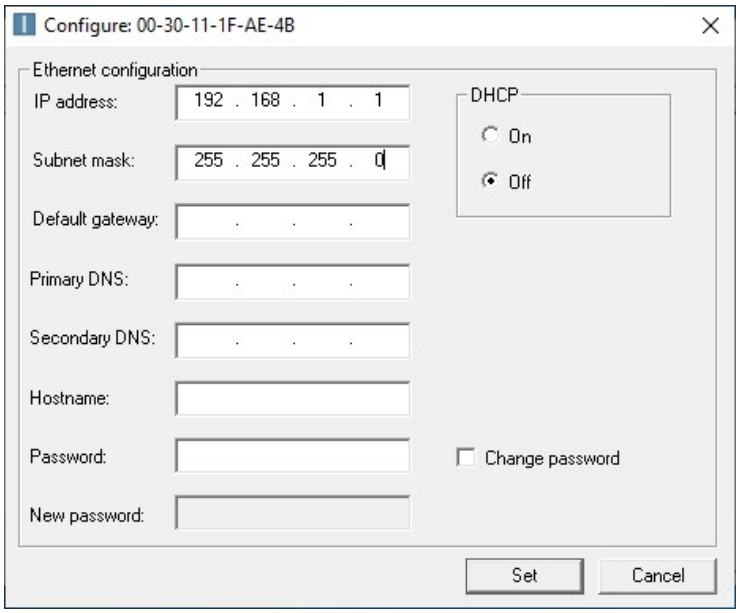
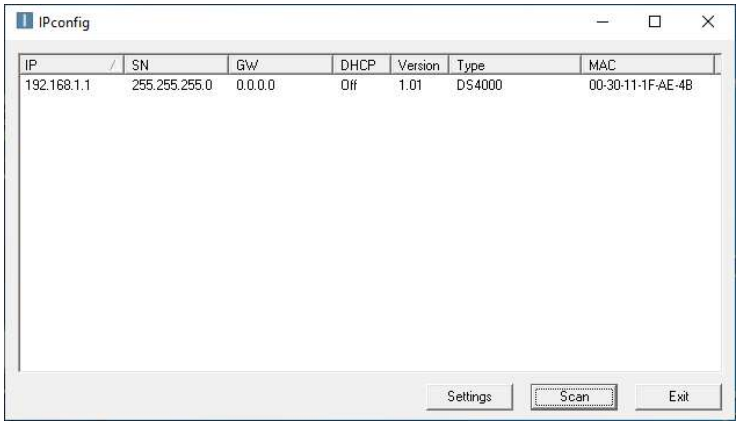
5.1. Configuring the IP address

A utility, IPConfig, is needed to configure the IP address of the DS4000 controller. The IPConfig utility is available for download from the IVEK website.

The IPConfig utility scans an Ethernet network for DS4000 controllers and provides the ability to modify the IP address and DHCP setting. After installing the utility, the following instructions show how to configure the IP address of the DS4000.

Instruction	Image

Press the Settings button to open the settings dialog for IPConfig.	
Choose whether to broadcast from a specific NIC or over all available NICs. It is necessary to broadcast on whichever NIC is attached to the same network as the DS4000. Press the OK button.	
Press the Scan button. Any DS4000s that are attached the same network as the broadcasting NIC(s) appear in the list along with information about the DS4000. Double click anywhere within the row containing the information of the DS4000.	

Configure the DS4000 for the desired network configuration. To configure the DS4000 to obtain it's IP address from a DHCP server (default), select the On radio button in the DHCP section and then press the set button.	
To configure the DS4000 to use a static IP address, first select the Off radio button in the DHCP section. This will unlock the IP address, subnet mask, and Default gateway fields. Type in the desired IP address and subnet mask and then press the set button.	
After configuring the DS4000, the new information will display in the information row (may need to press the Scan button to update the display). The settings are saved in non-volatile memory on the EtherNet/IP module of the DS4000.	

5.2. Accessing the DS4000 via HTTP

All parameters are available by browsing the web pages provided by the HTTP server. The web pages are accessed using a standard web browser and the IP address of the DS4000 controller as the destination address.

