VACON®
AC DRIVES

DEVICENET OPTION BOARD OPTE7
USER MANUAL

VACON®

TABLE OF CONTENTS

Document: DPD01171C
Release date : 26.01.2024

1. SAFETY

This manual contains clearly marked cautions and warnings that are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Read the information included in cautions and warnings carefully.

The cautions and warnings are marked as follows:

Table 1. Warning signs

	**= DANGER! Dangerous voltage**
	**= WARNING or CAUTION**
	**= Caution! Hot surface**

1.1 DANGER

	The **components of the power unit are live** when the drive is connected to mains potential. Coming into contact with this voltage is **extremely dangerous** and may cause death or severe injury.
	The **motor terminals U, V, W and the brake resistor terminals are live** when the AC drive is connected to mains, even if the motor is not running.
	**After disconnecting** the AC drive from the mains, **wait** until the indicators on the keypad go out (if no keypad is attached, see the indicators on the cover). Wait 5 more minutes before doing any work on the connections of the drive. Do not open the cover before this time has expired. After expiration of this time, use a measuring equipment to absolutely ensure that no voltage is present. **Always ensure absence of voltage before starting any electrical work!**
	The control I/O-terminals are isolated from the mains potential. However, the **relay outputs and other I/O-terminals may have a dangerous control voltage** present even when the AC drive is disconnected from mains.
	**Before connecting** the AC drive to mains make sure that the front and cable covers of the drive are closed.
	During a ramp stop (see the Application Manual), the motor is still generating voltage to the drive. Therefore, do not touch the components of the AC drive before the motor has completely stopped. Wait until the indicators on the keypad go out (if no keypad is attached, see the indicators on the cover). Wait additional 5 minutes before starting any work on the drive.

1.2 WARNINGS

	The AC drive is meant for **fixed installations only**.
	**Do not perform any measurements** when the AC drive is connected to the mains.
	The **earth leakage current** of the AC drives exceeds 3.5mA AC. According to standard EN61800-5-1, **a reinforced protective ground connection** must be ensured. See Chapter 1.3.
	If the AC drive is used as a part of a machine, the **machine manufacturer is responsible** for providing the machine with a **supply disconnecting device** (EN 60204-1).
	Only **spare parts** delivered by Vacon can be used.
	At power-up, power brake or fault reset **the motor will start immediately** if the start signal is active, unless the pulse control for Start/Stop logic has been selected. Furthermore, the I/O functionalities (including start inputs) may change if parameters, applications or software are changed. Disconnect, therefore, the motor if an unexpected start can cause danger.
	The **motor starts automatically** after automatic fault reset if the auto restart function is activated. See the Application Manual for more detailed information.
	**Prior to measurements on the motor or the motor cable**, disconnect the motor cable from the AC drive.
	**Do not touch the components on the circuit boards**. Static voltage discharge may damage the components.
	Check that the **EMC level** of the AC drive corresponds to the requirements of your supply network.

1.3 GROUNDING AND EARTH FAULT PROTECTION

CAUTION!

The AC drive must always be earthed with an grounding conductor connected to the grounding terminal marked with ⏚.

The earth leakage current of the drive exceeds 3.5mA AC. According to EN61800-5-1, one or more of the following conditions for the associated protective circuit must be satisfied:

a) The protective conductor must have a cross-sectional area of at least 10 mm^2 Cu or 16 mm^2 Al, through its total run.

b) Where the protective conductor has a cross-sectional area of less than 10 mm^2 Cu or 16 mm^2 Al, a second protective conductor of at least the same cross-sectional area must be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm^2 Cu or 16 mm^2 Al.

c) Automatic disconnection of the supply in case of loss of continuity of the protective conductor.

The cross-sectional area of every protective grounding conductor which does not form part of the supply cable or cable enclosure must, in any case, be not less than:

- 2.5mm^2 if mechanical protection is provided or
- 4mm^2 if mechanical protection is not provided.

The earth fault protection inside the AC drive protects only the drive itself against earth faults in the motor or the motor cable. It is not intended for personal safety.

Due to the high capacitive currents present in the AC drive, fault current protective switches may not function properly.

Do not perform any voltage withstand tests on any part of the AC drive. There is a certain procedure according to which the tests must be performed. Ignoring this procedure can cause damage to the product.

NOTE! You can download the English and French product manuals with applicable safety, warning and caution information from https://www.danfoss.com/en/service-and-support/.

REMARQUE Vous pouvez télécharger les versions anglaise et française des manuels produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site https://www.danfoss.com/en/service-and-support/.

2. DeviceNet option board OPTE7 - General

2.1 Overview

OPTE7 is a DeviceNet option board for VACON® AC drives. It allows the AC drive to be controlled using the DeviceNet protocol. The option board implements the AC Drive device profile as defined by CIP.

DeviceNet™ is a trademark of ODVA, Inc. The OPTE7 option board connects a drive into the DeviceNet network. There can be 64 nodes in one network. The baud rate is up to 500 kbit/s. The DeviceNet master can control and monitor the drives.

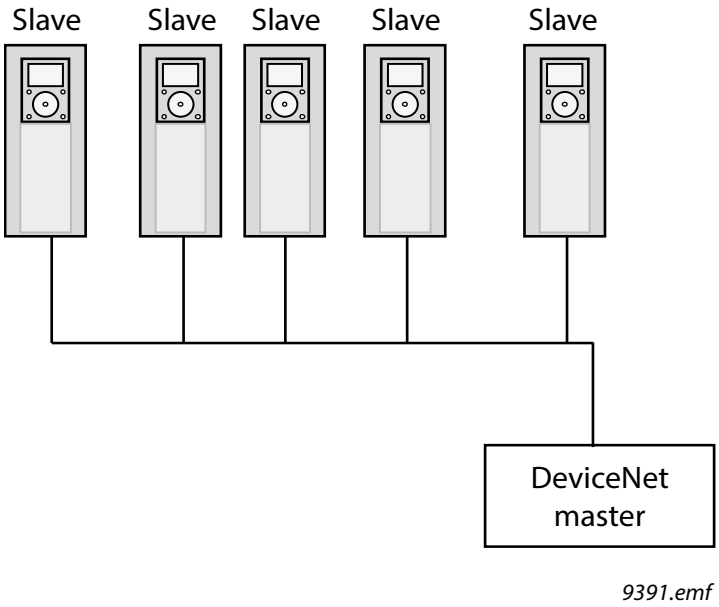


Figure 1. Typical DeviceNet network structure

2.1.1 DeviceNet physical layer and media

The basic trunkline-dropline topology provides separate twisted pair busses for both signal and power distribution. Thick or thin cable can be used for either trunklines or droplines. End-to-end network distance varies with data rate and cable size.

Devices can be powered directly from the bus and communicate with each other using the same cable. Nodes can be removed from or inserted to the network without powering down the network.

Power taps can be added at any point in the network which makes redundant power supplies possible. The trunkline current rating is 8 amperes. An opto-isolated design option allows externally powered devices (e.g. AC drive's starters and solenoid valves) to share the same bus cable. Other CAN-based networks allow only a single power supply (if at all) for the entire network.

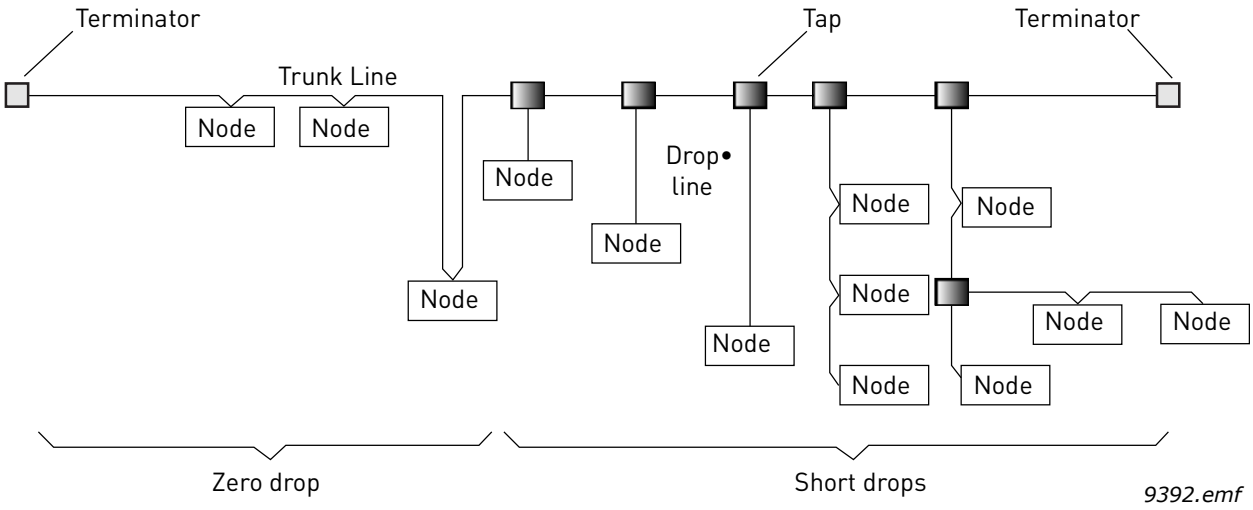


Figure 2. Thick or thin cable for either trunklines or droplines

2.2 DEVICENET PROTOCOL DESCRIPTION

DeviceNet is a communication protocol that is managed by the ODVA (Open DeviceNet Vendors Association). It uses CAN (Controller Area Network) as the backbone technology and at the higher level it implements CIP (Common Industrial Protocol). CIP is used by the following protocols:

- DeviceNet
- EtherNet/IP
- ControlNet
- CompoNet

CIP ensures high integrity/interoperability between all of these, especially from the end user perspective. CIP is object-oriented. It defines objects with its attributes and supported services. The objects can have multiple instances. Instance zero indicates object's class itself. Depending on the implemented profile, some objects are mandatory and have to be implemented. Additionally, each vendor can implement vendor-specific objects.

The following objects are implemented by the OPTE7 option board:

Table 2.

	Class	Object
Required by DeviceNet	0x01	Identity
	0x02	Message Router
	0x03	DeviceNet
	0x04	Assembly
	0x05	DeviceNet Connection
Required by Drive Profile	0x28	Motor Data
	0x29	Control Supervisor
	0x2A	AC/DC Drive
Vendor-Specific	0xA0	Vendor Parameter

Table 3.

Physical / Data link layer	CAN - Controller Area Network
Application layer	CIP - Common Industrial Protocol
Profiles	AC/DC Drives
Configuration file	EDS - Electronic Data Sheet
Baud rates	125 kbit/s, 250 kbit/s, and 500 kbit/s
Bus length	Trunk length is inversely proportional to the speed, i.e. 500, 250 and 100 meters respectively
Max nodes	64

2.2.1 EDS (Electronic Data Sheet) file

EDS is a configuration file that describes the capabilities of the DeviceNet node. It can be used by the configuration tool to simplify the process of commissioning. EDS is actually a simple text file that follows the rules specified by the ODVA in the DeviceNet specification. Therefore, it could be opened and viewed with a simple text editor e.g. Notepad.

The EDS file for the OPTE7 option board can be downloaded from http://drives.danfoss.com website.

3. DEVICENET OPTION BOARD OPTE7 - TECHNICAL DATA

3.1 GENERAL

Table 4. Technical data of OPTE7 option board

CAN bus electrical isolation	500 VDC	
Ambient temperature	As specified in drive specification (-10°C...40°C)	
Storing temperature	As specified in drive specification (-40°C...70°C)	
Humidity	0-95%, non-condensing, corrosive	
Vibration and electrical safety	EN 61800-5-1 (2007) 5-15.8 Hz 1mm (peak) 15.8-150 Hz 1 G	
Emission	C2 level, EN 61800-3 (2004)	
Immunity	C2 level, EN 61800-3 (2004)	
CAN Interface	Isolation	2500 V rms isolation with a less than 10-ns propagation delay
	Protection	±8kV ESD IEC 61000-4-2 Contact Discharge ±80V Fault Protection greater than ±12V common Mode Range

3.2 CAN CABLE

The recommended cables for installation are 4-wire twisted and shielded cables with an impedance of 120 Ohm. The network topology is a 2-wire bus line that is terminated at both ends by resistors representing the characteristic impedance of the bus line. The typical CAN cable impedance is 120 Ohm, so you must use termination resistors of ~120 Ohm. For long networks, use a higher resistor value (150-300 Ohm).

Table 5. Bus parameter relation to cable length

Cable length	Max bit rate [kbit/s]
100 m	500
250 m	250
500 m	120

3.2.1 Recommended cable

For all DeviceNet installations the use of 4-wire cable is recommended.

The manufacturer recommends the following cable:

- UNITRONIC® BUS CAN FD P, colour-coded in accordance with DIN 47100.

Figure 3. Recommended cable

Table 6. Cable thickness, length and baud rate relation

Bit rate	Min cable thickness [mm^2]		
500 kbit/s	0.34		
250 kbit/s	0.34	0.6	
125 kbit/s	0.34	0.6	0.6
Cable length [m]	100	250	500

4. OPTE7 LAYOUT AND CONNECTIONS

4.1 LAYOUT AND CONNECTIONS

OPTE7 has two different hardware revisions with slightly different layouts. The layout is different in the LED arrangement and the termination resistor orientation.

The two hardware revisions are marked with different product codes, and this product code can be seen in the sticker on the top side of the option board (see the location in Figure 6).

The two hardware revisions are 70CVB01817 and 70CVB01555.

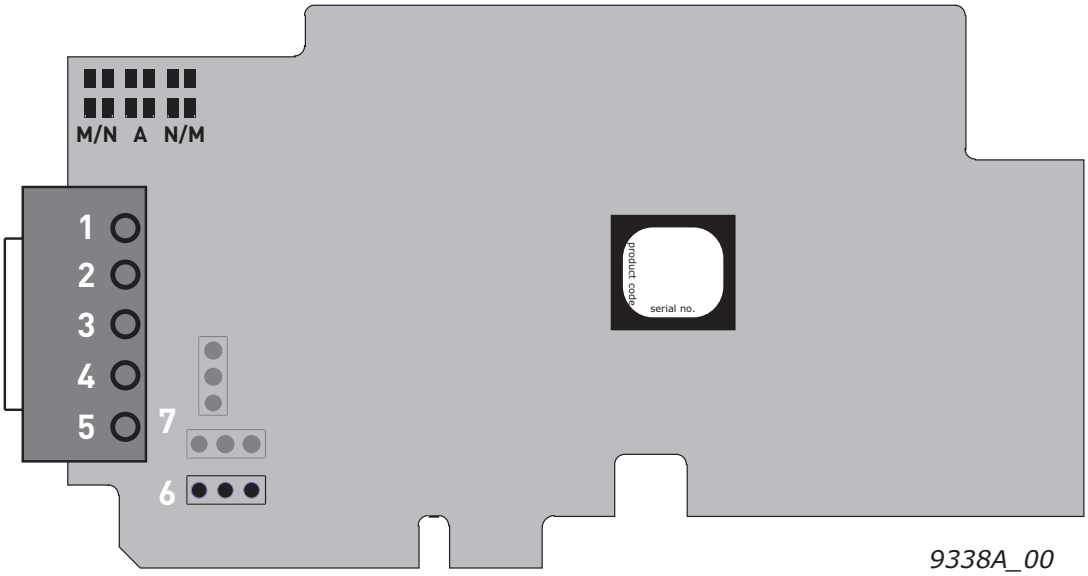


Figure 4. OPTE7 board layout

1 = V- (GND)
2 = CAN L
3 = SHIELD (shield connector)
4 = CAN H
5 = V+ (24V)
6 = Cable shield grounding option
7 = CAN bus termination jumper

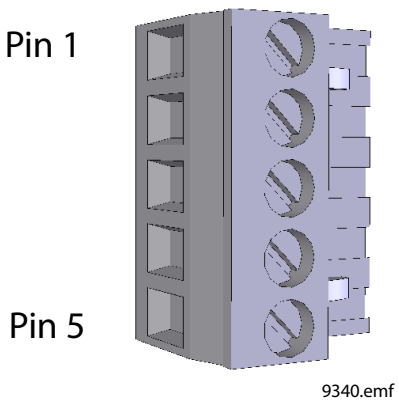


Figure 5. CAN connector

Table 7. CAN connector pinout

Pin	Description
1	V-, isolated digital ground
2	CAN LO
3	Shield connector
4	CAN HI
5	V+ (24V), communication power supply

4.2 LED Indications

The DeviceNet option board includes two LED status indicators next to the connector: network status (N), and module status (M).

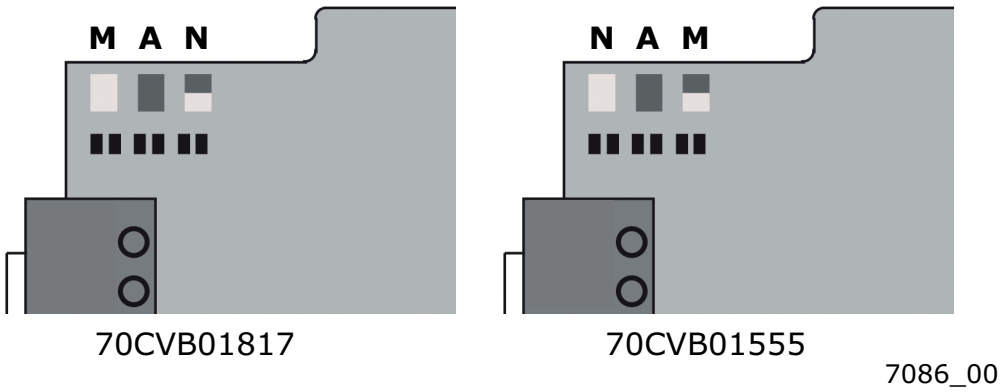


Figure 6. OPTE7 LED indicators

The network status provides information on the network connection status, and the module status provides information on the DeviceNet module.

Table 8. Module status led

LED status	Description
OFF	No power is supplied to the drive.
Green	OPTE7 is operating normally.
Flashing green	OPTE7 is in the Standby state, or the device needs commissioning due to missing, incomplete or incorrect configuration.
Flashing red	The OPTE7 has detected a Recoverable Fault.
Red	The OPTE7 has detected an Unrecoverable Fault.

Table 9. Network status led

LED status	Description
OFF	OPTE7 is not online. • The device has not completed the Dup_MAC_ID test yet. • If the Module Status LED is off, the device is not powered.
Flashing green	The OPTE7 has passed the Dup_MAC_ID test, is online, but is not allocated to a master.
Green	The OPTE7 is online and allocated to a master.
Flashing red	One or more I/O connections are in the Timed–Out state.
Red	The OPTE7 cannot communicate on the network (Duplicate MAC ID, or Bus–off).

4.3 JUMPERS

The termination resistor jumper location differs on used hardware version. The jumper locations can be seen from figure below.

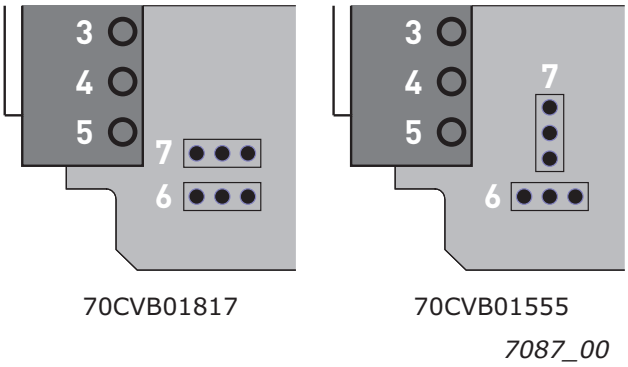


Figure 7. Jumper locations

The jumper settings for the CAN bus termination resistor are shown in the figure below.

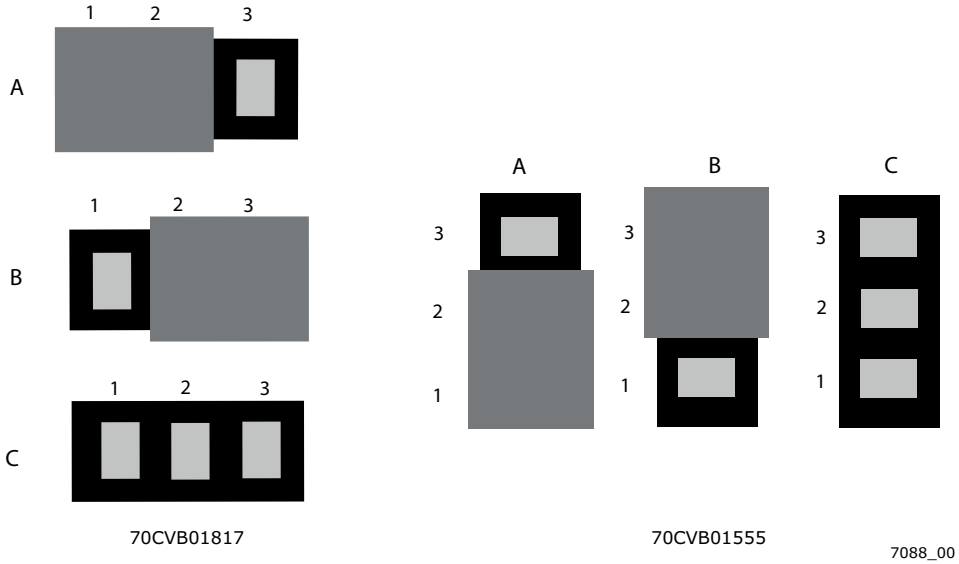


Figure 8. Termination resistor settings

A = Termination resistor 120 Ohm connected

B = Termination resistor is not connected to the CAN bus. (Factory default setting)

C = Termination resistor is not connected to the CAN bus

The jumper settings for the CAN cable shield grounding are shown in the following figure.

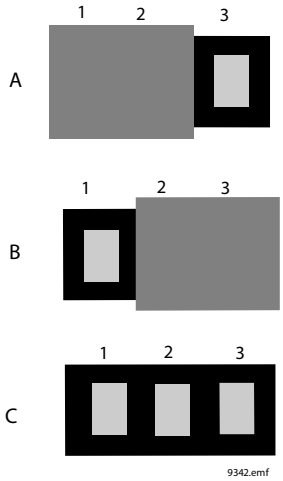


Figure 9. Cable shield grounding option

A = CAN connector pin 3 (shield) connected to the drive chassis with a high-impedance RC circuit. Recommended option when equipotential bonding is poor.

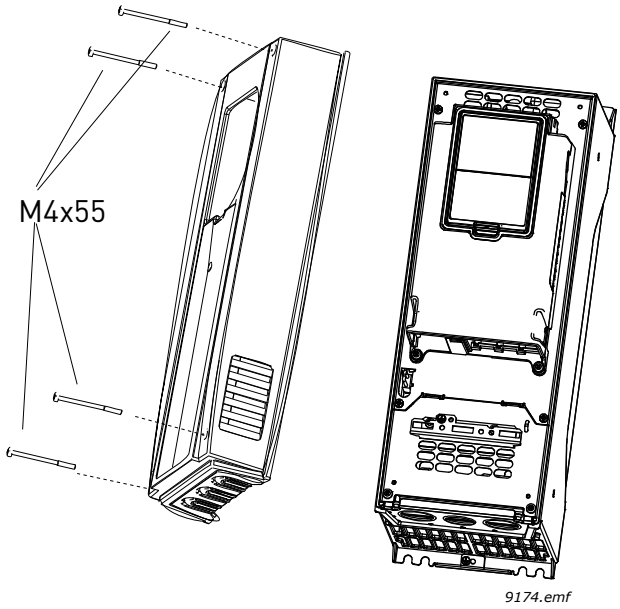
B = CAN connector pin 3 (shield) connected directly into the drive chassis. Recommended option when equipotential bonding is good. (Factory default setting).

C = CAN connector pin 3 is unconnected.

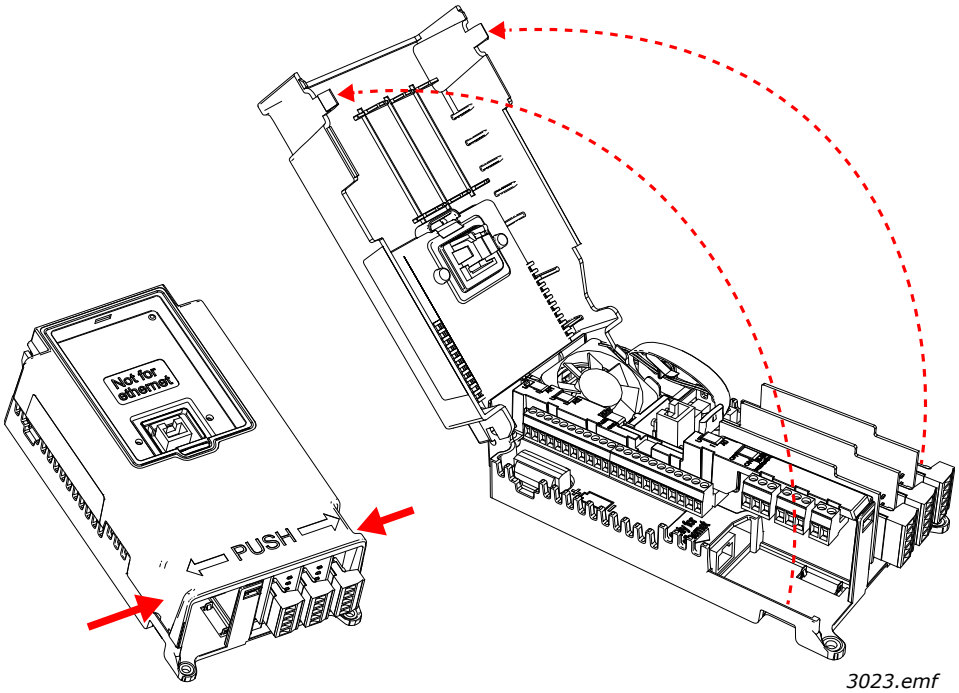
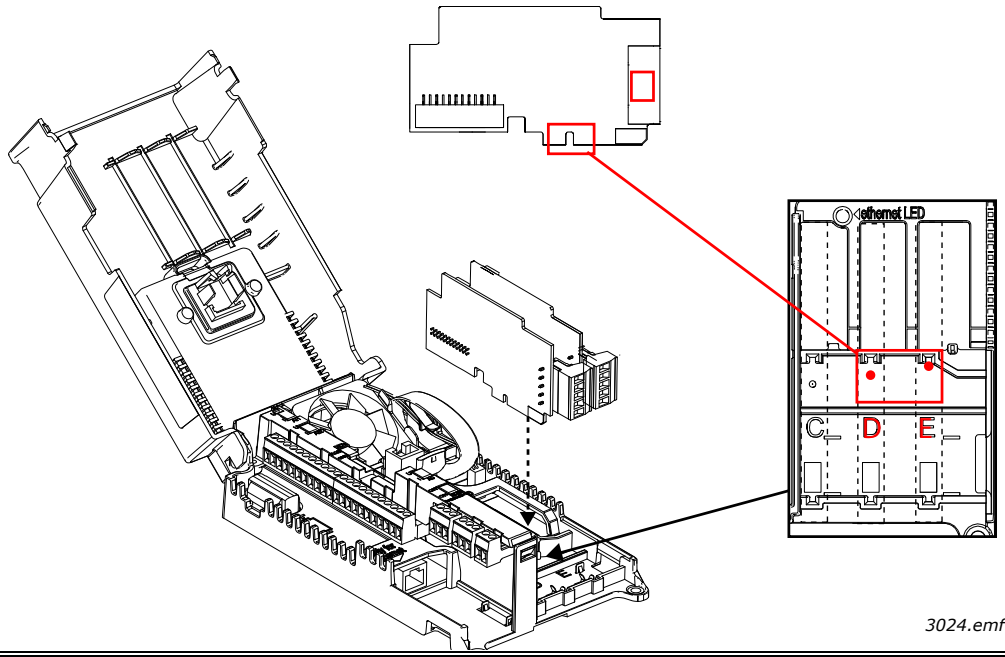
5. INSTALLATION

The VACON® OPTE7 DeviceNet option board can be used with VACON® 100 family, VACON® 20, VACON® 20 X and VACON® 20 CP AC drives. OPTE7 support was added to VACON® NXP firmware version V197 and to VACON® NXS firmware version V184. NXP/NXS support requires OPTE7 firmware version V006.

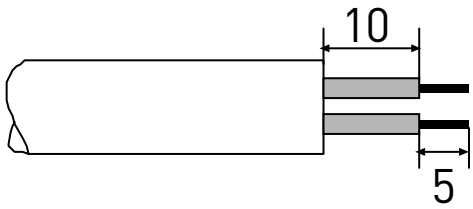
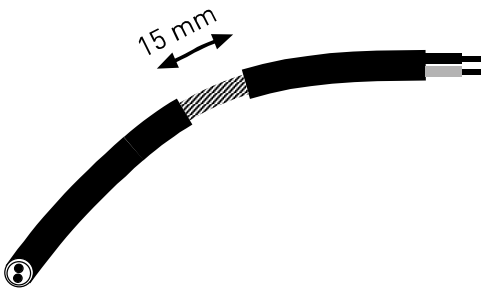
5.1 INSTALLATION IN VACON® 100 INDUSTRIAL

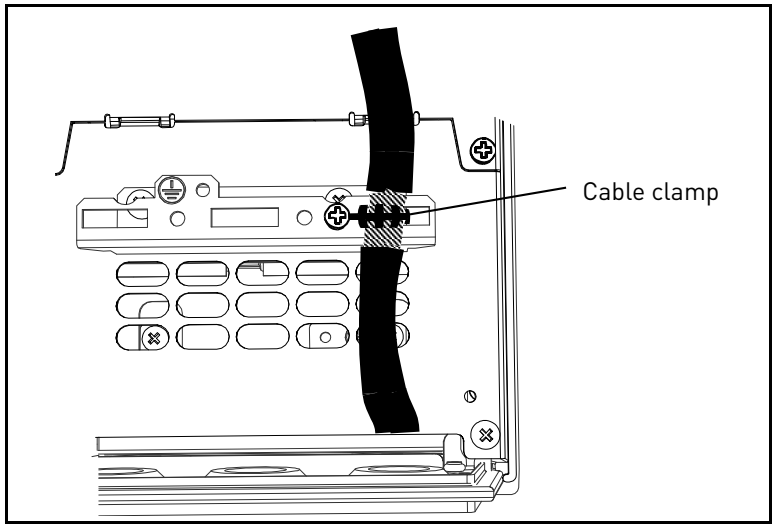
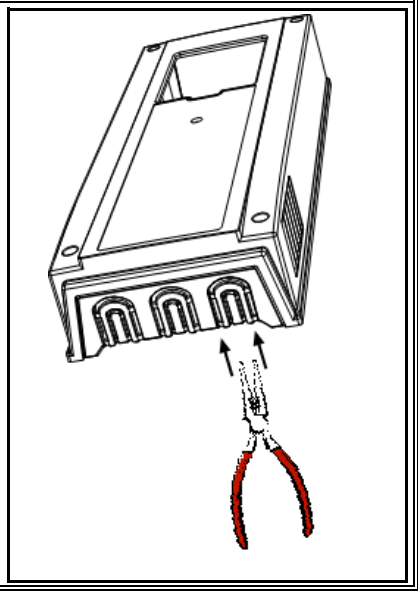
1	Open the cover of the AC drive.  9174.emf

The relay outputs and other I/O terminals may have a dangerous control voltage present even when the AC drive is disconnected from mains.

2	Open the inner cover to reveal the option board slots **(C,D,E)**.  *3023.emf*
3	Install the fieldbus board into slot **D** or **E**. **NOTE!** Incompatible boards cannot be installed on the drive. Compatible boards have a slot coding that enable the placing of the board.  *3024.emf*

5.2 PREPARE FOR USE THROUGH FIELDBUS

4	Strip about 15 mm of the fieldbus cable and cut off the grey cable shield. Remember to do this for both bus cables (except for the last device). Leave no more than 10 mm of the cable outside the terminal block and strip the cables at about 5 mm to fit in the terminals.  Also strip the cable now at such a distance from the terminal that you can fix it to the enclosure with the grounding clamp. Strip the cable at a maximum length of 15 mm. **Do not strip the aluminum cable shield!** 
5	Then connect the cable to its appropriate terminals on the OPTE7 DeviceNet option board terminal block.

