USER'S MANUAL

NX
FREQUENCY CONVERTERS

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

FOR SMOOTH CONTROL vacon

INDEX

1. General information

Vacon NX range embodies a wide selection of *expander* and *adapter boards* with which the available I/O of Vacon NX frequency converter 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 control unit is designed to accept a total of five boards. 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 frequency converter (see Vacon NX User's Manual, Chapter 6.2). 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 frequency converter types may be restricted.

1.1 Board slots on the control board

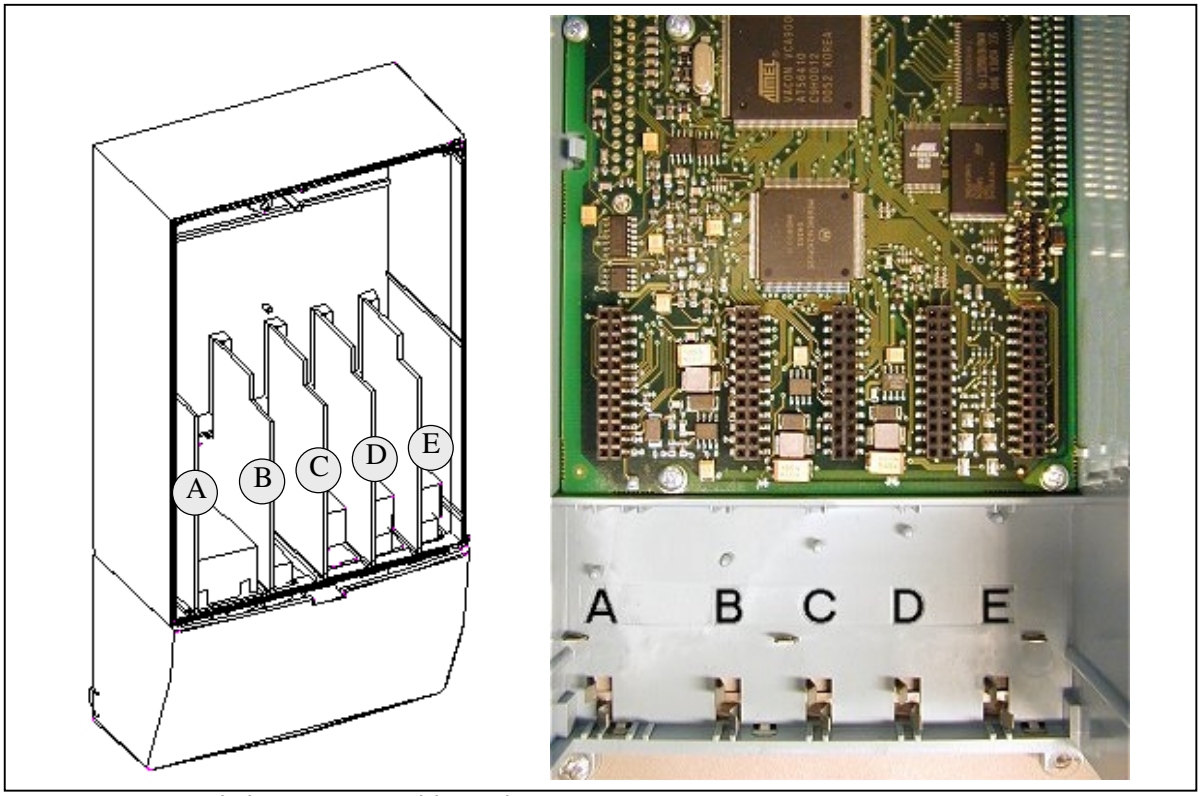


Figure 1. Board slots on control board

The control board is situated inside the *control unit* of the Vacon NX frequency converter. There are **five** board slots (labelled **A** to **E**) on the control board: 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 16 to 45.

Usually, when the frequency converter 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 frequency converter. 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 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:

NXOPTA_

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

See pages 15 to 34 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 48.

NXOPTB_

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

See pages 35 to 41 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 48.

NXOPTC_

- 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.

NXOPTD_

- 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 pages 42 to 45 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 48.

1.3 Technical data

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

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 ≥ 200 kΩ, 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 = 250Ω, 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 > 5kΩ
Digital inputs (DI), AC voltage controlled	Control voltage 42…240 VAC "0"<33V, "1">35V
Auxiliary voltage (output) (+24V) Auxiliary voltage (input) (ext. +24V)	24V (±15%), max 250mA (total summarized load from ext. +24V outputs, max. 150 mA from one board. 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_{ref})	10V – 0% – +2%, max. 10mA
Analogue output (AO), current (mA)	0(4)…20mA, R_L<500Ω, resolution 10 bits/0.1%, accuracy ≤ ±2%
Analogue output (AO), voltage (V)	0(2)…10V, RL ≥ 1kΩ, resolution 10 bits, accuracy ≤ ±2%
Relay outputs (RO)	Switching capacity 24VDC/8A 250VAC/8A 125VDC/0.4A Max. continuous load 2A rms
Thermistor input (TI)	R_{trip} = 4.7kΩ (PTC type)
Encoder control voltage (+5V/+15V/+24V)	See NXOPTA4 and NXOPTA5 technical data on pp. 22
Encoder connections (inputs, outputs)	See NXOPTA4 and NXOPTA5 technical data on pp. 22

1.3.1 Isolation

The control connections are isolated from the mains potential and the I/O ground is connected directly to the frame of the frequency converter. 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.

