

**VACON<sup>®</sup> NX**  
AC DRIVES

**BASIC I/O BOARDS  
EXPANDER I/O BOARDS  
ADAPTER I/O BOARDS**

**USER MANUAL**

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**VACON<sup>®</sup>**

## 1. GENERAL INFORMATION

VACON® NX range embodies a wide selection of expander and adapter boards with which the available I/O of VACON® NX AC drive can be increased and its versatility improved.

The input and output configuration (I/O) of VACON® NX is designed with modularity in mind. The total I/O is comprised of option boards, each having its own input and output configuration. The boards contain not only normal analogue and digital inputs and outputs, but also fieldbuses and additional application-specific hardware.

The basic, expander and adapter boards are placed in the board slots on the control board of the AC drive. The I/O boards are usually interchangeable between different VACON® types, i.e. NXS and NXP. However, the control boards of these types differ from each other to some extent which means that the use of some I/O boards in different VACON® AC drive types may be restricted.

### 1.1 BOARD SLOTS ON THE CONTROL BOARD OF VACON® NXS AND NXP

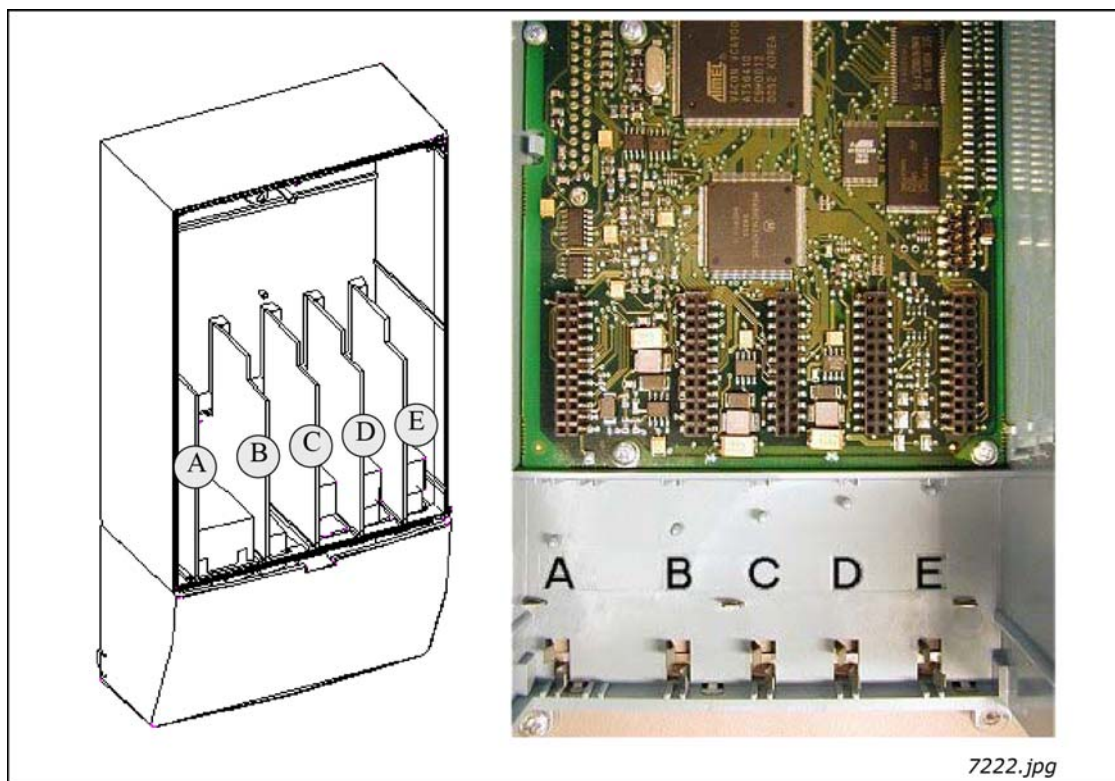


Figure 1. Board slots on control board of the VACON® NXS and NXP

The control board is situated inside the control unit of the VACON® NX AC drive. There are five board slots (labelled A to E) on the control board of NXS and NXP (See NXS/P User Manual): The connectability of different option boards to different slots depends greatly on the type of the board. For more information on this, see Chapter 1.2. See also the descriptions of the options boards on pages 18 to 79.

Usually, when the AC drive is delivered from the factory, the control unit includes at least the standard compilation of two basic boards (I/O board and relay board) which are normally installed in slots A and B. The I/O boards mounted at the factory are indicated in the type code of the AC drive. The three expander slots C, D and E are available for different option boards i.e. I/O expander boards, fieldbus boards and adapter boards.