6	Using the cable clamp included in the delivery of the drive, ground the shield of the CAN cable to the enclosure of the AC drive. **NOTE!** This can be done in all drives if there is no difference in PE potential between the drives. However, if there is PE potential difference then the shield should be connected to PE only at one point in the system. The shields of the cables shall be joint but not connected to several PE points with different potential. 
7	**If the AC drive is the last device on the bus**, the bus termination must be set with jumper X13.
8	Unless already done for the other control cables, cut free the opening on the AC drive cover for the fieldbus cable (protection class IP21). **NOTE!** Cut the opening on the same side you have installed the board in! 

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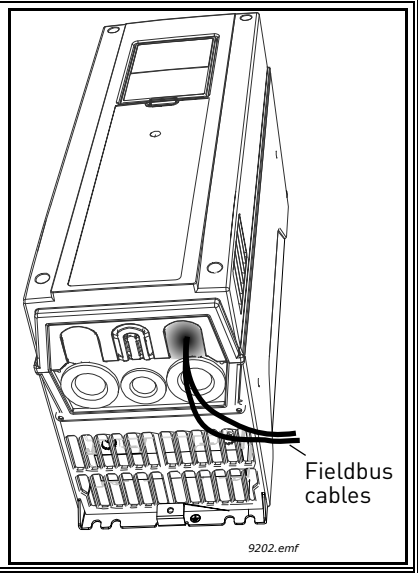
Remount the AC drive cover and run the cable as shown in picture.
NOTE! When planning the cable runs, remember to keep the distance between the fieldbus cable and the motor cable at a **minimum of 30 cm**. It is recommended to route the option board cables away from the power cables as shown in the picture.



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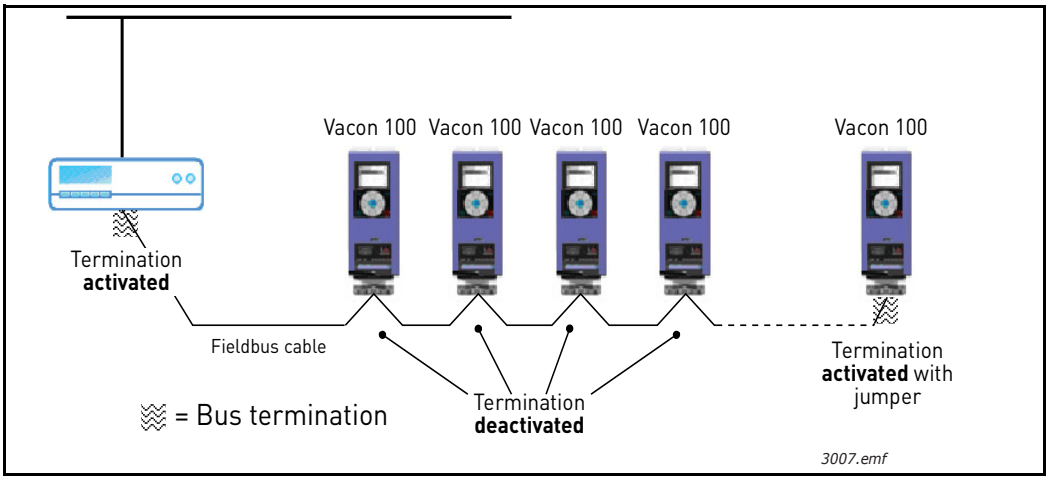
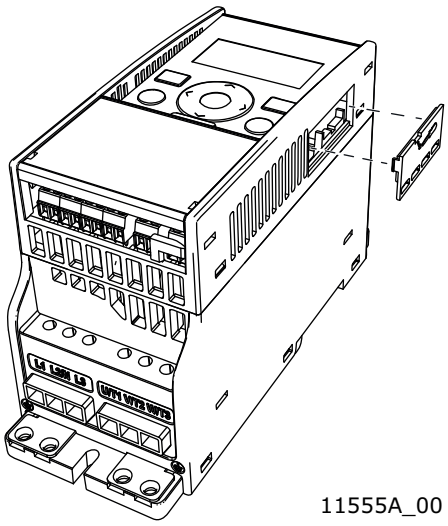
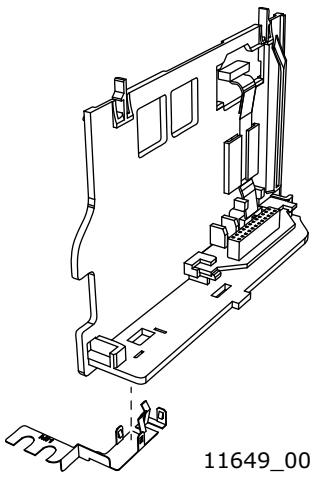
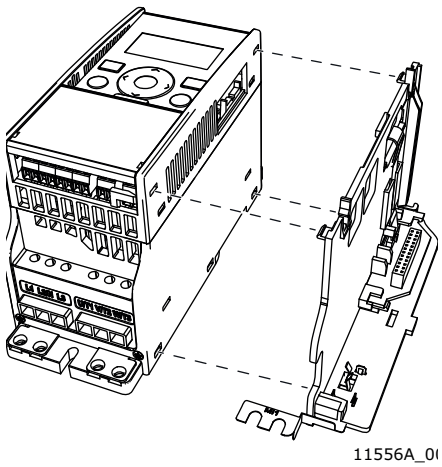
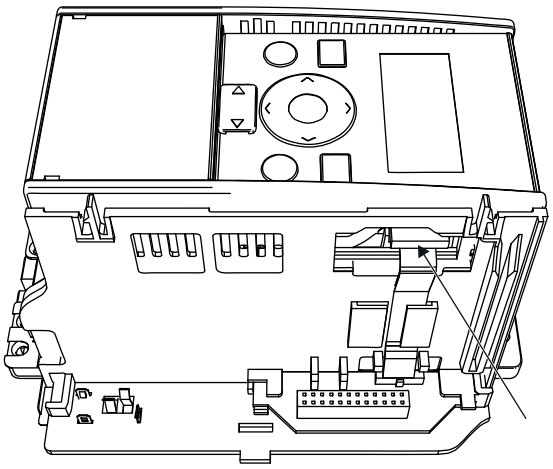
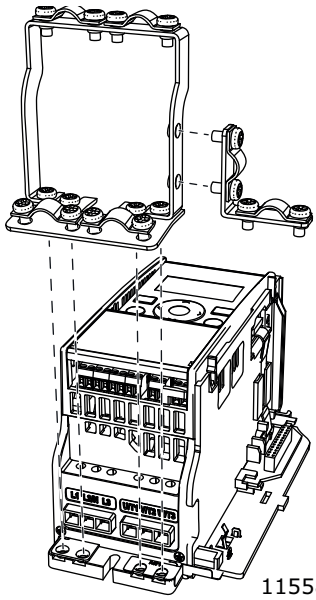
The bus termination must be set for the first and the last device of the fieldbus line. See also step 7 on page 22. We recommend that the first device on the bus and, thus, terminated was the master device.

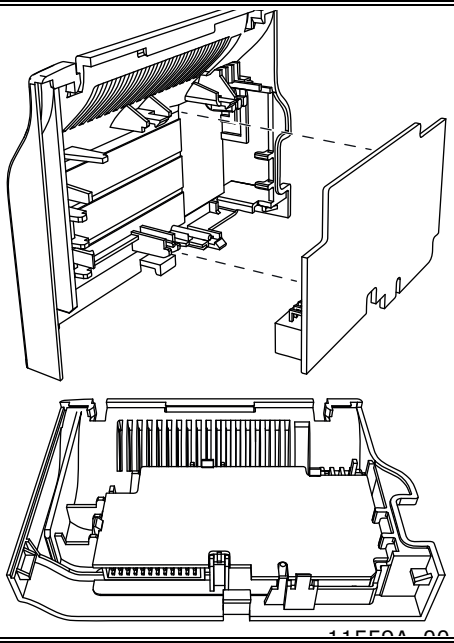
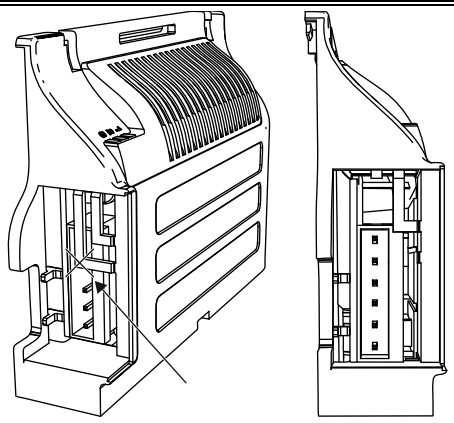
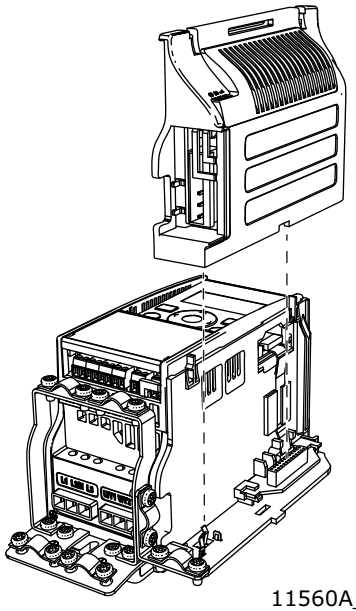


5.3 INSTALLATION IN VACON® 20

5.3.1 ENCLOSURES MI1, MI2, MI3

1	Remove the cable connector lid from the AC drive.	 11555A_00
2	Select a correct grounding plate and attach it to the option board mounting enclosure. The grounding plate is marked with the supported enclosure size.	 11649_00
3	Attach an option board mounting enclosure to the drive.	 11556A_0(

4	Connect the flat cable from the option board mounting enclosure to the drive.  11557A_00
5	If a cable strain relief is required, attach the parts as shown in the figure.  11558A_00

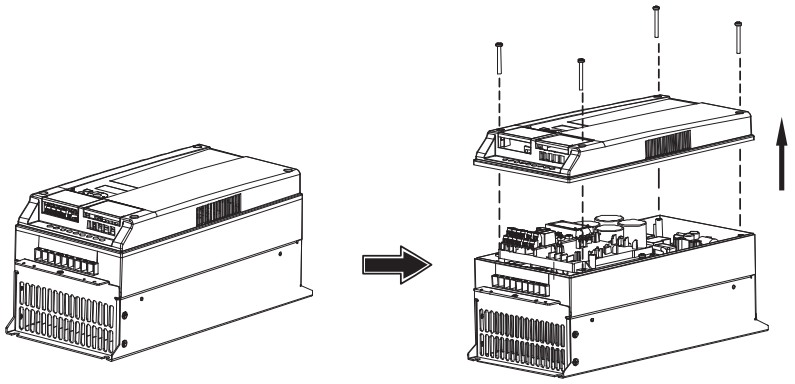
6	Install the option board to the option board holder. Make sure that the option board is securely fastened. 
7	Cut free a sufficiently wide opening for the option board connector.  11650_00
8	Attach the option board cover to the drive. Attach the strain relief cable clamp with screws if needed.  11560A_00

5.3.2 ENCLOSURES MI4, MI5

⚠ Make sure power is disconnected before opening the cover of the drive.

1

1a: For MI4: Open the cover.



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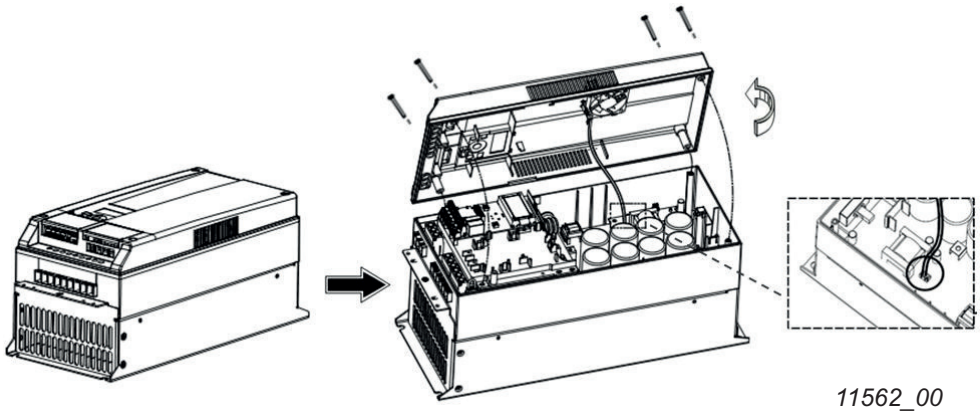
1b: For MI5: Open the cover and release the fan connector.



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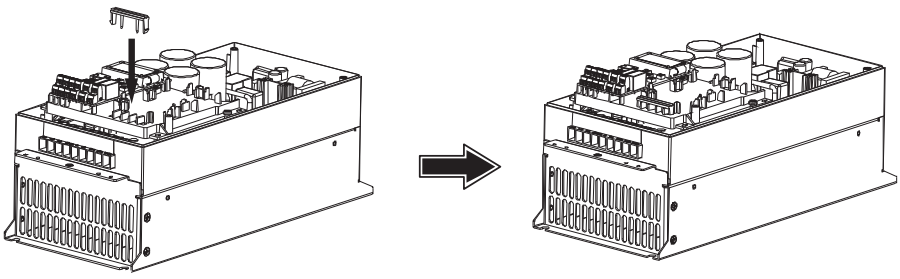
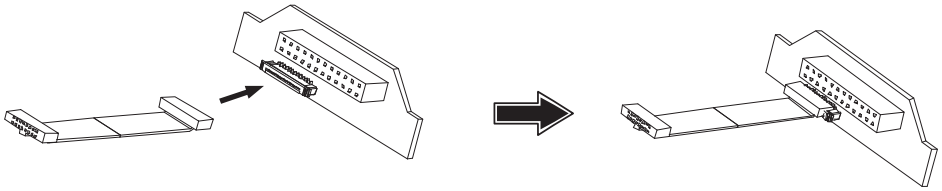
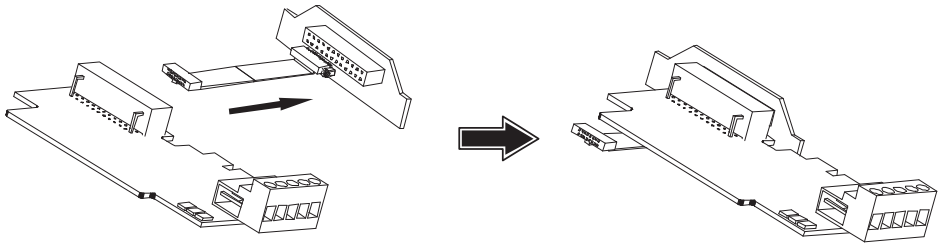
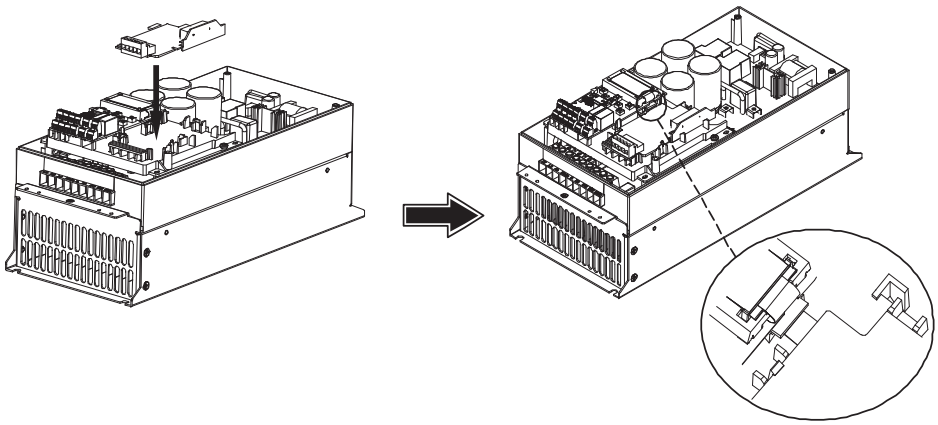
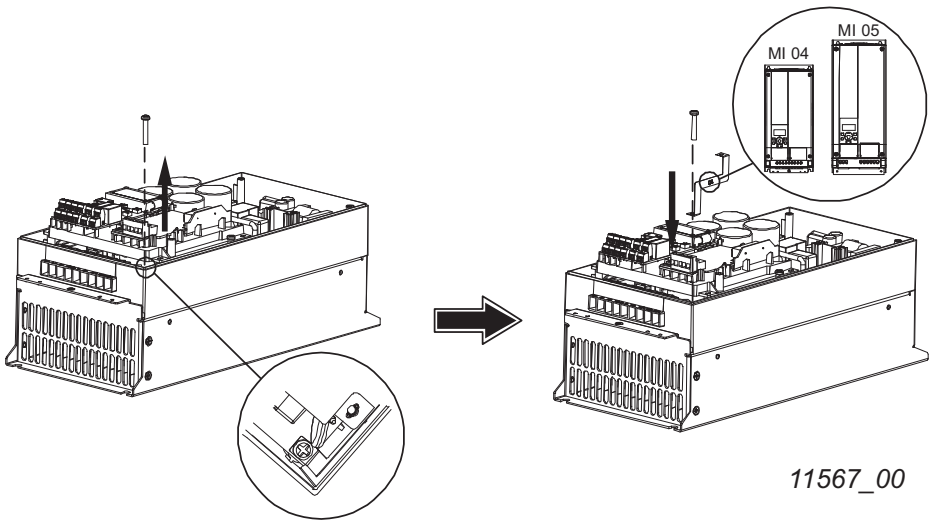
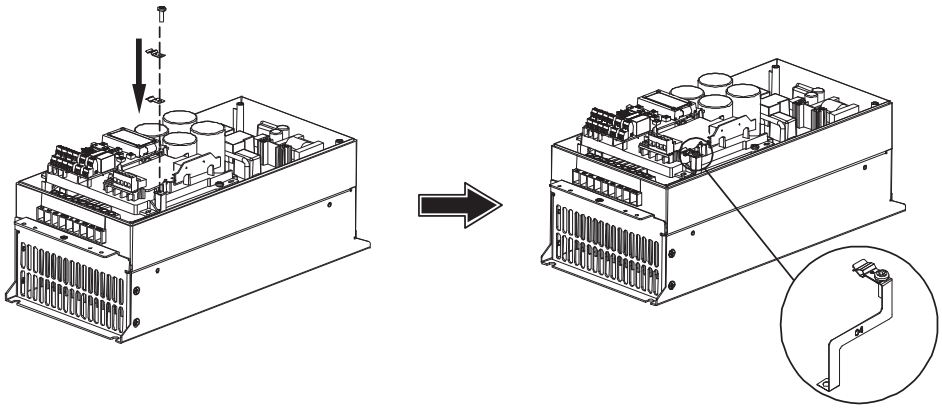
2

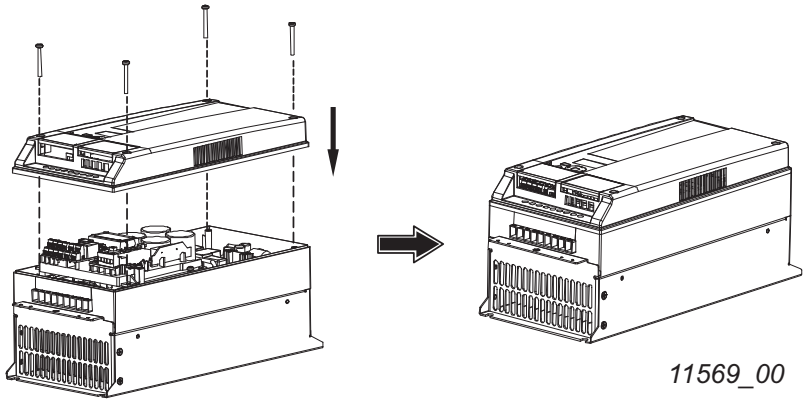
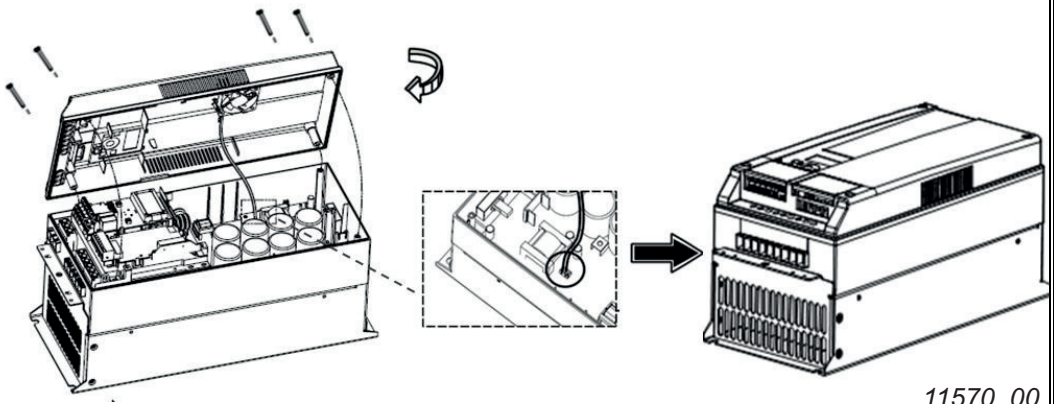
Attach the option board support.



11563_00

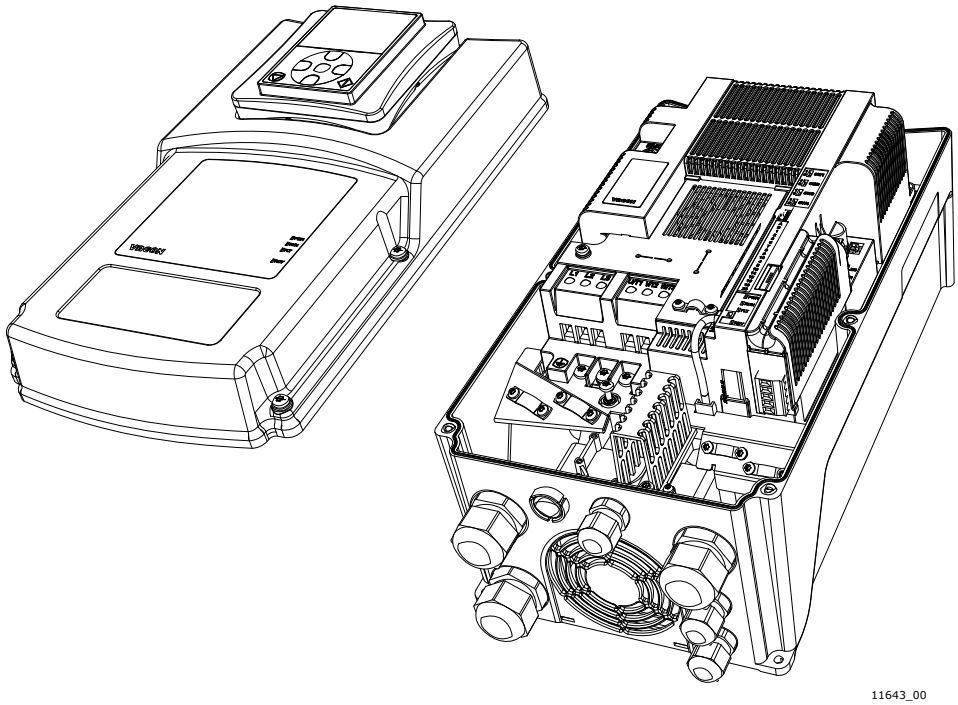
3	Connect the flex cable to option board connector PCB.  *11564_00*
4	Connect the option board to connector PCB.  *11565_00*
5	Attach the option board with connector PCB to the drive and connect the flex cable.  *11566_00*

6	Attach a suitable grounding plate to the drive. The grounding plate is marked with supported enclosure size.  11567_00
7	Assemble a clamp on top of the grounding plate on both sides of the option board.  11568_00

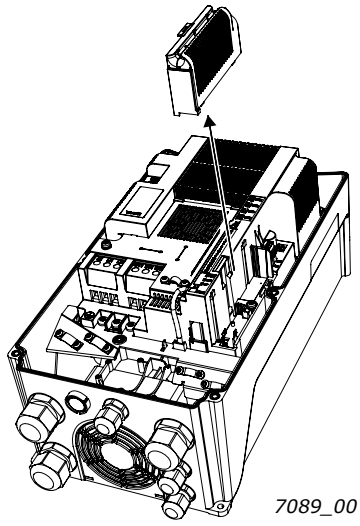
8	8a: For MI4: Close the cover.  *11569_00* 8b: For MI5: Remount the fan connector and close the cover.  *11570_00*

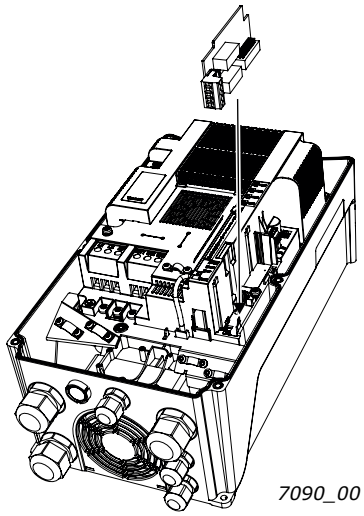
5.4 INSTALLATION IN VACON® 20 X AND 20 CP

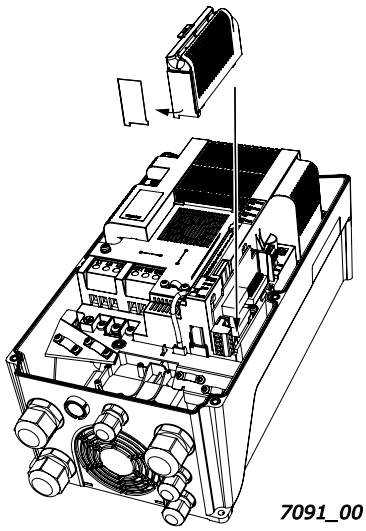
Do not add or replace option boards or fieldbus boards on an AC drive with the power switched on. This may damage the boards.

1	Open the cover of the drive.  MU3 example

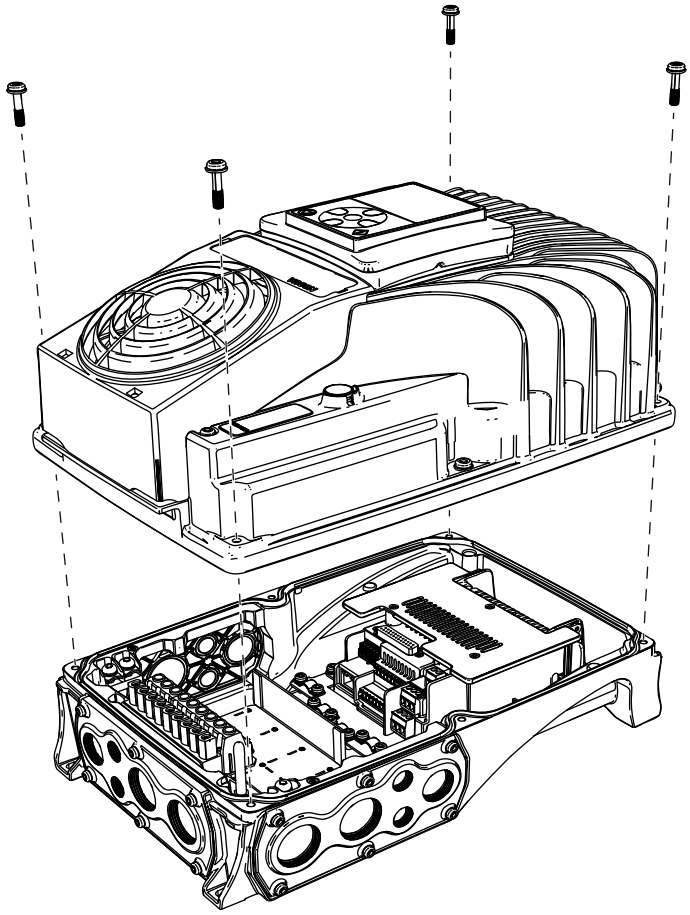
The relay outputs and other I/O-terminals may have a dangerous control voltage present even when the drive is disconnected from mains.

