VACON® 100 INDUSTRIAL
VACON® 100 FLOW
VACON® 100 X
VACON® 20
VACON® NXP
AC DRIVES

OPTE9, OPTEA
ADD-ON INSTRUCTION FOR ETHERNET/IP
USER MANUAL

VACON®

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Date: 15.2.2018
DPD Code: DPD02074A

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1 INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of this document and the provided Add-On Instructions (AOIs) is to give instructions and a working example on how to integrate VACON® series AC drives into RSLogix5000 control systems. The AOIs are provided with source codes to provide easy programming to end-user.

Several AOIs are provided from simple to more complex AOIs that allow access to more AC drive features.

All AOIs require parameterization from AC drive before they can be used. All parameter settings that differ from those set by default are described in this document.

NOTE!

Provided AOIs are examples and are not meant to be used as-is by the end user. The AOIs can be modified at will and serve as an example to start the programming of VACON® AC drives. The code should not be used as or a part of a safety system.

1.2 COMPATIBILITY

Use RSLogix5000 version 20.01. If you use newer versions, check the compatibility before starting.

2 AVAILABLE ADD-ON INSTRUCTIONS AND FEATURES

The table shows the Add-On Instructions (AOIs) that are available for use and modification.

Table 1. The AOIs available

AOI	Drive series			EtherNet/IP Assemblies	Use case	Motor control
	NXP	100	20			
VACON_DRIVE_20_70	x	x	x	20/70	Basic speed control	Speed
VACON_DRIVE_21_71	x	x	x	21/71	Extended speed control	Speed
VACON_NXP_111_117	x			111/117	Extended features for VACON® NXP	Frequency / Torque
VACON_100_111_117		x		111/117	Extended features for VACON® 100	Frequency / Torque

These examples provide means to control the drive using speed, frequency, and torque references.

2.1 VACON_DRIVE_20_70

This AOI uses EtherNet/IP CIP standard assembly instances 20 and 70. This provides a simple interface to control the AC drive.

- Start and stop of the drive handled with one bit
- Speed reference given as rpm
- Actual speed given as rpm
- Fault indication and resetting

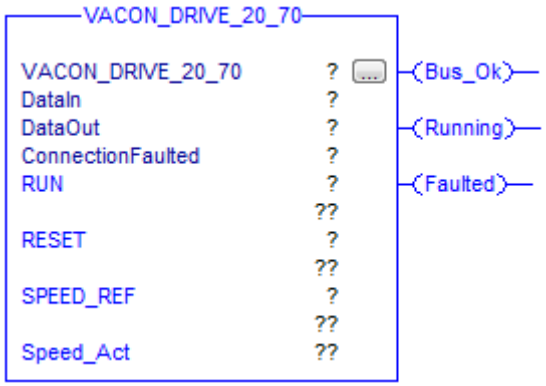


Figure 1.

Table 2.

Tag	Usage	Type	Description	Range
RUN	Input	BOOL	0 = Stop motor, 1 = Start motor	0..1
RESET	Input	BOOL	Rising edge resets faults from AC drive	0..1
SPEED_REF	Input	INT	Speed reference in rpm	0..32767
Bus_Ok	Output	BOOL	0 = Connection faulted, 1 = Connection ok	
Running	Output	BOOL	Motor is running	
Faulted	Output	BOOL	AC drive has an active fault	
Speed_Act	Output	INT	Actual speed (rpm)	

Supported AC drives: VACON® 100 family, VACON® 20 family, VACON® NX family.

2.2 VACON_DRIVE_21_71

This AOI uses EtherNet/IP CIP standard assembly instances 21 and 71. This provides slightly more control options and more information about the AC drive status.

- Start and stop of the drive handled with one bit
- Speed reference given as rpm
- Actual speed given as rpm, At_Ref indicates speed reference is reached
- Direction of motor controllable with one bit
- Fault and warning indication and resetting

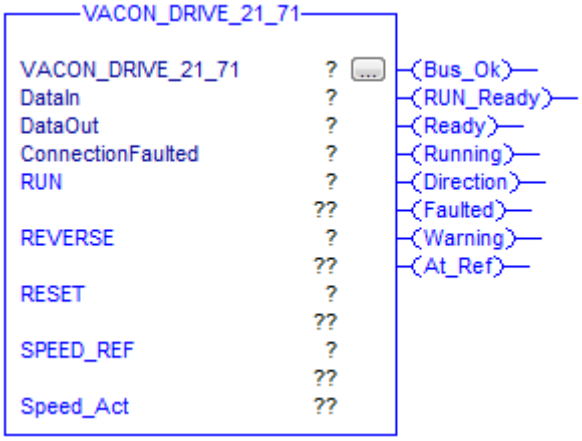


Figure 2.

Table 3.

Tag	Usage	Type	Description	Range
RUN	Input	BOOL	0 = Stop motor, 1 = Start motor	0..1
REVERSE	Input	BOOL	0 = Clockwise, 1 = Counter-clockwise	0..1
RESET	Input	BOOL	Rising edge resets faults from AC drive	0..1
SPEED_REF	Input	INT	Speed reference (rpm)	0..32767
Bus_Ok	Output	BOOL	0 = Connection faulted, 1 = Connection ok	
RUN_Ready	Output	BOOL	RUN command is accepted	
Ready	Output	BOOL	AC drive is ready to run	
Running	Output	BOOL	Motor is running	
Direction	Output	BOOL	0 = Clockwise, 1 = Counter-clockwise run direction	
Faulted	Output	BOOL	AC drive has an active fault	
Warning	Output	BOOL	AC drive has an active warning	
At_Ref	Output	BOOL	Motor is running at requested reference	
Speed_Act	Output	INT	Actual speed (rpm)	

Supported AC drives: VACON® 100 family, VACON® 20 family, VACON® NX family

2.3 VACON_NXP_111_117

This AOI is for VACON® NXP AC drives only. This AOI uses VACON® specific assembly instances 111 and 117. It is assumed that process data configuration is not modified from the default values of the VACON® Multi-Purpose application. If values are modified, the PDOs 1-8 might not display values correctly.