## 1.2 BOARD SLOTS ON THE CONTROL BOARD OF VACON® NXL

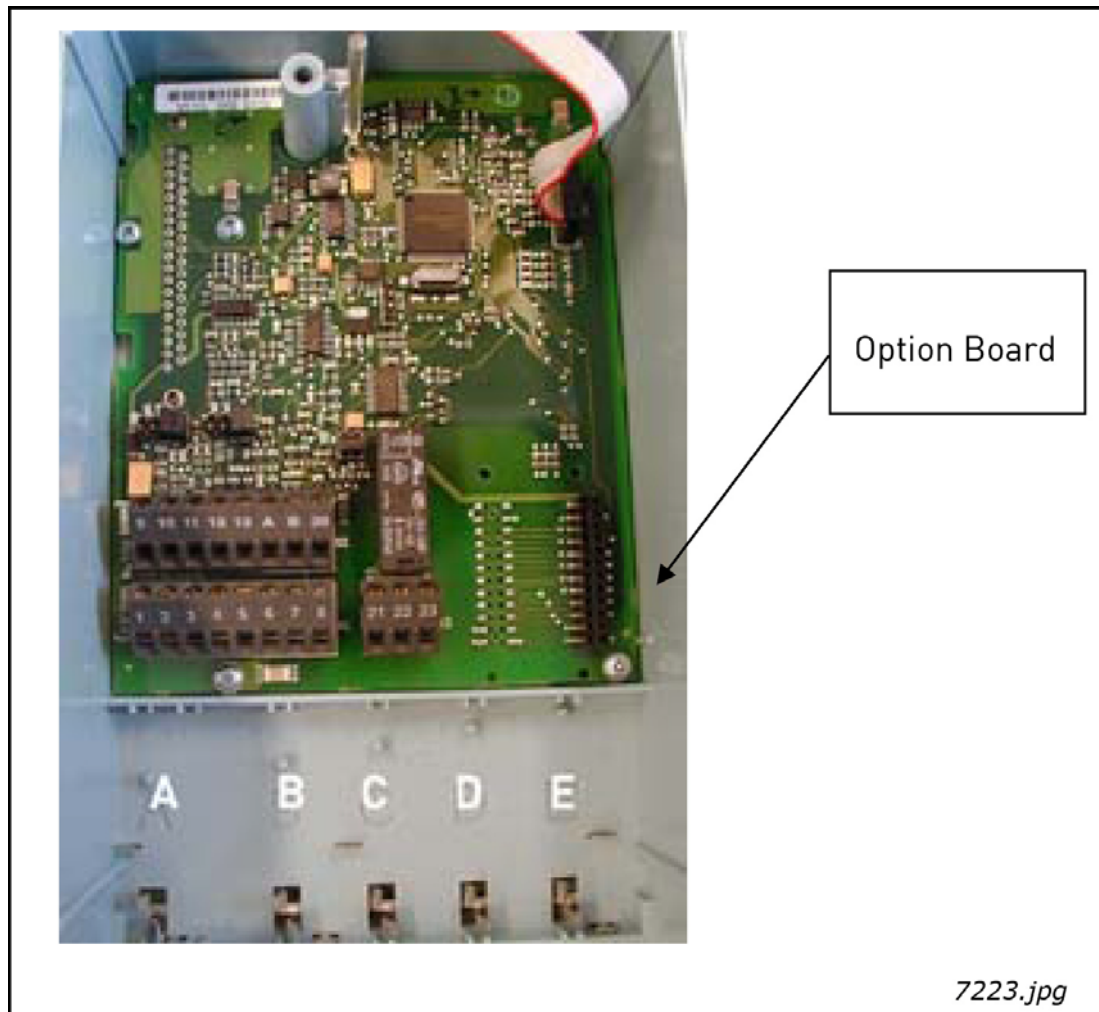


Figure 2. Board slots on control board of VACON® NXL.

The control board of NXL includes fixed standard I/O and one place for option boards (see NXL User Manual of NXL). The most typical option board for NXL, OPT-AA, is specified in the NXL User Manual.

### 1.3 OPTION BOARD TYPES

The VACON® option boards are divided in four groups according to their characteristics: types A, B, C and D. Short descriptions of the types below:

#### OPTA\_

- Basic boards used for basic I/O (NXS, NXP); normally pre-installed at the factory.
- This board type uses slots A, B or C.

See pages 17 to 49 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 81.

#### OPTB\_

- Option boards used for I/O expansion.
- Normally pluggable into slots B, C, D and E.

See pages 53 to 64 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 81.

#### OPTC\_

- Fieldbus boards (e.g. Profibus or Modbus).
- These boards are connected to slots D and E.

See a separate manual on each individual Fieldbus Board. Ask factory or your nearest distributor for more information.

#### OPTD\_

- Adapter boards
- Boards with fiber optic adapters, e.g. System Bus Fiber Optic Adapter Board.
- Connect the adapter boards to slots D and E (see however page 77).

See pages 69 to 79 for a detailed presentation of the boards of this type. See also the principle diagram on the option boards and their equipment on page 81.

## 1.4 TECHNICAL DATA

The data in the table below applies to the inputs and outputs on all basic and expander boards.

Table 1. Technical data

Safety (all boards)	Comply with EN50178, C-UL and EN60204-1 Inputs/outputs galvanically isolated; Isolation voltage rate 500V
Input/output type	Specification
Analogue inputs (AI), voltage	0...±10V, $R_i \geq 200 \text{ k}\Omega$ , single-ended; Resolution 10 bits/0.1%, accuracy ±1% of the full display (-10...+10V joystick control)
Analogue inputs (AI), current	0(4)...20mA, $R_i = 250 \Omega$ , differential Resolution 10 bits/0.1%, accuracy ±1% of the full display
Digital inputs (DI), DC voltage controlled	24V: "0" ≤ 10V, "1" ≥ 18V, $R_i > 5 \text{ k}\Omega$
Digital inputs (DI), AC voltage controlled	Control voltage 42...240 VAC "0" < 33V, "1" > 35V
Auxiliary voltage (output) (+24V)	24V (±15%), max 250mA (total summarized load from ext. +24V outputs, max. 150 mA from one board.
Auxiliary voltage (input) (ext. +24V)	24VDC (±10%, max. ripple voltage 100mV RMS), max. 1A. In special applications where PLC type functions are included in the control unit the input can be used as external auxiliary power supply for control boards as well as I/O boards.
Reference voltage (output) (+10V <sub>ref</sub> )	10V - 0% - +2%, max. 10mA
Analogue output (AO), current (mA)	0(4)...20mA, $R_L < 500 \Omega$ , resolution 10 bits/0.1%, accuracy ≤ ±2%
Analogue output (AO), voltage (V)	0(2)...10V, $R_L \geq 1 \text{ k}\Omega$ , resolution 10 bits, accuracy ≤ ±2%
Relay outputs (RO)	Switching capacity    24VDC/8A 250VAC/8A 125VDC/0.4A Max. continuous load   2A rms Min.switching load:    5V/10mA
Thermistor input (TI)	$R_{\text{trip}} = 4 \text{ k}\Omega$ (PTC type)
Encoder control voltage (+5V/+12V/+15V/+24V)	See OPTA4, OPTA5, OPTA7, OPTAE and OPTBB technical data
Encoder connections (inputs, outputs)	See OPTA4, OPTA5, OPTA7, OPTAE and OPTBB technical data
Environment (all boards)	
Ambient operating temperature	-10...55°C
Storing temperature	-40...60°C
Humidity	<95%, no condensation allowed
Altitude	Ma 1000m
Vibration	0.5 G at 9...200 Hz