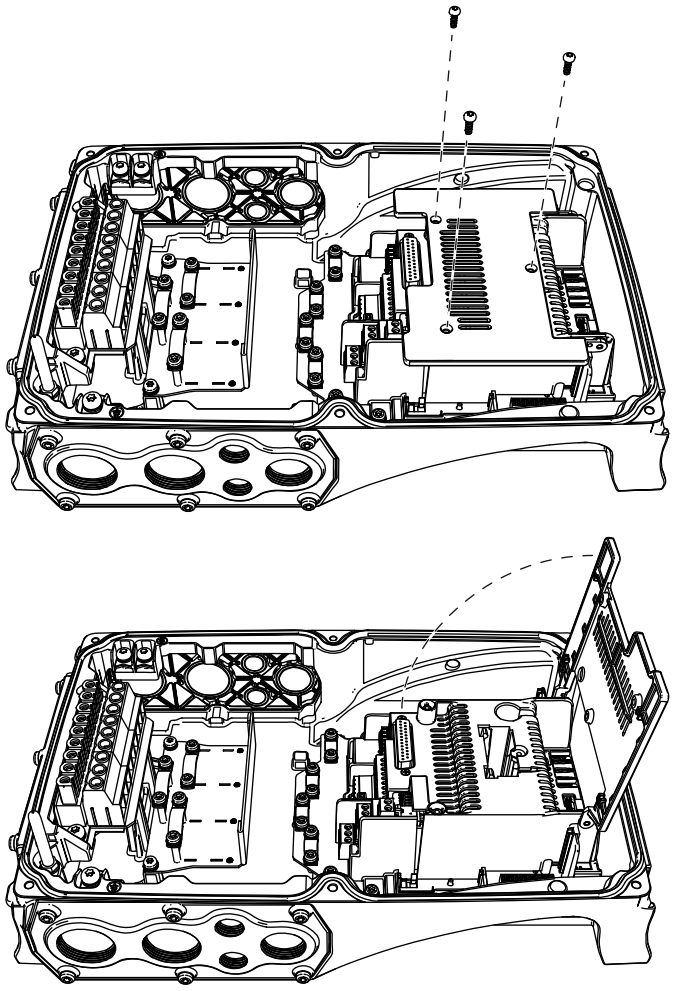
2	Remove the option slot cover.  7089_00

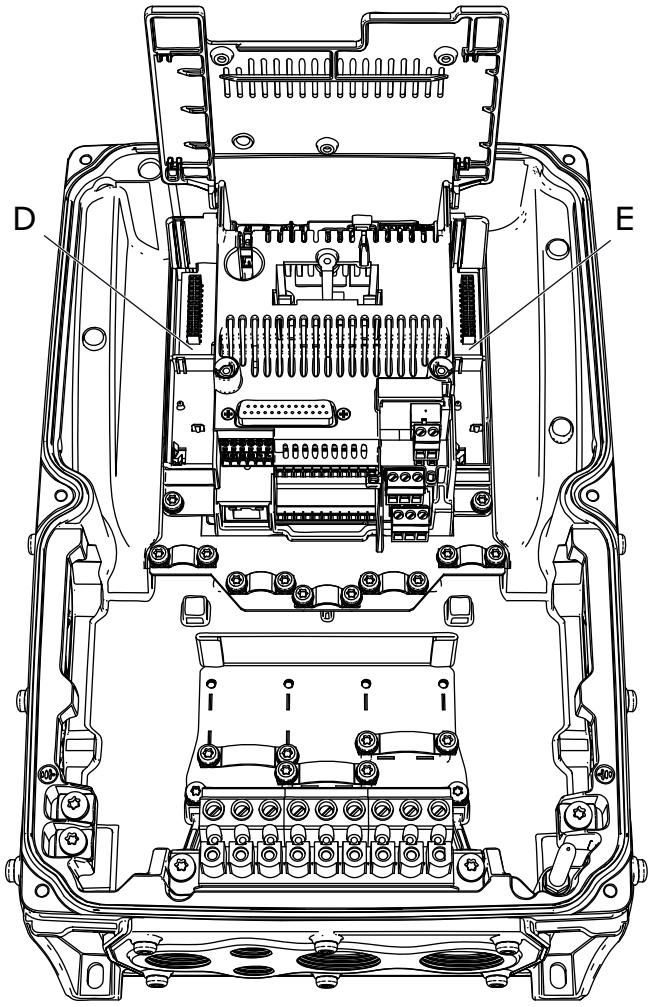
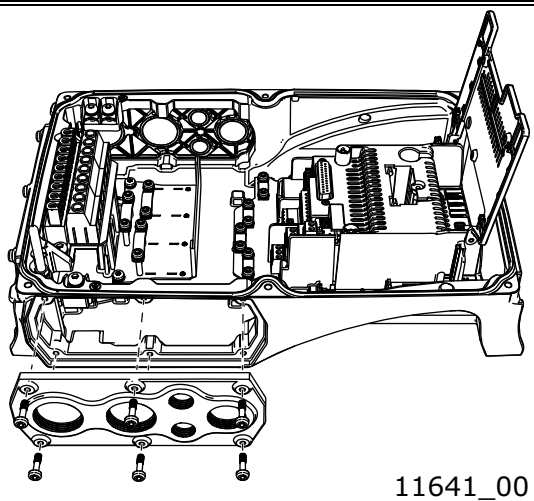
3	Install the option board into the slot as shown in the figure.  7090_00

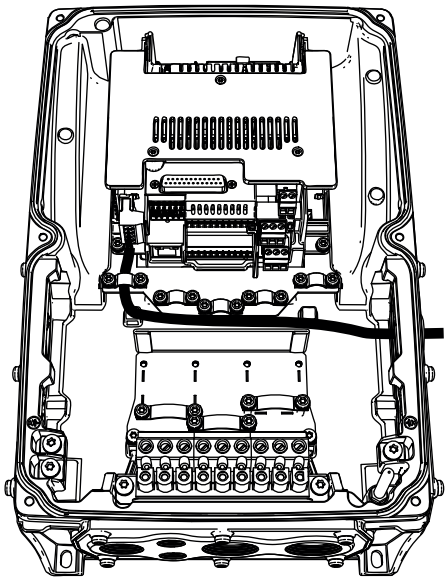
4	Mount the option slot cover. Remove the plastic opening for the option board terminals.  *7091_00*

5.5 INSTALLATION IN VACON® 100 X (ENCLOSURES MM4-MM6)

1	Open the cover of the AC drive.  11638_00

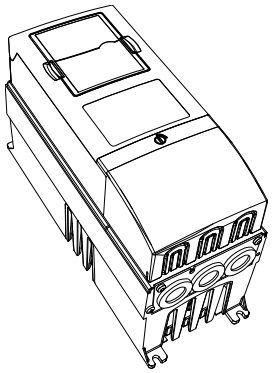
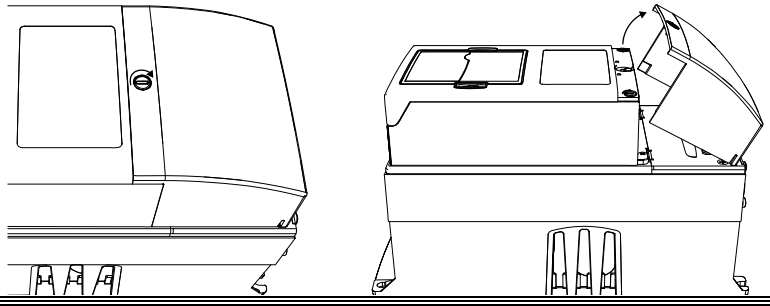
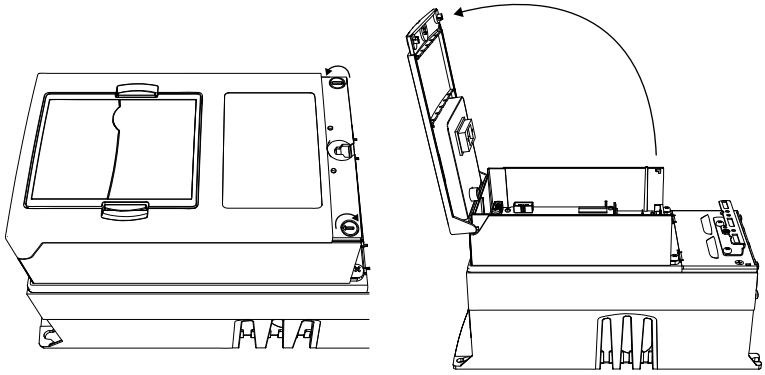
2	To get access to the option board slots, remove the screws and open the cover of the control unit.  11639_00

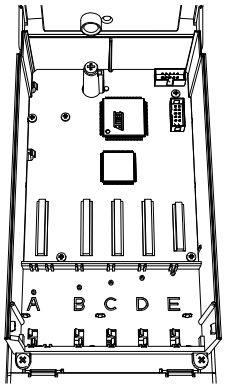
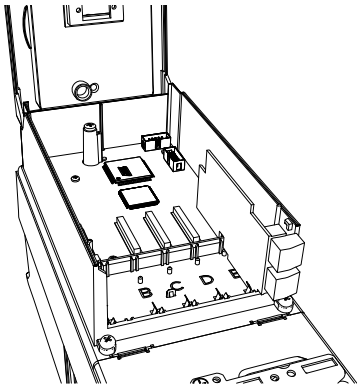
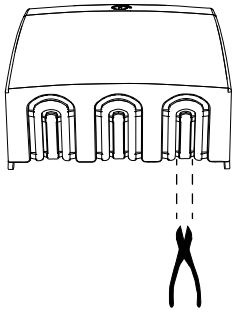
3	Install the option board into the correct slot, D or E.  11640_00
4	Close the option board cover.
5	Remove the cable entry plate. If you installed the option board in the slot D, use the cable entry plate on the right side. If you installed the option board in the slot E, use the cable entry plate on the left side. **NOTE!** The cable entry plate at the bottom of the drive is used only for mains and motor cables.  11641_00
6	Open the necessary holes in the cable entry plate. Do not open the other holes. See the VACON® 100X Installation Manual for the dimensions of the holes.

7	Attach a cable gland on the hole in the cable entry plate. Pull the fieldbus cable through the hole. **NOTE!** The fieldbus cable must go through the correct cable entry plate to avoid going near the motor cable.  11642_00
8	Put the cable entry plate back.
9	Close the cover of the AC drive.

5.6 INSTALLATION IN VACON® NX

⚠ Make sure that the AC drive **is switched off** before an option or fieldbus board is changed or added!

1	VACON® NX AC drive. 
2	Remove the cable cover. 
3	Open the cover of the control unit. 

4	Install the option board in slot D or E on the control board of the AC drive. Make sure that the grounding plate fits tightly in the clamp.  
5	Make a sufficiently wide opening for your cable by cutting the grid as wide as necessary. 
6	Close the cover of the control unit and the cable cover.

6. COMMISSIONING

6.1 PARAMETER VIEW

Table 10. Parameter view

Name	Default	Range	Description
MAC ID	63	0...63	Slave address. Valid device addresses are in the range of 0 to 63 decimal.
Baud rate	125 kbit/s	125 kbit/s 250 kbit/s 500 kbit/s	Communication speed
Output instance	21	20 21 23 25 101 111 151 161	Output assembly used by the polled connection. Setting of this value via panel is not allowed when the I/O connection is established. If setting of this value fails, the value is not updated.
Input instance	71	70 71 73 75 107 117 157 167	Input assembly used by the polled connection. Setting of this value via panel is not allowed when the I/O connection is established. If setting of this value fails, the value is not updated.
Mode	Normal	Normal (1) OPTCx (2)	Only in VACON® NXP family. After this setting is changed, drive must be restarted.
Comm. Timeout	0	0...65535	Additional communication timeout in seconds. When normal watchdog timeout notices that connection has been lost, fieldbus communication fault is activated after this additional time has passed.

6.1.1 MODE

The emulation mode parameter is available only when the OPTE7 option board has been installed to the VACON® NXP family AC drive. When the mode is changed to "OPTCx", OPTE7 emulates the functionality of old OPTC7 option board. For more information, see Chapter 6.7 "OPTCx Emulation Mode".

Table 11. Emulation mode values

Value	Emulation mode	Description
1	Normal	Normal operation
2	OPTCx	OPTE7 emulates OPTC7 functionality and behavior

Restart the AC drive after you have changed this value.

6.2 MONITOR VIEW

Table 12. Monitor view

Name	Range	Description
DeviceNet Status	Y.X	Y = Message counter X = DeviceNet status
FB Protocol Status	Initializing (1) Stopped (2) Operational (3) Faulted (4) Failing (5)	When the device has started, it stays in "initializing" status until the connection to the device is opened. Then the status changes to "operational". If the connection is closed or lost, the status changes to "failing" until communication time out time has elapsed. Then the status changes to "faulted".
Drive Control Word	0...65535	Control word in drive format
Drive Status Word	0...65535	Status word in drive format
Protocol CW	0...65535	Control word in protocol format
Protocol SW	0...65535	Status word in protocol format

Table 13. DeviceNet status

DeviceNet Status	Description
0	Non-existent
1	Configuring
3	Established
4	Timeout

6.3 SOFTWARE INFO VIEW

Table 14. Software info view

Number	Name	Range	Description
1	Version number		Version number of the software in the option board
2	Board status		Shows the status of the option board

6.4 CONTROL AND STATUS WORD MONITORING VALUES

Drive Control Word always shows the internal control word (FBFixedControlWord) which is written to the drive by the option board. If the control word written by the PLC does not use FBFixedControlWord (CIP CW), the control word along with profile specific state machine is used to generate the FBFixedControlWord. If the used telegram already uses FBFixedControlWord, it is shown directly in this monitoring value. The only exception to this is that the bit 15 is set/removed to indicate "Master Connection state" in the VACON® NX AC drives. The Drive Status word always shows the FBFixedStatusWord received from the drive.

The Protocol Control Word shows the value which was sent by the PLC to the option board. It always shows the protocol specific control word (CIP CW) if it is in the used telegram. Otherwise the FBGeneralControlWord is shown. However, if the telegram contains only the FBFixedControlWord, then it is shown in both control word monitoring values.

The Protocol Status word shows the value which was sent by the option board to the PLC. It always shows the protocol specific status word (CIP SW) if it is in the used telegram. Otherwise the FBGeneralStatusWord is shown. However, if the telegram contains only FBFixedStatusWord, then it is shown in both status word monitoring values.

For telegram specific configuration, see dedicated chapters in this manual. For example, Chapter 7.1.2.2 "21/71 Extended Speed Control (default)".

6.5 FIELDBUS PARAMETRIZATION

Fieldbus parametrization is explained in detail in Chapter 14 "Appendix F - Fieldbus parametrization". This chapter contains DeviceNet specific information about fieldbus parametrization.

In DeviceNet, the bits NetCtrl, NetRef and NetProc must be set in order for the option board to send commands / reference setpoint values to the AC drive. The bits CtrlFromNet and RefFromNet can be read to determine the actual control/reference place. Note that these bits are valid only if the NetCtrl/NetRef bits are also set.

The AC drive can be parametrized by using the drive panel, PC tools or fieldbus protocol. For more information on how to read and write ID's over DeviceNet fieldbus, see Chapter 9.1.11 "Class code 0xA0 - Vendor Parameter Object".

6.6 PC TOOLS

Usually before connecting the option board to network some parameters must be changed. This can be done directly from the panel or with VACON® PC tools. Some times also the option board firmware must be updated. The following chapters describe how to do this and what tools to use.

6.6.1 PC TOOL SUPPORT

The following table describes what PC tools each AC drive type supports. Connect to the AC drive via panel connector using the serial cable.

Tool	VACON® 100 family	VACON® NXS/NXP family	VACON® 20 family
VACON® Loader	x	x	x
VACON® Live	x		x
NCDrive		x	
NCLoad	Not supported		

6.6.2 UPDATING THE OPTE7 OPTION BOARD FIRMWARE WITH VACON® LOADER

The VACON® Loader can be downloaded from http://drives.danfoss.com website. It has been bundled with the VACON® Live software package. VACON® Loader is also used when the option board has been installed to VACON® NXP drive.

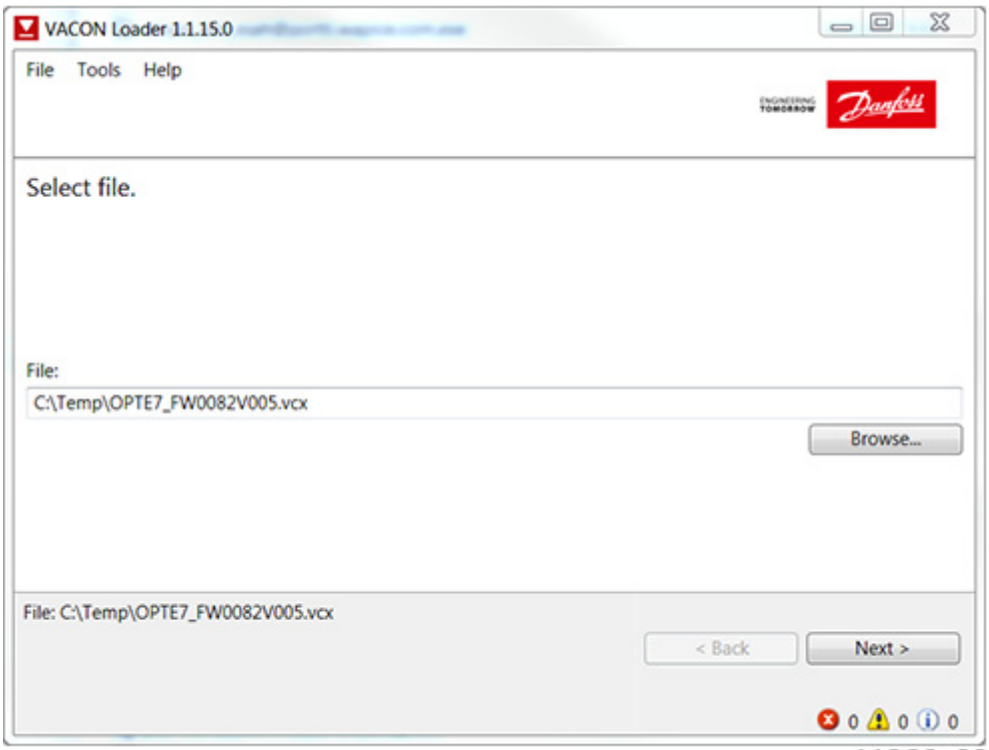
To update the option board firmware, follow the steps below.

Step 1. Connect your PC to the controller by using the USB/RS485 cable.

Then select the firmware file that you want to load to the option board and double-click it. This starts the VACON® Loader software. You can also start the program from the Windows Start menu.

In this case, select the firmware file using the Browse button.

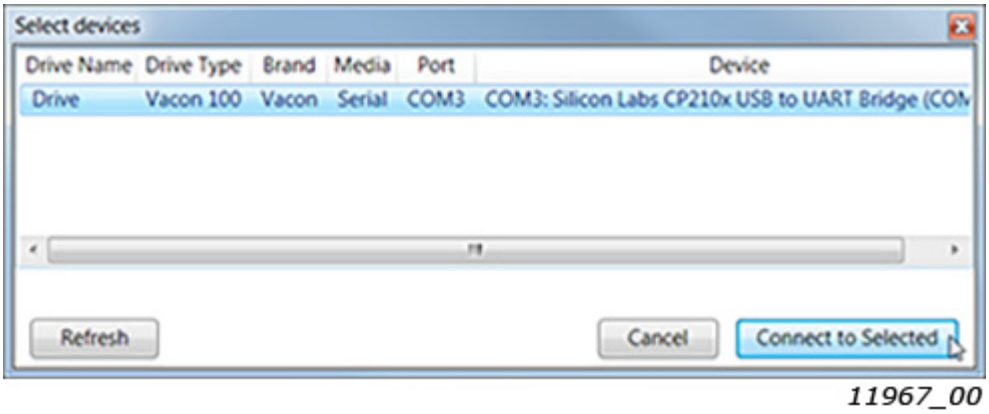
Figure 10. VACON® Loader: File selection



Step 2. Press "Next" and wait until the loader finds the network drives.

Then select a drive from the list and press "Connect to Selected".

Figure 11. VACON® Loader: Connecting to drive



Step 3. Select the modules to be updated, press "Next" and wait until the operation is finished.

Figure 12. VACON® Loader: Select modules

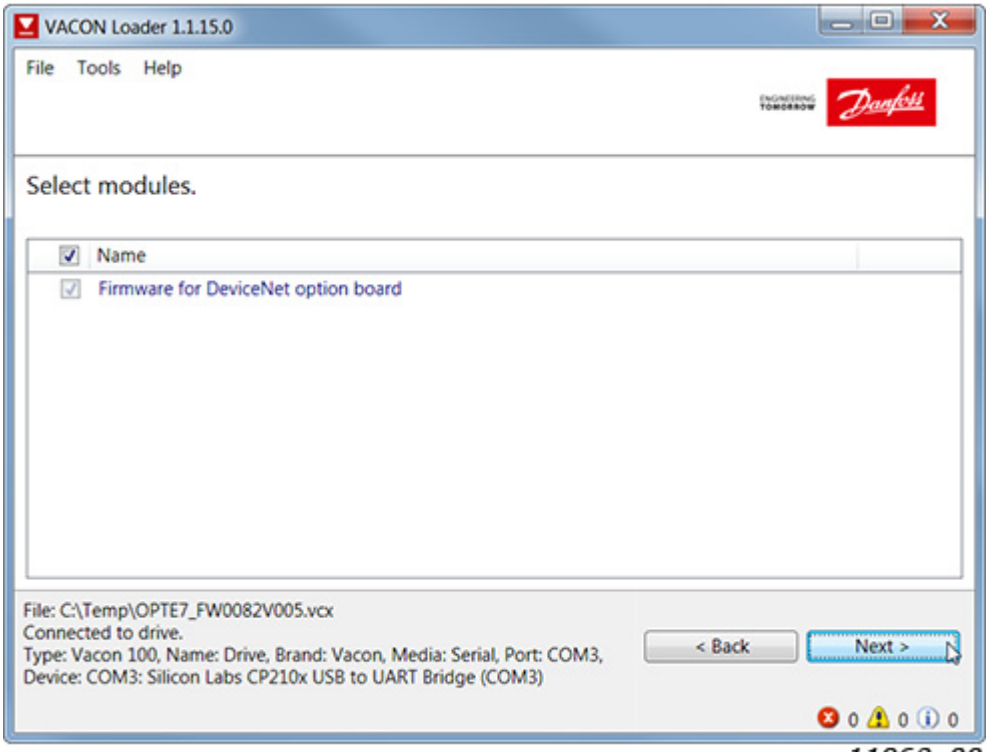


Figure 13. VACON® Loader: Firmware loading

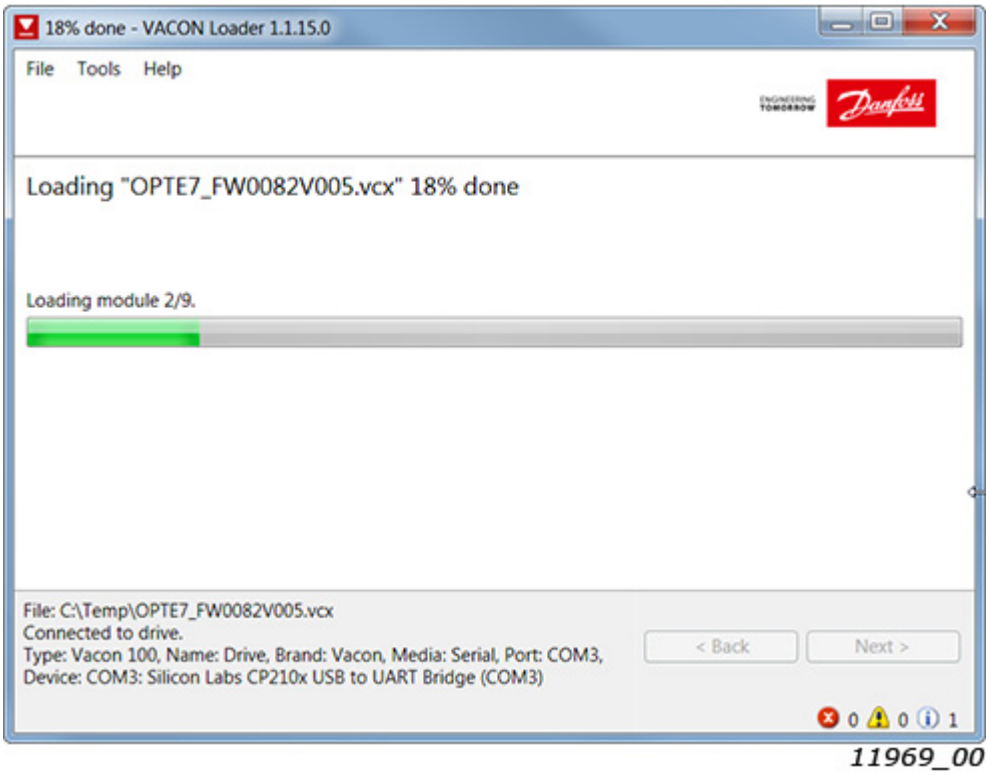
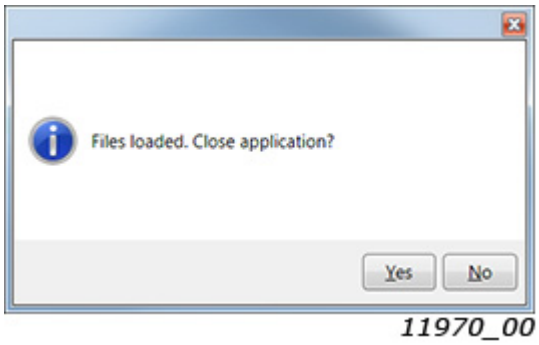


Figure 14. VACON® Loader: Loading is finished



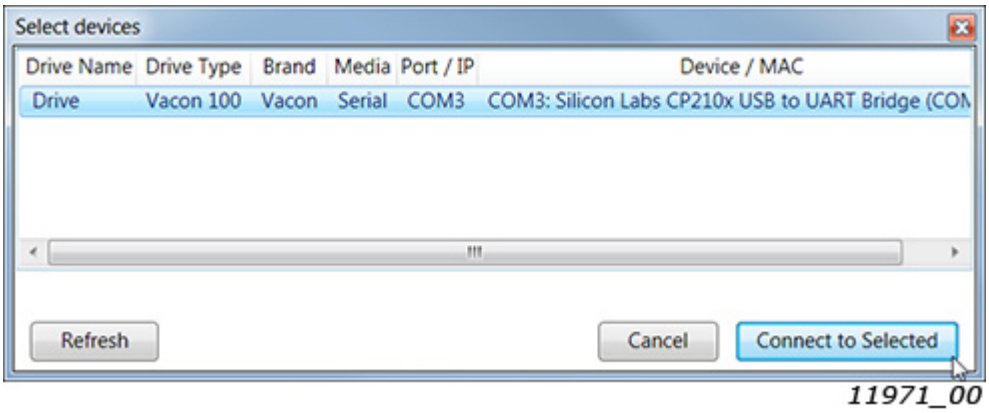
6.6.3 PARAMETRIZING OPTE7 WITH VACON® LIVE

VACON® Live can be used to configure the communication settings of the OPTE7 option board. VACON® Live can be downloaded from http://drive.danfoss.com website.

Step 1. Connect your PC to the controller by using the USB/RS485 cable.

Then start the VACON® Live PC tool. It shows a pop-up window with a button "Online" that starts the scan dialog. If the pop-up window is not shown, select from the VACON® Live menu "Drive" and then "New Drive...". When you see the drive you want to connect to, select it and press "Connect to Selected".

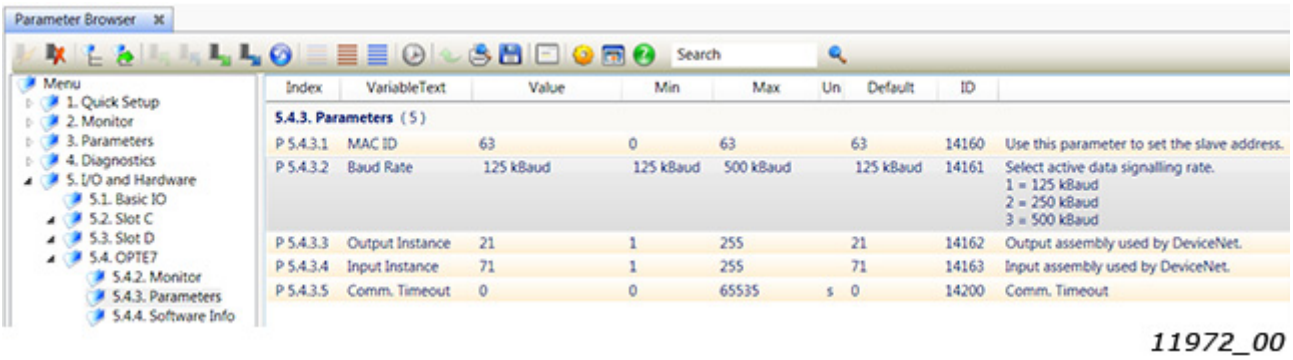
Figure 15. VACON® Live: Select devices



Step 2. VACON® Live now connects to the drive and loads all parameters.

The the parameters are loaded, navigate to the "5. I/O Hardware" menu and select the slot that the OPTE7 is connected to.

Figure 16. VACON® Live: Parameter view



6.6.4 PARAMETRIZING OPTE7 WITH VACON® NCDRIVE

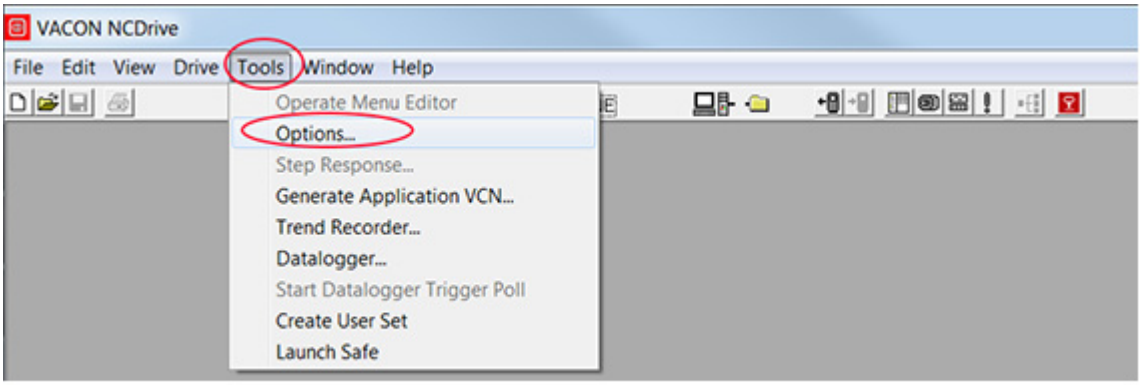
NCDrive PC tool can be used to configure the OPTE7 and AC drive. NCDrive PC tool can be downloaded from http://drives.danfoss.com website. After starting the installation program, follow the on-screen instructions. Once the program is installed successfully, launch it by selecting it in the "Windows Start" menu. For more information on the software features, select "Help" and then "Contents".

Step 1. Connect your PC to the controller by using the USB/RS232 cable.

Check from your computer settings that the USB/RS232 cable is connected to the COM port. If you do not know how to do this, ask help from your IT department.

Before opening connection to the drive, set the communication parameters. From the "Tools" menu select "Options".

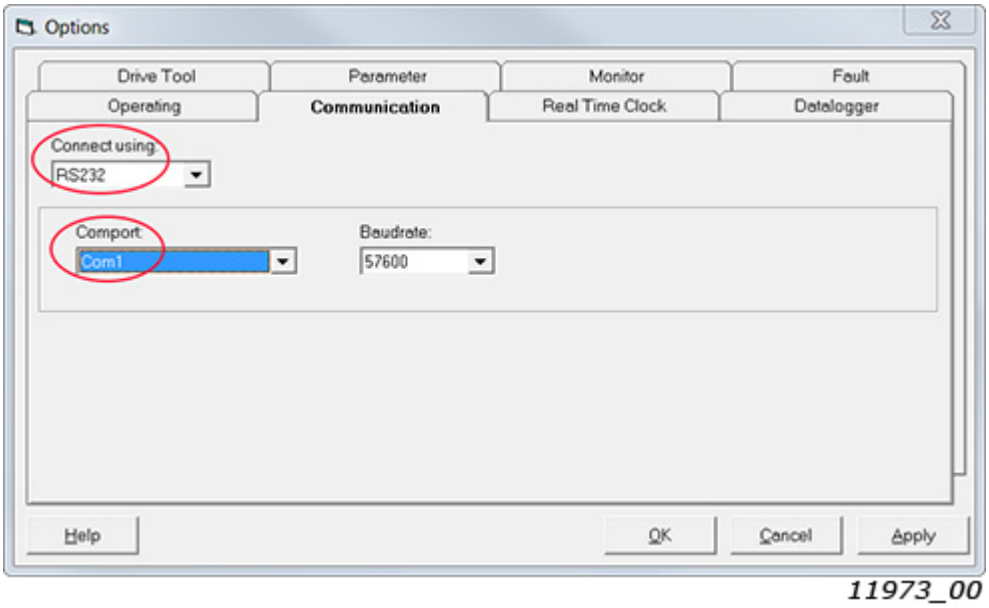
Figure 17. NCDrive menu structure



Step 2. Setup NCDrive communication parameters.

In the "Options" window, select the "Communication" tab. Make sure that RS232 is selected. Then select the used COM port and set baudrate to 57600.

Figure 18. NCDrive communication parameters



Step 3. Go online.

Press the "ON-LINE" radio button. NCDrive will then try to connect to the AC drive. Once the connection is made, NCDrive loads parameters and other information from the AC drive. This takes a few minutes the first time the connection is opened. From then on, opening the connection takes only a few seconds.