- Start and stop of the drive handled with one bit
- Speed reference given as percentage of maximum frequency

- Actual speed given as percentage of maximum frequency, At_Reference indicates reference reached
- Fault and warning indication and resetting
- 8 process data items displaying additional information about the drive, for example, frequency, current, power, voltage, etc.
- (Optional) Torque reference as percentage
    - Requires AC drive to be parameterized to torque control

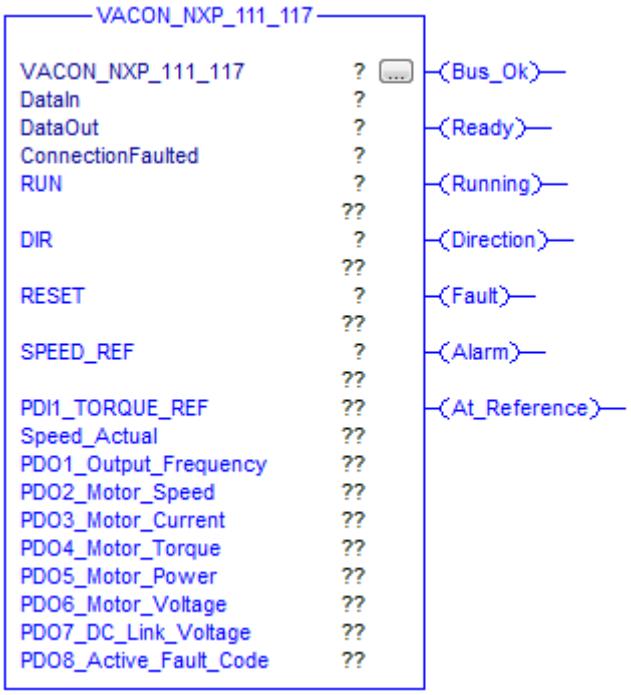


Figure 3.

Table 4.

Tag	Usage	Type	Description	Range
RUN	Input	BOOL	0 = Stop motor, 1 = Start motor	0..1
DIR	Input	BOOL	0 = Clockwise, 1 = Counter-clockwise	0..1
RESET	Input	BOOL	Rising edge resets faults from AC drive	0..1
SPEED_REF	Input	REAL	Speed reference in percentage of maximum frequency	0..100
PDI1_TORQUE_REF	Input	REAL	Torque reference in percentage of maximum torque	0..100
Bus_Ok	Output	BOOL	0 = Connection faulted, 1 = Connection ok	
Ready	Output	BOOL	AC drive is ready to run	
Running	Output	BOOL	Motor is running	

Direction	Output	BOOL	0 = Clockwise, 1 = Counter-clockwise run direction	
Fault	Output	BOOL	AC drive has an active fault	
Alarm	Output	BOOL	AC drive has an active alarm	
At_Reference	Output	BOOL	Motor is running at requested reference	
Speed_Actual	Output	REAL	Actual speed as percentage of maximum frequency	
PD01_Output_Frequency	Output	REAL	Output frequency of the motor (Hz)	
PD02_Motor_Speed	Output	INT	Actual speed of the motor (calculated) (rpm)	
PD03_Motor_Current	Output	REAL	Measured current of the motor (A)	
PD04_Motor_Torque	Output	REAL	Actual torque of the motor (calculated) in percentage of maximum torque (%)	
PD05_Motor_Power	Output	REAL	Actual shaft power of the motor (calculated) as a percentage of the motor nominal power (%)	
PD06_Motor_Voltage	Output	REAL	Actual output voltage of the motor (V)	
PD07_DC_Link_Voltage	Output	INT	Measured voltage in the DC-link of the drive (V)	
PD08_Active_Fault_Code	Output	INT	Latest activated fault code that is not reset	

Supported AC drives: VACON® NXP

2.4 VACON_100_111_117

This AOI is for VACON® 100 family AC drives only. This AOI uses VACON® specific assembly instances 111 and 117. It is assumed that process data configuration is not modified from the default values of the VACON® INDUSTRIAL application. If values are modified, the PDOs 1-8 might not display values correctly.

- Multiple stop modes and signals. Stop by ramp, coast and quick stop
- Reference as percentage of maximum frequency
- Actual speed as percentage of maximum frequency
- 8 process data items displaying additional information about the drive, e.g. frequency, current, power, voltage, etc.
- Quick ramp to make acceleration/deceleration faster
- Freeze and zero setpoint enables modifying setpoint
- Force control and reference to fieldbus regardless of AC drive parameterization
- Enable 2 jogging references

- (Optional) Torque reference as a percentage between minimum and maximum torque
  - Requires AC drive to be parameterized to torque control
  - 0 = Minimum torque reference

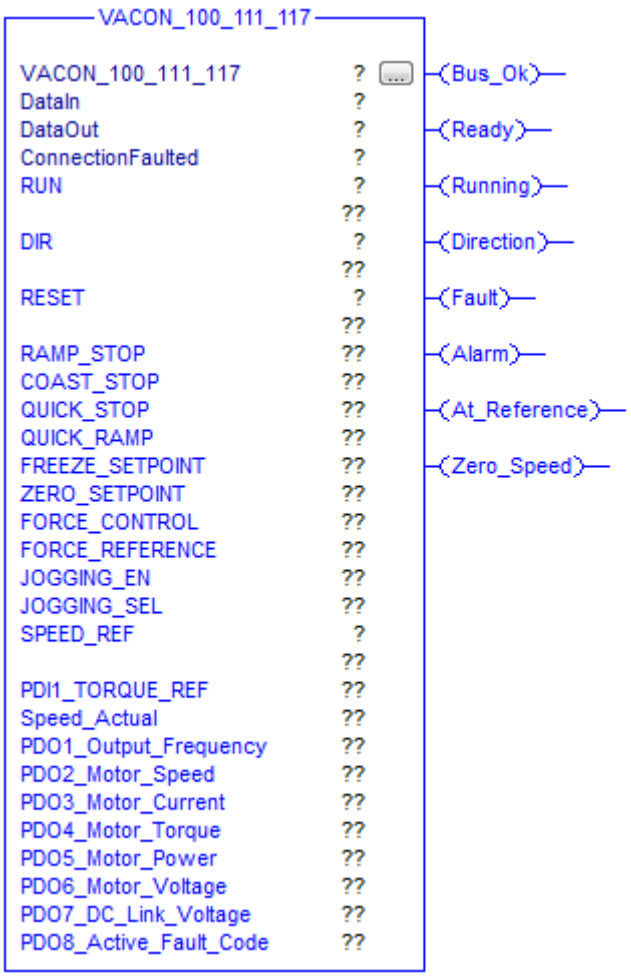


Figure 4.