1.3.2 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.

1.3.3 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.

1.3.4 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 may not exceed 250mA. The maximum load on the +24V/EXT+24V output **per board** is 150mA. See Figure 2.

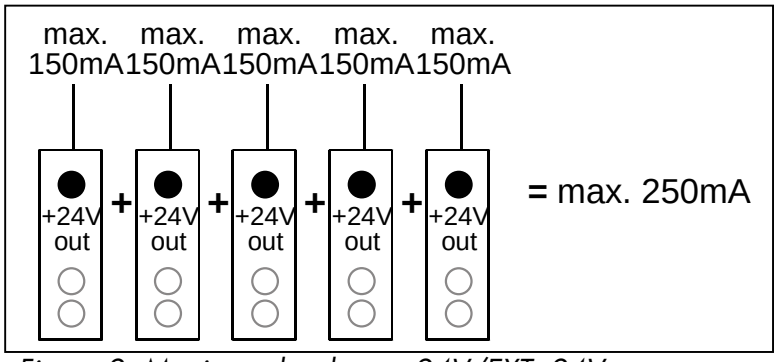


Figure 2. Maximum loads on +24V/EXT+24V output

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 should be lost on the frequency converter. 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 frequency converter. **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 +24DC±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. Should one of the +24V/EXT+24V outputs short-circuit, the others would remain powered because of the local protection.

1.3.5 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 3, Figure 4 and Figure 5.

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 frequency converter, the following arrangements are possible:

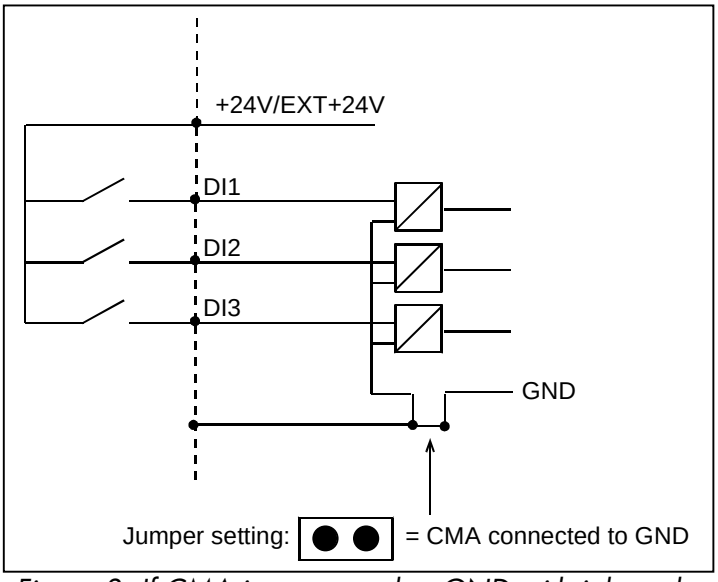


Figure 3. If CMA is connected to GND with inboard jumper the internal +24V is used and the CMA terminal need not be wired

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

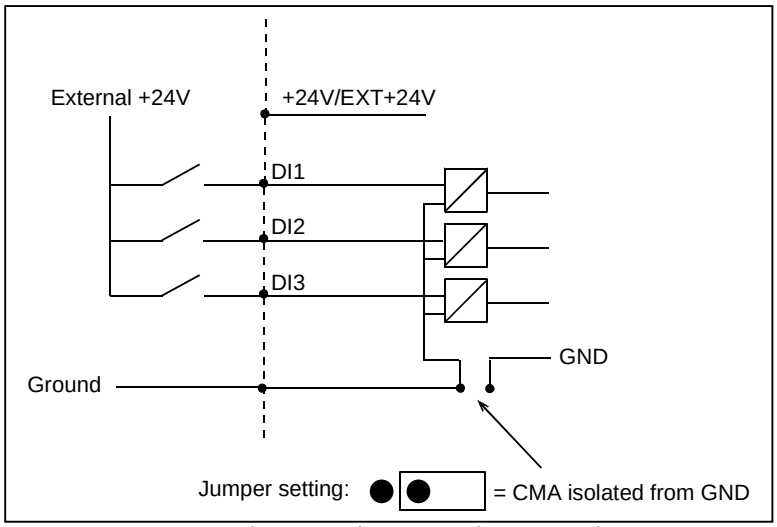


Figure 4. Positive logic with external +24V when CMA is isolated from GND using onboard jumper. The input is active when the switch is closed.