Figure 19. NCDrive and ON-LINE button

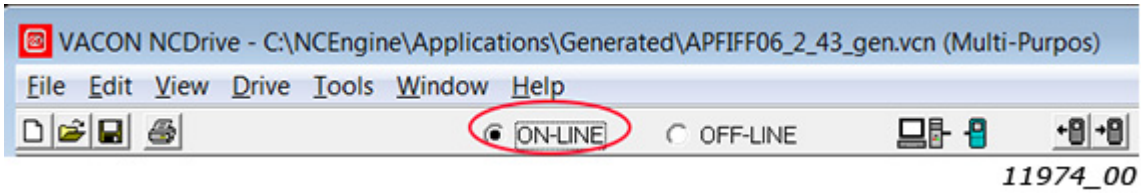
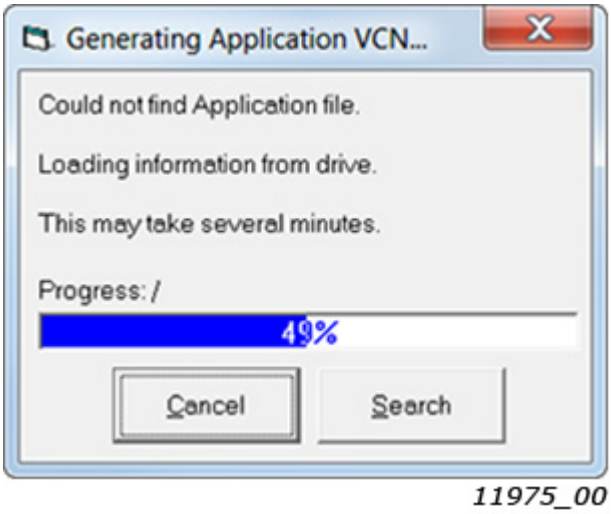


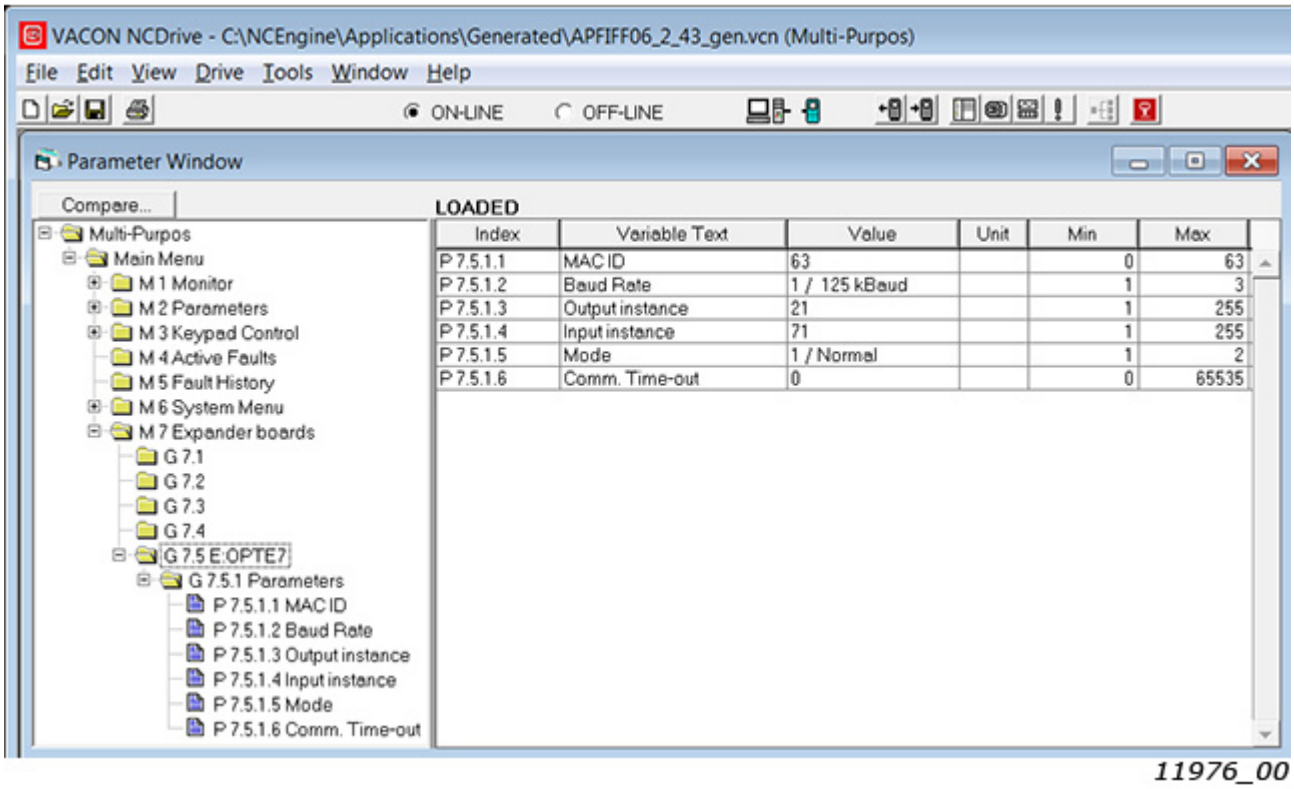
Figure 20. Generating application / loading parameters



Step 4. Change parameters.

Once the parameters have been loaded, navigate to "Expander boards" and select the slot where the OPTE7 option board is installed to. Now you can see it and change its settings.

Figure 21. NCDrive: Parameters view



6.7 OPTCx Emulation Mode

When the OPTE7 option board is installed to VACON® NXP AC drive, it has a parameter called "Mode". When this parameter is set to "OPTCx", the OPTE7 option board emulates the behaviour of the OPTC7 option board. The option board also identifies itself to the bus as OPTC7, and the EDS file for OPTC7 must be used.

The OPTCx mode can be used when new drives are added to an installation that consists of OPTC7 option boards and it is not desired or possible to do major changes to the PLC program. Using this mode a new device can simply be added to the configuration. Later if the installation is upgraded to use only OPTE7, the mode can be changed back to "Normal".

The following list contains the functionality changes when OPTCx mode is activated:

- Product name on bus is "Vacon NX" instead of "OPTE7"
- Major/minor version info is always 1.3
- When the NetRef bit is set, the option board automatically writes the previously given speed reference to the AC drive
- When the FaultReset bit is set (even when the NetControl bit is not set), the option board activates fieldbus communication fault (F53)
- Control Supervisor object's DNFaultMode attribute is supported only in the OPTCx mode
- Monitor data object is supported only in the OPTCx mode

7. DeviceNet interface

VACON® supports two types of DeviceNet messaging. They are I/O Messaging and Explicit Messaging.

7.1 I/O messaging

I/O polling messages are for time-critical, control-oriented data. The messages are transferred between the devices all the time and they are used for continuous control of the AC drive. They provide a dedicated, special-purpose communication path between a producing application (master) and one or more consuming applications (slaves). They are exchanged across single or multi-cast connections, typically using high priority identifiers. I/O polling messages contain no protocol in the 8-byte data field. The meaning of the message is implied by the connection ID (CAN identifier). Before messages are sent using these IDs, both the device sending and receiving them must be configured. The configuration contains the source and destination object attribute addresses for the master and the slave.

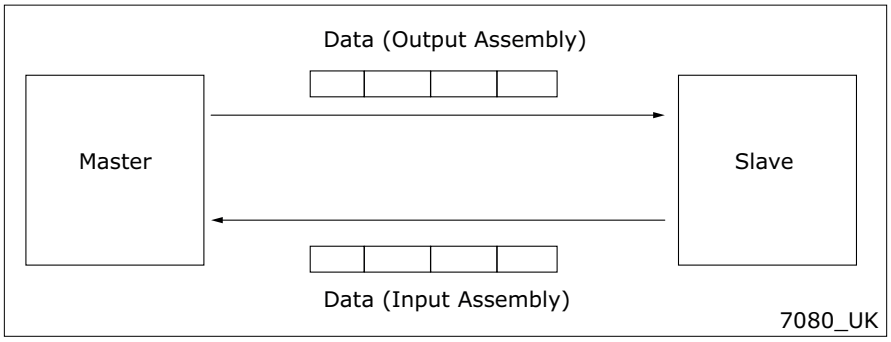


Figure 22. DeviceNet I/O messaging

The contents of the data message are chosen by input and output assemblies. These assemblies can be selected via panel or by setting Produced Connection Path (14) and Consumed Connection Path (16) attributes in DeviceNet connection object. Note that setting of instances is not allowed via panel, if I/O connection is open. Chapter 7.1.2 describes all supported input and output assemblies.

7.1.1 CONNECTION BEHAVIOUR

The following figure provides a general overview of the behaviour associated with an I/O connection object (instance type attribute = I/O).

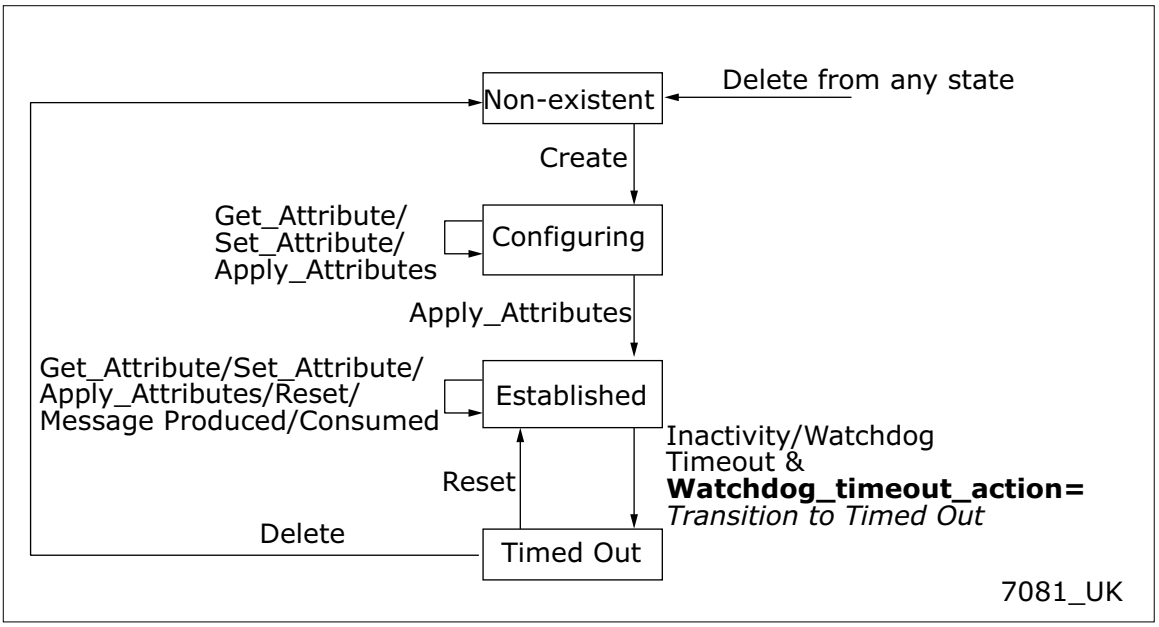


Figure 23. I/O Connection Object State Transition Diagram

By default, Expected Packet Rate (EPR) of I/O connection is set to zero, meaning that no transition to Timed Out state will occur. If EPR Timeout is set to other than zero, timeout will occur after four times Expected Packet Rate (4 * EPR). For example value 1000 (ms) will result in timeout after four seconds.

7.1.2 INPUT AND OUTPUT ASSEMBLIES

The following table contains a simple list of the supported assembly instances. Each assembly instance is described in more detail in the following chapters. As the detailed descriptions can contain exceptions based on the drive type, application version and so on, read them before taking any assembly instance into use.

Table 15. Quick reference table for assembly instances

Name	Instance id	Size	Control / status word type	Speed reference / actual type	Process data items
Basic Speed Control	20	4	CIP	CIP	0
	70	4	CIP	CIP	0
Extended Speed Control (default)	21	4	CIP	CIP	0
	71	4	CIP	CIP	0
Extended Speed and Torque Control	23	6	CIP	CIP	0
	73	6	CIP	CIP	0
Process Control	25	6	CIP	CIP	1
	75	6	CIP	CIP	1

Table 15. Quick reference table for assembly instances

Name	Instance id	Size	Control / status word type	Speed reference / actual type	Process data items
Dynamic Process Control	101	8	CIP	Vacon	2
	107	8	CIP	Vacon	2
Bypass Control Output	111	20	Vacon	Vacon	8
	117	34	Vacon	Vacon	8
Vendor Extended Speed Control Variant 3	151	38	Vacon	Vacon	16
	157	38	Vacon	Vacon	16
Vendor Extended Speed Control Variant 4	161			Vacon	16
	167			Vacon	16

Assembly data mapping

The control word bits are mapped to the object data according to the following table.

Table 16. CIP control word mapping to object data

Bit	Bit name	Object	Attribute name	Attribute ID
0	RunFwd	Control Supervisor Object	Run1	3d
1	RunRev	Control Supervisor Object	Run2	4d
2	FaultRst	Control Supervisor Object	FaultRst	12d
3	-	-	-	-
4	-	-	-	-
5	NetCtrl	Control Supervisor Object	NetCtrl	5d
6	NetRef	AC/DC Drive Object	NetRef	4d
7	NetProc	AC/DC Drive ObjectFaulted	NetProc	5d

The process data IN is mapped according to the following table.

Table 17. Process data IN mapping to object data

Parameter name	Object	Attribute name	Attribute ID
Speed Reference	AC/DC Drive Object	SpeedRef	8d
Torque Reference	AC/DC Drive Object	TorqueRef (ProcessDataIn1)	12d
Process Reference	AC/DC Drive Object	ProcessRef If drive mode is: 0 = ProcessDataIn1 4 = ProcessDataIn2	14d
Drive Mode	AC/DC Drive Object	DriveMode	6d

The process data OUT is mapped according to the following table.

Table 18. Process data OUT mapping to object data

Parameter name	Object	Attribute name	Attribute ID
Speed Actual	AC/DC Drive Object	SpeeActual	7d
Torque Actual	AC/DC Drive Object	TorqueActual	11d
Process Actual	AC/DC Drive Object	ProcessActual (ProcessDataOut1)	13d
Drive State	Control Supervisor Object	State	6d

The Speed Reference is updated to the drive only when the NetRef bit is set to 1. The torque reference is updated to the drive only when the motor control mode is "Torque Control".

Assemblies consist of different types of attributes. Others follow CIP specification and others are vendor specific. The following table lists these attributes.

NOTE! When using assemblies with RMP speed reference or actual speed, it is recommended to set the values of the AC drive's "Fieldbus min scale" and "Fieldbus max scale" parameters to zero. Otherwise the RPM scaling does not work properly.

Some NXP applications contain "Fieldbus min scale" and "Fieldbus max scale" settings. For example, in APFIFF06 Multipurpose application these parameters can be found from the menus P2.9.1 and P2.9.2.

Table 19. Assembly attributes reference list

Attribute	Unit	Range	Note
Speed Reference	rpm	0...32767	
Speed Actual	rpm	0...32767	
Drive Mode			See Table 20, "Drive mode selection in process control".
Drive State	-	0...7	See Chapter 7.1.3 "Control Supervisor Behaviour"
Torque Reference		-32768...32767	
Torque Actual		-32768...32767	
Process Reference	-	-	See Table 20, "Drive mode selection in process control".
Process Actual	-	-	ProcessDataOut1
FBSpeedReference	%	-10000...10000	See Chapter 13 "Appendix E - VACON® IO data description".
FBSpeedActual	%	-10000...10000	See Chapter 13 "Appendix E - VACON® IO data description".
ProcessDataIn	-	-	See Chapter 13 "Appendix E - VACON® IO data description".
ProcessDataOut	-	-	See Chapter 13 "Appendix E - VACON® IO data description".
RPM Speed Actual	rpm	-32768...32767	Ramp output frequency converted to rpm.
Speed actual with slip	rpm	0...32767	Slip compensated RPM value.

Table 20. Drive mode selection in process control

Drive Mode	Process Reference Mapping
0	ProcessDataIn1
4	ProcessDataIn2
Other	Not valid

7.1.2.1 20/70 Basic Speed Control

Basic speed control is the most basic control type, where the run direction is limited to only forward, and only Run and Fault reset commands are supported. Speed reference is given in revolutions per minute. The run/stop commands work as described in Table 29, with Run Rev always interpreted as zero. In this mode, the control supervisor attributes NetCtrl and NetRef bits are always set to one.

Table 21. Basic Speed Control Instance descriptions

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Basic Speed Control Output									
20	0						Fault Reset		Run Fwd
	1								
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							
Basic Speed Control Input									
70	0						Running1		Faulted
	1								
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							

7.1.2.2 21/71 Extended Speed Control (default)

Extended speed control provides more functionality over the basic speed control. NetRef and NetCtrl bits must be set to one, in order for the commands and reference values to be sent to the AC drive. When these bits are set, the actual control/reference place can be read from "Ctrl From Net" and "Ref From Net" bits. Run Forward and Run Reverse bits are used to control the direction of the motor. See Table 29 for complete description of the run commands.

Table 22. Basic Speed Control Instance descriptions

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Extended Speed Control Output									
21	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1								
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							
Extended Speed Control Input									
71	0	At Reference	Ref from Net	Ctrl from Net	Ready	Running2 (Rev)	Running1	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							

7.1.2.3 23/73 Extended Speed and Torque Control

Extended speed and torque assemblies can be used when torque reference is needed.

Torque Reference is converted from $^{\tau\,(Nm)}/2^{n}$, where *n* is the torque scale value (AC/DC Drive object, instance 2, attribute 24), to a %-value for the AC drive. This value is sent in ProcessDataIn1 for the control unit when NetRef bit is set. Therefore, ProcessDataIn1 should be selected as torque reference selection. See the application manual or Chapter for more details.

Table 23. Extended Speed and Torque Control Instance descriptions

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Extended Speed and Torque Control Output									
23	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1								
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							
	4	Torque Reference (Low Byte)							
	5	Torque Reference (High Byte)							
Extended Speed and Torque Control Input									

Table 23. Extended Speed and Torque Control Instance descriptions

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
73	0	At Reference	Ref from Net	Ctrl from Net	Ready	Running2 (Rev)	Running1	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							
	4	Torque Actual (Low Byte)							
	5	Torque Actual (High Byte)							

7.1.2.4 25/75 Extended Process Control

Extended process control assemblies can be used to send process reference value directly to the application. The Process Reference value destination can be selected with Drive Mode byte according to Table 20. This should be configured in application as the receiving input. Process Actual value is always mapped to ProcessDataOut1. Note that process reference value is sent to drive only when NetProc bit is set.

Table 24. Extended Process Control Instance descriptions

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Extended Process Control Output									
25	0	NetProc	NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1	Drive Mode							
	2	Speed Reference (Low Byte)							
	3	Speed Reference (High Byte)							
	4	Process Reference (Low Byte)							
	5	Process Reference (High Byte)							
Extended Process Control Input									
75	0	At Reference	Ref from Net	Ctrl from Net	Ready	Running2 (Rev)	Running1	Warning	Faulted
	1	Drive State							
	2	Speed Actual (Low Byte)							
	3	Speed Actual (High Byte)							
	4	Process Actual (Low Byte)							
	5	Process Actual (High Byte)							

7.1.2.5 101/107 Vendor Dynamic Process Control

These assemblies can be used to send/receive process data directly to and from the application. The FB Speed Reference and the FB Speed Actual values are given as percentage of the minimum and maximum frequency. The control and status words are still given as CIP standard specific values.

Table 25. Vendor Dynamic Process Control Instance descriptions

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Dynamic Process Control Output									
101	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1	Process Data 1 Selector (bits 4-7)				Process Data 2 Selector (bits 0-3)			
	2	FB Speed Reference (Low Byte)							
	3	FB Speed Reference (High Byte)							
	4	ProcessDataIn1 (Low Byte)							
	5	ProcessDataIn1 (High Byte)							
	6	ProcessDataIn2 (Low Byte)							
	7	ProcessDataIn2 (High Byte)							
Dynamic Process Control Input									
107	0	At Reference	Ref from Net	Ctrl from Net	Ready	Running2 (Rev)	Running1	Warning	Faulted
	1	Drive State							
	2	FB Speed Actual (Low Byte)							
	3	FB Speed Actual (High Byte)							
	4	ProcessDataOut1 (Low Byte)							
	5	ProcessDataOut1 (High Byte)							
	6	ProcessDataOut2 (Low Byte)							
	7	ProcessDataOut2 (High Byte)							

Process data selector bits can be used to select what content is mapped to ProcessDataOut 1 & 2 (bytes 4-7). The following table describes what values in these fields correspond to which process data items

.

Table 26. Process Data Selector 1 & 2 description

Value	Bytes 4-5 of instance 107	Bytes 6-7 of instance 107
0*	Speed Actual [%]	Speed Actual [%]
1	ProcessDataOut1	ProcessDataOut1
2	ProcessDataOut2	ProcessDataOut2
3	ProcessDataOut3	ProcessDataOut3
4	ProcessDataOut4	ProcessDataOut4
5	ProcessDataOut5	ProcessDataOut5
6	ProcessDataOut6	ProcessDataOut6

Table 26. Process Data Selector 1 & 2 description

Value	Bytes 4-5 of instance 107	Bytes 6-7 of instance 107
7	ProcessDataOut7	ProcessDataOut7
8	ProcessDataOut8	ProcessDataOut8
Other	ProcessDataOut1	ProcessDataOut2

*If both Process Data selectors are 0, bytes 4-5 are ProcessDataOut1 and bytes 6-7 are ProcessDataOut2.

7.1.2.6 111/117 Vendor Bypass Control

These assemblies can be used to bypass the CIP standard assemblies, and control the AC drive application directly. The FB Speed Reference and the FB Speed Actual values are given as percentage of the minimum and maximum frequency. The control and status words are application-specific values.

Table 27. Vendor Bypass Control Instance descriptions

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Bypass Control Output									
111	0-1	FBFixedControlWord							
	2-3	RPM Speed Reference							
	4-5	ProcessDataIn1							
	6-7	ProcessDataIn2							
	8-9	ProcessDataIn3							
	10-11	ProcessDataIn4							
	12-13	ProcessDataIn5							
	14-15	ProcessDataIn6							
	16-17	ProcessDataIn7							
	18-19	ProcessDataIn8							
Bypass Control Input									
117	0-1	FBFixedStatusWord							
	2-3	FB Speed Actual [%]							
	4-5	FB Speed Actual [rpm]							
	6-7	Speed Actual With Slip							
	8-17	Reserved							
	18-19	ProcessDataOut1							
	20-21	ProcessDataOut2							
	22-23	ProcessDataOut3							
	24-25	ProcessDataOut4							
	26-27	ProcessDataOut5							
	28-29	ProcessDataOut6							
	30-31	ProcessDataOut7							
	32-33	ProcessDataOut8							

7.1.2.7 Vendor Extended Speed Control Variant 3

These assemblies can be used to bypass the CIP standard assemblies and to control the AC drive application directly. The FB Speed Reference and the FB Speed Actual values are given as percentage of the minimum and maximum frequencies. The control and status words are application specific values. For more information, see Chapter 13 "Appendix E - VACON® IO data description".

This assembly pair brings support for 16 process data items (for limitations, see Chapter 16 "Appendix H - Fieldbus option board communication").

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Vendor Extended Speed Control Output Variant 3									
151	0-1	FBFixedControlWord							
	2-3	FBGeneralControlWord							
	4-5	FBSpeedReference [%]							
	6-7	FBProcessDataIn1							
	...	...							
	20-21	FBProcessDataIn8							
	22-23	FBProcessDataIn9							
	...								
	36-37	FBProcessDataIn16							
Vendor Extended Speed Control Input Variant 3									
157	0-1	FBFixedStatusWord							
	2-3	FBGeneralStatusWord							
	4-5	FBSpeedActual [%]							
	6-7	FBProcessDataOut1							
	...								
	20-21	FBProcessDataOut8							
	22-23	FBProcessDataOut9							
	...								
	36-37	FBProcessDataOut16							

7.1.2.8 Vendor Extended Speed Control Variant 4

These assemblies combine CIP control/status word with VACON® speed control. The FB Speed Reference and the FB Speed Actual values are given as percentage of the minimum and maximum frequencies. For more information, see Chapter 13 "Appendix E - VACON® IO data description".

This assembly pair brings support for 16 process data items (for limitations, see Chapter 16 "Appendix H - Fieldbus option board communication".

Instance	Byte	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Vendor Extended Speed Control Output Variant 4									
161	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1	FBSpeedReference [%]							
	2-3	FBProcessDataIn1							
	4-5	...							
	...	FBProcessDataIn8							
	18-19	FBProcessDataIn9							
	20-21	...							
	...	FBProcessDataIn16							
	34-35								
Vendor Extended Speed Control Input Variant 4									
167	0	At ref.	Ref from Net	Ctrl from Net	Ready	Running 2 (rev)	Running 1	Warning	Faulted
	1	Drive state							
	2-3	FBSpeedActual [%]							
	4-5	FBProcessDataOut1							
	...	FBProcessDataOut8							
	18-19	FBProcessDataOut9							
	20-21	...							
	...	FBProcessDataOut16							
	34-35								

7.1.3 CONTROL SUPERVISOR BEHAVIOUR

The State Transition Diagram provides a graphical description of the states and the corresponding state transitions for the control supervisor.

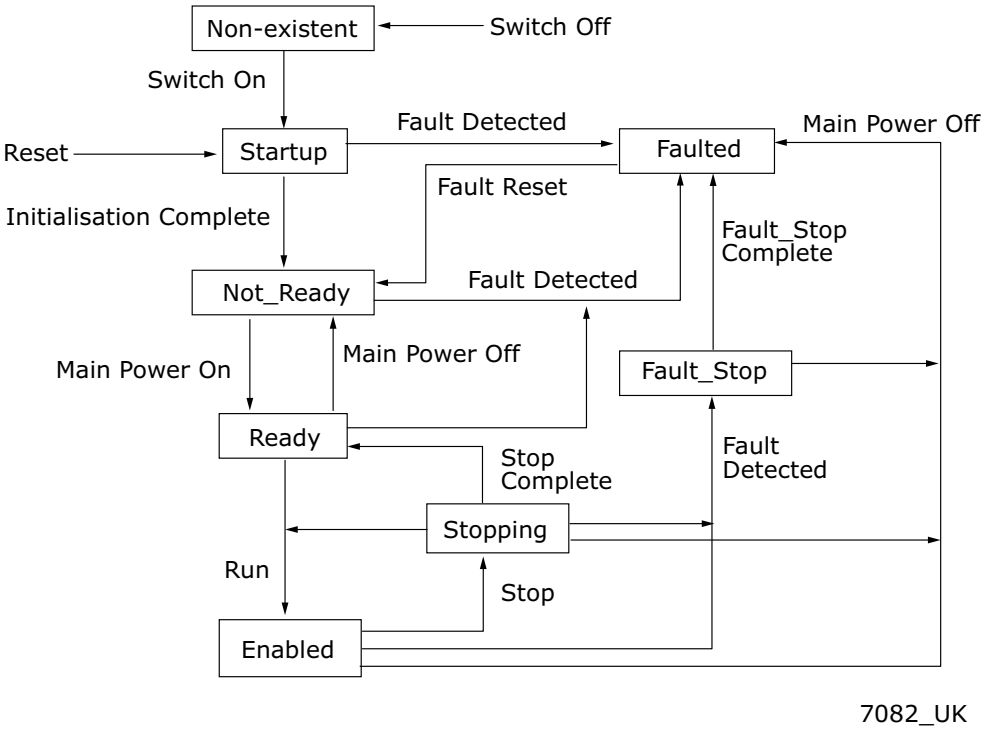


Figure 24. Control Supervisor State Transition Diagram

The current state of the Control Supervisor State can be read from Control Supervisor Object (Class 0x29), Instance 1, Attribute 6. The values correspond to the states according to the following table.

Table 28. Control Supervisor State

Value	State
0	Non-existent
1	Startup
2	Not_Ready
3	Ready
4	Enabled
5	Stopping
6	Fault_Stop
7	Faulted

The "Main Power On" and "Main Power Off" refer to the motor control status (READY / NOT READY). Stop command will result in stop by "Stop Function". The stop mode is selectable in application.

Run1 and Run2 bits trigger Stop and Run commands according to Table 29. Fault Reset will occur on a rising edge of the Reset command.

Table 29. Run/Stop Event Matrix

Run1	Run2	Trigger Event	Run Type
0	0	Stop	N/A
0 -> 1	0	Run	Run1
0	0 -> 1	Run	Run2
0 -> 1	0 -> 1	No Action	N/A
1	1	No Action	N/A
1 -> 0	1	Run	Run2
1	1 -> 0	Run	Run1

7.2 Explicit messaging

Explicit Messaging is used in commissioning and parametrizing of the DeviceNet option board. Explicit messages provide multipurpose, point-to-point communication paths between two devices. They provide the typical request/response-oriented network communication used to perform node configuration and problem diagnosis. Explicit messages typically use low priority identifiers and contain the specific meaning of the message right in the data field. This includes the service to be performed and the specific object attribute address.

7.2.1 Connection behaviour

Here you can see a general overview of the behaviour associated with an Explicit Messaging Connection Object (Instance type attribute = Explicit Messaging).

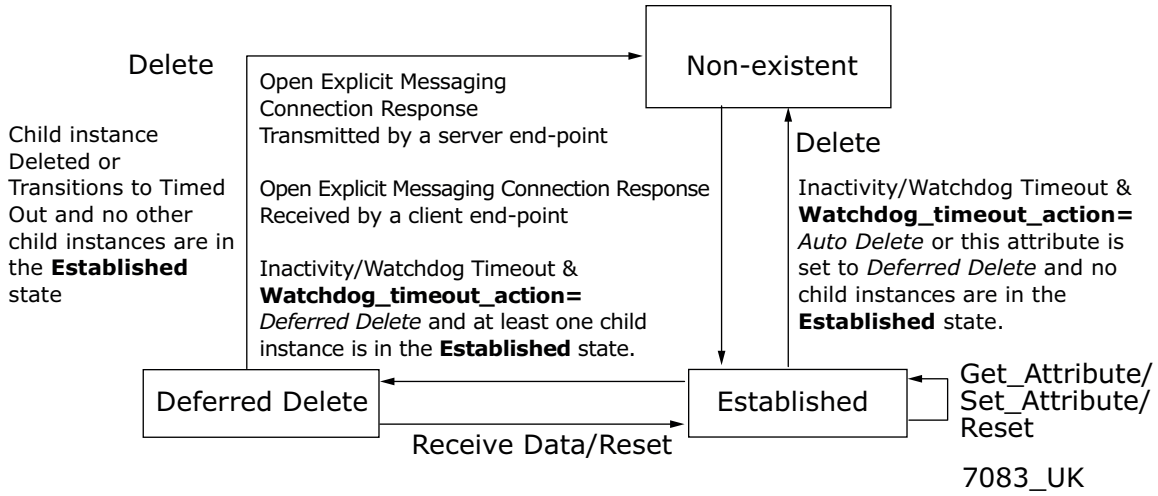


Figure 25. Explicit Messaging Connection Object State Transition Diagram

Explicit Connection Expected Packet Rate (EPR) is set by default to 2500, meaning that watchdog timeout action will occur after 10s.

8. DEVICENET FAULT HANDLING

The following chapter describes different fault activation situations in OPTE7. For more information on fault tracing, see Chapter 15 "Appendix G - Fault tracing".

Table 30. Fault Activation Sources

Name	Description	N LED
BUS-OFF	CAN driver in bus-off state	Red
DUP_MAC-ID	Duplicate MAC ID is found during startup/ MAC ID change	Red
PASSIVE	CAN driver is in passive state	-
EXT_PWR	External +24V is not detected	Off
PIO_TO	Polled I/O connection Expected Packet Rate watchdog timeout	Flashing red

- Bus-off and passive states are cleared when CAN driver goes to active state.
- External power fault is cleared when +24V is connected to option board connector.
- Duplicate MAC check is made every time the MAC-ID is changed or the option board is powered up. The fault is cleared, when the duplicate MAC-ID check passes.
- Polled I/O connection timeout is cleared when the I/O connection is released or allocated

How the AC drive will react to these fault situations can be defined in application:

Table 31. Fieldbus Fault Reaction in VACON® 100 and VACON® 20 (standard application)

Code		Parameter	Min	Max	Default	ID	Description
VACON® 100	VACON® 20						
P3.9.1.6	P13.19	Response to fieldbus fault	0	4	3	733	0 = No response 1 = Alarm 2 = Fault, stop by stop function 3 = Fault, stop by coasting

Table 32. Fieldbus Fault Reaction in VACON® 20X (standard application)

Code	Parameter	Min	Max	Default	ID	Description
P9.15	Response to fieldbus fault	0	2	2	733	0 = No action 1 = Warning 2 = Fault

8.1 General and additional error codes

The following table contains a list of CIP error codes that you may receive when there are problems with requests done by your PLC.

Table 33. General Error Codes

Code	General Error	Description
0x00	Success	Service was successfully performed by the object specified.
0x02	Resource Unavailable	Resources needed for the object to perform the requested service were unavailable.
0x08	Service Not Supported	The requested service was not implemented or was not defined.
0x09	Invalid Attribute Value	Invalid attribute data detected.
0x0B	Already In Requested State	Requested release connection does not exist.
0x0C	Object State Conflict	The object cannot perform the requested service in its current mode/state.
		Already allocated to another master.
0x0E	Attribute Not Settable	A request to modify a non-modifiable attribute was received.
0x10	Device State Conflict	The current mode/state of the device prohibits the execution of the requested service.
0x13	Not Enough Data	Explicit request was too short.
0x14	Attribute Not Supported	The attribute specified in the request is not supported.
0x15	Too Much Data	The service supplied more data than was expected.
0x16	Object Does Not Exist	The object specified does not exist in the device.
0x20	Invalid Parameter	Message received on Group 2 unconnected requested port was not an allocate or release message.
		A parameter associated with the request was invalid.
0x28	Invalid Member ID	The Member ID specified in the request does not exist.

Table 34. Additional Error Codes

Code	Description
0x01	Predefined Master/Slave Connection Set allocation conflict
0x02	Invalid Allocation/Release Choice parameter
0x03	Message received on Group 2 Only Unconnected Explicit Request message port that was not an Allocate or Release message
0x04	Resource required for use with the Predefined Master/Slave Connection Set is not available

9. APPENDIX A - OBJECT DICTIONARY

9.1 IMPLEMENTED CIP OBJECTS

9.1.1 LIST OF OBJECT CLASSES

The Communication Interface supports the following object classes.