Table 5.

Tag	Usage	Type	Description	Range
RUN	Input	BOOL	0 = Stop motor, 1 = Start motor	0..1
DIR	Input	BOOL	0 = Clockwise, 1 = Counter-clockwise	0..1
RESET	Input	BOOL	Rising edge resets faults from AC drive	0..1
RAMP_STOP	Input	BOOL	Stop motor with ramp stop even if RUN is set	0..1
COAST_STOP	Input	BOOL	Stop motor with coast stop even if RUN is set	0..1
QUICK_STOP	Input	BOOL	Activate quick stop	0..1
QUICK_RAMP	Input	BOOL	Activate quick ramp time	0..1

FREEZE_SETPOINT	Input	BOOL	Freeze setpoint, modification of SPEED_REF has no effect	0..1
ZERO_SETPOINT	Input	BOOL	Zero setpoint, force reference to zero	0..1
FORCE_CONTROL	Input	BOOL	Force Control place to Fieldbus	0..1
FORCE_REFERENCE	Input	BOOL	Force Reference place to Fieldbus	0..1
JOGGING_EN	Input	BOOL	Enable jogging, not possible if RUN is set	0..1
JOGGING_SEL	Input	BOOL	0 = Jogging reference 1, 1 = Jogging reference 2	0..1
SPEED_REF	Input	REAL	Speed reference in percentage of maximum frequency	0..100
PDI1_TORQUE_REF	Input	REAL	Torque reference between minimum and maximum torque	0..100
Bus_Ok	Output	BOOL	0 = Connection faulted, 1 = Connection ok	
Ready	Output	BOOL	AC drive is ready to run	
Running	Output	BOOL	Motor is running	
Direction	Output	BOOL	0 = Clockwise, 1 = Counter-clockwise run direction	
Fault	Output	BOOL	AC drive has an active fault	
Alarm	Output	BOOL	AC drive has an active alarm	
At_Reference	Output	BOOL	Motor is running at requested reference	
Zero_Speed	Output	BOOL	Motor is at zero speed	
Speed_Actual	Output	REAL	Actual speed as percentage of maximum frequency	
PDO1_Output_Frequency	Output	REAL	Output frequency of the motor (Hz)	
PDO2_Motor_Speed	Output	INT	Actual speed of the motor (calculated) (rpm)	
PDO3_Motor_Current	Output	REAL	Measured current of the motor (A)	
PDO4_Motor_Torque	Output	REAL	Actual torque of the motor (calculated) (%)	
PDO5_Motor_Power	Output	REAL	Actual shaft power of the motor (calculated) as a percentage of the motor nominal power (%)	
PDO6_Motor_Voltage	Output	REAL	Actual output voltage of the motor (V)	
PDO7_DC_Link_Voltage	Output	INT	Measured voltage in the DC-link of the drive (V)	

PDO8_Active_Fault_Code	Output	INT	Latest activated fault code that is not reset	

Supported AC drives: VACON® 100 family.

3 CONFIGURATION OF THE AC DRIVE

The chapters 2.1 and 2.2 describe how to get the AC drive to communicate and to be controllable over EtherNet/IP. One or several of the following tools can be used for commissioning depending on the used AC drive:

- Keypad
- NCDrive (VACON® NXP)
- VACON® Live (VACON® 100)
- NCIPConfig (OPTE9/A in all drives)

The following chapters describe the parameterization of VACON® 100 INDUSTRIAL and VACON® NXP Multi-Purpose applications. If you are using a different application, refer to the relevant application manual for details on parameters.

3.1 ETHERNET/IP PARAMETERIZATION

Use the OPTE9/A option board or the inbuilt EtherNet/IP of VACON® 100.

For the OPTE9/A option board, change the following settings. These parameters can be found under path 7.5 in VACON® NXP, and under path 5.4.3 in VACON® 100 (when the OPTE9/A option board is installed into slot E).

Table 6. OPTE9/A Ethernet parameters

Description	Setting
Comm. Protocol	EtherNet/IP
IP Mode	Static IP / Fixed IP
IP Address Part 1 - 4	e.g. 192.168.1.10
Subnet Mask Part 1 -4	e.g. 255.255.255.0

For the inbuilt EtherNet/IP of VACON® 100, change the following settings:

Table 7. VACON® 100 Ethernet parameters (without OPTE9/A)

Parameter	Description	Setting
5.9.1.1	IP Address Mode	Fixed IP
5.9.1.4.1	IP Address	e.g. 192.168.1.10
5.9.1.4.2	Subnet Mask	e.g. 255.255.255.0
5.9.4.1.1	EtherNet/IP Protocol in use	Yes

3.2 AC DRIVE PARAMETERIZATION

Some parameters must be set for the AC drive to be controllable via fieldbus and to control the motor correctly. Note that only settings that differ from application default values are listed here.