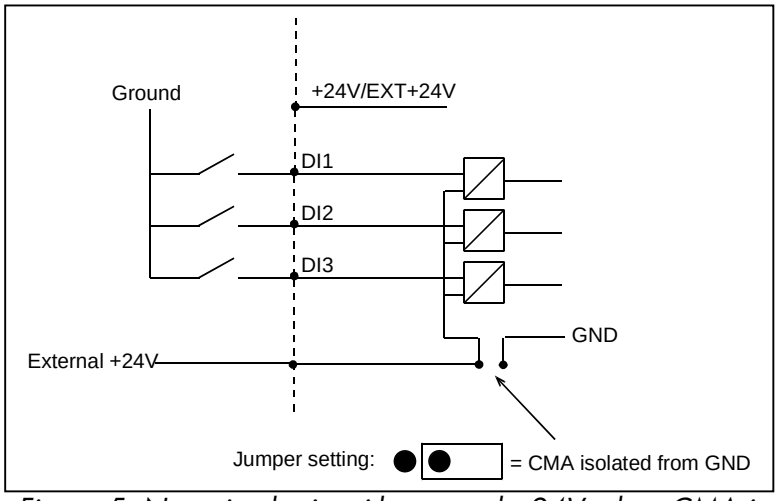


Figure 5. Negative logic with external +24V when CMA is isolated with onboard jumper. The input is active when the switch is closed (0V is the active signal).

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 frequency converter.

1.4 Hardware protections

1.4.1 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.

1.4.2 Board slot guides and allowed slots

You cannot mount an option board into any slot. Table 25 shows 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.

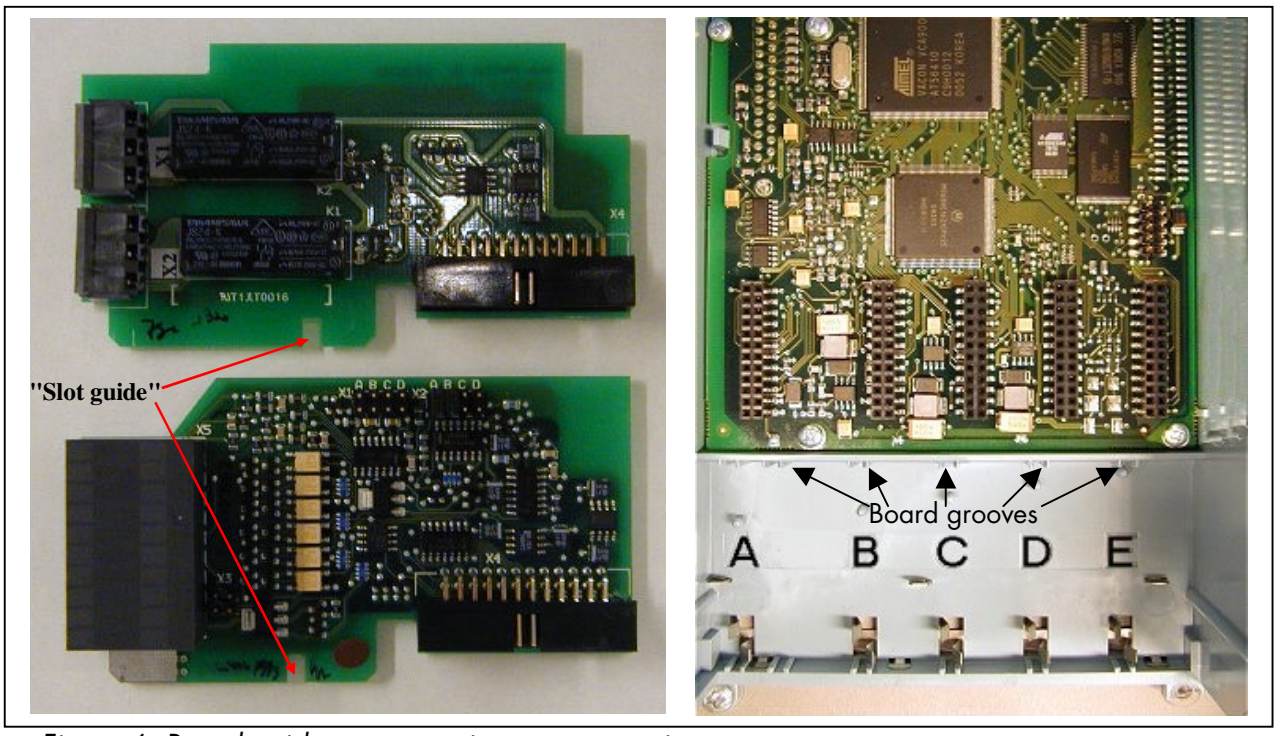


Figure 6. Board guide to prevent incorrect mountings

1.5 Type identification number

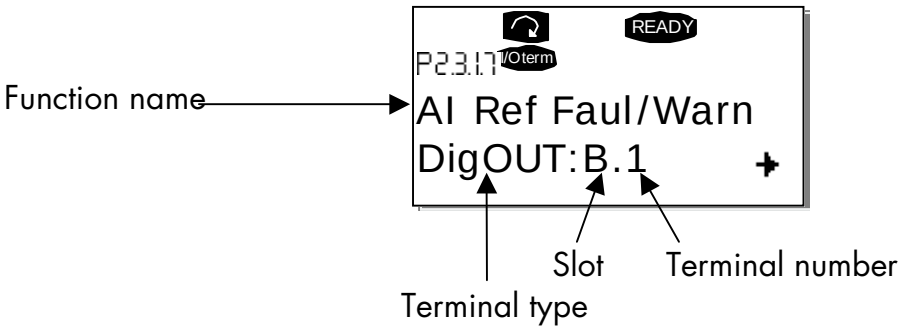
Note: *This information is relevant only for special applications designers using the Vacon NC1131-3 engineering tool.*

Each Vacon NXOPTxx 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.