**1.4.1 ISOLATION**

The control connections are isolated from the mains potential and the I/O ground is connected directly to the frame of the AC drive. Digital inputs and relay outputs are isolated from the I/O ground. For digital input arrangements, see Chapter Digital input signal conversions on page 7.

**1.4.2 ANALOGUE INPUTS (mA/V)**

Analogue inputs of I/O boards can be used as either current inputs or voltage inputs (see detailed description of each board). The signal type is selected with a jumper block on the board. In case the voltage type input is used you still have to define the voltage range with another jumper block. The factory default value for the analogue signal type is given in the description of the board. For detailed information, see the description of the board in question.

**1.4.3 ANALOGUE OUTPUTS (mA/V)**

In the same way as in the analogue inputs, the output signal type (current/voltage) can be selected with jumper except for some expander boards with analogue outputs used only with current signals.

**1.4.4 CONTROL VOLTAGE (+24V/EXT +24V)**

The control voltage output +24V/EXT+24V can be used in two ways. Typically, the +24V control voltage is wired to digital inputs through an external switch. The control voltage can also be used to power-up external equipment, such as encoders and auxiliary relays.

Observe that the specified total load on all available +24V/EXT+24V output terminals must not exceed 250mA. The maximum load on the +24V/EXT+24V output per board is 150mA. See Figure 3.

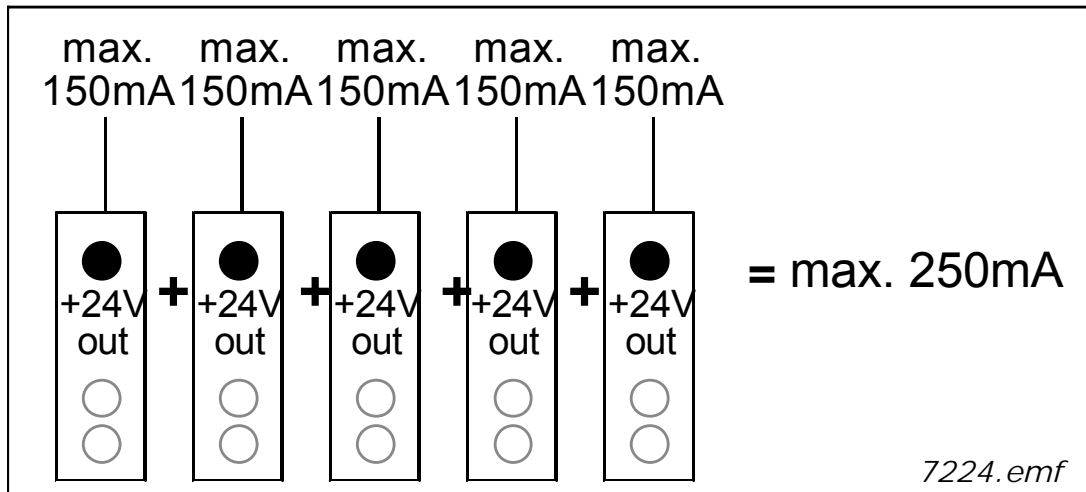


Figure 3. Maximum loads on +24V/EXT+24V output

The +24V/EXT+24V outputs can further be used to externally power-up the control board as well as the basic and expander boards. If an external power supply is connected to EXT+24V output, the control board, basic boards and expander boards remain live even if mains is lost on the AC drive. This ensures sufficient functioning of the control logic (not the motor control, however) and some alarms in exceptional power-loss situations. Furthermore, fieldbus links remain powered which enables e.g. the Profibus Master to read valuable data on the AC drive.

**NOTE:** The power unit is not powered through the EXT+24V and therefore the motor control does not work if the mains is lost.

Requirements for an external power back-up:

- output voltage +24VDC±10%, max. ripple voltage 100mV RMS
- max. current 1A
- 1A external fuse (no internal short-circuit protection on the control board)

**NOTE:** Analogue outputs and inputs do not work with only +24V supplied to the control unit.

If there is a +24V/EXT+24V output on the board it is short-circuit protected locally. If one of the +24V/EXT+24V outputs short-circuits, the others remain powered because of the local protection.

#### 1.4.5 DIGITAL INPUT SIGNAL CONVERSION

The active signal level depends on which potential the common input CMA (and CMB if available) is connected to. The alternatives are +24V or Ground (0V). See Figure 4, Figure 5 and Figure 6.