Table 35. Implemented Object Classes

	Class	Object
Required by DeviceNet	0x01	Identity
	0x02	Message Router
	0x03	DeviceNet
	0x04	Assembly
	0x05	DeviceNet Connection
Required by Drive Profile	0x28	Motor Data
	0x29	Control Supervisor
	0x2A	AC/DC Drive
Vendor-Specific	0xA0	Vendor Parameter

9.1.2 List of Services

The following table shows the services supported by these object classes.

	Service Name	Identity		Message Router		DeviceNet		Assembly		Connection			Motor Data		Control Supervisor		AC/DC Drive		Vendor Parameter	
Service Code (in hex)		Class	Inst	Class	Inst	Class	Inst	Class	Inst.	Class	Inst. (Explicit)	Inst. (Polled)	Class	Inst.	Class	Inst.	Class	Inst.	Class	Inst.
0x05	Reset		Y*								Y	Y								
0x09	Delete										Y	Y								
0x0E	Get_Attribute_Single	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
0x10	Set_Attribute_Single		Y		Y		Y		Y		Y	Y		Y		Y		Y		Y
0x4B	Allocate_Master/ Slave_Connection_Set						Y													
0x4C	Release_Master/ Slave_Connection_Set						Y													

*Supports reset type 0 and 1

9.1.3 CLASS CODE 0X01 - IDENTITY OBJECT

Table 36.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	1	UINT	Revision of this object
2	Max Instance	Get	1	UINT	Maximum instance number
3	Number of Instances	Get	1	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			2	UINT	Number of services
			{5, 14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute
7	Max Instance Attribute ID	Get	10	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	“Identity”	SHORT_STRING	ASCII Name for the Object Class
Instance 1					
1	Vendor ID	Get	443	UINT	Identification of each vendor by number. 443 = Vacon Plc
2	Device Type	Get	2	UINT	Indication of the general type of product. 2 = AC Drive
3	Product Code	Get	2	UINT	Identification of a particular product of an individual vendor. 2 = OPTE7
4	Revision	Get	N/A	STRUCT of:	Revision of the item the Identity Object represents
				USINT	Major revision
				USINT	Minor revision

Table 36.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
5	Status	Get	N/A 0 65535	WORD	Summary status of the device. Defined in ODVA DeviceNet specification. Supported bits: Bit 0 = Owned Bit 7 = System fault Bit 8 = Minor Recoverable Fault Bit 9 = Minor Unrecoverable Fault Bit 10 = Major Recoverable Fault Bit 11 = Major Unrecoverable Fault
6	Serial Number	Get	N/A	UDINT	Serial number of the device. YYMMDDxxxx, where YY = year of manufacture MM = month of manufacture DD = day of manufacture xxxx = running number
7	Product Name	Get	"OPTE7"	SHORT_STRING	Human readable identification
8	State	Get	N/A 0 5	USINT	Present state of the device as represented by the state transition diagram. 0 = Nonexistent 1 = Device Self-Testing 2 = Standby 3 = Operational 4 = Major Recoverable Fault 5 = Major Unrecoverable Fault
9	Configuration Consistency Value	Get	N/A 0 65535	UINT	Contents identify configuration of the device
10	Heartbeat Interval	Get Set	0 0 255	USINT	Heartbeat message send interval in seconds. By default disabled. Zero disables the transmission.

9.1.4 CLASS CODE 0X02 - MESSAGE ROUTER OBJECT

Table 37.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	1	UINT	Revision of this object
2	Max Instance	Get	1	UINT	Maximum instance number
3	Number of Instances	Get	1	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			1	UINT	Number of services
			{14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute
7	Max Instance Attribute ID	Get	1	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"Message Router"	SHORT_STRING	ASCII Name for the Object Class
Instance 1					
1	Object List	Get	N/A	STRUCT of:	Structure with an array of object class codes supported by the device
				UINT	Number of classes
				ARRAY of UINT	Classes

9.1.5 CLASS CODE 0X03 - DEVICENET OBJECT

Table 38.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	2	UINT	Revision of this object
2	Max Instance	Get	1	UINT	Maximum instance number
3	Number of Instances	Get	1	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			1	UINT	Number of services
			{14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute
7	Max Instance Attribute ID	Get	10	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"Device-Net"	SHORT_STRING	ASCII Name for the Object Class
Instance 1					
1	MAC ID	Get Set	63 0 63	USINT	Node address
2	Baud Rate	Get Set	0 0 2	USINT	The baud rate of the device 0 = 125 kBaud 1 = 250 kBaud 2 = 500 kBaud If value is changed via network, it will be taken into use only after a reset / power cycle. If changed via panel, baud rate will be taken into use immediately.
3	BOI (Bus-off Interrupt)	Get Set	1 0 1	BOOL	0 = Hold the CAN chip in bus-off state upon detection of a bus-off indication 1 = If possible, fully reset the CAN chip and continue communication upon detection of a bus-off indication

Table 38.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
4	Bus-off counter	Get Set	0 0 255	USINT	Number of times CAN went to bus-off state. Received data is not used. Counter always reset to 0.
5	Allocation Information	Get	N/A	STRUCT of:	Allocation Choice Master's Mac ID
				BYTE	Allocation Choice Byte Bit 0 = Explicit messaging Bit 1 = Polled I/O
				USINT	Master's MAC ID 0-63 = valid 255 = unallocated
100	Bus-off Separation	Get	128	USINT	Messages that have to be received by the device to leave bus-off state. This value is set by the CAN controller.

9.1.6 CLASS CODE 0X04 - ASSEMBLY OBJECT

Table 39.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	2	UINT	Revision of this object
2	Max Instance	Get	117	UINT	Maximum instance number
3	Number of Instances	Get	12	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			1	UINT	Number of services
			{14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute

Table 39.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
7	Max Instance Attribute ID	Get	3	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"Assembly"	SHORT_STRING	ASCII Name for the Object Class
Instance 20					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.1.
Instance 21					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.2.
Instance 23					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.3.
Instance 25					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.4.
Instance 70					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.1.
Instance 71					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.2.
Instance 73					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.3.
Instance 75					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.4.
Instance 101					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.5.
Instance 111					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.6.
Instance 107					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.5.
Instance 117					
3	Data	Get	N/A	ARRAY	See Chapter 7.1.2.6.

9.1.7 CLASS CODE 0X05 - DEVICENET CONNECTION OBJECT

Table 40.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	1	UINT	Revision of this object
2	Max Instance	Get	2	UINT	Maximum instance number
3	Number of Instances	Get	2	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			1	UINT	Number of services
			{14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute
7	Max Instance Attribute ID	Get	17	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"Device-Net Connection"	SHORT_STRING	ASCII Name for the Object Class
Instance 1 - Explicit Connection					
1	State	Get	0 0 5	USINT	State of the object 0 = Non-existent 1 = Configuring 2 = Waiting 3 = Established 4 = Timeout 5 = Deferred Delete
2	Instance Type	Get	0	USINT	Indicates either I/O or Messaging Connection. 0 = Explicit Messaging 1 = I/O
3	Transport Class Trigger	Get	0x83	BYTE	Defines behavior of the connection. Defines behavior of the Connection. See CIP Vol.1 chapter 3.4.4.3 for more details.

Table 40.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
4	Produced Connection ID	Get	0x5FA 0x403 0x5FA	UINT	Placed in CAN Identifier Field when the Connection transmits on a DeviceNet subnet.
5	Consumed Connection ID	Get	N/A	UINT	CAN Identifier Field value that denotes message to be received on a DeviceNet subnet.
6	Initial Comm. Characteristics	Get	0x21	BYTE	Defines the Message Group(s) across which productions and consumptions associated with this connection occur. See CIP Vol.3 chapter 3-2.4 for more details.
7	Produced Connection Size	Get	99	UINT	Maximum number of bytes transmitted across this Connection
8	Consumed Connection Size	Get	99	UINT	Maximum number of bytes received across this Connection
9	Expected Packet Rate	Get Set	2500 0 65535	UINT	Defines timing associated with this connection
12	Watchdog Timeout Action	Get Set	1 1 3	USINT	Defines how to handle Inactivity/Watchdog timeouts. 1 = Auto Delete 2 = Invalid for Explicit Connection 3 = Deferred Delete
13	Produced Connection Length	Get	0	UINT	Not used in Explicit Connection
14	Produced Connection Path	Get	{0}	ARRAY of USINT	Not used in Explicit Connection
15	Consumed Connection Path Length	Get	0	UINT	Not used in Explicit Connection
16	Consumed Connection Path	Get	{0}	ARRAY of USINT	Not used in Explicit Connection
17	Production Inhibit Time	Get	0	UINT	Not used in Explicit Connection
Instance 2 - Polled I/O Connection					

Table 40.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
1	State	Get	0 0 4	USINT	State of the object 0 = Non-existent 1 = Configuring 2 = Waiting 3 = Established 4 = Timeout
2	Instance Type	Get	1	USINT	Indicates either I/O or Messaging Connection. 0 = Explicit Messaging 1 = I/O
3	Transport Class Trigger	Get	131	BYTE	Defines behavior of the connection. See CIP Vol.1 chapter 3.4.4.3 for more details.
4	Produced Connection ID	Get	0x3FF 0x3C1 0x3FF	UINT	Placed in CAN Identifier Field when the Connection transmits on a DeviceNet subnet.
5	Consumed Connection ID	Get	N/A	UINT	CAN Identifier Field value that denotes message to be received on a DeviceNet subnet.
6	Initial Comm. Characteristics	Get	1	BYTE	Defines the Message Group(s) across which productions and consumptions associated with this connection occur. See CIP Vol.3 chapter 3-2.4 for more details.
7	Produced Connection Size	Get	99	UINT	Maximum number of bytes transmitted across this Connection
8	Consumed Connection Size	Get	99	UINT	Maximum number of bytes received across this Connection
9	Expected Packet rate	Get Set	0 0 65535	UINT	Defines timing associated with this connection
12	Watchdog Timeout Action	Get Set	0 0 0	USINT	Defines how to handle Inactivity/Watchdog timeouts. 0 = Transition to Timed Out 1 = Invalid for I/O Connection
13	Produced Connection Length	Get	6	UINT	Number of bytes in the Produced Connection Path attribute
14	Produced Connection Path	Get Set	N/A	ARRAY of USINT	Application obj. producing data on this connection.

Table 40.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
15	Consumed Connection Path Length	Get	6	UINT	Number of bytes in the Consumed Connection Path attribute
16	Consumed Connection Path	Get Set	N/A	ARRAY of USINT	Specifies the application object(s) that are to receive the data consumed by this connection.
17	Production Inhibit Time	Get	0	UINT	Not used in Polled I/O Connection

9.1.8 CLASS CODE 0X28 - MOTOR DATA OBJECT

Table 41.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	1	UINT	Revision of this object
2	Max Instance	Get	1	UINT	Maximum instance number
3	Number of Instances	Get	1	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			1	UINT	Number of services
			{14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute
7	Max Instance Attribute ID	Get	15	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"Motor Data"	SHORT_STRING	ASCII Name for the Object Class
Instance 1					
3	Motor Type	Get Set	7 3 7	USINT	Motor types supported: 3 = PM Synchronous Motor 7 = Squirrel Cage Induction Motor
6	Rated Current	Get Set	N/A	UINT	Motor nominal current Unit: 100 mA
7	Rated Voltage	Get Set	N/A	UINT	Motor nominal voltage Unit: Volts
9	Rated Frequency	Get Set	N/A	UINT	Motor nominal frequency Unit: Hz
12	Pole Count	Get	N/A	UINT	Number of poles in the motor
15	Base Speed	Get Set	N/A	UINT	Nominal speed at rated frequency. Unit: RPM

9.1.9 CLASS CODE 0X29 - CONTROL SUPERVISOR OBJECT

Table 42.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	1	UINT	Revision of this object
2	Max Instance	Get	1	UINT	Maximum instance number
3	Number of Instances	Get	1	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			1	UINT	Number of services
			{14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute
7	Max Instance Attribute ID	Get	15	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"Control Supervisor"	SHORT_STRING	ASCII Name for the Object Class
Instance 1					
3	Run1	Get Set	0 0 1	BOOL	See Table 29.
4	Run2	Get Set	N/A	BOOL	See Table 29.

Table 42.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
5	NetCtrl	Get Set	0 0 1	BOOL	Requests Run/Stop control to be local or from network. 0 = Local Control 1 = Network Control Note that this selection does not force control place to network if set. This bit only enables commands to be sent to the drive. Depending on how it is parametrized, this command might be ignored or used. See Chapter 6.4 for more details. Actual status of control is reflected in attribute 15.
6	State	Get	0 0 7	USINT	State of Control Supervisor Instance. See Chapter 7.1.3. 0 = Vendor-Specific 1 = Startup 2 = Not_Ready 3 = Ready 4 = Enabled 5 = Stopping 6 = Fault_Stop 7 = Faulted
7	Running1	Get	N/A 0 1	BOOL	Running forward status 0 = Other state 1 = Running forward
8	Running2	Get	N/A 0 1	BOOL	Running reverse status 0 = Other state 1 = Running reverse
9	Ready	Get	N/A 0 1	BOOL	Ready to accept a run event 0 = Other state 1 = Ready to accept a run event
10	Faulted	Get	N/A 0 1	BOOL	Fault occurred 0 = No faults present 1 = Fault occurred (latched)
11	Warning	Get	N/A 0	BOOL	Warning present 0 = No warnings present 1 = Warning present (not latched)
12	FaultRst	Get Set	0 0 1	BOOL	Fault reset request 0 = No action 0 -> 1 = Fault reset request 1 = No action

Table 42.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
13	FaultCode	Get	N/A	UINT	If in Faulted state, the Fault-Code indicates the fault that caused the transition to Faulted state. If not in Faulted state, the FaultCode indicates the fault that caused the last transition to the Faulted state. The supported fault codes are listed in Chapter 10.
14	WarnCode	Get	N/A	UINT	Indicates the lowest valued warning that caused the Warning bit to be TRUE.
15	CtrlFromNet	Get	N/A 0 1	BOOL	Status of the Run/Stop control source 0 = Control is local (as parametrized) 1 = Control is from network

9.1.10 CLASS CODE 0X2A - AC/DC DRIVE OBJECT

Table 43.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	1	UINT	Revision of this object
2	Max Instance	Get	1	UINT	Maximum instance number
3	Number of Instances	Get	1	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			8	UINT	Number of attributes
			{1, 2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers
5	Optional Service List	Get		STRUCT of:	List of optional services
			1	UINT	Number of services
			{14}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute

Table 43.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
7	Max Instance Attribute ID	Get	29	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"AC/DC Drive"	SHORT_STRING	ASCII Name for the Object Class
Instance 1					
3	At Reference	Get	N/A 0 1	BOOL	1 = Drive actual at reference (speed or torque reference) based on mode
4	Net Ref	Get Set	0 0 1	BOOL	Requests torque or speed reference to be local or from the network. 0 = Set Reference not DN Control 1 = Set Reference at DN Control This selection does not force the drive to use network reference. When set, the reference values are sent to the drive, but depending on how it is parametrized, it might ignore this reference value. See Chapter 6.4 for more details. Actual status of reference is reflected in attribute 29.
5	Net Proc	Get Set	0 0 1	BOOL	Requests process control reference to be active. See Chapter 7.1.2.4 for more details.
6	Drive Mode	Get Set	N/A 0 3	USINT	0 = Open loop frequency 1 = Open loop speed 2 = Closed loop speed 3 = Torque control
7	Speed Actual	Get	N/A 0 32767	INT	Actual drive speed Unit: RPM
8	Speed Ref	Get Set	N/A 0 32767	INT	Speed reference Unit: RPM
9	Current Actual	Get	N/A 0 32767	INT	Actual motor phase current Unit: 100 mA
10	Current Limit	Get Set	N/A 0 32767	INT	Motor phase current limit Unit: 100 mA

Table 43.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
11	Torque Actual	Get	N/A -32768 32767	INT	Actual torque Unit: Nm / $2^{TorqueScale}$, where TorqueScale is attribute 24
12	Torque Ref	Get Set	N/A -32768 32767	INT	Torque reference Unit: Nm / $2^{TorqueScale}$, where TorqueScale is attribute 24
13	Process Actual	Get	N/A	INT	Actual process control value. Mapped to FB Process-DataOut1.
14	Process Ref	Get Set	N/A	INT	Process control reference. See Chapter 7.1.2.4 for detailed information.
15	Power Actual	Get	N/A	INT	Actual output power Unit: Watts
16	Input Voltage	Get	N/A	INT	Input Voltage Unit: Volts
17	Output Voltage	Get	N/A	INT	Output Voltage Unit: Volts
18	Accel Time	Get Set	N/A	UINT	Acceleration time Unit: ms
19	Decel Time	Get Set	N/A	UINT	Deceleration time Unit: ms
20	Low Spd Limit	Get Set	N/A	UINT	Minimum speed limit Unit: RPM
21	High Spd Limit	Get Set	N/A	UINT	Maximum speed limit Unit: RPM
24	Torque Scale	Get Set	0 -8 7	SINT	Torque scaling factor. Scaling is accomplished as follows: ScaledTorque = Nm / $2^{TorqueScale}$
29	Ref From Net	Get	N/A 0 1	BOOL	Status of torque/speed reference. 0 = Local torque/speed reference 1 = Network torque/speed reference

9.1.11 CLASS CODE OXA0 - VENDOR PARAMETER OBJECT

Table 44.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
NOT SINGLE ATTRIBUTE PROVIDED					

The Vendor Parameter Object is used to read and write parameters with an ID number directly from control unit. The desired Instance number and attribute number is constructed in the following way:

- Instance = Parameter ID (High Byte) + 1
- Attribute = Parameter ID (Low Byte)

Examples:

1) Energy Counter, ID = 2291 = 0x**08**F3
   a) Instance ID = **0x08** + 1 = 0x09
   b) Attribute ID = 0xF3
2) Maximum Frequency, ID = 102 = 0x**00**66
   a) Instance ID = **0x00** + 1 = 0x01
   b) Attribute ID = 0x66

NOTE! All the values (when applicable) are truncated to 16-bit values and the scale varies between different types of values.

9.0.1 CLASS CODE OXAA - MONITORING DATA OBJECT

This object can be used only in the OPTCx mode.

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
Instance 0					
1	Revision	Get	1	UINT	Revision of this object
2	Max Instance	Get	1	UINT	Maximum instance number
3	Number of Instances	Get	1	UINT	Number of object instances
4	Optional Attribute List	Get		STRUCT of:	List of optional instance attributes
			7	UINT	Number of attributes
			{2, 3, 4, 5, 6, 7, 176}	ARRAY of UINT	List of optional attribute numbers

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
5	Optional Service List	Get		STRUCT of:	List of optional services
			3	UINT	Number of services
			{14, 20, 24}	ARRAY of UINT	List of optional service codes
6	Max Class Attribute ID	Get	176	UINT	The attribute ID number of the last class attribute
7	Max Instance Attribute ID	Get	1	UINT	The attribute ID number of the last instance attribute
176	Object Name	Get	"Moni-torin Data"	SHORT_STRING	ASCII Name for the Object Class
Instance 1					
1-99		Get	N/A N/A N/A	UINT	Actual values. Attributes are defined in EDS file (depend on drive application).
101-108	E1-E8	Get Set	N/A 0 65535	UINT	Event code for event 1–8. See table Table 45.
109	EC	Get Set	N/A 0 65535	UINT	Total number of events
110	SafeStateType	Get Set	0 0 2	UINT	Selects Safe State response to errors which specify safe state operation. Currently only a loss of connection other than by de-allocation is a safe state error. Alarm: Review the application for safe operation before specifying a value for this attribute. 0 = DriveFault (fault and stop) 1 = No Action (hold last speed) 2 = Preset Speed/Direction
111	PresetDir	Get Set	N/A 0 1	UINT	Sets safe state direction of rotation if the Safe State Behavior attribute specifies "Preset Speed/Direction". Alarm: Review the application for safe operation before specifying a value for this attribute. Inverter requires external stop. 0 = Forward 1 = Reverse

#	Attribute Name	Services	Default Minimum Maximum	Data Type	Description
112	PresetRPM	Get Set	N/A 0 30000	UINT	Sets safe state speed reference (RPM) if the Safe State Behavior attribute specifies "Preset Speed/Direction". Alarm: Review the application for safe operation before specifying a value for this attribute. Inverter requires external stop.
113	PresetTq	Get Set	N/A 0 10000	UINT	Sets safe state torque reference (0.00%) if the Safe State Behavior attribute specifies "Preset Speed/Direction". Alarm: Review the application for safe operation before specifying a value for this attribute. Inverter requires external stop.
120	Polled Input Assembly Type	Get Set	71 70 167	UINT	Input assembly used by the polled connection.
121	Polled Output Assembly Type	Get Set	21 20 161	UINT	Output assembly used by the polled connection.

List of monitoring data object event codes in OPTC7.

Table 45. List of OPTC7 event codes

Event code (hex)	Event name	Event description
0x00	No event	Default value in EventList entries.
0x01	Drive Communication Error	Inverter interface communication error with the drive
0x02	I/O Connection Timeout - Fault_Stop	Control Supervisor transitions to Fault_Stop.
0x03	I/O Connection Timeout - No Action	Control Supervisor remains in Enabled State. Hold last speed.
0x04	I/O Connection Timeout - Preset Direction and Speed	Control Supervisor remains in Enabled State. Run at preset direction and speed.
0x05	Explicit Connection Timeout - Fault_Stop	Control Supervisor transitions to Fault_Stop.
0x06	Explicit Connection Timeout - No Action	Control Supervisor remains in Enabled State. Hold last speed.

Event code (hex)	Event name	Event description
0x07	Explicit Connection Timeout - Preset Direction and Spee	Control Supervisor remains in Enabled State. Run at preset direction and speed.
0x08	Low DeviceNet Voltage	Connection timeout may occur next.
0x09	Bus Off	Connection timeout may occur next.
0x0C	CAN Overrun	Connection timeout may occur next.
0x0E	Configuration Consistency Value (CRC) mismatch	The configuration of the device is incorrect or incomplete. Major Recoverable Fault. An Identity Reset type 1 is needed for recovery.
0x0F	Microprocessor watchdog timeout	The device detected a serious problem with itself. Major Unrecoverable Fault.
0x10	Received explicit message is too big	Message is ignored.
0x11	Received IO message is too big	Message is ignored.
0x12	Parameter Range Error	An out-of-range parameter value exists in the drive.
0x14	I/O Connection Released - Fault_Stop	Control Supervisor transitions to Fault_Stop.
0x15	I/O Connection Released - No Action	Control Supervisor remains in Enabled State. Hold last speed.
0x16	I/O Connection Released - Preset Direction and Speed	Control Supervisor remains in Enabled State. Run at preset direction and speed.
0x17	Receive_Idle - Fault_Stop	Control Supervisor transitions to Fault_Stop.
0x18	Receive_Idle - No Action	Control Supervisor remains in Enabled State. Hold last speed.
0x19	Receive_Idle - Preset Direction and Speed	Control Supervisor remains in Enabled State. Run at preset direction and speed.
0x1A	Explicit Connection Released - Fault_Stop	Control Supervisor transitions to Fault_Stop.
0x1B	Explicit Connection Released - No Action	Control Supervisor remains in Enabled State. Hold last speed.
0x1C	Explicit Connection Released - Preset Direction and Speed	Control Supervisor remains in Enabled State. Run at preset direction and speed.
0x21	Connection unable to read message	Error detected by connection object code
0x22	Connection unable to send message	Error detected by connection object code
0x23	Consumer unable to read message	Error detected by connection object code
0x24	Consumer unable to send message	Error detected by connection object code
0x25	Producer unable to send buffer	Error detected by connection object code
0x26	Producer unable to send acknowledgement	Error detected by connection object code

Event code (hex)	Event name	Event description
0x27	Unexpected notification that message was sent	Error detected by connection object code
0x31	Explicit reply is too big	Error detected by connection object code
0x34	First fragment of an IO message is too big	Error detected by connection object code
0x35	Reassembled IO message is too big	Error detected by connection object code
0x36	IO message is too big for producer	Error detected by connection object code
0x37	IO/Explicit message is too big for producer	Error detected by connection object code

10. APPENDIX B - FAULT AND WARNING CODES

OPTE7 uses the implied fault/warning codes for the device profile. For AC drives, the implied fault/warning codes used are DRIVECOM Nutzergruppe e.V 16-bit codes. The supported fault codes are listed in the table below. The full list of error codes can be found in Vol. 1 of CIP, section 5-29.6.

Table 46.

Code Value [Hex]	Meaning
0000	No fault
1000	General Fault
2300	Current, Device Output Side
2330	Short to Earth
3130	Phase Failure
3210	Overvoltage inside the device
3220	Undervoltage inside the device
4210	Excess Device Temperature
4220	Inadequate Device Temperature
5120	DC Link Power Supply
5200	Control
5420	Chopper
6010	Software Reset (Watchdog)
6100	Internal Software
7111	Brake Chopper Failure
7120	Motor
7500	Communication
7600	Data Memory
9000	External Malfunction

11. APPENDIX C - DEVICENET COMMUNICATION EXAMPLES

This chapter contains examples on how some DeviceNet actions are done. Examples explain how these commands are seen on CAN bus.

11.1 DEVICENET'S USE OF THE CAN IDENTIFIER FIELD

When sending DeviceNet messages, make sure to use the proper message ID value.

Identifier Bits											Identity hex
10	9	8	7	6	5	4	3	2	1	0	
0	Group 1 Message ID				Source MAC ID						
0	1	1	0	1	Source MAC ID						Slave's I/O Change of State or Cyclic Message
0	1	1	1	0	Source MAC ID						Slave's I/O Bit-Strobe Response Message
0	1	1	1	1	Source MAC ID						Slave's I/O Poll Response Message
1	0	MAC ID						Group 2 Message ID			
1	0	Source MAC ID						0	0	0	Master's I/O Bit-Strobe Command Message
1	0	Source MAC ID						0	0	1	Reserved of Master's use - Use ID TBD
1	0	Source MAC ID						0	1	0	Master's Change of State/Cyclic Acknowledge Message
1	0	Source MAC ID						0	1	1	Slave's Explicit Response Messages
1	0	Destination MAC ID						1	0	0	Master's Connected Explicit Request Message
1	0	Destination MAC ID						1	0	1	Master's I/O Poll command/ change of state/Cyclic Message
1	0	Destination MAC ID						1	1	0	Group 2 Only Unconnected Explicit Request Messages
1	0	Destination MAC ID						1	1	1	Duplicate MAC ID Check Messages

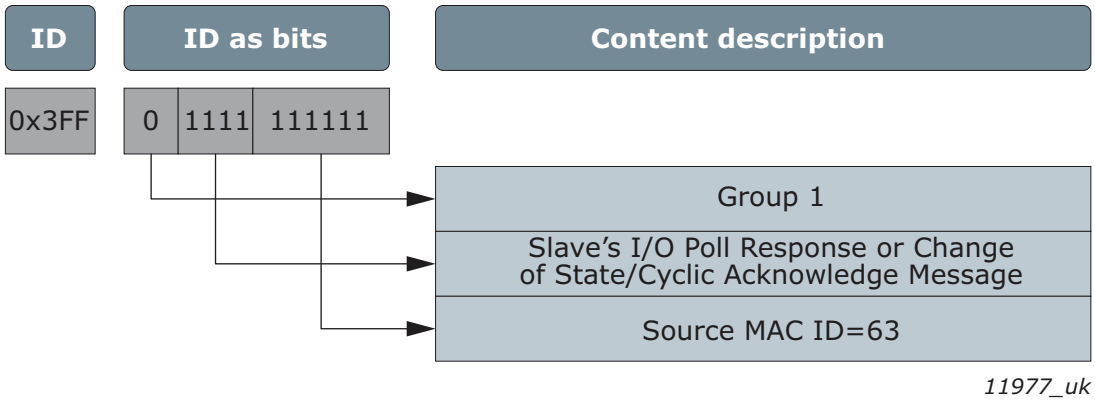


Figure 26. Group 1 message example

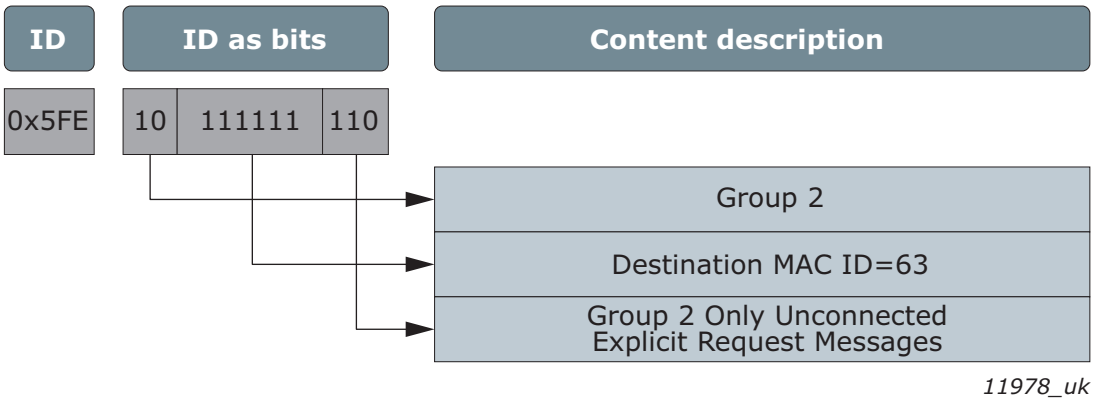


Figure 27. Group 2 message example: Explicit request

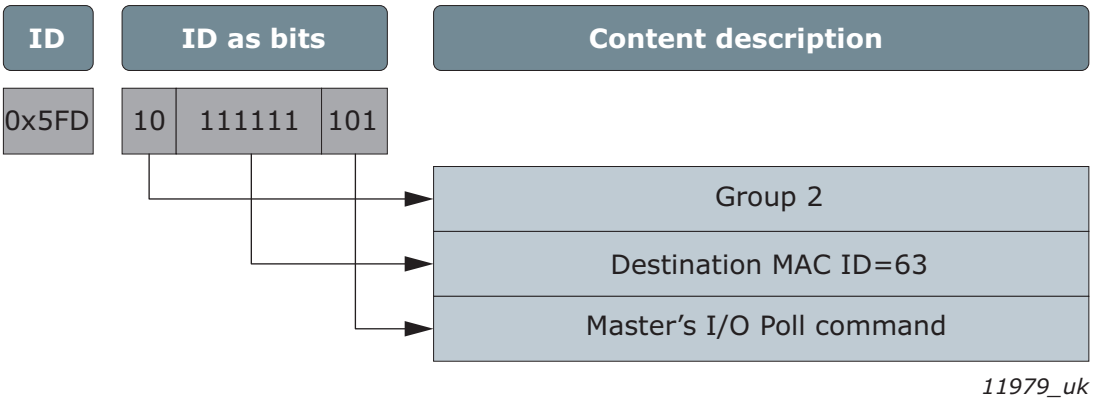


Figure 28. Group 2 message example: I/O Poll Command

11.2 FRAGMENTATION PROTOCOL

Messages that exceed 8 bytes must be fragmented to multiple frames. This is done by adding the fragmentation protocol to the frames. The first byte of the frame is used for the fragmentation protocol. It contains the fragment type and count.

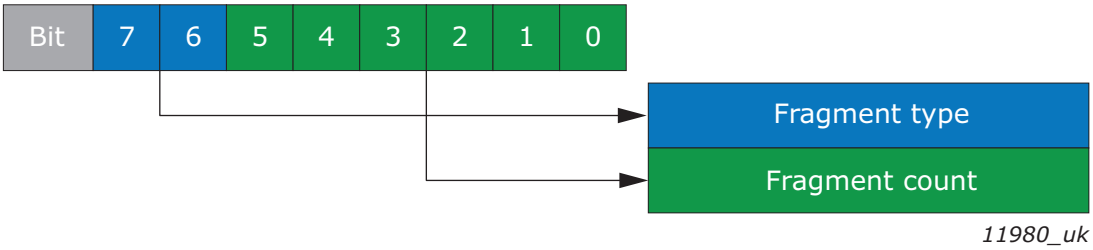


Figure 29. Fragmentation protocol

The following table contains the fragmentation types. In the first fragment the fragment count must be either zero or 0x3F. If the value 0x3F is used, it means that the first fragment is also the last fragment. Otherwise the fragment count is increased by one in each transmission.