In VACON® NXP, change the following parameters:

Table 8. VACON® NXP parameters

Parameter	Description	Setting	Note
2.6.1	Motor Ctrl Mode	Freq Control OL/CL SpeedCont OL/CL TorqCtrl	
2.10.4	Torq Ref Select	Fieldbus	Only if TorqCtrl is used
3.1	Control Place	Fieldbus	

In VACON® 100, change the following parameters:

Table 9. VACON® 100 parameters

Parameter	Description	Setting	Note
3.1.2.1	Control Mode	Frequency Ctrl OL Speed Ctrl OL Torque Ctrl	
3.2.1	Rem Control Place	FieldbusCTRL	
3.3.2.1	Torque Ref Sel	ProceDataIn1	Only if OL Torque Ctrl is used

Motor control mode: Depending on the used AOI and use case, the motor control mode should be set. If torque mode is set, torque reference selection must also be set. In the example AOI provided (VACON_100_111_117 and VACON_NXP_111_117), it is assumed that torque reference is sent in Process Data In 1. Therefore, torque reference must be set to Process Data In 1.

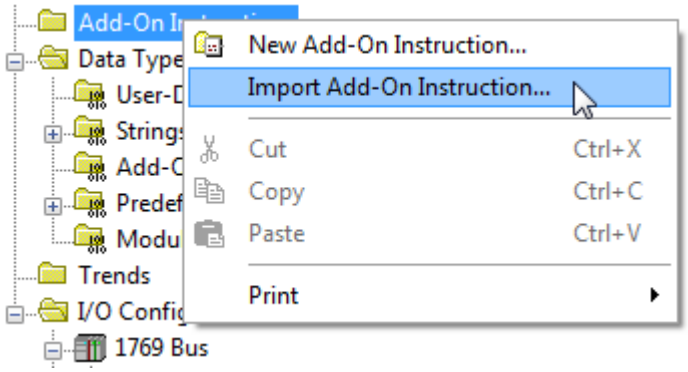
4 USING THE ADD-ON INSTRUCTION (AOI)

The following example uses AOI VACON_DRIVE_21_71 using CIP standard assembly instances 21 & 71, and a VACON® NXP drive with the OPTE9/A option board.

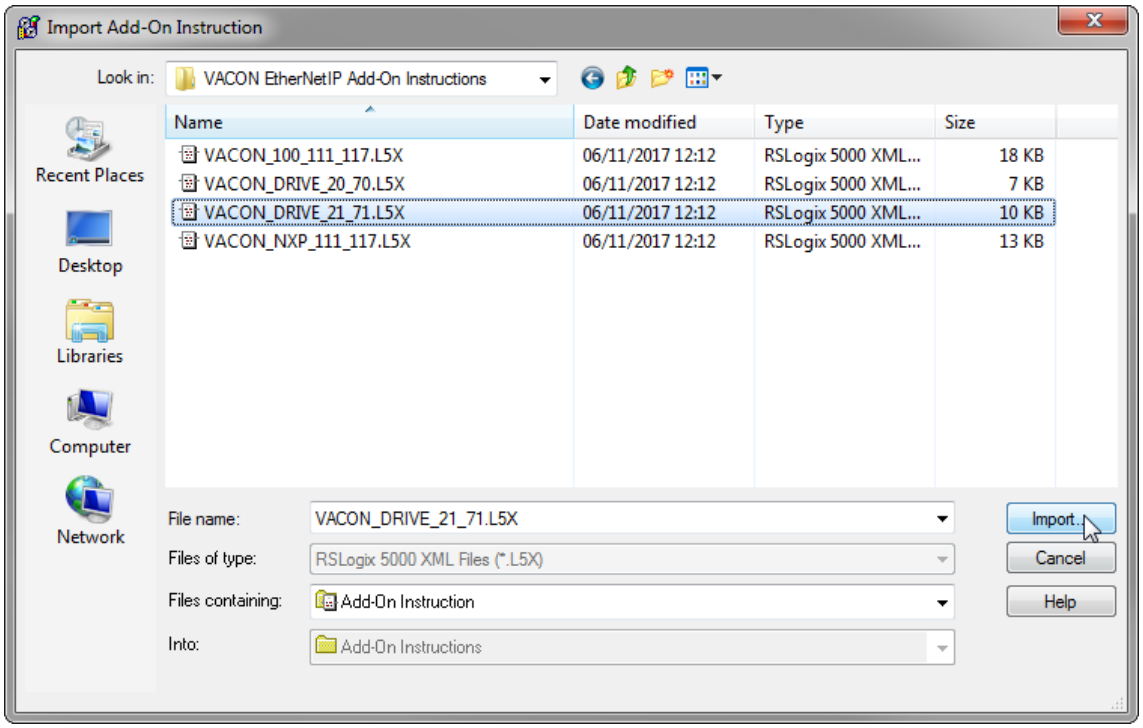
This example uses RSLogix5000 version 20.01. There might be differences between RSLogix5000 versions that are not accounted for in this example.