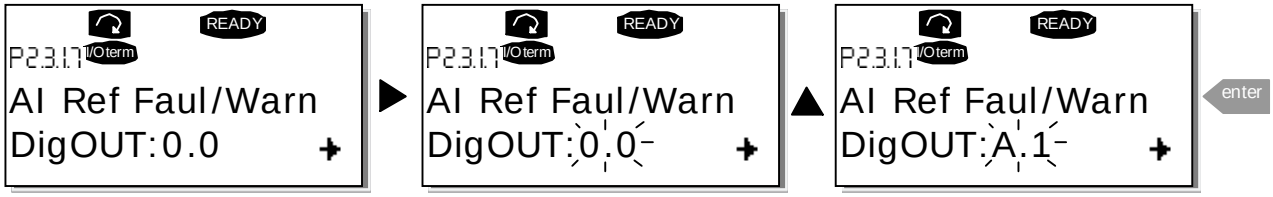
1.6 Defining functions to inputs and outputs

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 Application Manuals). 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 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 NXOPTA1.*
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.



1.7 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 7 below).

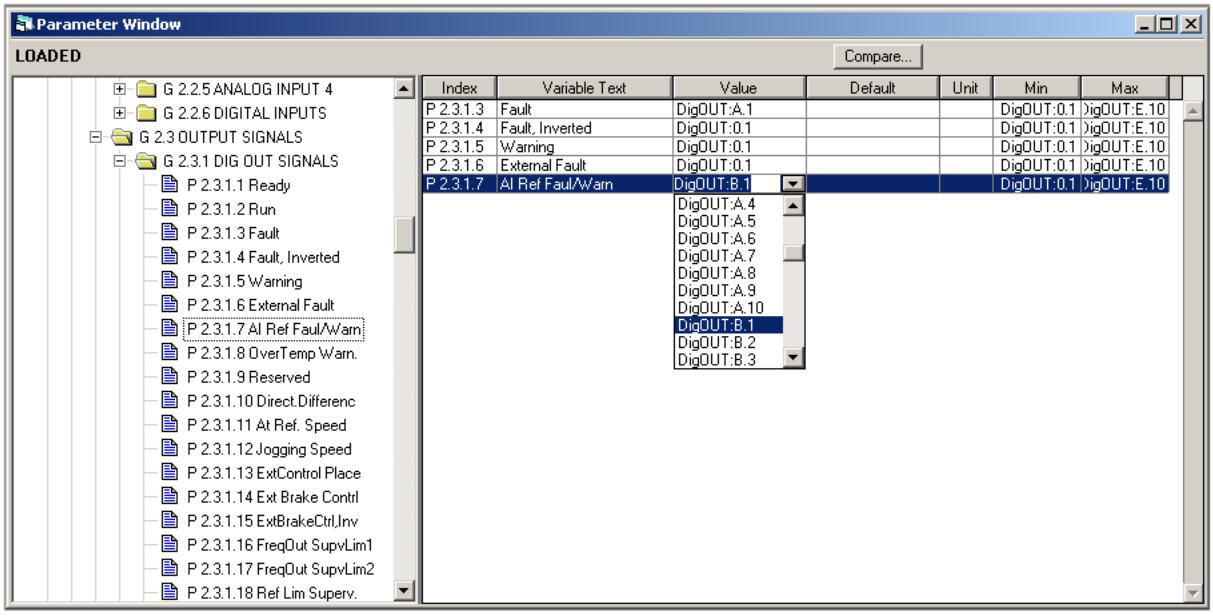


Figure 7. Screenshot of NCDrive programming tool; Entering the address code

WARNING	**Be ABSOLUTELY sure not to connect two functions to one and same output in order to avoid function overruns and to ensure flawless operation.**

Note: The *inputs*, unlike the *outputs*, cannot be changed in RUN state.

1.8 Option board related parameters in NXOPTA_

Some of the input and output functions of certain NXOPTA_ type 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 NX User's Manual, Chapter 7. See Figure 8.