Value	Meaning
0	First fragment. The Fragment Count Field must contain the value 0 or 0x3F.
1	Middle fragment
2	Last fragment
3	Fragment Acknowledge

11.3 EXAMPLE MESSAGES

11.3.1 OPENING EXPLICIT MESSAGING CONNECTION

This message is used to open an explicit messaging connection. This must be done before sending any other explicit messages.

Table 47. Message ID: 0x5FE

#	Data (hex)	Description
1	01	Message header
2	4B	Allocate Master / Slave Connection set
3	03	Class ID: DeviceNet Object
4	01	Instance ID
5	01	Explicit message
6	01	Allocators MAC ID

The OK answer is [5FB: 01 CB 00].

11.3.2 SETTING EXPLICIT CONNECTION TIMEOUT

After the explicit connection is opened, you must set the connection timeout. If the value is set to zero, the connection does not timeout. The value is in milliseconds. The expected packet rate attribute value also affects when the connection timeouts.

Table 48. Message ID: 0x5FC

#	Data (hex)	Description
1	01	Message header
2	10	Set attribute single
3	05	Class ID: DeviceNet Connection object
4	01	Instance ID (explicit connection)
5	09	Attribute ID: Expected Packet Rate
6	00	Data byte 1
7	00	Data byte 2; in this example. Expected packet rate is set to zero so connection does not timeover ever.

The OK answer is [5FB: 01 90 00 00].

11.3.3 CLOSING EXPLICIT MESSAGING CONNECTION

The explicit messaging connection is closed with the following message.

Table 49. Message ID: 0x5FE

#	Data (hex)	Description
1	01	Message header
2	4C	Deallocate Master / Slave Connection set
3	03	Class ID: DeviceNet Object
4	01	Instance ID
5	01	Explicit message

The OK answer is [5FB: 01 CC].

11.3.4 READING ID 102 VALUE USING VENDOR PARAMETER OBJECT

When reading the ID value using Vendor Parameter Object, read ID is set to Instance ID and Attribute ID fields. The instance ID field is always at least 1.

The lower byte of the parameter ID will be set to the Attribute ID field and the higher byte with +1 to the Instance ID field.

When the ID value is less than the size of one byte (255), for example 102 (0x00 66), the Instance ID is 0x01 and the attribute ID is 0x66.

If the ID is greater than 255, for example 601 (0x02 59), the instance ID is 0x02 + 0x01 = 0x03 and the attribute ID is 0x59.

Table 50. Message ID: 0x5FC

#	Data (hex)	Description
1	01	Message header
2	0E	Get attribute single
3	A0	Class ID: Vendor Parameter Object
4	01	Instance ID:
5	66	Attribute ID: Max Frequency (ID 102)

If the operation was successful, the answer is:

Table 51. Message ID: 0x5FB

#	Data (hex)	Description
1	01	Message header
2	8E	OK, get attribute single
3	88	Data byte 1
4	13	Data byte 2; => 0x1388 => 5000 DEC => 50.00 Hz

11.3.5 WRITING ID 102 VALUE USING VENDOR PARAMETER OBJECT

Writing ID value is a similar process as reading the ID value. In request you change service to "Set Attribute Single" and add value for the ID in the end of the message.

Table 52. Message ID: 0x5FC

#	Data (hex)	Description
1	01	Message header
2	10	Set Attribute Single
3	A0	Class ID Vendor Parameter Object
4	01	Instance ID
5	66	Attribute ID: Max Frequency (ID 102)
6	A0	Data byte 1
7	0F	Data byte 2; => 0x0FA0 => 4000 DEC => 40.00Hz

If operation was successful, answer is [5FB: 01 90].

11.3.6 OPENING POLL I/O CONNECTION

Before opening the poll connection, you must open the explicit messaging connection. This is needed to set timeout and so on. This command is identical compared to the opening explicit messaging connection part from byte number 5.

Table 53. Message ID: 0x5FE

#	Data (hex)	Description
1	01	Message header
2	4B	Allocate Master / Slave Connection set
3	03	Class ID: DeviceNet Object
4	01	Instance ID
5	02	Poll
6	01	Allocators MAC ID

If the operation was successful, the answer is [5FB: 01 CB 00].

11.3.7 SETTING POLL CONNECTION TIMEOUT

After poll connection is opened, you must set connection timeout. If the value zero is set, then the connection does not timeout. It is not recommended to use zero timeout with I/O connection. The value is in milliseconds. The attribute value of expected packet rate also affects when the connection timeouts.

Table 54. Message ID: 0x5FC

#	Data (hex)	Description
1	01	Message header
2	10	Set attribute single
3	05	Class ID: DeviceNet Connection Object
4	02	Instance ID (poll connection)
5	09	Attribute ID: Expected Packet Rate
6	03	Data byte 1
7	E8	Data byte 2; in this example. Expected packet rate is set to 1,000 milliseconds. If Expected Packet Rate is four, then timeout occurs after four seconds.

11.3.8 CLOSING POLL CONNECTION

Poll I/O connection is closed with the following message.

Table 55. Message ID: 0x5FE

#	Data (hex)	Description
1	01	Message header
2	4C	Deallocate Master/Slave Connection set
3	03	Class ID: DeviceNet Object
4	01	Instance ID
5	02	Poll connection

OK answer is [5FB: 01 CC].

11.3.9 SENDING I/O DATA

Before you can send I/O data, you must open poll connection. The simplest I/O data frames contain only IO data. In the following example, output instance 21 and input instance 71 data is been transferred.

Table 56. Message ID: 0x5FD

#	Data (hex)	Description
1	61	Data 1: Output instance 21: CIP control word
2	0	Data 2: Output instance 21: Reserved
3	0	Data 3: Output instance 21: Speed ref byte 1
4	0	Data 4: Output instance 21: Speed ref byte 2

If connection is open and the slave is accepting the data, it will respond with I/O frame.

Table 57. Message ID: 0x3FF

#	Data (hex)	Description
1	F4	Data 1: Input instance 71: CIP status word
2	04	Data 2: Input instance 71: Drive mode
3	00	Data 3: Input instance 71: Actual speed byte 1
4	00	Data 4: Input instance 71: Actual speed byte 2

11.3.10 SENDING FRAGMENTED I/O DATA

Sending fragmented data is more complex. When doing it, you must add fragmentation protocol into the frames. In this example the output/input instance pair is 151/157. In the example the assembly data is: CW= 1, Gen. CW = 0, Speed ref = 5000 and PDI values are from 1 to 16. Because this assembly is 38 bytes long, it must be divided into six different frames.

Table 58. Message ID: 0x5FD, fragmented frame 1

#	Data (hex)	Description
1	00	Fragmentation protocol: First frame (fragment type = 0, fragment count = 0)
2	01	Data 1: Output data byte 1
3	00	Data 2: Output data byte 2
4	00	Data 3: Output data byte 3
2	00	Data 4: Output data byte 4
3	88	Data 5: Output data byte 5
4	13	Data 6: Output data byte 6
5	01	Data 7: Output data byte 7

Table 59. Message ID: 0x5FD, fragmented frame 2

#	Data (hex)	Description
1	41	Fragmentation protocol: Middle frame (fragment type = 1, fragment count = 1)
2	00	Data 1: Output data byte 8
3	02	Data 2: Output data byte 9
4	00	Data 3: Output data byte 10
2	03	Data 4: Output data byte 11
3	00	Data 5: Output data byte 12
4	04	Data 6: Output data byte 13
5	00	Data 7: Output data byte 14

Table 60. Message ID: 0x5FD, fragmented frame 3

#	Data (hex)	Description
1	42	Fragmentation protocol: Middle frame (fragment type = 1, fragment count = 2)
2	05	Data 1: Output data byte 15
3	00	Data 2: Output data byte 16
4	06	Data 3: Output data byte 17
2	00	Data 4: Output data byte 18
3	07	Data 5: Output data byte 19
4	00	Data 6: Output data byte 20
5	08	Data 7: Output data byte 21

Table 61. Message ID: 0x5FD, fragmented frame 4

#	Data (hex)	Description
1	43	Fragmentation protocol: Middle frame (fragment type = 1, fragment count = 3)
2	00	Data 1: Output data byte 22
3	09	Data 2: Output data byte 23
4	00	Data 3: Output data byte 24
2	0A	Data 4: Output data byte 25
3	00	Data 5: Output data byte 26
4	0B	Data 6: Output data byte 27
5	00	Data 7: Output data byte 28

Table 62. Message ID: 0x5FD, fragmented frame 5

#	Data (hex)	Description
1	44	Fragmentation protocol: Middle frame (fragment type = 1, fragment count = 4)
2	0C	Data 1: Output data byte 29
3	00	Data 2: Output data byte 30
4	0D	Data 3: Output data byte 31
2	00	Data 4: Output data byte 32
3	0E	Data 5: Output data byte 33
4	00	Data 6: Output data byte 34
5	0F	Data 7: Output data byte 35

Table 63. Message ID: 0x5FD, fragmented frame 6

#	Data (hex)	Description
1	85	Fragmentation protocol: Last frame (fragment type = 2, fragment count = 5)
2	00	Data 1: Output data byte 36
3	10	Data 2: Output data byte 37
4	00	Data 3: Output data byte 38

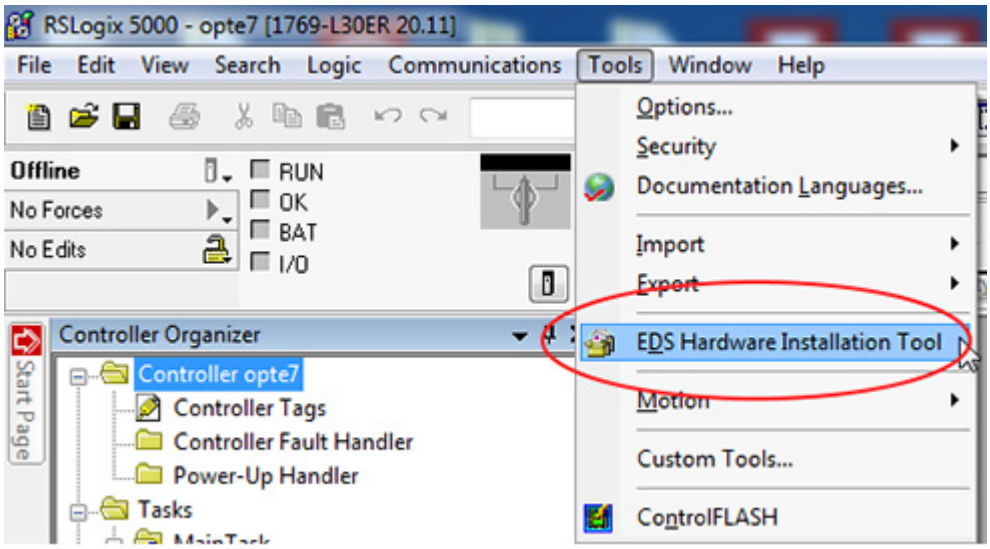
Once the slave has received the last frame, it responds with a fragmented response. In this response, the status word is 0x40 and the rest of the data is zeros.

Frame #	Frag. protocol	Data 1	Data 2	Data 3	Data 4	Data 5	Data 6	Data 7
1	00	40	00	00	00	00	00	00
2	41	00	00	00	00	00	00	00
3	42	00	00	00	00	00	00	00
4	43	00	00	00	00	00	00	00
5	44	00	00	00	00	00	00	00
6	85	00	00	00	00	00	00	00

12. APPENDIX D - EXAMPLE WITH RSLOGIX5000

This example is with the OPTE7 option board and Allen-Bradley PLC. The example shows how to add the OPTE7 option board to a simple DeviceNet project.

1. Start the RSLogix5000 software. First add OPTE7 EDS to the system:
   Click menu item "Tools", then "EDS Hardware Installation Tool".

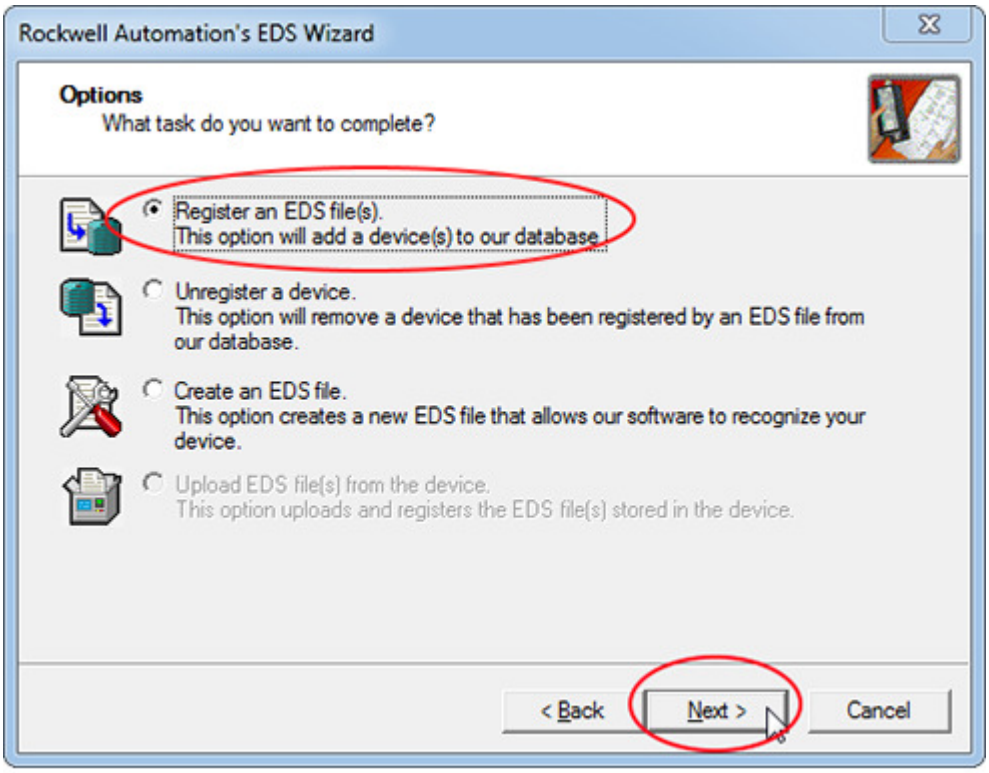


11981_00

2. When EDS wizard is started, press "Next".

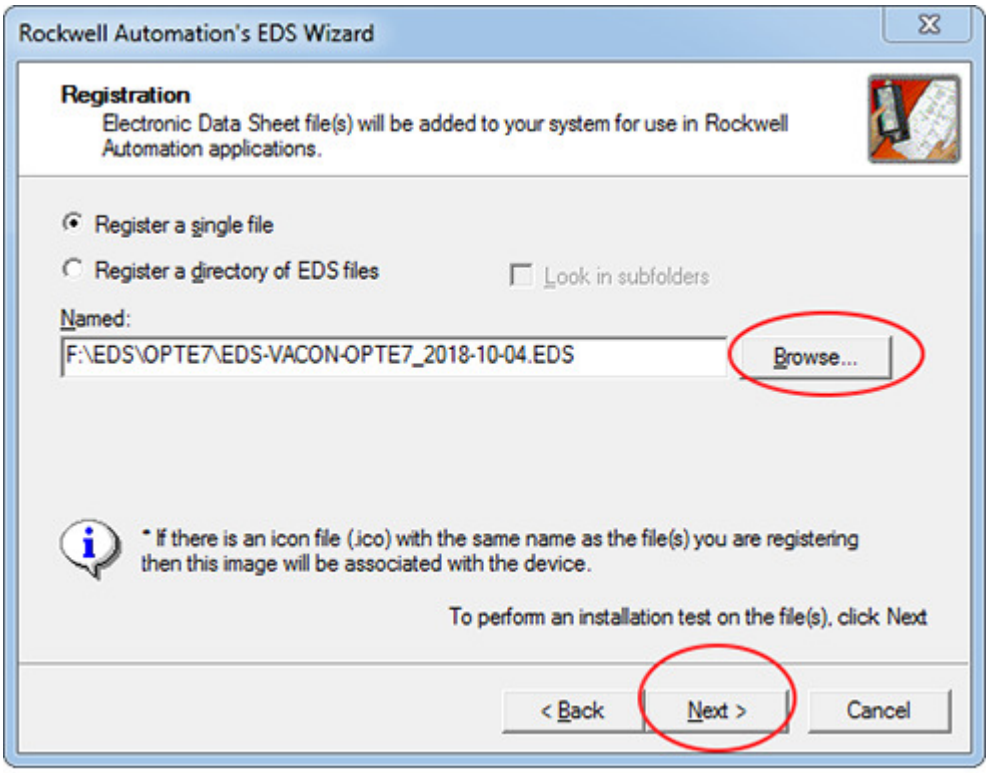
11982_00

3. Select "Register an EDS file(s)" and press "Next".



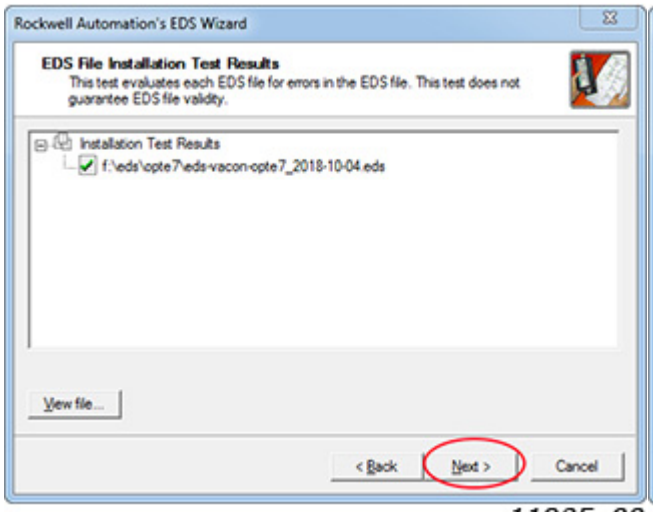
11983_00

4. Browse for the folder where you have stored the OPTE7 EDS file (EDS file for the OPTE7 option board can be downloaded from http://drives.danfoss.com). Once you have selected the correct file, press "Next".

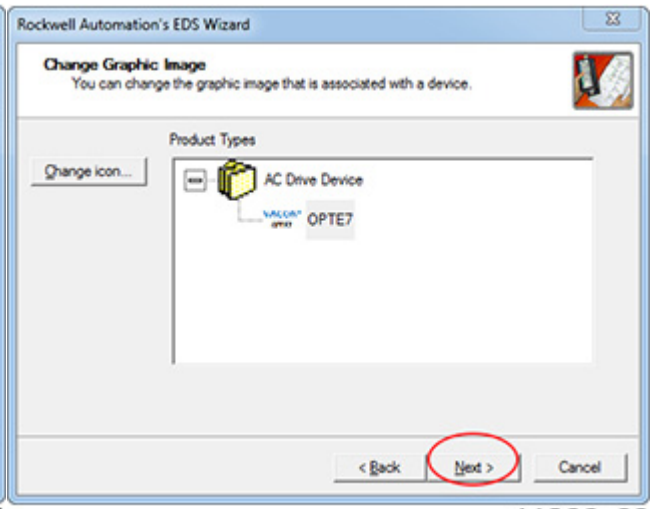


11984_00

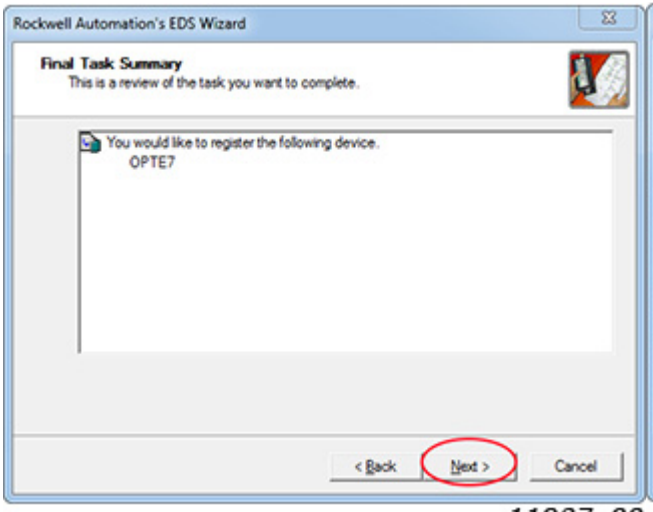
5. Now EDS has been checked and installed.
   Press "Next" in the next three windows and finally finish by pressing the "Finish" button.



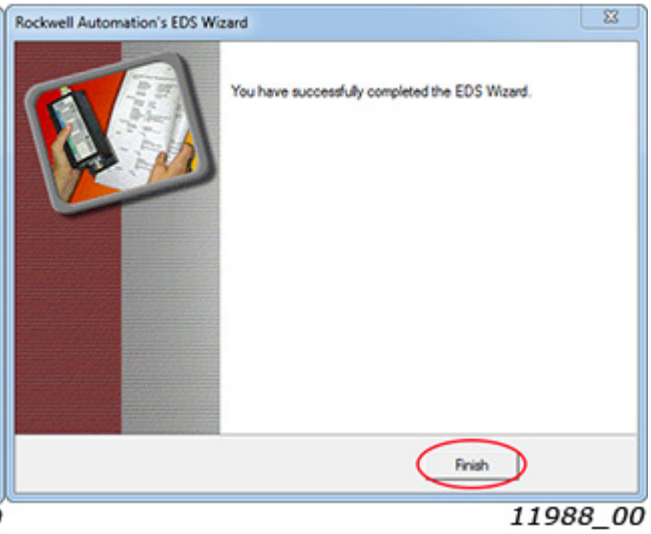
11985_00



11986_00

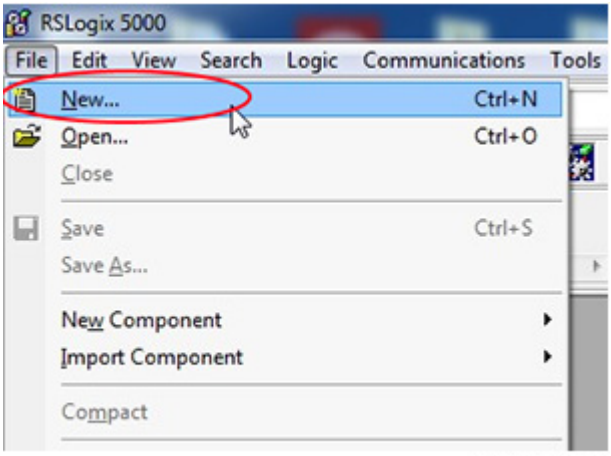


11987_00



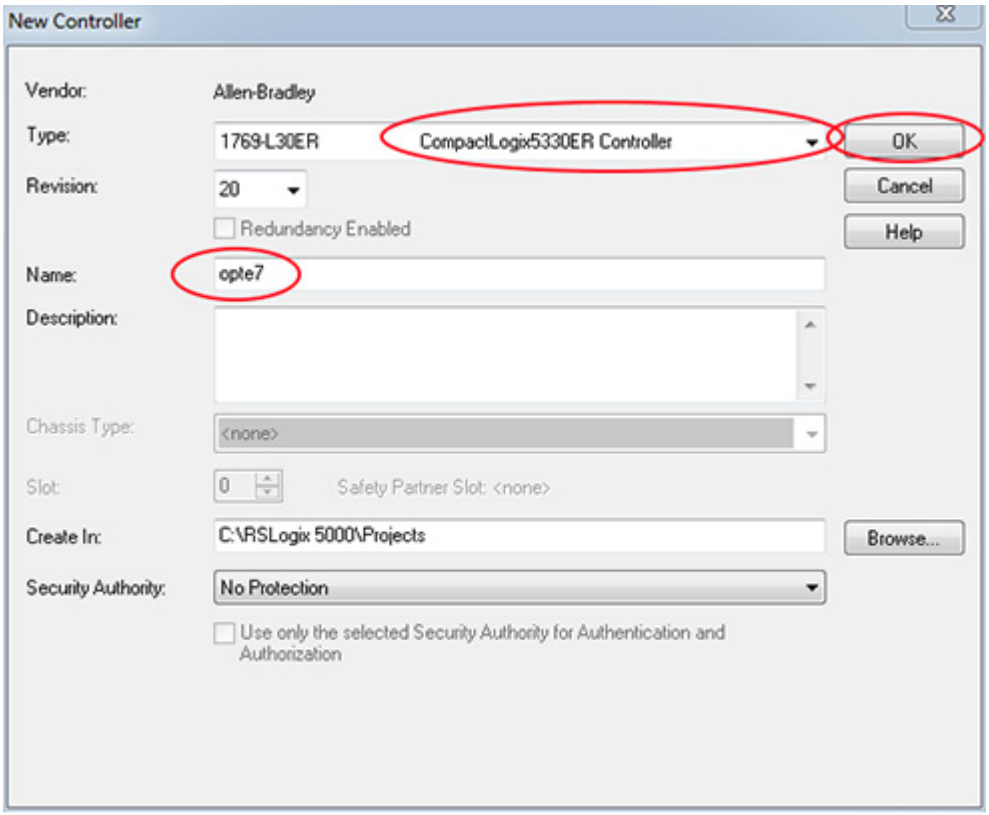
11988_00

6. To create a new project, select “File” and “New”.



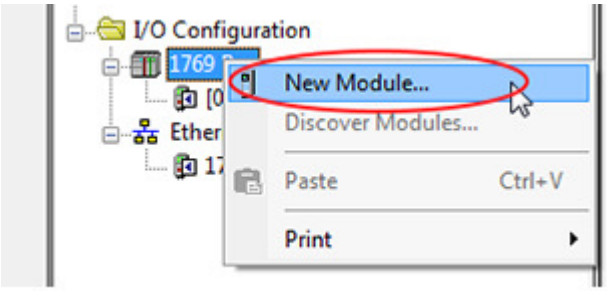
11989_00

7. Select your PLC and give the project a name. Then press "OK".



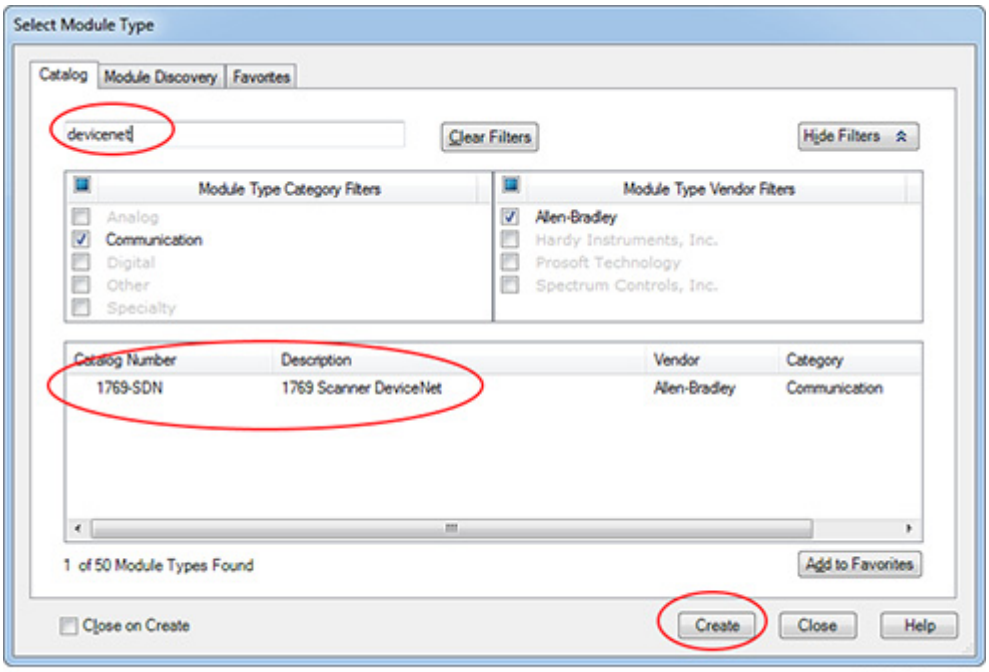
11990_00

8. Next add a new module from the tree with a right-click.



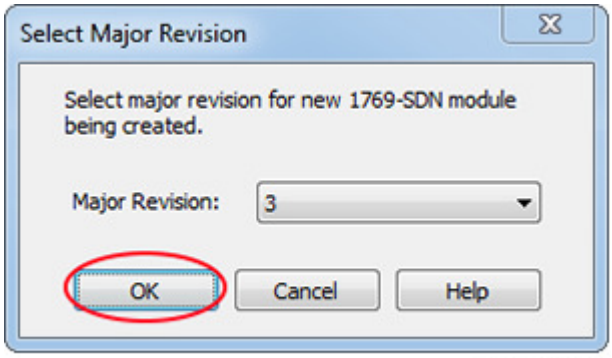
11991_00

9. Search for "devicenet" module. Add scanner to the project and press "Create".



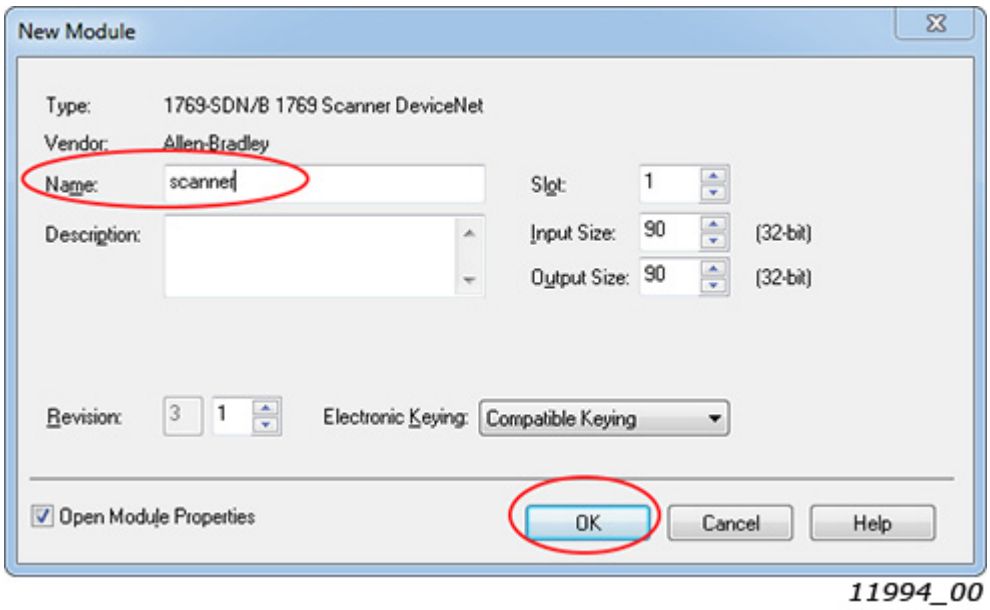
11992_00

10. Choose the major revision of the module and press "OK".



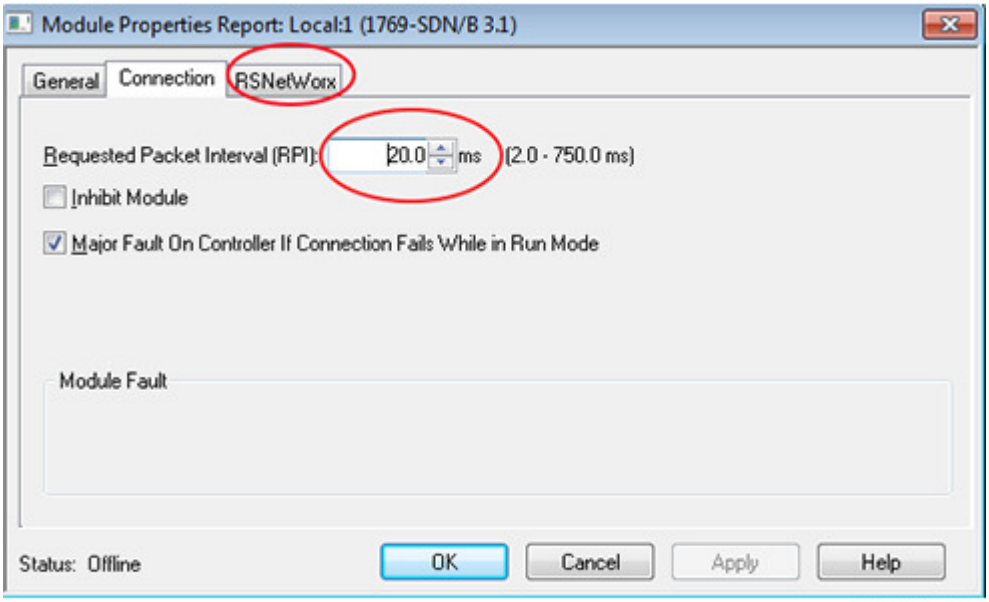
11993_00

11. Give name for the device and press "OK".



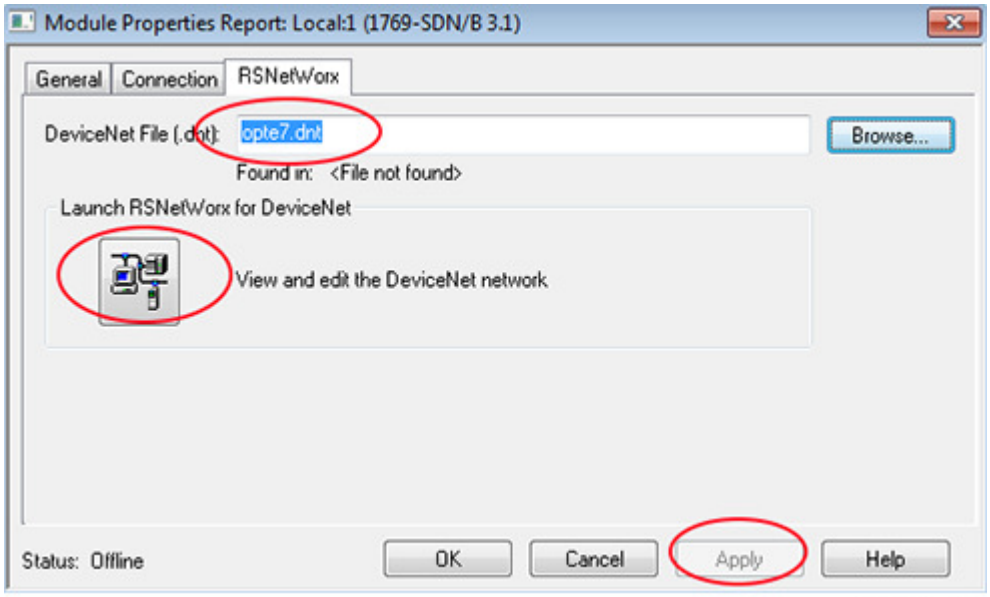
11994_00

12.Set RPI for the communication and go to the "RSNetWorx" tab.