The 24-volt control voltage and the ground for the digital inputs and the common input (CMA) can be either internal or external.

Some typical input signal conversion examples are shown below. If you use the internal +24V from the AC drive, the following arrangements are possible:

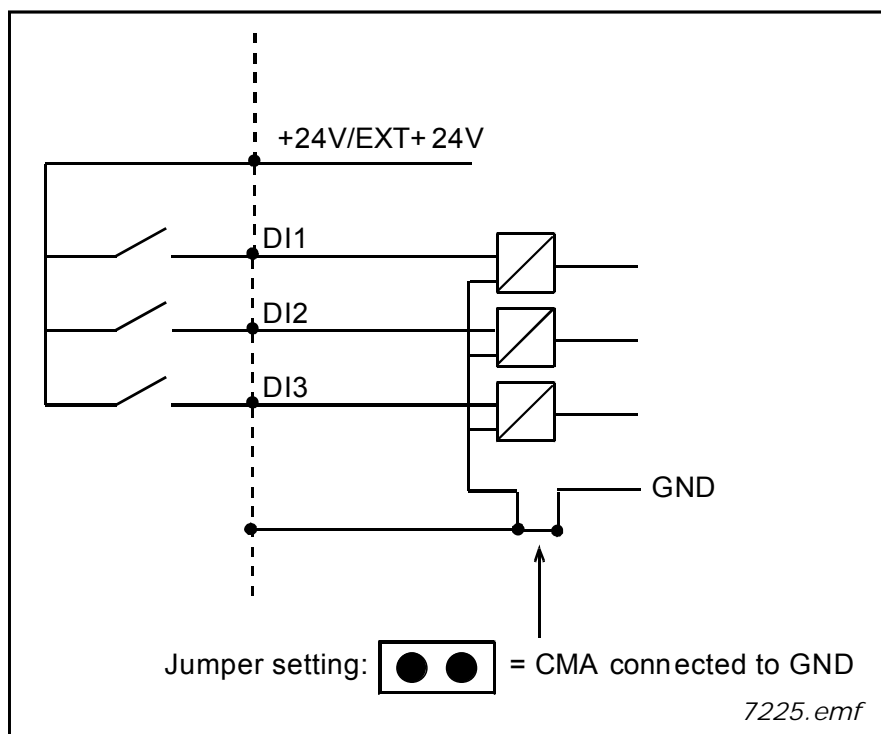


Figure 4. If CMA is connected to GND with inboard jumper the internal +24V is used and the CMA terminal ed not be wired

If you use an external +24V the following arrangements are possible:

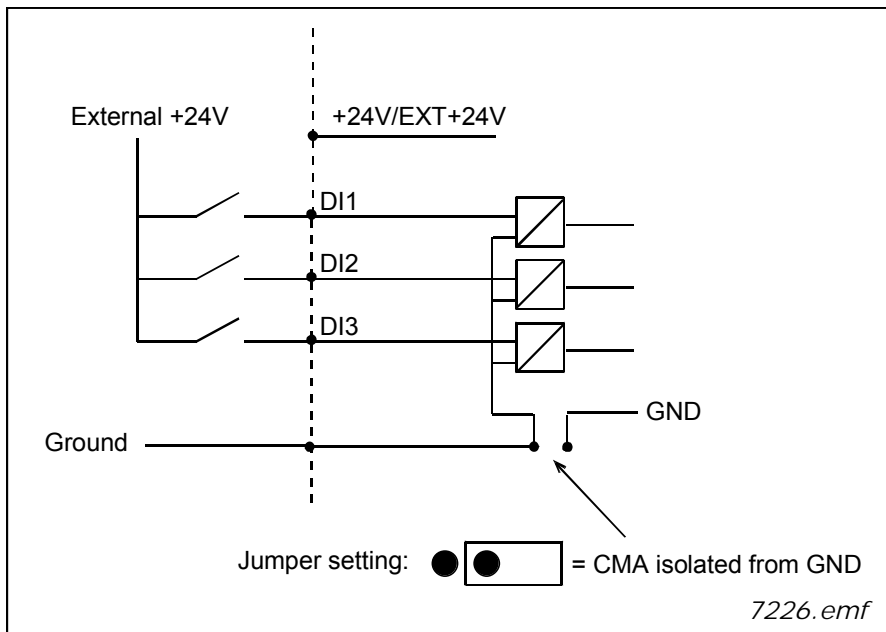


Figure 5. Positive logic with external +24V when CMA is isolated from GND using onboard jumper. The input is active when the switch is closed