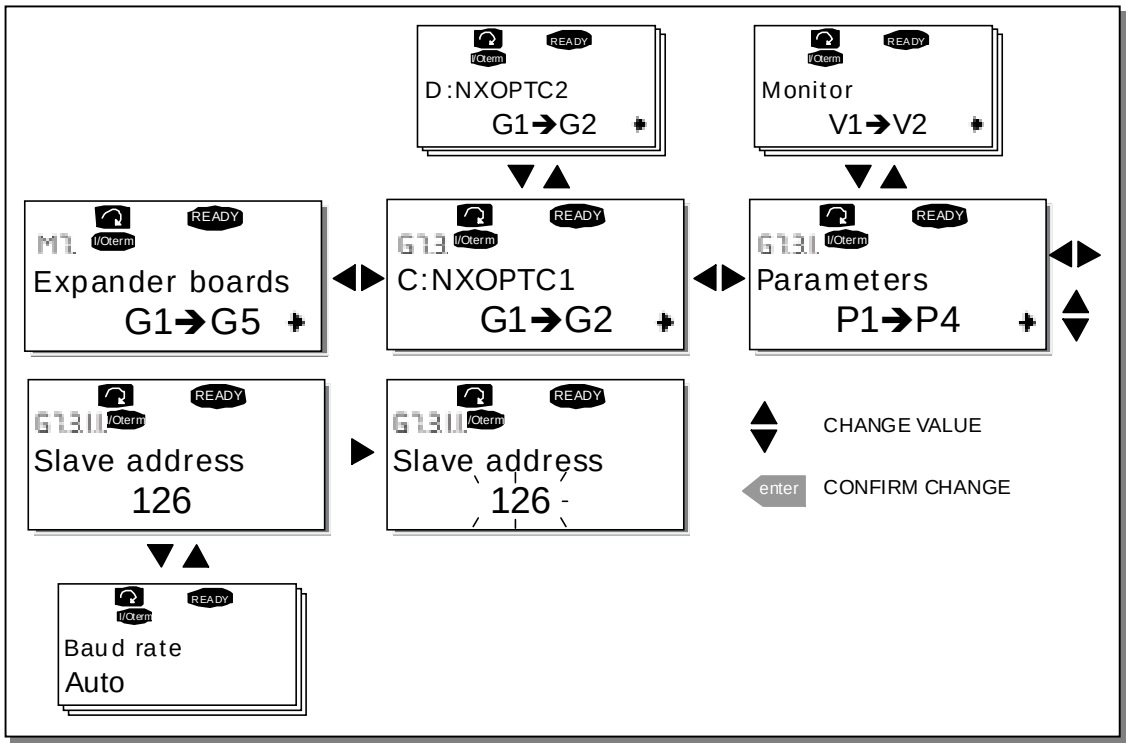
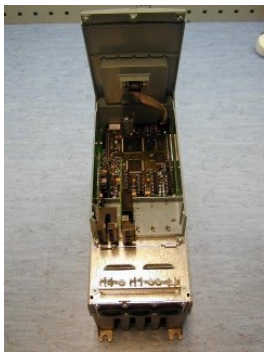
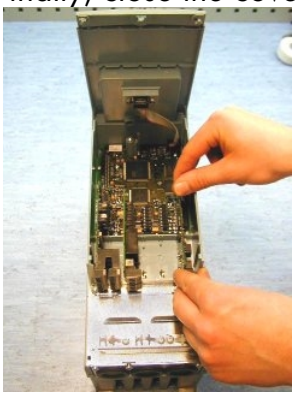


Figure 8. Board parameter value editing

Note: Fieldbus boards (NXOPTC_) also have fieldbus-related parameters. These boards are, however, described in the separate fieldbus board manuals (please visit http://www.vacon.com/support/documents.html.

2. Installation of Vacon Option Boards

A	Vacon NX frequency converter 
B	Remove the cable cover. 
C	Open the cover of the control unit. 
D	Install the option board in a correct slot on the control board of the frequency converter. 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 frequency converter and the cable cover.  

2.1 Control cables

The control cables used shall be at least 0.5mm^2 screened multicore cables. The maximum terminal wire size is 2.5mm^2 for the relay terminals and 1.5 mm^2 for other terminals.

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

Terminal screw	Tightening torque	
	Nm	lb-in.
Relay and thermistor terminals (screw M3)	0.5	4.5
Other terminals (screw M2.6)	0.4	3.5

Table 1. Tightening torques of terminals

Cable type	Level H	Level C*
Control cable	4	4

Table 2. Cable types required to meet standards.

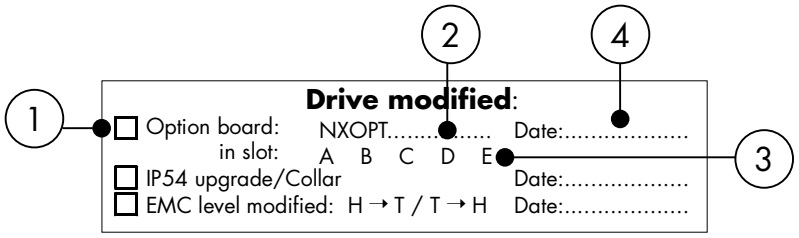
Level H = EN 61800-3, 1st environment
EN 50081-2

Level C = EN 50081-1
*Also requires an external filter between the frequency converter and the mains

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

2.2 Board information sticker

Each I/O option board package delivered by the factory includes a sticker (shown below). 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.



3. Descriptions of Vacon option boards

3.1 Basic boards NXOPTA_

- Basic boards used for basic I/O; normally pre-installed at the factory
- This board type uses slots **A**, **B** and **C**.

The standard Vacon NXS frequency converter contains two boards placed in slots A and B. The board in slot A (NXOPTA1, NXOPT8 or NXOPTA9) has digital inputs, digital outputs, analogue inputs and an analogue output. The board in slot B (NXOPTA2) has two change-over relay outputs. As an alternative to NXOPTA2, a board of type NXOPTA3 can also be placed in slot B. In addition to the two relay outputs, this board has one thermistor input.