4.1 IMPORTING THE AOI

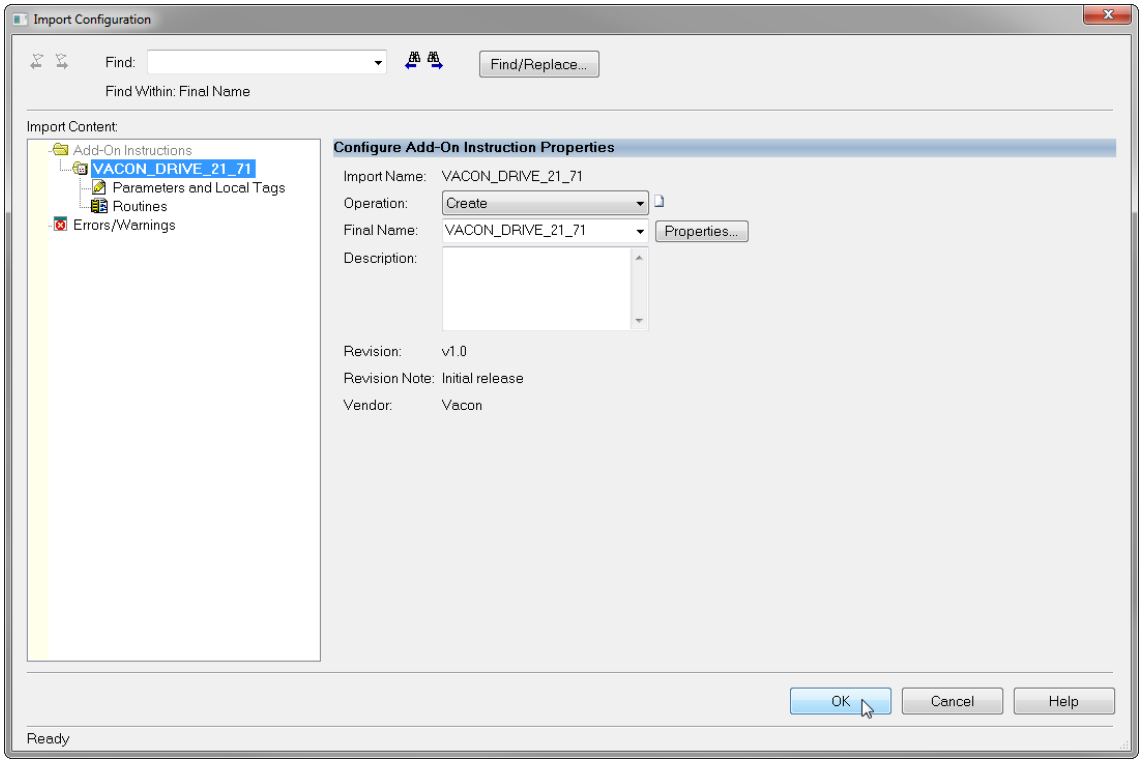
1) Download the VACON® AOIs from the Danfoss Drives website under "Downloads" and "Fieldbus configuration files".
2) Create a new project in RSLogix5000.
3) Right click the Add-On Instructions folder in the Controller Organizer and click "Import Add-On Instruction..."



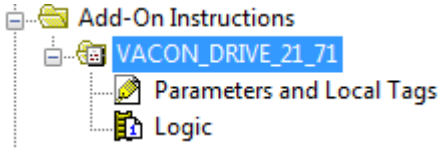
4) Select the VACON_DRIVE_21_71.L5X and click "Import".



5) Make sure that there are no errors or warnings.
   a. If there are no errors or warnings, importing can be continued.
6) Press "OK".



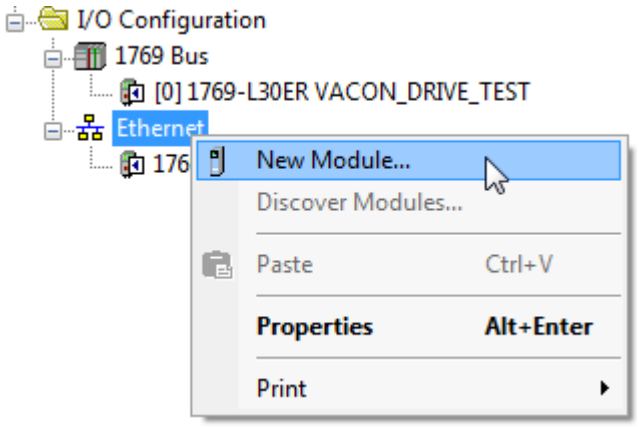
7) The AOI is now imported and is visible under "Add-On Instructions".



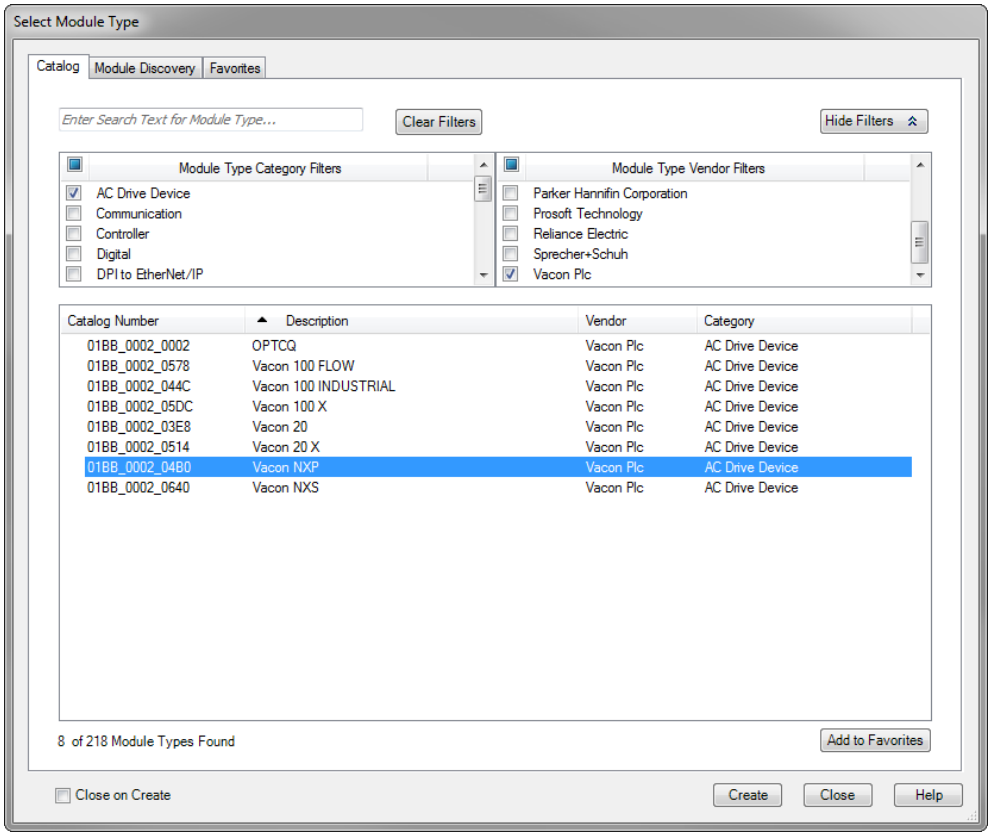
8) The logic of the AOI can now be browsed and modified.