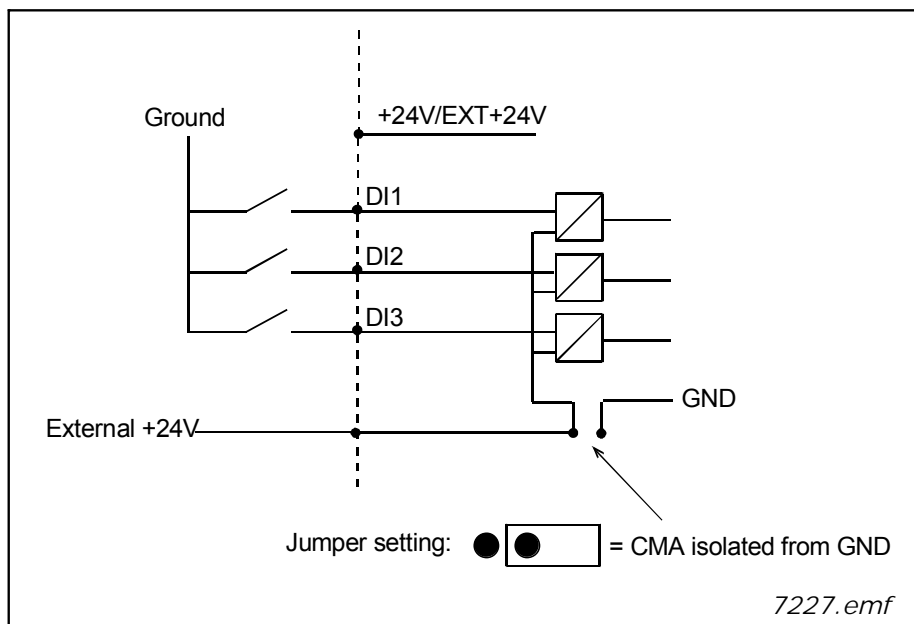


Figure 6. Negative logic with external +24V when CMA is isolated with onboard jumper. The input is active when the switch is closed (0V is the active signal)

You can make the positive and negative logic arrangements also with the internal +24V. Place the jumper block in the 'CMA isolated from GND' position (as above) and wire the CMA terminal to the GND terminal of the AC drive.



## 1.5 HARDWARE PROTECTIONS

### 1.5.1 TERMINAL BLOCK CODING

In order to avoid incorrect connections of terminal blocks to boards, some terminal blocks as well as related terminal connectors on the board are uniquely coded. For more information, see the description of the individual board.

### 1.5.2 BOARD SLOT GUIDES AND ALLOWED SLOTS

You cannot mount an option board into any slot. Table 46 and Table 47 show which slots are allowed for which option boards. For reasons of safety, slots A and B are protected in hardware against mounting of unallowed boards. As regards mounting of unallowed boards into slots C, D and E, the boards just will not work, there is no danger of health or equipment damage.

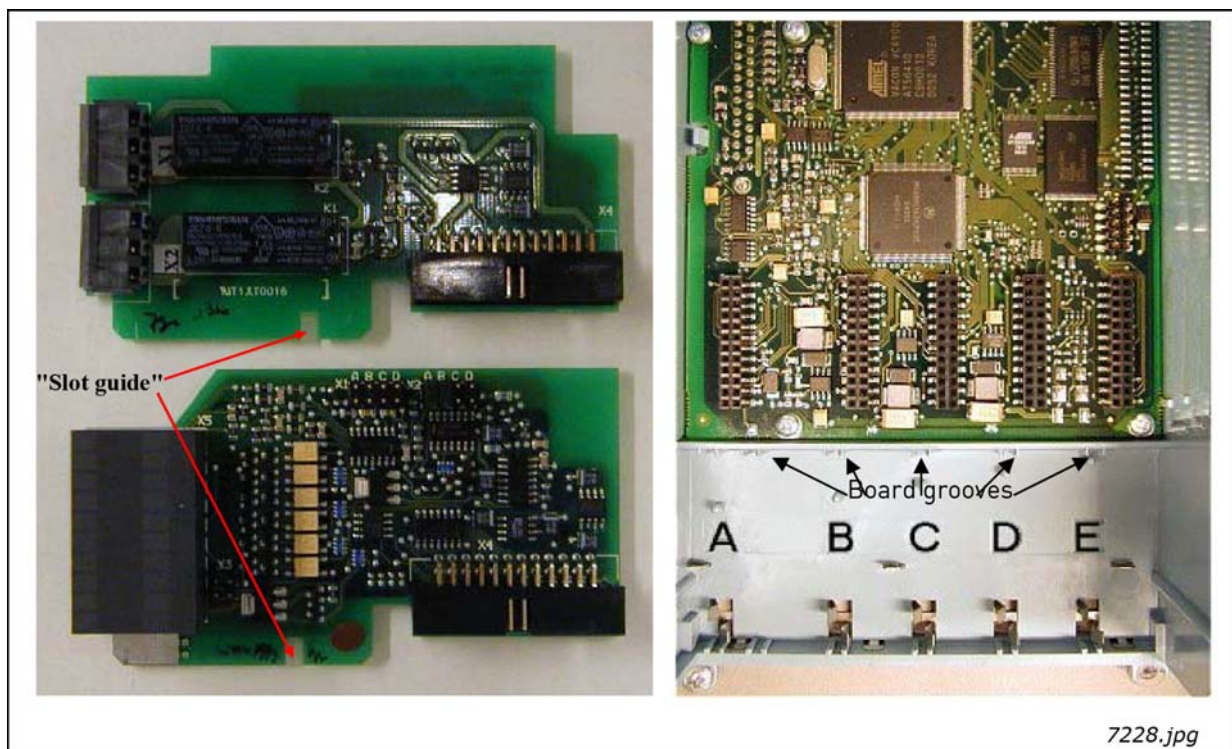


Figure 7. Board guide to prevent incorrect mountings

### 1.6 TYPE IDENTIFICATION NUMBER

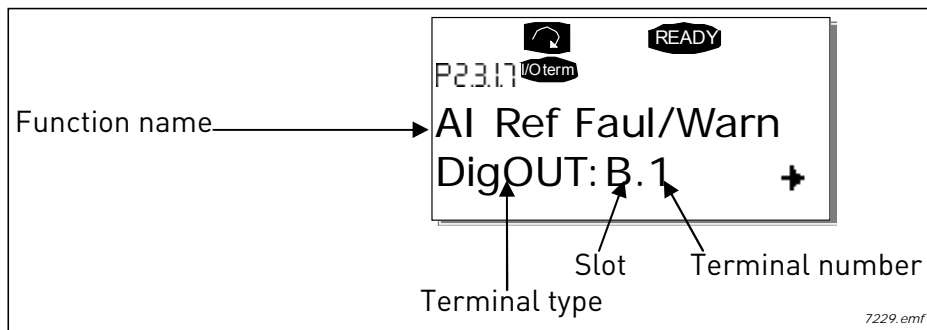
**NOTE:** This information is relevant only for special applications designers using the VACON® NC1131-3 engineering tool.