The boards you wish to have installed in your frequency converter have to be defined in the type designation code of the frequency converter when ordering it from the factory.

FC type	I/O board	Allowed slots	DI	DO	AI	AO	RO	TI	Other
NXS NXP	NXOPTA1	A	6	1	2 (mA/V), incl. -10...+10V	1 (mA/V)			+10Vref +24V/ EXT+24V
NXS NXP	NXOPTA2	B					2 (NO/NC)		
NXS NXP	NXOPTA3	B					1 (NO/NC) + 1 NO	1	
NXS[1] NXP	NXOPTA4	C	3 DI encoder (RS-422) + 2 DI (qualifier & fast input)						+5V/+15V/ +24V (progr.)
NXS[1] NXP	NXOPTA5	C	3 DI encoder (wide range) + 2 DI (qualifier & fast input)						+15V/+24 V (progr.)
NXS NXP	NXOPTA8	A	6	1	2 (mA/V), incl. -10...+10V (de-coupled from GND)	1 (mA/V) (decoupled from GND)			+10Vref (decoupled from GND) +24V/ EXT+24V
NXS NXP	NXOPTA9	A	6	1	2 (mA/V), incl. – 10...+10V	1 (mA/V)			+10ref +24V/ EXT+24V

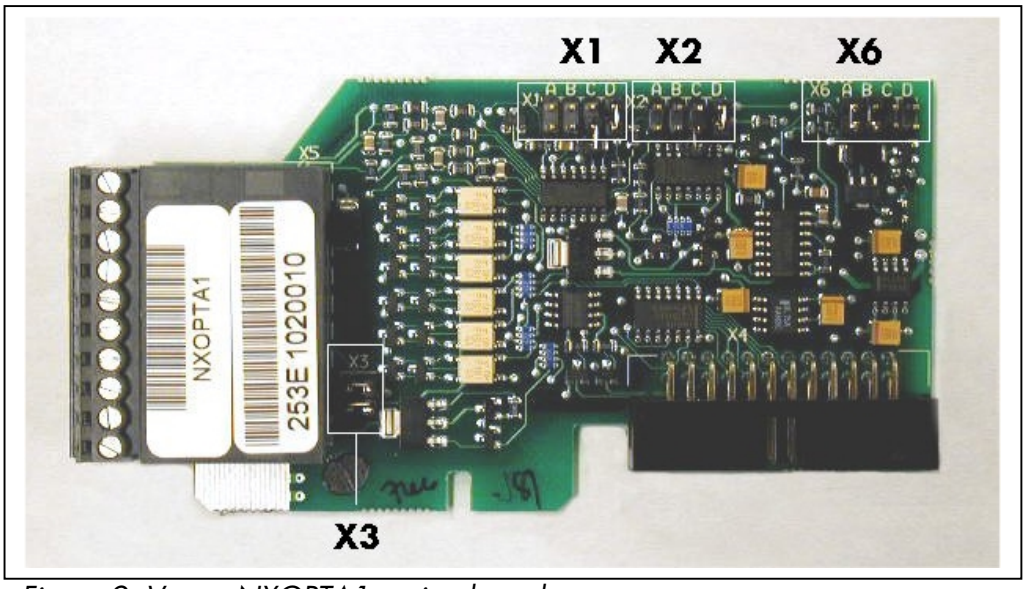
Table 3. Vacon NX Basic boards and their equipment

[1] Encoder board can be used in Vacon NXS with special applications only.

DI = Digital input
AI = Analogue input
TI = Thermistor input
DO = Digital output
AO = Analogue output
RO = Relay output

NXOPTA1

3.1.1 NXOPTA1



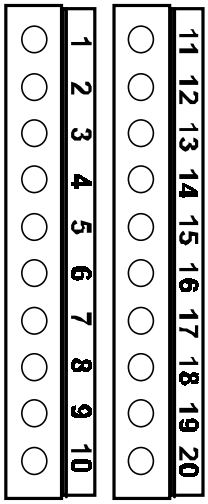


Figure 9. Vacon NXOPTA1 option board

Description:	Standard I/O board with digital inputs/outputs and analogue inputs/outputs
Allowed slots:	A
Type ID:	16689
Terminals:	Two terminal blocks (coded = mounting of blocks in wrong order prevented, terminals #1 and #12); Screw terminals (M2.6)
Jumpers:	4; X1, X2, X3 and X6 (See Figure 10)
Board parameters:	Yes (see page 19)

I/O terminals on NXOPTA1 (coded terminals painted black)