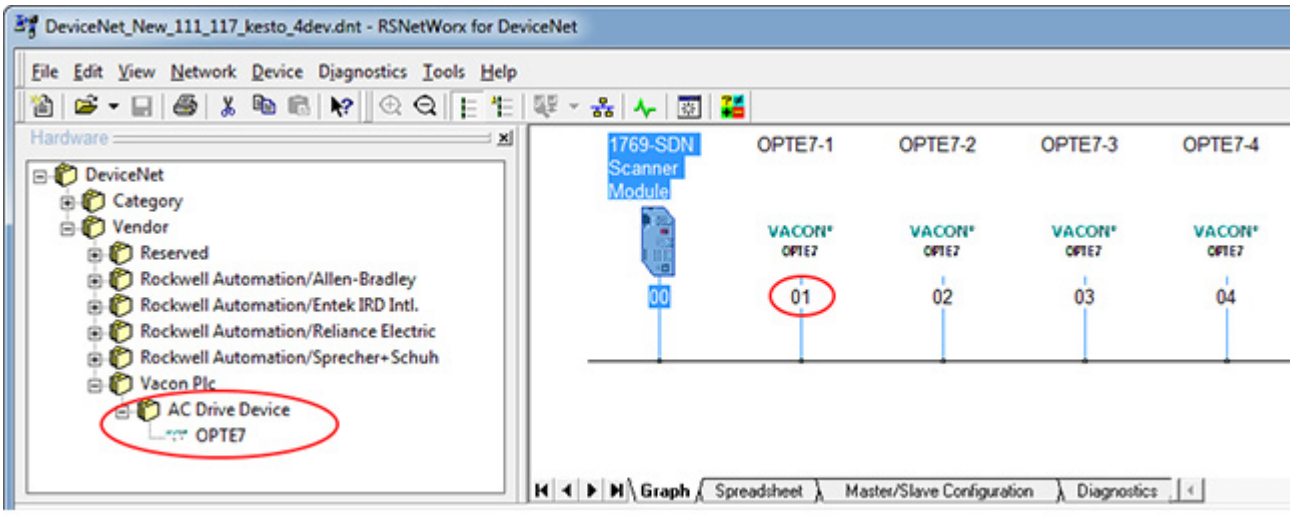
11995_00

13.Give a name for the DeviceNet network and press "Apply". After that you can press the "Launch RSNetWorx" button.



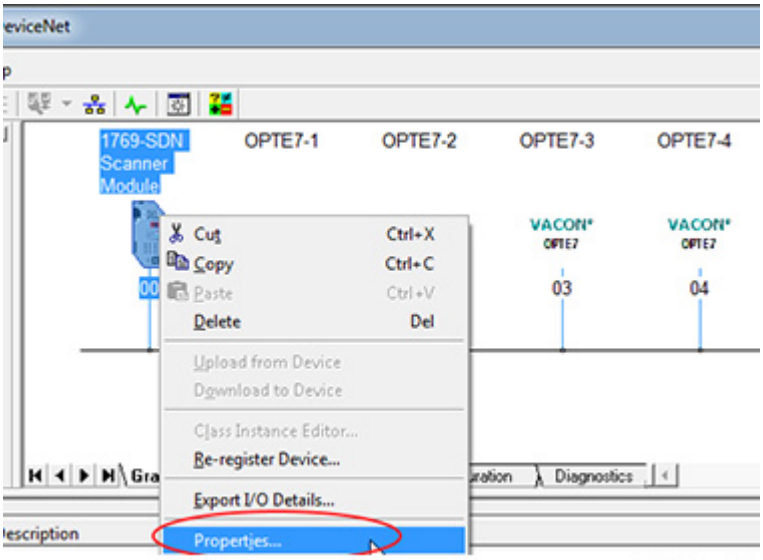
11996_00

14. RSNetWorks was launched. Find your scanner module from the tree and add it to the project.
    Then find VACON® OPTE7 and add it. In the figure below, we have added four OPTE7 option boards. You can set MAC ID for the device by clicking the number below the device. Use the same numbers you have set to the actual devices.



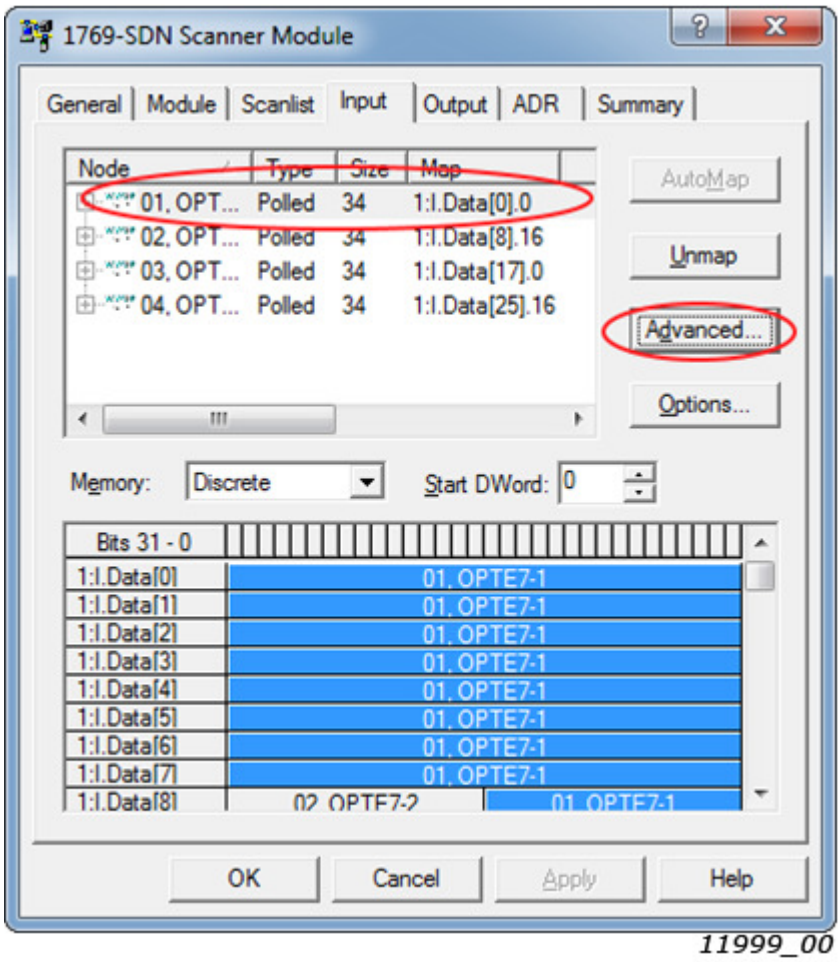
11997_00

15. Next right-click on the scanner module and select "Properties".



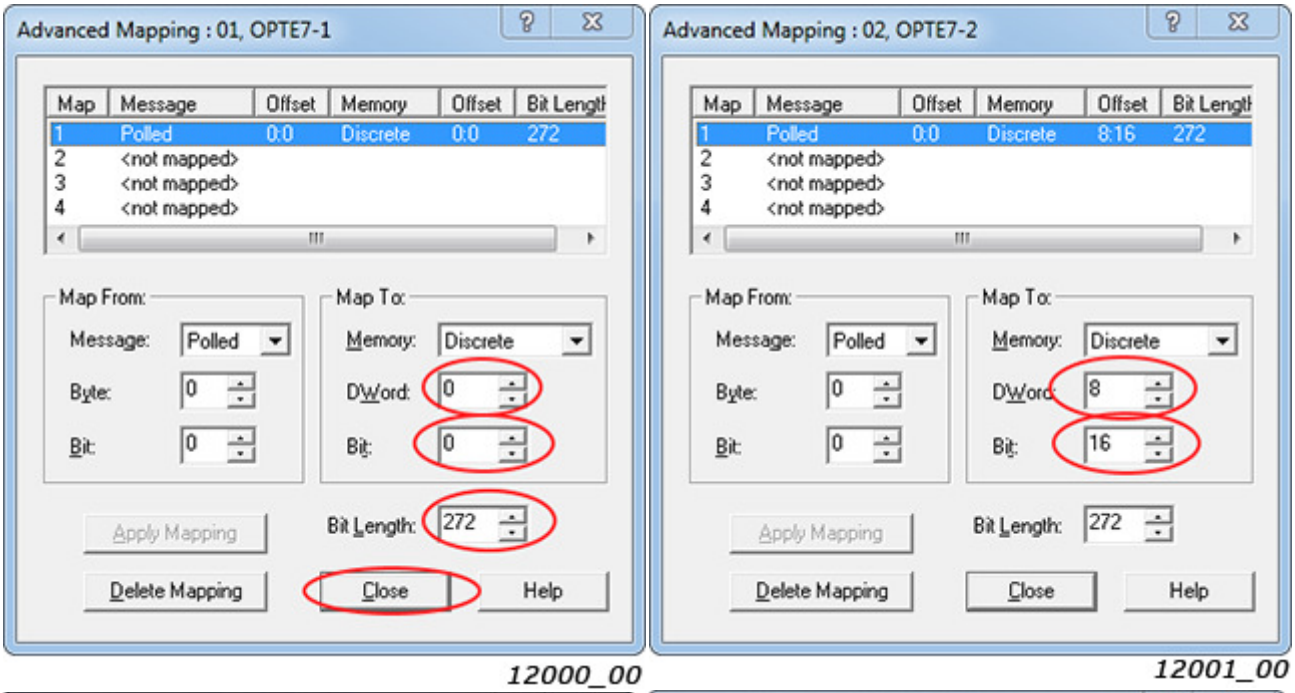
11998_00

16.In this view, select the first row and press "Advanced".



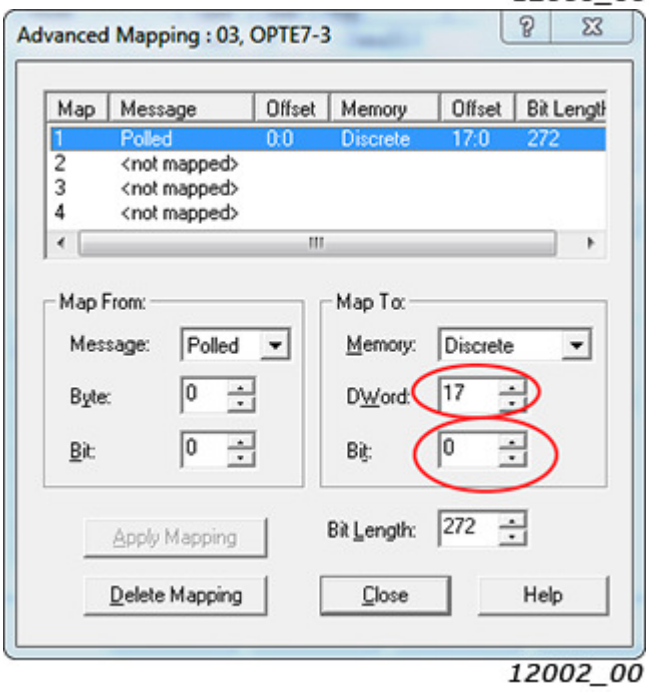
11999_00

17. In this example we have used assembly instances 111 and 117. For the first device, set "DWord" and "Bit" to zero. The messaging type is "Polled". The field "Bit Length" is set to 272. Next press "Close" and select the next row (device) from the previous view. For the second device, the values are the same except for "DWord" and "Bit". Those are set to 8 and 16. For the third device, the values are set to 17 and 0, and for the fourth 25 and 16. Now the assembly data is set and you can save changes and close RSNetWorks.

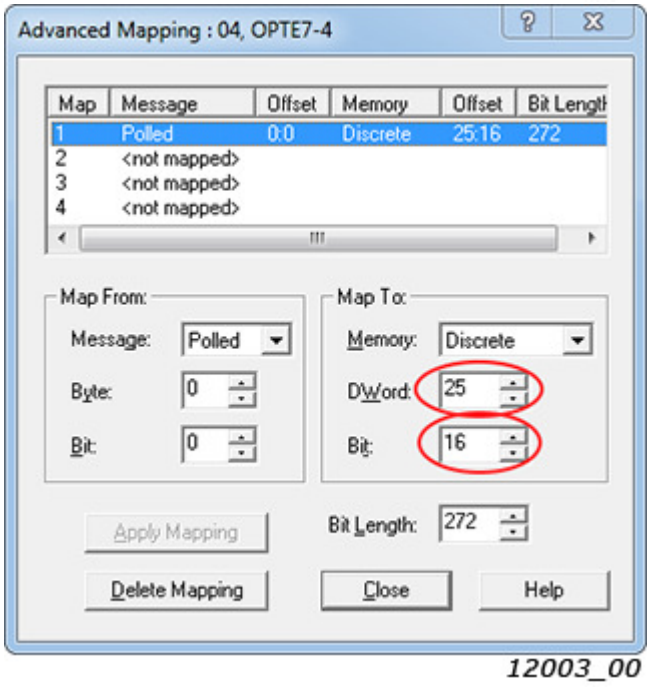


12000_00

12001_00

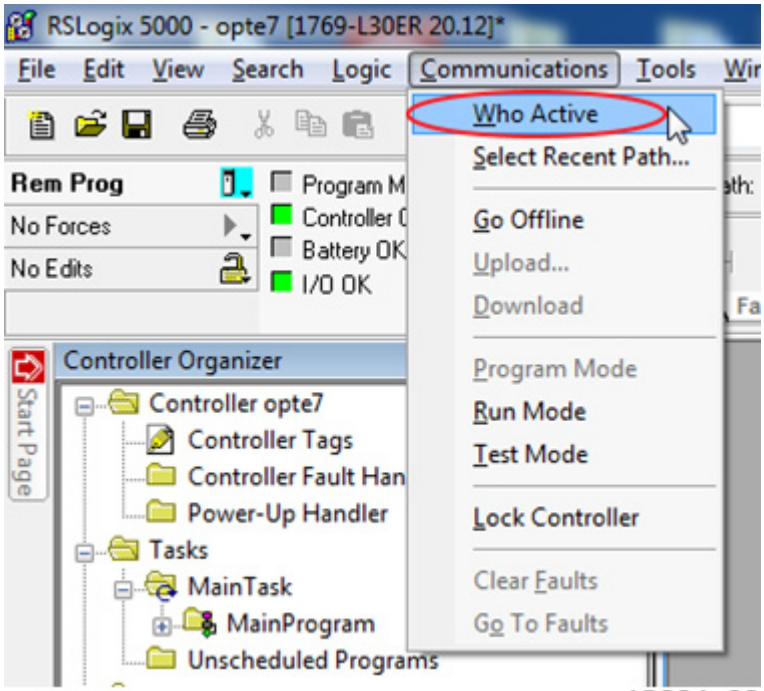


12002_00



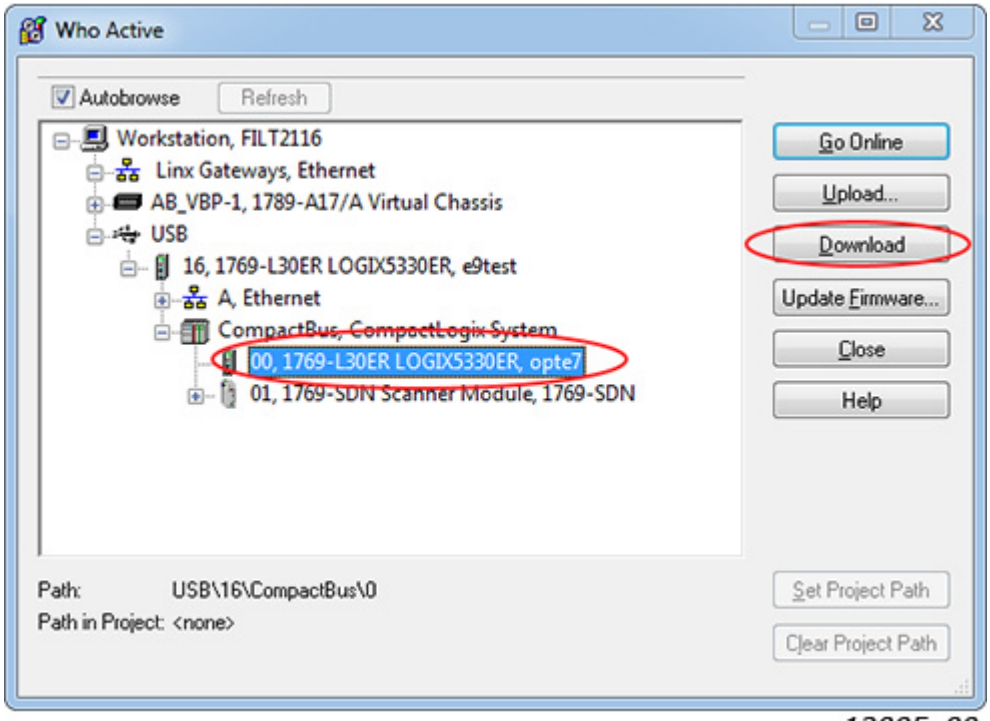
12003_00

18.In RSLogix5000, first select "Communications" and then "Who Active".



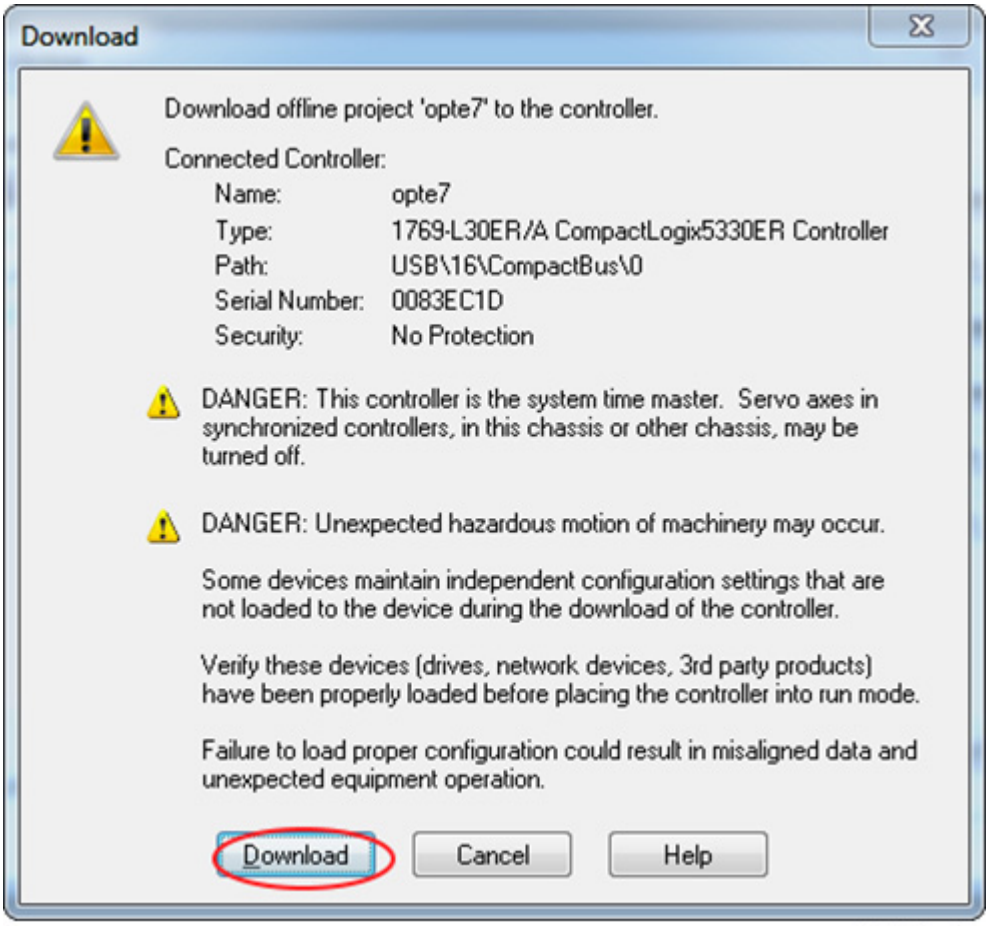
12004_00

19.Browse the tree for your PLC, select it and press "Download".



12005_00

20. Before download begins, you might get this warning. Just press "Download". Then the PLC starts to communicate with the devices.



12006_00

13. APPENDIX E - VACON® IO DATA DESCRIPTION

13.1 VACON® CONTROL WORD - FBFIXEDCONTROLWORD

The VACON® Control Word is composed of 32 bits. This control data is split into two words: FBFixedControlWord consist of the first 16 bits and FBGeneralControlWord consist of the remaining 16 bits.

While the functionality of FBFixedControlWord is fixed in VACON® standard applications, the functionality of FBGeneralControlWord is completely application specific and can vary even in VACON® standard applications.

The FBFixedControlWord bit definitions are described in the following table. Note that there are some control word bit modifications in the VACON® NXP AC drive. These modifications are described in Table 65 FBFixedControlWord modifications in VACON® NXP. Unused bits must be set to zero.

Table 64. FBFixedControlWord bits

Bit	Function		Description
0	Start/Stop	0	Stop request from fieldbus.
		1	Run request from fieldbus.
1	Direction	0	Requested direction is “FORWARD”.
		1	Requested direction is “REVERSE”.
2	Fault reset	0	No action.
		1	No action when 1 -> 1. Rising edge (0 -> 1) = Active faults, alarms and infos are reset.
3	Stop mode 1	0	Stop mode is unmodified.
		1	Stop mode is overridden to "Coasting".
4	Stop mode 2	0	Stop mode is unmodified.
		1	Stop mode is overridden to "Ramping".
5	Quick ramp time	0	Normal deceleration ramp time.
		1	Deceleration ramp time is switched to shorter than normal.
6	Freeze setpoint	0	Changes in the setpoint value from fieldbus (FBSpeedReference) are taken into use by the application.
		1	Changes in the setpoint value from fieldbus (FBSpeedReference) are not taken into use by the application.
7	Setpoint to zero	0	The setpoint value from fieldbus is taken from FB Speed Reference.
		1	The setpoint value from fieldbus is changed to 0.
8	Request Fieldbus Control	0	Control Place is as parametrized in the drive (unchanged).
		1	Control Place is overridden to Fieldbus Control.
9	Request Fieldbus Reference	0	Source of the setpoint value is as parametrized in the drive (unchanged).
		1	Source of the setpoint value is overridden to Fieldbus.
10	Jogging 1	0	No action.
		1	Jogging request with jogging reference 1.

Bit	Function		Description
11	Jogging 2	0	No action.
		1	Jogging request with jogging reference 2.
12	Quick stop	0	No action.
		1	Drive executes quick stop / emergency stop.
13	Reserved	0	-
		1	-
14	Reserved	0	-
		1	-
15	Master connected*	0	Only in VACON® NXP. Fieldbus sets this bit to zero when it detects that there is no connection to the master.
		1	Only in VACON® NXP. Fieldbus sets this bit to zero when it detects valid connection from the master.

*This functionality can be enabled/disabled by application from drive parameters.

Table 65. FBFixedControlWord modifications in VACON® NXP

Bit	Function		Description
3	Fieldbus DIN1	0	Fieldbus DIN1 off
		1	Fieldbus DIN1 on
4	Fieldbus DIN2	0	Fieldbus DIN2 off
		1	Fieldbus DIN2 on
5	Fieldbus DIN3	0	Fieldbus DIN3 off
		1	Fieldbus DIN3 on
6	Fieldbus DIN4	0	Fieldbus DIN4 off
		1	Fieldbus DIN4on
7	Fieldbus DIN5	0	Fieldbus DIN5 off
		1	Fieldbus DIN5 on

13.2 CONTROL WORD BIT SUPPORT IN VACON® AC DRIVES

The following table describes the control word bit support in different AC drives. Notice that the table is valid only for VACON® standard applications. Always check the application specific manual.

Table 66. FBFixedControlWord bit support in different VACON® AC drives

Bit	Function	VACON® 100 family	VACON® NXP	VACON® 20	VACON® 20 X/CP
0	Start/Stop	x	x	x	x
1	Direction	x	x	x	x
2	Fault reset	x	x	x	x
3	Stop mode 1	x	o		x
4	Stop mode 2	x	o		x
5	Quick ramp time	x	o		x
6	Freeze setpoint	x	o		x
7	Setpoint to zero	x	o		x
8	Request Fieldbus Control	x	x		x
9	Request Fieldbus Reference	x	x		x
10	Jogging 1	x			
11	Jogging 2	x			
12	Quick stop	x			x
13–14	Reserved				
15	Master connected		x		

x) Supports standard function
o) FBDIN function instead of standard function

13.3 VACON® STATUS WORD - FBFIXEDSTATUSWORD

The VACON® Status Word is composed of 32 bits. This status data is split into two words: FBFixedStatusWord consist of the first 16 bits and FBGeneralStatusWord consist of the remaining 16 bits.

While the functionality of FBFixedStatusWord is fixed in VACON® standard applications, the functionality of the FBGeneralStatusWord is totally application specific and can vary even in VACON® standard applications.

The FBFixedStatusWord bit definitions are described in the following table. Unused bits are set to zero. In VACON® NX series AC drives FBFixedStatusWord comes from firmware variable "MCStatus".

Table 67. FBFixedStatusWord bits

Bit	Function		Description
0	Ready	0	Drive is not ready.
		1	Drive is ready to run.
1	Run	0	Motor is not running.
		1	Motor is running.
2	Direction	0	Motor is running clockwise.
		1	Motor is running counterclockwise.
3	Fault*	0	No fault active.
		1	Drive has an active fault.
4	Alarm*	0	No alarm active.
		1	Drive has an active alarm.
5	At reference	0	Motor is not running at reference speed.
		1	Motor is running at reference speed.
6	Zero speed	0	Motor is not at zero speed.
		1	Motor is running at zero speed.
7	Flux ready	0	Motor is not magnetized.
		1	Motor is magnetized.
8	Info*	0	No info active.
		1	Drive has an active info.
9–15	Reserved	0	-
		1	-

*Drive faults have three levels: Fault, Alarm and info. Bits 3, 4 and 8 are set to 1 if the given fault type is activated.

13.4 STATUS WORD BIT SUPPORT IN VACON® AC DRIVES

Bit	Function	VACON® 100 family	VACON® NXP	VACON® 20	VACON® 20 X/CP
0	Ready	x	x	x	x
1	Run	x	x	x	x
2	Direction	x	x	x	x
3	Fault	x	x	x	x
4	Alarm	x	x	x	x
5	At reference	x	x	x	x
6	Zero speed	x	x		x
7	Flux ready	x	x		
8	Info	x			
9–15	Reserved				

13.5 MONITORING OF CONTROL AND STATUS WORDS IN VACON® AC DRIVES

The following table describes from where the control / status words can be read in different AC drives via panel or PC tool.

Table 68. Panel tree for control and status words

Signal	VACON® 100 family	VACON® NXP	VACON® 20	VACON® 20 X/CP
FBFixedControlWord	V2.12.1 (Low Word)	V1.24.1*	-	-
FBGeneralControlWord	V2.12.1 (High Word)	-	-	-
FBFixedStatusWord	V2.12.11 (Low Word)	V1.24.16*	V3.1	-
FBGeneralStatusWord	V2.12.11 (Low Word)	V1.24.3*	V3.2	-

* Advanced application only

For VACON® 100 family, VACON® 20 and VACON® 20 X/CP, VACON® Live PC tool is used for accessing the drive parameters. VACON® NCDrive PC tool is used with VACON® NXP drive.

NCDrive:

- View -> Monitoring
- Type: Firmware

Table 69. Signal name in PC tools

Signal	VACON® NCDrive	VACON® Live		
	VACON® NXP	VACON® 100 family	VACON® 20	VACON® 20 X/CP
FBFixedControlWord	FBFixedControl-Word	FB Control Word (Low Word)	-	-
FBGeneralControl-Word	FBGeneralCon-trolWord	FB Control Word (High Word)	-	-
FBFixedStatusWord	MCStatus	FB Status Word (Low Word)	Drive status word	-
FBGeneralStatusWord	FBGeneralSta-tusWord	FB Status Word (High Word)	Application status word	-

13.6 VACON® SPEED REFERENCE AND ACTUAL SPEED - FBSPEEDREFERENCE AND FBACTUALSPEED

The FBSpeedReference value is signed in the range of -10000...10000d (d8f0...2710h). The given reference is scaled in percentage between the minimum and maximum frequency parameters by application. The value 0 corresponds to minimum frequency and the value 10000d corresponds to maximum frequency. The scale of the value is 0.01%. Negative value indicates direction. If the direction bit in control word is set (means direction should be counterclockwise) and the reference is negative, motor runs clockwise despite the direction bit.

The FBActualSpeed value is signed in the range -10000...10000d (d8f0...2710h). Actual speed is scaled in percentage between the minimum and maximum frequency parameters by application. The value 0 corresponds to minimum frequency and the value 10000d corresponds to maximum frequency. The scale of the value is 0.01%.

13.7 PROCESS DATA

The process data variables are vendor specific variables that can be communicated to and from the AC drive. Eight process data items can be communicated between PLC and the drive. Some drives and firmware versions can support up to sixteen process data items in a single telegram. If the drive does not support 9–16 PD items, then PDI 9–16 are ignored and PDO9–16 are zeros. For more information, see chapter "16. Appendix H - Fieldbus option board communication" and chapter "17. Appendix I - Parameters for application developers".

Values sent from the drive to the PLC are called ProcessDataOut variables, whereas the values sent from the PLC to the drive are called ProcessDataIn variables. The contents of the ProcessDataOut variables can be parametrized in the AC drive using a feature known as fieldbus process data mapping. For more information, see the following chapter.

13.8 FIELDBUS PROCESS DATA MAPPING AND SCALING

This chapter describes how standard applications map process data out items by default. For more information, especially when not using a standard application, see the application manual for the AC drive in use.