The web pages have a little bit of security to limit access by unauthorized users. Upon browsing to the web page, the web browser will ask for a user name and password. The user name is “Supervisor” and the password is contained in a separate Tech Bulletin (should be included with your unit, or ask your Sales representatives to provide the password to you). This password is not able to be changed.

Several pages are available that provide access to the various parameters. The parameters have been grouped into seven categories (Information, Production, Fluidic, Pump, System, Statistics, Operation) in order to facilitate understanding. Parameters that are modifiable will have a “Set” button listed to the right of the value; parameters that are read-only will have not have a “Set” button available. There are also web pages that provide information about the network statistics, and other web pages that provide help (e.g., how to contact IVEK for Technical Support).

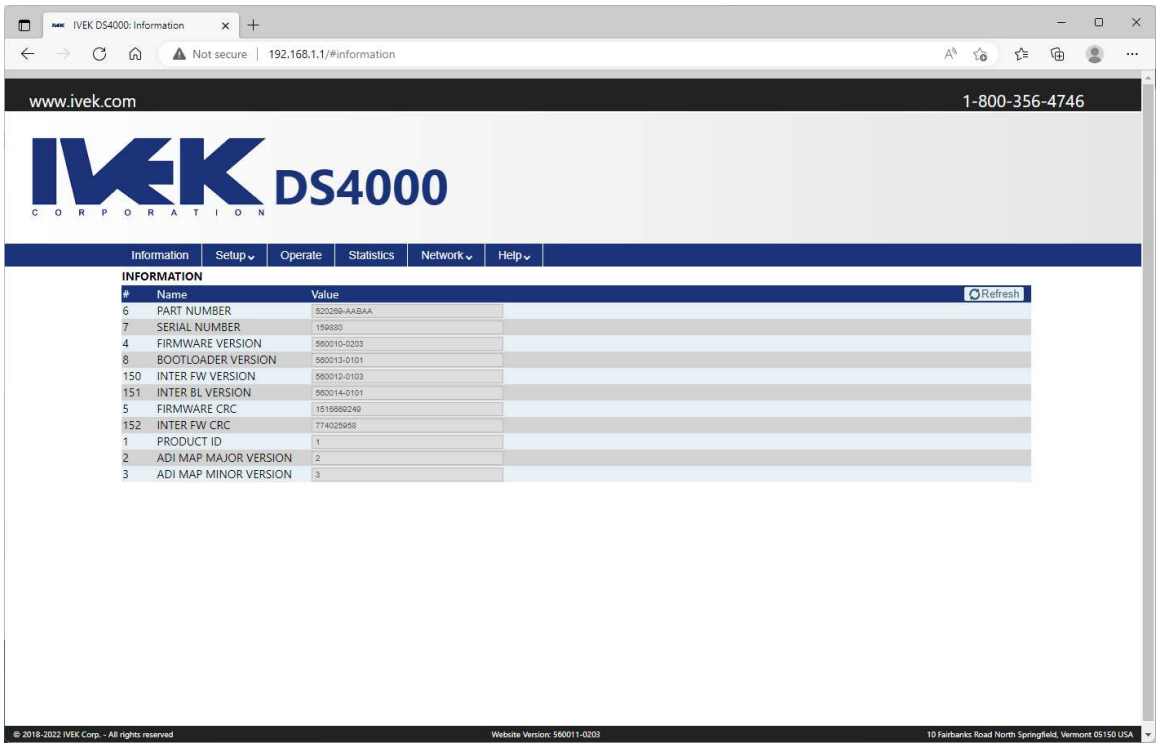
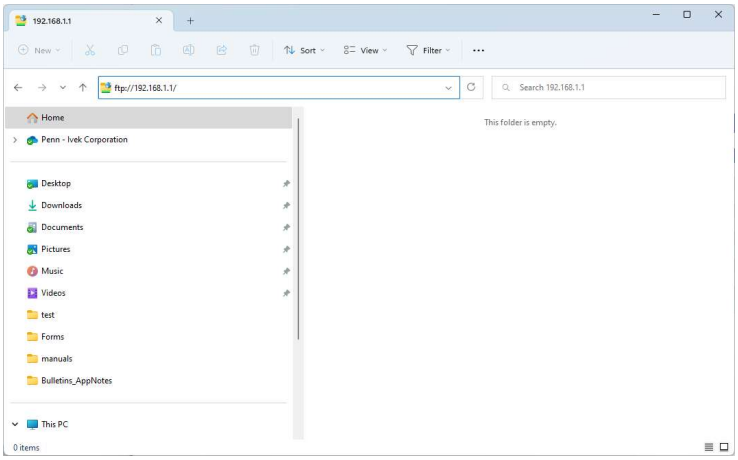
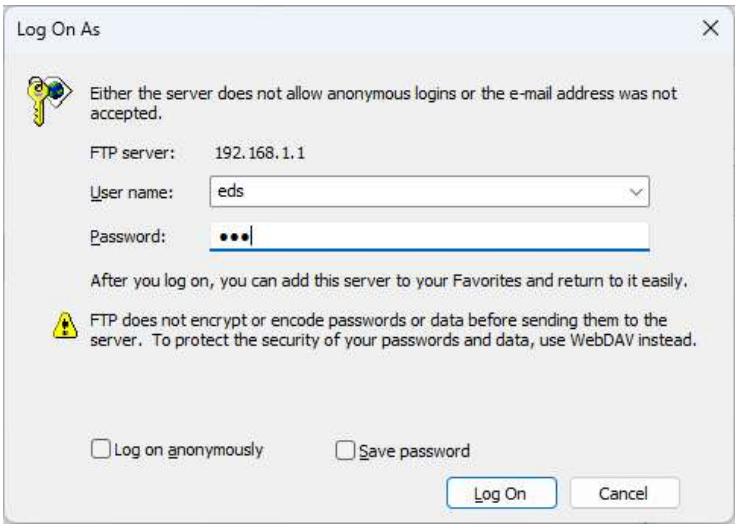
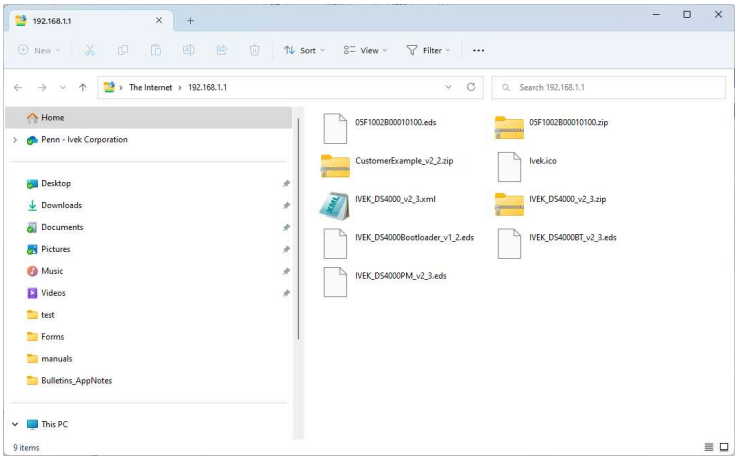