Terminal		Parameter reference on keypad and NCDrive	Technical information
1	+10 Vref		Reference output +10V; Maximum current 10 mA
2	AI1+	An.IN:**A.1**	Selection V or mA with jumper block X1 (see page 18): Default: 0– +10V (Ri = 200 kΩ) (-10V…..+10V Joy-stick control, selected with a jumper) 0– 20mA (Ri = 250 Ω) Resolution 0.1%; Accuracy ±1%
3	AI1–		Differential input if not connected to ground; Allows ±20V differential mode voltage to GND
4	AI2+	An.IN:**A.2**	Selection V or mA with jumper block X2 (see page 18): Default: 0– 20mA (Ri = 250 Ω) 0– +10V (Ri = 200 kΩ) (-10V…..+10V Joy-stick control, selected with a jumper) Resolution: 0.1%; Accuracy ±1%
5	AI2–		Differential input if not connected to ground; Allows ±20V differential mode voltage to GND
6	24 Vout (bidirectional)		24V auxiliary voltage output. Short-circuit protected. ±15%, maximum current 150 mA, see 1.3.4 +24Vdc external supply may be connected. Galvanically connected to terminal #12.
7	GND		Ground for reference and controls Galvanically connected to terminals #13,19.
8	DIN1	DigIN:**A.1**	Digital input 1 (Common CMA); R_i = min. 5kΩ
9	DIN2	DigIN:**A.2**	Digital input 2 (Common CMA); R_i = min. 5kΩ
10	DIN3	DigIN:**A.3**	Digital input 3 (Common CMA); R_i = min. 5kΩ
11	CMA		Digital input common B for DIN1, DIN2 and DIN3. Connection by default to GND. Selection with jumper block X3 (see page 18):
12	24 Vout (bidirectional)		Same as terminal #6 Galvanically connected to terminal #6.
13	GND		Same as terminal #7 Galvanically connected to terminals #7 and 19
14	DIN4	DigIN:**A.4**	Digital input 4 (Common CMB); R_i = min. 5kΩ
15	DIN5	DigIN:**A.5**	Digital input 5 (Common CMB); R_i = min. 5kΩ
16	DIN6	DigIN:**A.6**	Digital input 6 (Common CMB); R_i = min. 5kΩ
17	CMB		Digital input common A for DIN4, DIN5 and DIN6. Connection by default to GND. Selection with jumper block X3 (see page 18):
18	AO1+	AnOUT:**A.1**	Analogue output Output signal range: Current 0(4)–20mA, R_L max 400Ω or Voltage 0—10V, R_L >1kΩ Selection with jumper block X6 (see page 18): Resolution: 0.1% (10 bits); Accuracy ±2%
19	AO1–		
20	DO1	DigOUT:**A.1**	Open collector output Maximum U_{in} = 48VDC Maximum current = 50 mA

Table 4. NXOPTA1 I/O terminals

Jumper selections

There are four jumper blocks on the NXOPTA1 board. The factory defaults and other available jumper selections are presented below.