Table 70. Process data output mapping defaults for VACON® 100 family

PD out	Mapped application data	ID	Unit	Scale
1	Output frequency	1	Hz	0.01 Hz
2	Motor speed	2	rpm	1 rpm
3	Motor current	3	A	Varies*
4	Motor torque	4	%	0.1%
5	Motor power	5	%	0.1%
6	Motor voltage	6	V	0.1 V
7	DC link voltage	7	V	1 V
8	Last active fault code	37	-	-

*Scaling is based on drive nominal power. Scaling can be seen from Table 74.

Table 71. Process data output mapping defaults for VACON® NXP (standard application)

PD out	Mapped application data	ID	Unit	Scale
1	Output frequency	1	Hz	0.01 Hz
2	Motor speed	2	rpm	1 rpm
3	Motor current	45	A	Varies*
4	Motor torque	4	%	0.1%
5	Motor power	5	%	0.1%
6	Motor voltage	6	V	0.1 V
7	DC link voltage	7	V	1 V
8	Last active fault code	37	-	-

Table 72. Process data output mapping defaults for VACON® 20 X/CP (standard applications)

PD out	Mapped application data	ID	Unit	Scale
1	Output frequency	1	Hz	0.01 Hz
2	Motor speed	2	rpm	1 rpm
3	Motor current	3	A	Varies*
4	Motor torque	4	%	0.1%
5	Motor power	5	%	0.1%
6	Motor voltage	6	V	0.1 V
7	DC link voltage	7	V	1 V
8	Last active fault code	37	-	-

*Scaling is based on drive nominal power. Sccaling can be seen from Table 74.

Table 73. Process data output mapping defaults for VACON® 20 (standard application)

PD out	Mapped application data	ID	Unit	Scale
1	Frequency reference	25	Hz	0.01 Hz
2	Output reference	1	Hz	0.01 Hz
3	Motor speed	2	rpm	1 rpm
4	Motor voltage	6	V	0.1 V
5	Motor torque	4	%	0.1%
6	Motor current	3	A	Varies*
7	Motor power	5	%	0.1%
8	DC link voltage	7	V	1 V

*Scaling is based on drive nominal power. Scaling can be seen from Table 74.

Table 74. Current scaling based on nominal power

Nominal power	Current scale
< 5 kW	0.01 A
5–100 kW	0.1 A
> 100 kW	1 A

Default process data out mapping can be changed in standard applications.

Table 75. FB process data out mapping

Parameter name	VACON® 100 family		VACON® NXP**		VACON® 20		VACON® 20 X/CP	
	Path	ID	Path	ID	Path	ID	Path	ID
FB DataOut 1 Selection	P3.6.1	852	P2.9.3	852	P10.1	852	P11.1	852
FB DataOut 2 Selection	P3.6.2	853	P2.9.4	853	P10.2	853	P11.2	853
...	...	...	...	...	...	...	...	...
FB DataOut 8 Selection	P3.6.8	859	P2.9.10	859	P10.8	859	P11.8	859
FB DataOut 9 Selection*, ***	P3.6.9	890	P2.9.12	558	-	-	-	-
FB DataOut 10 Selection*, ***	P3.6.10	891	P2.9.13	559	-	-	-	-
...	...	...	...	...	...	...	...	...
FB DataOut 16 Selection*, ***	P3.6.16	897	P2.9.18	565	-	-	-	-

*Only in applications and option boards that support fast or extended communication modes with VACON® NXP. See chapter "16. Appendix H - Fieldbus option board communication".

**Multipurpose application.

***Currently only in VACON® 100 family internal protocols.

Process data in can also be mapped in VACON® NXP AC drives.

Table 76. FB process data in mapping

Parameter name	VACON® NXP**	
	Path	ID
FB DataIn 1 Selection	P2.9.19	876
FB DataIn 2 Selection	P2.9.20	878
...	...	...
FB DataIn 8 Selection	P2.9.26	883
FB DataIn 9 Selection*	P2.9.27	550
FB DataIn 10 Selection*	P2.9.28	551
...	...	...
FB DataIn 16 Selection*	P2.9.34	557

*Only in applications and option boards that support fast or extended communication modes with VACON® NXP. See chapter "16. Appendix H - Fieldbus option board communication".
**Multipurpose application.

14. APPENDIX F - FIELDBUS PARAMETRIZATION

The following chapter describes briefly how to parametrize the AC drive in order for the motor to be controllable via fieldbus. These instructions are written for some basic applications. For more information, see the application specific manual.

In order for the AC drive to accept commands from the fieldbus network, the control place of the AC drive has to be set to fieldbus. The default value of the parameter "Control Place" is usually I/O. Note that if the control unit firmware is updated, the default settings are restored. In addition, some applications may have the remote speed reference selection set by default to other than fieldbus. In these cases, the speed reference selection must be set to fieldbus, in order for the speed reference to be controlled via fieldbus.

NOTE! The motor control mode should be selected to support the used process and profile.

14.1 FIELDBUS CONTROL AND REFERENCE SELECTION

The following tables list some of the parameters related to fieldbus control in case of standard applications for the VACON® 100 family, VACON® NXP, VACON® 20 and VACON® 20 X AC drives. See the application specific manuals for more detailed information and latest updates.

The parameters can be read and written by using the drive panel, PC tools or fieldbus protocol. The following table contains links to chapters where the ID value reading is described.

For information on how to read and write ID's with DeviceNet, see chapter "9.1.11 Class code 0xA0 - Vendor Parameter Object".

Table 77. Fieldbus parametrization for VACON® 100 family (standard application)

Parameter name	ID	Value	Default	Panel Tree
Control mode	600	0 = Frequency 1 = Speed 2 = Torque	0	P3.1.2.1
Remote control place	172	1 = Fieldbus CTRL	0	P3.2.1
Local / remote	211	0 = Remote	0	P3.2.2
Fieldbus ref. sel.	122	3 = Fieldbus	3	P3.3.1.10
Controlling fieldbus	2539	-	1	P5.13.1

Table 78. Fieldbus parametrization for VACON® 20 (standard application)

Parameter name	ID	Value	Default	Panel Tree
Motor control mode	600	0 = Frequency 1 = Speed	0	P1.8
Rem. Control place 1 sel.	172	1 = Fieldbus CTRL	0	P2.1
Local / remote	211	0 = Remote	0	P2.5
Rem. Control place 1 freq. ref. sel.	117	3 = Fieldbus	7	P3.3

Table 79. Fieldbus parametrization for VACON® 20X (multipurpose application)

Parameter name	ID	Value	Default	Panel Tree
Motor control mode	600	0 = Frequency 1 = Speed	0	P8.1
Control place selection	125	2 = Fieldbus	0	P1.11
Local / remote	211	0 = Remote	0	P3.2.2
Frequency ref. sel.	1819	5 = Fieldbus	5–7	P1.12

Fieldbus parametrization for VACON® NXP (multipurpose application)

Parameter name	ID	Value	Default	Panel Tree
Motor control mode	600	0 = Frequency 1 = Speed 2 = Torque	0	P2.6.1
Control place selection	125	3 = Fieldbus	1	P3.1
Frequency Ctrl ref.	122	9 = Fieldbus	3	P2.1.13

14.2 CONTROLLING FIELDBUS PARAMETER

VACON® 100 family AC drives have parameter called “Controlling Fieldbus”. It is used to select the instance from which the process data is sent to the drive application. By default, the setting is in "Automatic" and the functionality (when receiving process data from multiple sources) is application dependent.

For example, if the option board has been installed to slot E and it is used with PROFINET to control the drive, the user can select "Slot E" as value for this parameter. Now only the process data from the option board in slot E is forwarded to the application. All other fieldbuses still receive process data out. With this setting it is possible to prevent that the monitoring fieldbuses accidentally write process data in.

Value name	Value	Description
Automatic	1	Process data from all sources is forwarded to application
Slot D	2	Only process data from slot D is forwarded to application. Value is visible only, if option board is installed to slot D.
Slot E	3	Only process data from slot E is forwarded to application. Value is visible only, if option board is installed to slot E.
RS485	4	Only process data from VACON® 100 family internal RS 485 protocol is forwarded to application
PROFINET IO	5	Only process data from VACON® 100 family internal PROFINET IO protocol is forwarded to application
EtherNet/IP	6	Only process data from VACON® 100 family internal EtherNet/IP protocol is forwarded to application

Value name	Value	Description
Modbus TCP/ UDP	7	Only process data from VACON® 100 family internal Modbus TCP/UDP protocol is forwarded to application
Bacnet IP	8	Only process data from VACON® 100 family internal Bacnet IP protocol is forwarded to application

14.3 TORQUE CONTROL PARAMETRIZATION

Some extra parametrization must be made in order to control the frequency control with torque control. The following instructions are for the VACON® 100 family and VACON® NXP application. For more information, see the application specific manual.

- Motor control mode (ID 600) must be configured to “Torque control” (2).

To configure the AC drive to use correct torque reference, select the parameter "Torque Reference Selection" to ProcessDataIn1 (9). This can be done with:

- PC tool or panel (VACON® 100 family: P3.3.2.1, VACON® NXP: P2.10.4) / ID 641
- Vendor Parameter Object

15. APPENDIX G - FAULT TRACING

When the option board or the AC drive control diagnostics detect an unusual operating condition, the drive opens a notification, for example, on the keypad. The keypad shows the ordinal number of the fault, the fault code and a short fault description. You can reset the fault with the Reset button on the control keypad, via the I/O terminal or via the used fieldbus protocol. The faults are stored in the Fault history menu, which can be browsed. The fault table presents only the fault conditions related to the fieldbus in use.

NOTE! When you contact a distributor or a factory because of a fault condition, always write down all the texts and codes on the keypad display. Then send the problem description together with the Drive Info File to the local distributor. See local contacts: http://drives.danfoss.com/danfossdrives/local-contacts/. If possible, also send a fieldbus communication log from the situation if applicable.

Table 80. Fieldbus communication log tools

Recommended tool	For	Boards
Wireshard	EtherNet based fieldbuses	OPTEA, OPTE9
ProfiTrace	Profibus	OPTE3-E5
CANalyzer	CAN based boards	OPTE6, OPTE7

15.1 TYPICAL FAULT CONDITIONS

Table 81. Typical fault conditions

Fault conditions	Possible cause	Remedy
Cabling	• Supply or motor cables are located too close to the fieldbus cable • Wrong type of fieldbus cable • Too long cabling	
Grounding	• Inadequate grounding	Ensure grounding in all the points on the net.
Connections	• Faulty connections: excessive stripping of cables • Faulty connections: conductors in wrong terminals • Faulty connections: too loose connections of conductors	
Parameter	• Faulty address • Overlapping slave addresses • Wrong control place selected	

15.2 OTHER FAULT CONDITIONS

The following fault tracing diagram helps to locate and fix some of the most common problems. If the problem persists, contact your local distributor.

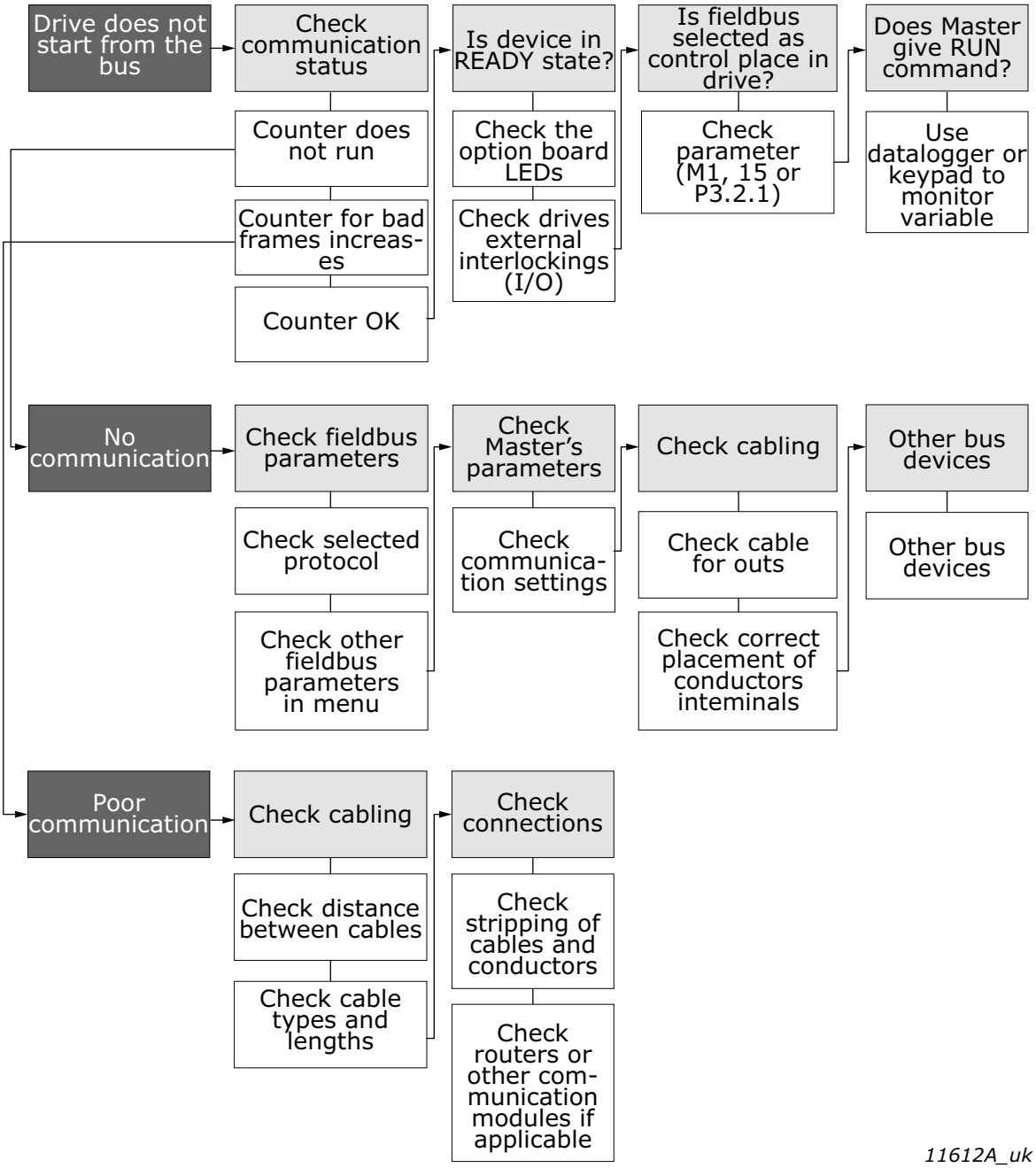


Figure 30. Fault tracing diagram

15.3 FIELDBUS FAULT CODES

The option board can report only Fieldbus communications fault (F53). This does not identify what went wrong and why the option board activated this fault. To that end, more information is now added to fault activation. Currently this works only with VACON® 100 family AC drives.

When fieldbus fault (F53 specifically) is activated in VACON® 100 family AC drive with default applications, new information is added to the source fields of the faults if the source fields are empty.

Table 82. Description of fault fields

Fault field	Description
Source 1	Activation source. Always “Control”.
Source 2	Slot where the option board is installed to (slot D or slot E)
Source 3	Additional fault code

The following table contains "source 3" additional fault codes. Note that not all subcodes listed here are applicable for all fieldbuses / option boards.

Table 83. Additional fault codes

Fault field	Fault name	Description
1	IO watchdog	IO connection timeout noticed by watchdog
2	IO master closed connection	IO connection was closed (gracefully) by master
3	EM watchdog	Explicit messaging connection timeout noticed by watchdog
4	EM master closed connection	Explicit messaging connection was closed (gracefully) by master
5	Cable disconnected	Fieldbus cable was disconnected after communication had been started
6	Cable not disconnected	Fieldbus cable was not connected after device start-up
7	IOPS changed to BAD	PROFINET IO master data status changed from GOOD to BAD
8	Idle state activated	EtherNet/IP IO connection status changed to IDLE when motor is been controlled
9	Internal system fault	General fieldbus failure. For example, when converting speed reference to drive format.
10	Too many bad messages	Fieldbus protocol has received too many bad messages in row and has closed the connection
11	CAN bus-off	CAN driver is in BUS-off state
12	CAN passive	CAN driver is in passive state
13	No external power	No external power (+24 V) detected
14	Heartbeat timeout	Heartbeat consumer timeout
15	Nodeguard timeout	Nodeguard timeout
16	PDO timeout	PDO timer event timeout
17	SNTP timeout	SNTP failed to get time update from time server
18	Ethercat state change fault	Ethercat state change fault
19	RHD timeout	PROFINET Redundant Data Hold Time elapsed

16. APPENDIX H - FIELDBUS OPTION BOARD COMMUNICATION

The different communication modes can be enabled for fieldbus option board for different features. There are different modes available for different setups:

- Normal mode, for most commonly used setups. 8 process data items.
- Normal extended mode, for setups that requires 16 process data items.
- Fast mode, with low latency process data. 16 process data items.
- Fast safety mode, with safety "black channel". 16 process data items.
- Fast PROFIBUS mode, for backward compatibility. 8 process data items.

The fast communication modes can be enabled to get minimum communication delay between fieldbus and application.

NOTE! Not all option boards support all modes. For details, see "Table 85. Required option board firmware for different fieldbus communication modes".

16.1 REQUIREMENTS FOR COMMUNICATION MODES

The following table describes the required components for different communication modes. The mentioned version or later is required.

Table 84. Requirements for different fieldbus communication modes

	Fast / Normal Extended since version (or later)	**Fast safe since version (or later)**	**Fast PROFIBUS since version (or later)**
Control board	VACON® NXP (serial no. 761)	VACON® NXP (serial no. 761)	VACON® NXP (serial no. 561)
Applications	Multipurpose V23 (Normal Extended Mode)	Any*	System Interface V11
			Advanced V085
			Marine V107

*If safety option is configured to use a safety fieldbus, the fast safe mode is automatically enabled regardless of the used application. However, the availability of 16 process items is limited by the application in use. Also the process data application cycle is normally set to 10 ms, instead of 1 ms for fast application.

Table 85. Required option board firmware for different fieldbus communication modes

	Fast / Normal Extended since firmware version (or later)	**Fast safe since firmware version (or later)**	**Fast PROFIBUS since firmware version (or later)**
OPTE3-E5	V006	V006	-
Advanced safety option OPTBL	-	V001	-
OPTC3-C5 (VB00279)	-	-	OPTC3_10502V014.vcn

	Fast / Normal Extended since firmware version (or later)	Fast safe since firmware version (or later)	Fast PROFIBUS since firmware version (or later)
OPTC3-C5 (VB01987)	-	-	OPTC3-5_FW0232V001.vcx
OPTE9	V007	-	-
OPTEA	V001	V001	-
OPTEC	V003	-	V001
OPTE6	V010	-	-
OPTE7	V006	-	-

Refer to application specific manuals for the latest information on application support for fieldbus communication modes.

Supported system software version depends on VACON® NXP hardware version. The hardware version can be determined reading the serial number.

Table 86. Requirement for system software version (or later)

Control	Support	Fast / Normal Extended	Fast safe	Fast PROFIBUS
VACON® NXP (SN 761)	Since firmware	V96	V196	V179
	Supported slot	D and E	D	E
VACON® NXP (SN 561)	Since firmware	-	-	V171
	Supported slot	-	-	D or E

16.2 FIELDBUS COMMUNICATION MODE FEATURES AND LIMITATIONS

Fast mode:

- 1 ms process data interval
- Available in VACON® NXP slots D and E
- Possible to run both slots simultaneously
- Have similar process data latency in both slots
- Service data latency is also reduced
- Running multiple service data queries at high interval can cause high CPU load in VACON® NXP AC drive
-

Fast safe mode:

- 1 ms process data interval
- Includes safety "black channel"
- Activated/deactivated automatically, cannot be set by user or application
- Fast safe mode is available only in slot E
- Advanced safety option board must be installed into slot D
- Safety fieldbus must be activated in safety configuration

16 process data items:

- 16 process data items always require support from application
- Available in both Fast mode and Normal extended mode
- If no support is available in the application, the process data out is always '0', while incoming process data items 9-16 are discarded

16.3 NORMAL FIELDBUS COMMUNICATION

The normal fieldbus communication between option board and the AC drive application is visible in Figure 31. In normal communication both process data and service data are transferred in succession at 5 ms interval.

Communication delay for process data can be calculated by summing all delays together:

$$t = t_{IOdatacycle} + t_{updateinterval} + 2 \cdot t_{communicationdelay} + t_{applicationcycle}$$

Example: With fieldbus cycle time of 4 ms and application cycle of 10 ms, the delay is:

$$t = 4ms + 10ms + (2 \cdot 5)ms + 10ms = 34ms$$

NOTE: This value does not include delays of the fieldbus master, jitter in the process data cycle of the communication protocol or resending due to electronic interference.

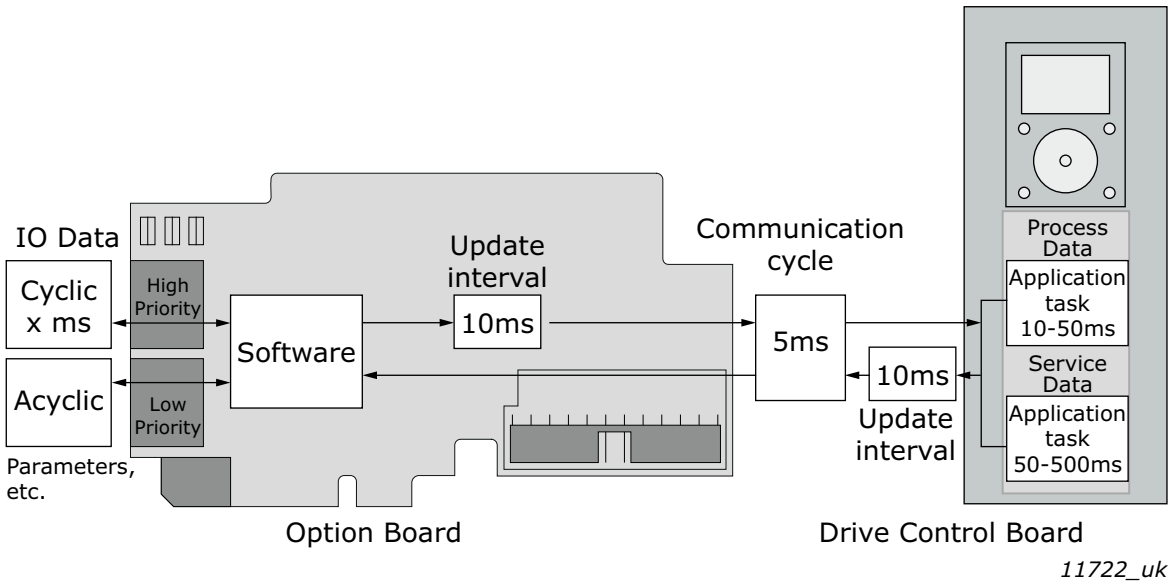


Figure 31. Normal fieldbus communication

16.4 FAST FIELDBUS COMMUNICATION

The fast mode decreases the communication delay between the PLC and the AC drive application significantly by using two communication channels separately for process and service data. The process data interval is set to 1 ms, while other data is sent acyclically. When the fast mode is activated, the application can be synchronized to run with the communication cycle. The Fast communication mode is visible in Figure 32. This mode also includes the ability to transfer 16 process data items.

The communication delay for process data in fast communication mode is (when application task is synchronized with communication):

$$t = t_{IOdata\ cycle} + t_{update\ interval} + t_{application\ cycle}$$

Example: With fieldbus cycle time of 1 ms and application cycle of 1 ms, the delay is:

$$t = 1\ ms + 1 + 1\ ms = 3\ ms$$

NOTE: This value does not include delays of the fieldbus master, jitter in the process data cycle of the communication protocol or resending due to electronic interference.

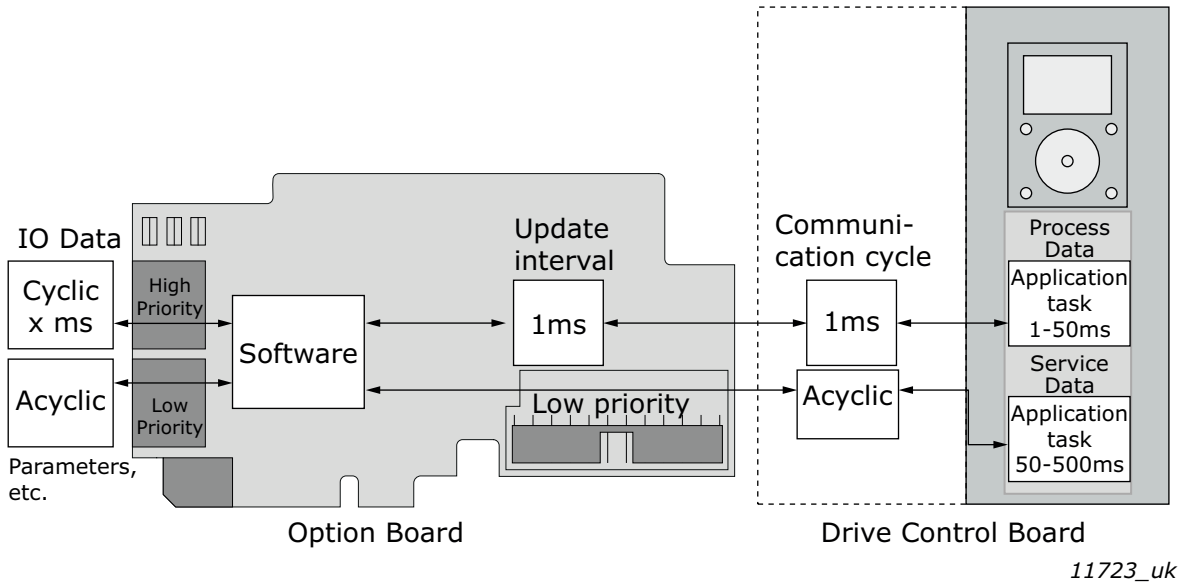


Figure 32. Fast fieldbus communication

16.5 NORMAL EXTENDED MODE

The normal extended mode uses the same communication method as in "Fast mode" but reduces the communication cycle to 10ms.

This can be used in applications where 16 process data items are required but the lowest possible communication delay is not needed or the increased CPU load of Fast mode to VACON® NXP drives is undesirable.

NOTE! This mode can be automatically enabled in VACON® applications supporting 16 process data items.

16.6 FAST SAFETY FIELDBUS COMMUNICATION

The fast safety mode uses the same communication methods as in "Fast mode" (Figure 32), but also transfers safety "black channel" data used by the safety fieldbus.

NOTE! This mode is automatically enabled if an extended safety option board is connected to slot D and the safety fieldbus is activated and cannot be set by the user. This mode is also automatically turned off when the safety option board is removed.

16.7 FAST PROFIBUS FIELDBUS COMMUNICATION

NOTE! This mode is not recommended for new installations.

There is also a second type of fast communication mode, the Fast PROFIBUS mode, originally designed for the OPTC3/C5 PROFIBUS option board. This mode can be seen in Figure 33. This mode can achieve the same latencies for process data as the fast mode introduced in "16.4 Fast fieldbus communication". However, this mode imposes the following limitations:

- No service data is available
- Option board can be run only in Bypass mode

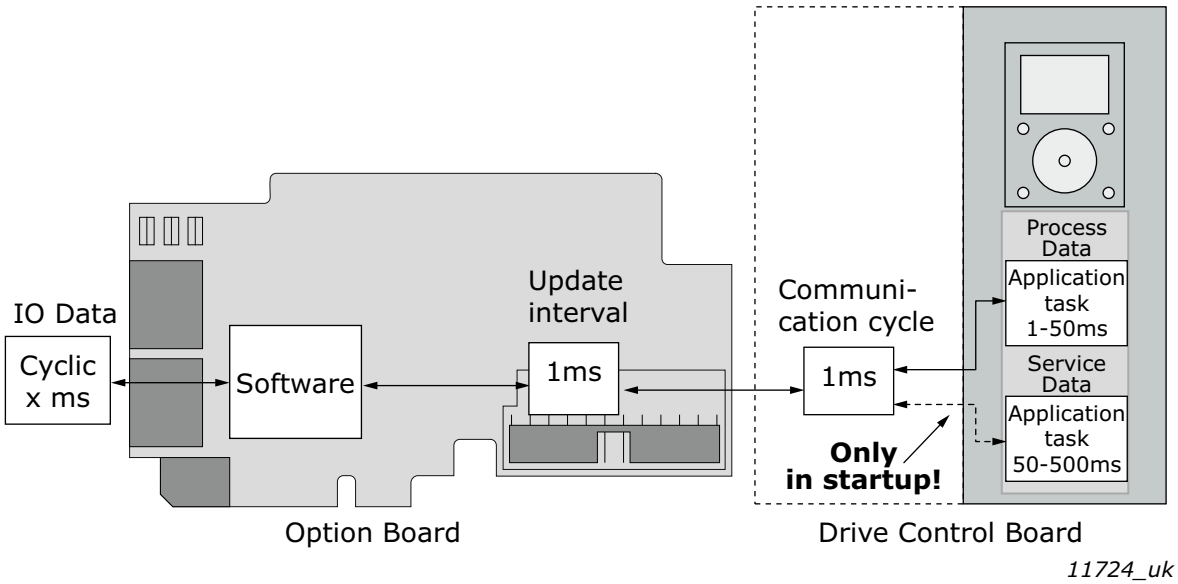


Figure 33. Fast PROFIBUS communication

17. APPENDIX I - PARAMETERS FOR APPLICATION DEVELOPERS

This appendix gives information for the application developers and system integrators on the VACON® NXP system software variables used to activate and control different fieldbus communication modes and features.

For more information on supported modes and required firmware version on given option board and control unit, see Appendix H - Fieldbus option board communication.

NOTE! Changing the mode while the motor is running is not supported because of security reasons.

Table 87. System software variables for selecting communication modes

Parameter	Value	Default
FBModeSlotD_fwu8	0 = Normal mode 1 = Fast safety mode* 2 = Fast mode 3 = Fast PROFIBUS mode 4 = Normal extended mode	0
FBModeSlotE_fwu8		0

* Fast safety mode is automatically enabled/disabled by system software. Cannot be set by user.

FBModeSlotX_fwu8 variables are used to select the active fieldbus option board communication mode. If no fieldbus option board is connected to the related slot, the selection of the FBModeSlot parameter is set to 0 = Normal mode.

Table 88. System software variables for monitoring supported communication modes

Parameter	Value	Default
FBModeSlotDSupModes_fwu16	0x00 = Not yet updated. Read again later. 0x01 = Fieldbus communication not supported 0x02 = Normal mode supported 0x04 = Fast safety mode supported 0x08 = Fast mode supported 0x10 = Fast PROFIBUS mode supported 0x20 = Normal extended mode supported	0
FBModeSlotESupModes_fwu16		0

FBModeSlotXSupModes_fwu16 variables can be used to determine the different supported modes of the fieldbus option boards. All features are set as bit fields as multiple modes can be supported.

Value '0' is returned while the feature set of the option board is not yet retrieved. The value should be asked again. Any option board not supporting fieldbus communication returns value '1'.

Example 1: OPTE3-E5_FW0083V006 PROFIBUS board returns value: 0x0E indicating support for Normal, Fast and Fast safety modes.

Example 2: OPTE9_FW0196V007 Dual Port Ethernet board returns value: 0x0A indicating support for Normal and Fast modes.

Table 89. System software variables for selecting the input process data slot

Parameter	Value	Default
FBControlSlotSelector_fwu8	0 = All slots 4 = Slot D only 5 = Slot E only 6 = Fast PROFIBUS D slot 7 = Fast PROFIBUS E slot	0

FBControlSlotSelector_fwu8 variable is used to select the controlling fieldbus option board slot. When selected (other than '0'), process data is accepted only from the selected slot and all other process data is discarded. Process data out is still updated normally to all slots.

This selector can be used to support redundant fieldbus connection. In fieldbus redundancy mode two fieldbus option boards are installed to VACON® NXP option board slots D and E. Application selects with FBControlSlotSelector_fwu8 variable which fieldbus option board can deliver process data from fieldbus master to the application.

Default value for FBControlSlotSelector_fwu8 is '0' which means that process data is accepted from both fieldbus option boards.

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Document ID:
DPD01171C
Rev. C

Sales code: DOC-OPTE7+DLUK

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