Each VACON® OPTxx board has a unique type designation code. Besides the type designation code, each board has a unique Type identification number which is used by the system program to identify which board is plugged into which board slot. The system program and the application use the Type ID also to establish the needed connections in order to achieve the desired functionality of the available I/O boards in the control unit. The ID code is loaded in the memory of the board.

### 1.7 DEFINING FUNCTIONS TO INPUTS AND OUTPUTS

How to connect functions and the available I/O depends on the application you use. The VACON® All in One Application Package includes seven applications: Basic Application, Standard Application, PID Control Application, Multi-Step Speed Control Application, Local/Remote Control Application, Pump and Fan Control Application with Autochange and Multipurpose Control Application (see All-in-One Application Manual). All but two applications of these use the conventional VACON® method to connect functions and the I/O. In the Function to Terminal Programming Method (FTT), you have a fixed input or output that you define a certain function for. The mentioned two applications, Pump and Fan Control and Multipurpose Control Application, however, use the Terminal to Function Programming Method (TTF) in which the programming process is carried out the other way round: Functions appear as parameters which the operator defines a certain input/output for.

Connecting a certain input or output to a certain function (parameter) is done by giving the parameter an appropriate value, the address code. The code is formed of the Board slot on the VACON® NX control board (see page 2 and 3) and the respective input/output number. See below.

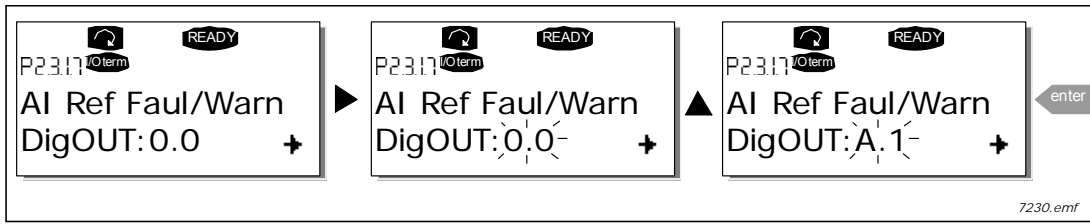


Example: You use the Pump and Fan Control Application. You want to connect the digital output function Reference fault/warning (parameter 2.3.1.7) to the digital output DO1 on the basic board OPTA1.

First find the parameter 2.3.1.7 on the keypad. Press the Menu button right once to enter the edit mode. On the value line, you will see the terminal type on the left (DigIN, DigOUT, An.IN, An.OUT) and on the right, the present input/output the function is connected to (B.3, A.2 etc.), or if not connected, a code 0.#.

When the value is blinking, hold down the Browser button up or down to find the desired board slot and input/output number. The program will scroll the board slots starting from 0 and proceeding from A to E and the I/O numbers from 1 to 10.

Once you have set the desired code, press the Enter button once to confirm the change.



**1.8 DEFINING A TERMINAL FOR A CERTAIN FUNCTION WITH NCDRIVE PROGRAMMING TOOL**

If you use the NCDrive Programming Tool for parametrizing you will have to establish the connection between the function and input/output in the same way as with the control panel. Just pick the address code from the drop-down menu in the Value column (see Figure 8 below).