4.2 CONFIGURING THE PLC I/O

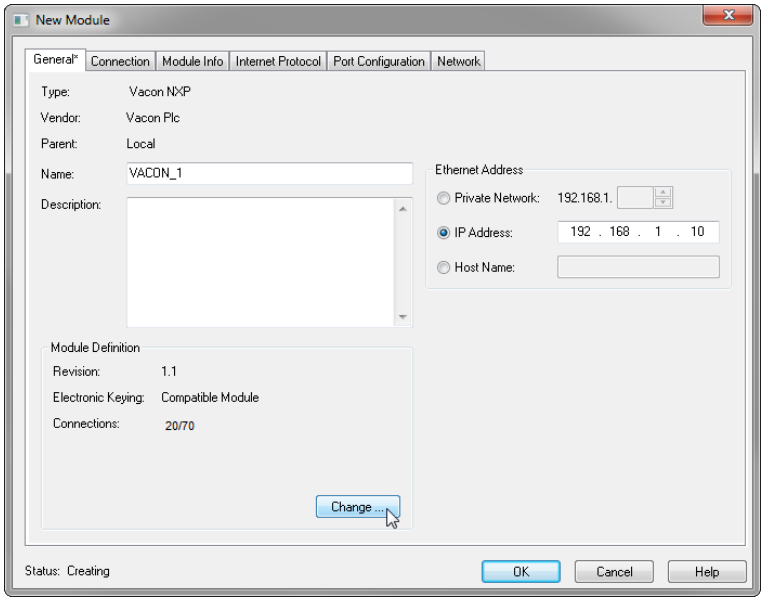
1) Download the VACON® EDS file for the selected AC drive or option from the Danfoss Drives website under "Downloads" and "Fieldbus configuration files".
2) Use the "EDS Hardware Installation Tool" under "Tools" to register the downloaded EDS files to RSLogix5000.
3) Create a new module for the I/O configuration by right clicking the controller and selecting "New Module..."



4) Select the correct EDS file according to the used setup and click "Create".
   a. In this example, the VACON® NXP drive is used with an OPTE9/A option board.

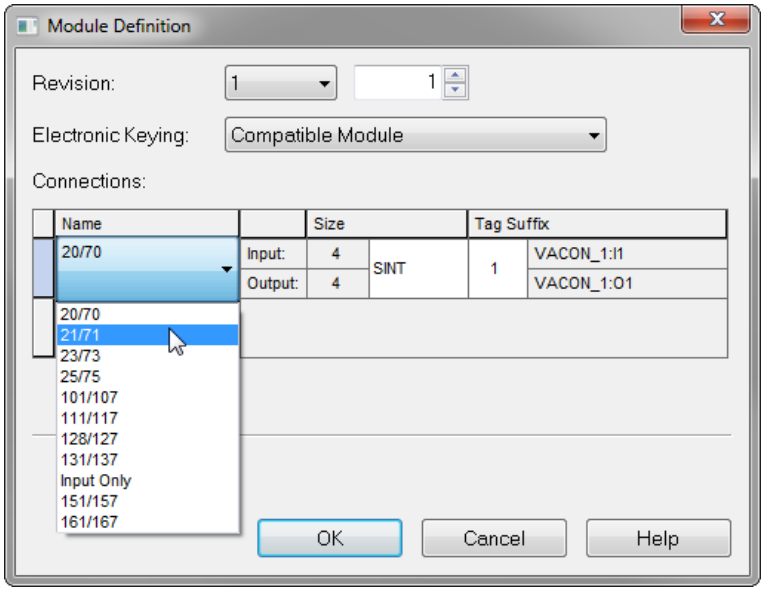


5) Give the module a name. In this example, "VACON_1" is used.
6) Give the module a valid IP address. The IP address must be same as what was configured for OPTE9/A (see Chapter 2.1).
7) Click "Change".

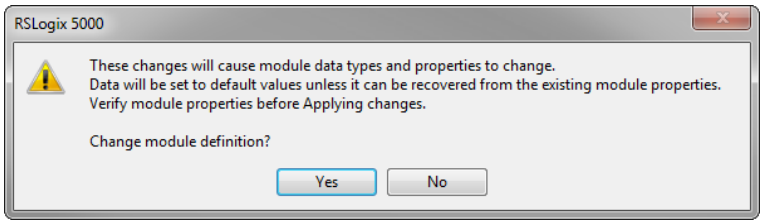


8) Change the module definition to use assembly instances 21/71.
   a. This should be selected to be the same as what the AOI is using. In this example, it is VACON_DRIVE_21_71.

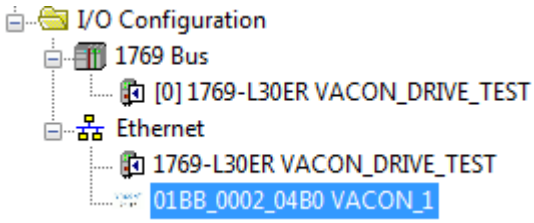
9) Make sure that the data type is “SINT”.
10) Click “OK”.



11) When the following warning message appears, click “Yes”.



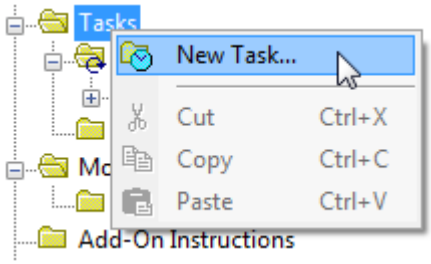
12) Confirm the settings by clicking “OK”.
13) Close the “Select Module Type” window by clicking “Close”.
    a. A valid I/O module for the VACON® NXP with OPTE9/A has now been added.