Figure 18, Accessing parameters using a web page

5.3. Accessing the DS4000 using FTP

The File Transfer Protocol (FTP) server provides access to documentation stored on the DS4000 file system such as the EDS file and icon. The following instructions demonstrate using Microsoft File Explorer to access these files, though other FTP clients may also be used.

Instruction	Image

Open the FTP client and enter the IP address of the DS4000.	
Enter “eds” for the user name and “eds” for the password.	
The FTP client provides access to the directory that contains the EDS file for EtherNet/IP, the GSD file for PROFINET, and the ESI file for EtherCAT. (e.g., IVEK_DS4000PM_v2_3.eds) and IVEK icon (e.g., Ivek.ico).	

6. CONNECTING WITH A GATEWAY

For PLCs that do not have an EtherNet/IP, PROFINET, or EtherCAT connection, a gateway (i.e., protocol converter) is necessary to convert the data from one fieldbus to the other (e.g., EtherNet/IP to PROFINET™). Also, some PLCs that provide an EtherNet/IP, PROFINET, or EtherCAT interface may provide more of a gateway type of interface, where cyclic data is easy to exchange but exchanging acyclic data is either more complicated or impossible.

When using a device that is only able to translate the data that is exchanged cyclically, it will be necessary to use an alternate interface (e.g., web pages) to modify the non-cyclic parameters. If modification of non-cyclic parameters during runtime is desired in this scenario, then the use of Recipes may be required (Recipes are described in section 7).

Configuring a gateway involves mapping the data bytes through the gateway. To facilitate that configuration, the cyclic data is described in the following table. **The DS4000 EDS, GSD, ESI and Product Manual contain the most up to date data structures and contents of the cyclic data.** Also note that there have been several mappings through the history of the DS4000, so **it is important to verify that the map in the gateway matches the map in the device**.

EtherNet/IP Producing Data Bytes (Assembly 100) **EtherCAT Transmit PDO Mapping** **PROFINET Module Mapping (Rack 0)** **(32 bytes total)**	**Contents**	**EtherNet/IP Parameter Instance (Assembly 100)**	**EtherCAT Index**	**PROFINET Slot**
0-3	Status Flags	12	0x200C	8
4-7	Status Flags Extended	13	0x200D	9
8	Status State	14	0x200E	10
9	Reserved	N/A	N/A	11A
10-11	Reserved	N/A	N/A	12
12	Recipe Current	17	0x2011	13
13	Reserved	N/A	N/A	14
14-15	Reserved	N/A	N/A	15
16-19	Fault Code	15	0x200F	16
20-23	Alert Code	16	0x2010	17
24-27	Last Production Volume	91	0x205B	18
28-31	Actual Rate	75	0x204B	19
EtherNet/IP Consuming Data Bytes (Assembly 150) **EtheCAT Receive PDO Mapping**	**Contents**	**EtherNet/IP Parameter Instance (Assembly 150)**	**EtherCAT Index**	**PROFINET Slot**

PROFINET Module Mapping (Rack 0) (20 bytes total)				
0-3	Command	10	0x200A	1
4-7	Commands Extended	11	0x200B	2
8	Recipe Get	18	0x2012	3
9	Reserved	N/A	N/A	4
10-11	Reserved	N/A	N/A	5
12-15	Dispense Volume	52	0x2034	6
16-19	Rate or Setpoint	76	0x204C	7

7. MODIFYING PARAMETERS USING RECIPES

Recipes provide a way to save the values of parameters together, in order to recall them later. The intention of Recipes is to ease parameter recall when controlling the DS4000 with the HMI, discrete I/O or RS232. However, since some Gateways and PLCs do not lend themselves to acyclic data exchange, recipes may be used to modify parameters during runtime using the cyclic data exchange mechanism. The limitation of this use case is that the recipes must be configured/saved beforehand using one of the non-cyclic parameter interfaces (e.g., web pages, HMI, etc.).

Since the command to recall a recipe (Recipe Get, parameter 18) is available in the cyclic data exchange, it is possible to quickly modify a set of parameters while controlling the DS4000. The DS4000 provides storage in non-volatile memory for up to 32 recipes (identified by numbers 1-32).

Before recalling recipes, it is necessary to first create the recipes in the controller. This is achieved using one of the non-cyclic interfaces (e.g., HMI, web pages, etc.). The method for creating (saving) recipes is as follows:

1) Verify that the Recipe Save parameter (parameter 19) is set to 0.
2) Modify the parameters to the values desired for the recipe.
3) Verify there are no alerts (optional)
4) Verify that the Current Recipe (parameter 17) is 0.
5) Save the Recipe by setting the Recipe Save parameter (parameter 19) to the desired recipe identification number (1-32).
6) Verify that there are no alerts (optional).
7) Verify that the Current Recipe (parameter 17) is the desired recipe identification number.
8) Set the Recipe Save parameter (parameter 19) back to 0.

The method for recalling (getting) recipes is as follows:

1) Recall the recipe by setting the Recipe Get parameter (parameter 18) to the desired recipe identification number (1-32).
2) Verify that there are no alerts (optional).
3) Verify that the Current Recipe (parameter 17) is the desired recipe identification number.
4) Set the Recipe Get parameter (parameter 18) back to 0.

Parameters and Recipe may also be saved to a backup file using the web pages. This backup file may then be restored to other DS4000 controllers to copy the parameters and recipe from one controller to others. Please see Application Note, AN-109, for more information on backing up and restoring DS4000 controller settings.