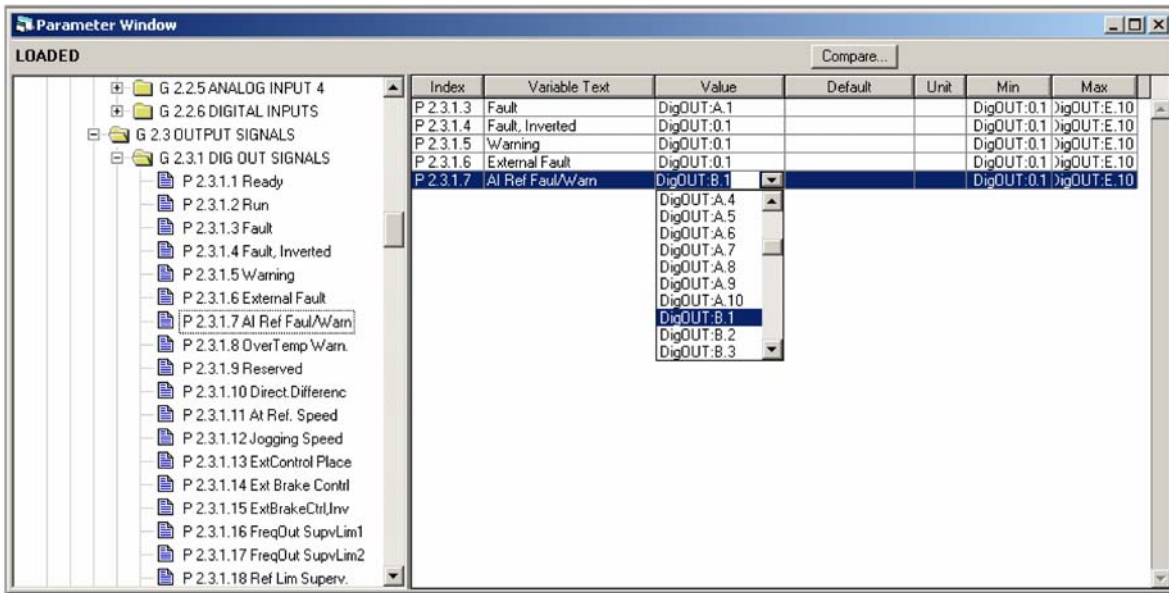


Figure 8. Screenshot of NCDrive programming tool; Entering the address code

	<p>Be <b>ABSOLUTELY</b> sure not to connect two functions to one and same <u>output</u> in order to avoid function overruns and to ensure flawless operation.</p>
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**NOTE:** The inputs, unlike the outputs, cannot be changed in RUN state.

### 1.9 OPTION BOARD RELATED PARAMETERS

Some of the input and output functions of certain option boards are controlled with associated parameters. The parameters are used to set the signal ranges for analogue inputs and outputs as well as values for different encoder functions.

The board-related parameters can be edited in the Expander Board Menu (M7) of the control keypad.

Enter the following menu level (G#) with the Menu button right. At this level, you can browse through slots A to E with the Browser buttons to see what expander boards are connected. On the lowermost line of the display you also see the number of parameters associated with the board. Edit the parameter value as shown below. For more information on the keypad operation, see VACON® NXS/P User Manual. See Figure 9.

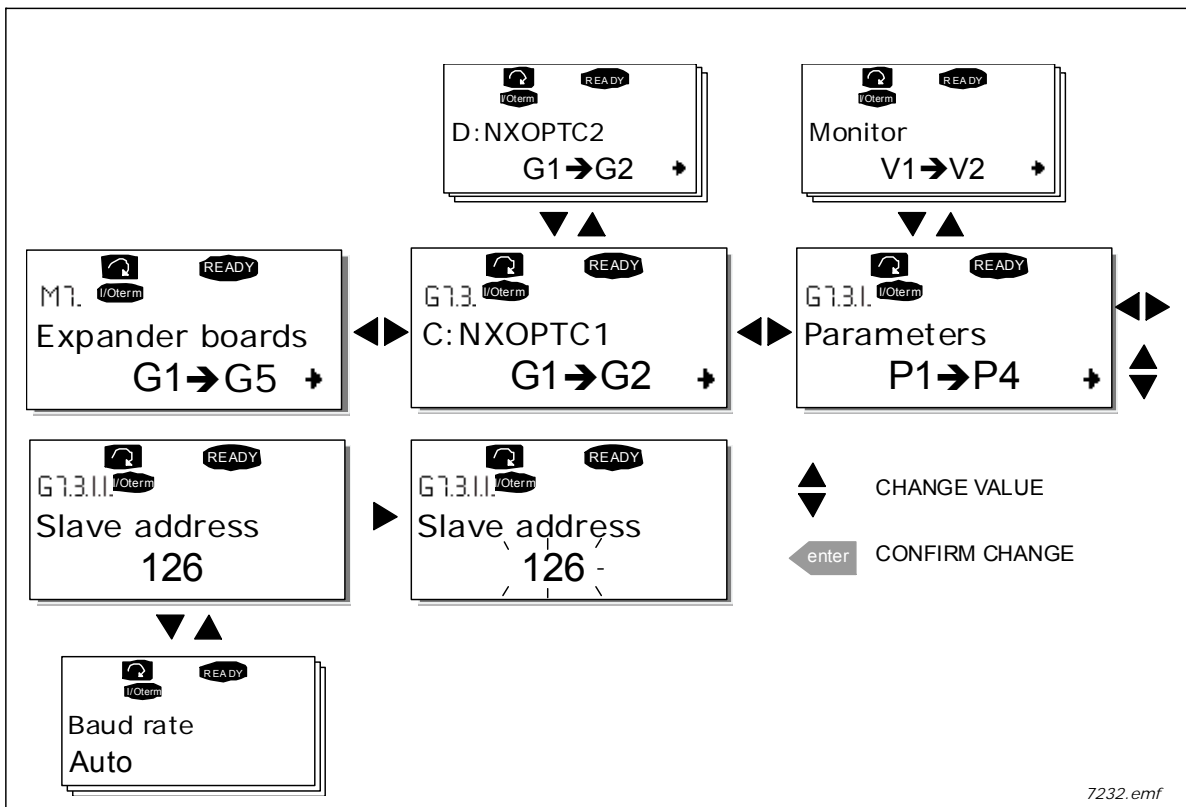



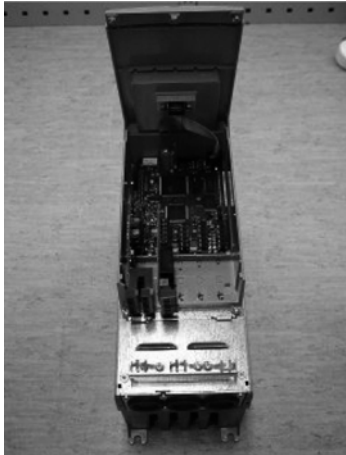


Figure 9. Board parameter value editing

**NOTE:** Fieldbus boards (OPTC\_) also have fieldbus-related parameters. These boards are, however, described in the separate fieldbus board manuals (see <http://drives.danfoss.com/knowledge-center/technical-documentation/>).