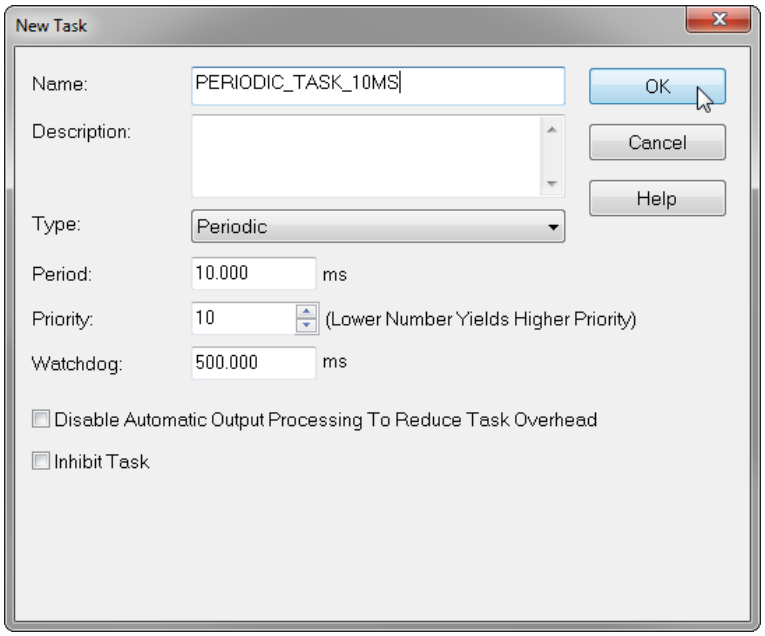
4.3 CREATING A TASK/PROGRAM/ROUTINE IN RSLOGIX5000

To handle the AOI, create a new periodic task. The AOI should not be run in the main task as it is run continuously.

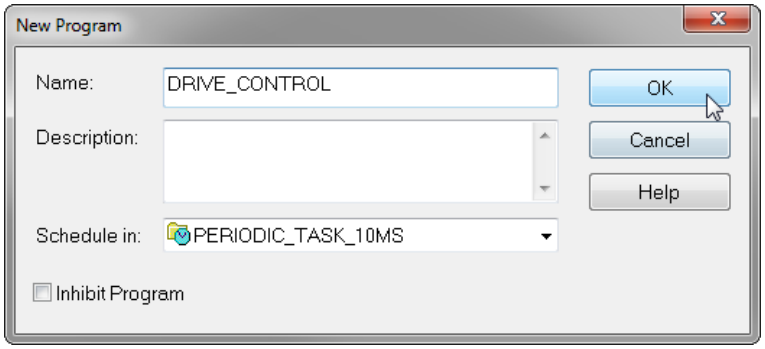
1) Right click "Tasks" and select "New Task..."



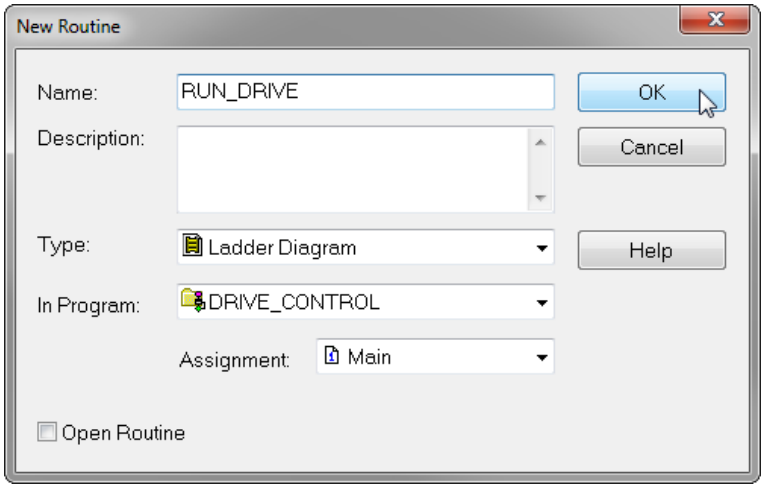
2) Give the task a name (in this example, PERIODIC_TASK_10MS).
3) Change the settings, if necessary.
    a. In this example, the default settings are used.



4) Right click the newly created task and click "New Program..."
5) Give the program the name "DRIVE_CONTROL".
6) Click "OK".



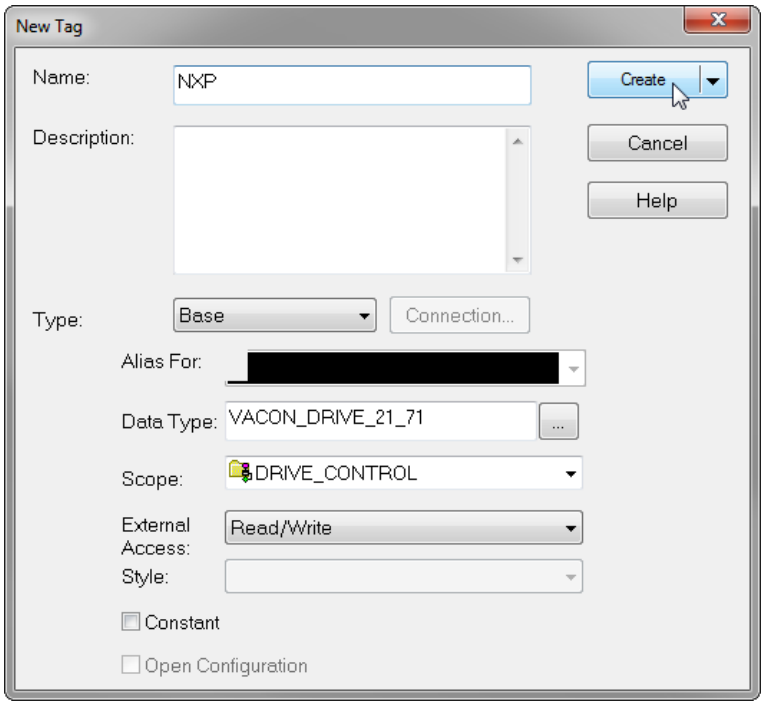
7) Right click the DRIVE_CONTROL program and click "New Routine…"
    a. In this example, "Ladder Diagram" is used.
8) Give the routine the name "RUN_DRIVE".
9) Click "OK".



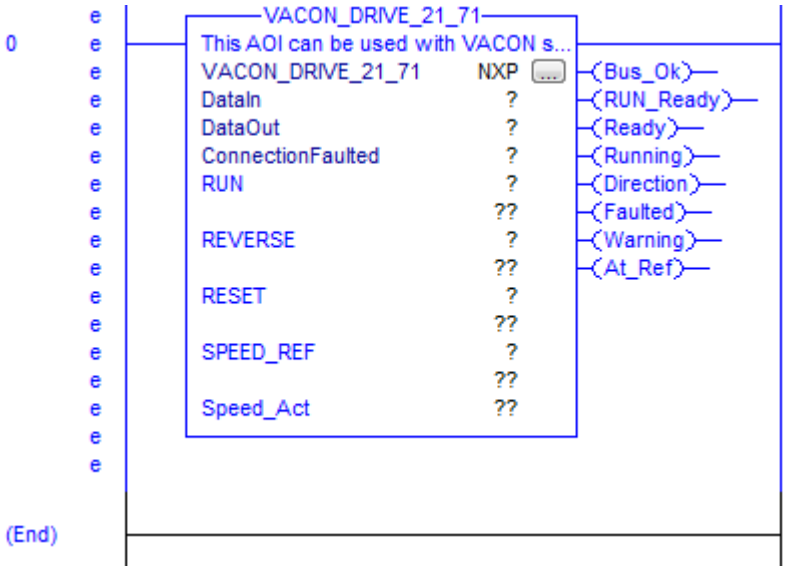
4.4 SETTING UP THE AOI

When the AOI is imported, a valid module created for VACON® NXP (OPTE9/A), and a task is available for it, the AOI can be taken into use.

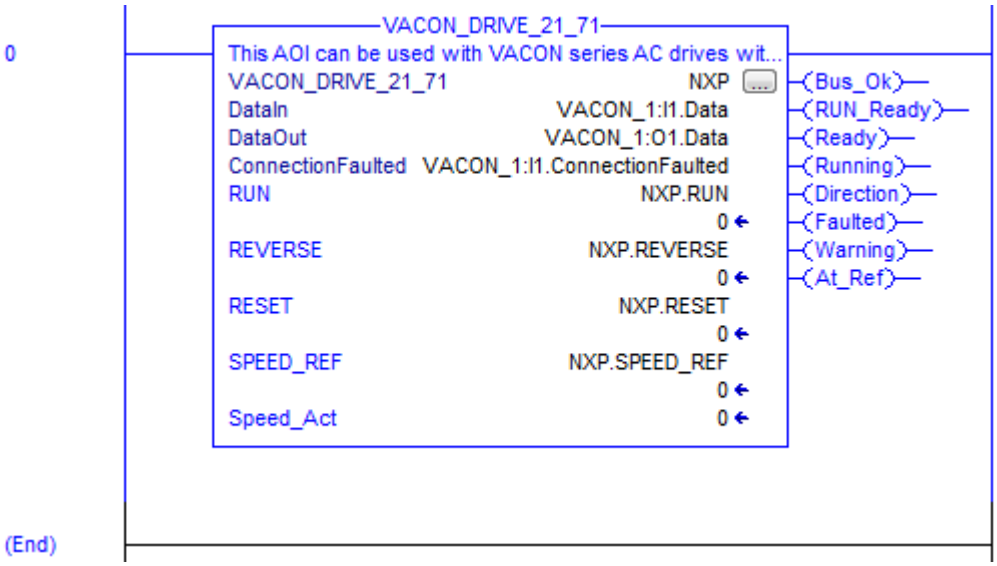
1) Create a new tag "NXP" under DRIVE_CONTROL.
2) Select VACON_DRIVE_21_71 as data type. Select the same data type as the imported AOI has.
3) Click "Create".



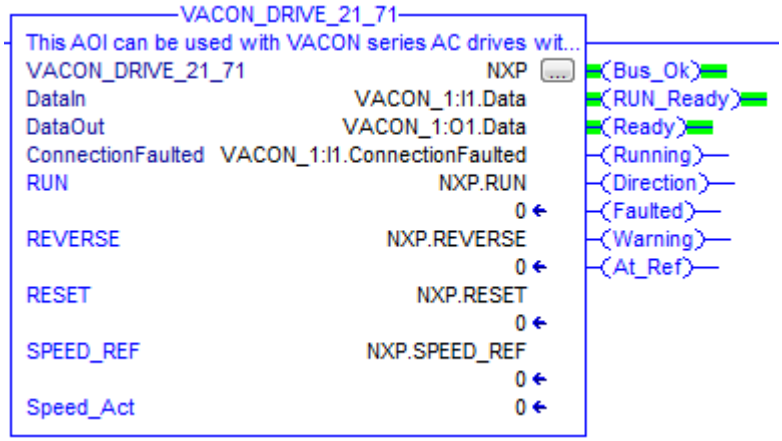
4) Open the routine RUN_DRIVE and drag the VACON_DRIVE_21_71 AOI under the Add-On-Instructions to the Rung.
   - When the AOI has been placed in the GUI, the you should see the following view.



5) Set the values of the AOI in the following way (I/O module "VACON_1" and data tag "NXP"):
   - DataIn: VACON_1:I1.Data
   - DataOut: VACON_1:O1.Data
   - ConnectionFaulted: VACON1:I1.ConnectionFaulted
   - RUN: NXP.RUN
   - REVERSE: NXP.REVERSE
   - RESET: NXP.RESET
   - SPEED_REF: NXP.SPEED_REF



6) The project can now be downloaded to the PLC.
7) Signals Bus_Ok, RUN_Ready and Ready are active when the AC drive is ready to run with the RUN signal. See the figure below.



8) The AC drive is now ready to run and by setting "1" to RUN, the motor starts with reference SPEED_REF.

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Document ID:
DPD02074A
Rev. A

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