## 2. INSTALLATION OF VACON® OPTION BOARDS

	<p>Do not add or replace option boards or fieldbus boards on an AC drive with the power switched on. This may damage the boards.</p>
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<p><b>A</b></p>	<p>VACON® NX AC drive.</p>	 <p style="text-align: right; font-size: small;">7233.jpg</p>
<p><b>B</b></p>	<p>Remove the cable cover.</p>	 <p style="text-align: right; font-size: small;">7234.jpg</p>
<p><b>C</b></p>	<p>Open the cover of the control unit.</p>	 <p style="text-align: right; font-size: small;">7235.jpg</p>

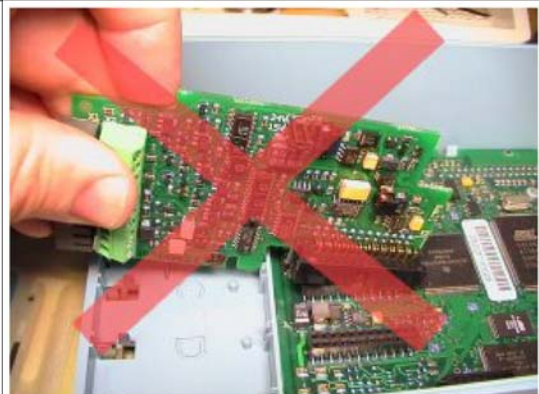


**D**

Install the option board in a correct slot on the control board of the AC drive. On attaching (also removing) the board, hold it in horizontally straight position to avoid twisting the connector pins. See the photos below.



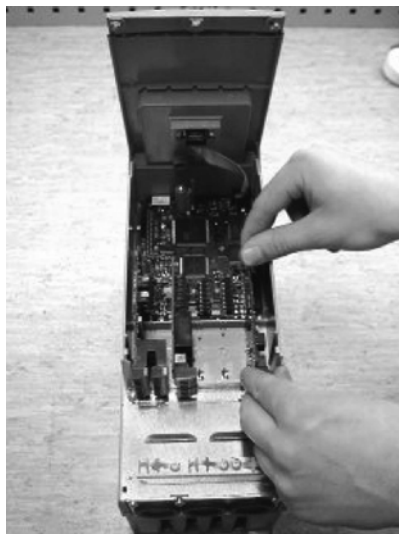
7236.jpg



7237.jpg

Make sure that the board (see below) fits tightly in the metal clamp and the plastic groove. If the board seems to be difficult to fit in the slot you may have to check the allowed slots for your option board.

**NOTE:** Check that the jumper settings on the board correspond to you needs. Finally, close the cover of the AC drive and the cable cover.



7238.jpg



7239.jpg

**2.1 CONTROL CABLES**

The control cables used must be at least 0.5mm<sup>2</sup> screened multicore cables. The maximum terminal wire size is 2.5mm<sup>2</sup> for the relay terminals and 1.5 mm<sup>2</sup> for other terminals.

Find the tightening torques of the option board terminals in the table below.

*Table 2. Tightening torques of terminals*

Terminal screw	Tightening torque	
	Nm	lb-in.
Relay and thermistor terminals (screw M3)	0.5	4.5
Other terminals (screw M2.6)	0.2	1.8

*Table 3. Cable types required to meet standards*

Cable type	Level H, C	Level L
Control cable	4	4

**Level H** = EN 61800-3+A11, 1<sup>st</sup> environment, restricted distribution  
EN 61000-6-4

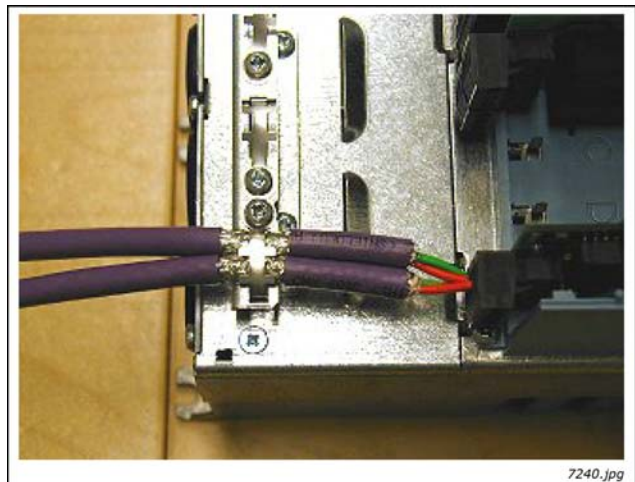
**Level L** = EN61800-3, 2<sup>nd</sup> environment

**4** = Screened cable equipped with compact low-impedance shield (NNCABLES /Jamak, SAB/ÖZCuY-0 or similar).

**2.1.1 CABLE GROUNDING**

We recommend to ground the control cables in the manner presented above.

Strip the cable at such distance from the terminal that you can fix it to the frame with the grounding clamp.



*Figure 10. Grounding of control cable*

## 2.2 BOARD INFORMATION STICKER

Each I/O option board package delivered by the factory includes a sticker (shown below) where possible modifications made in the AC drive are noted. Please check Option board (1), mark the board type (2), the slot into which the board is mounted (3) and the mounting date (4) on the sticker. Finally, attach the sticker on your drive.

**Drive modified:**

<input type="checkbox"/> Option board:	NXOPT.....	Date:.....
in slot:	A B C D E	Date:.....
<input type="checkbox"/> IP54 upgrade/ Collar		Date:.....
<input type="checkbox"/> EMC level modified: H to T/ T to H		Date:.....

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