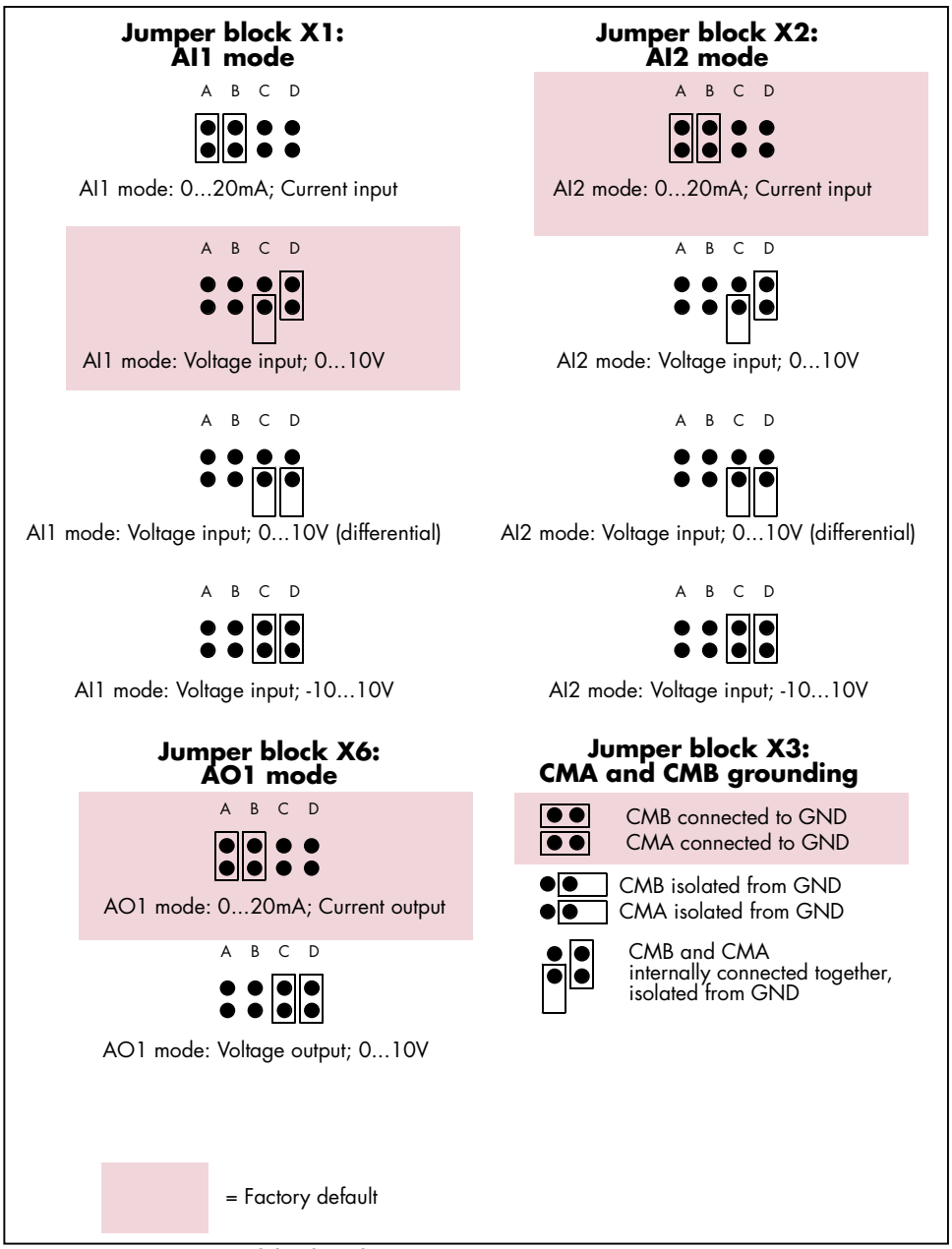


Figure 10. Jumper block selection on NXOPTA1

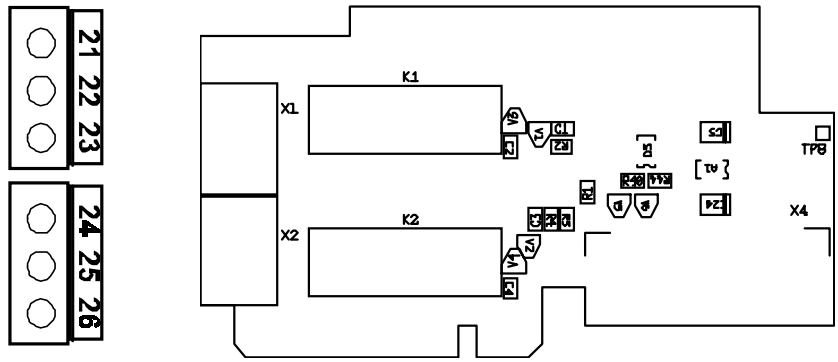
NXOPTA1 parameters

Number	Parameter	Min	Max	Default	Note
1	AI1 mode	1	5	3	**1** = 0...20mA **2** = 4...20mA **3** = 0...10V **4** = 2...10V **5** = -10...+10V
2	AI2 mode	1	5	1	**1** = 0...20mA **2** = 4...20mA **3** = 0...10V **4** = 2...10V **5** = -10...+10V
3	AO1 mode	1	4	1	**1** = 0...20mA **2** = 4...20mA **3** = 0...10V **4** = 2...10V

Table 5. NXOPTA1 board-related parameters

NXOPTA2

3.1.2 NXOPTA2



Description: Standard Vacon NX frequency converter relay board with two relay outputs

Allowed slots: B

Type ID: 16690

Terminals: Two terminal blocks; Screw terminals (M3); No coding

Jumpers: None

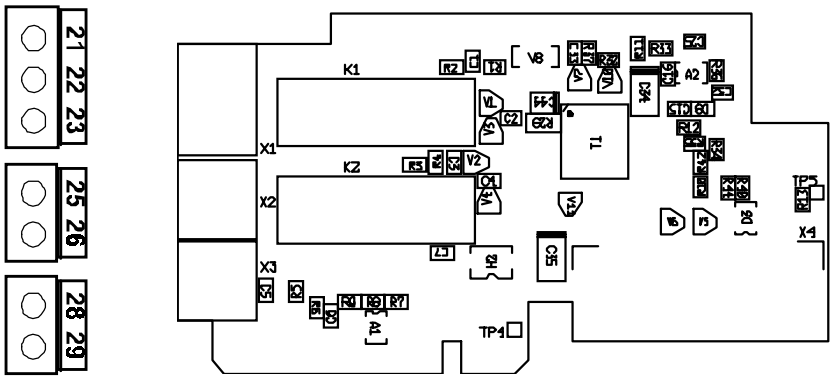
Board parameters: None

I/O terminals on NXOPTA2

Terminal		Parameter reference on keypad and NCDrive	Technical information
21	RO1/normal closed	DigOUT:**B.1**	Relay output 1 (NO/NC)
22	RO1/common		Switching capacity 24VDC/8A
23	RO1/normal open		250VAC/8A
			125VDC/0.4A
24	RO2/normal closed	DigOUT:**B.2**	Relay output 2 (NO/NC)
25	RO2/common		Switching capacity 24VDC/8A
26	RO2/normal open		250VAC/8A
			125VDC/0.4A

Table 6. NXOPTA2 I/O terminals

3.1.3 NXOPTA3



Description: Relay board with two relay outputs and one thermistor input for Vacon NX frequency converter

Allowed slots: B

Type ID: 16691

Terminals: Three terminal blocks; Screw terminals (M3); No coding.

Jumpers: None

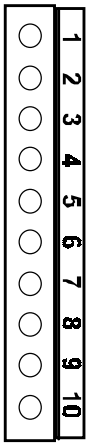
Board parameters: None

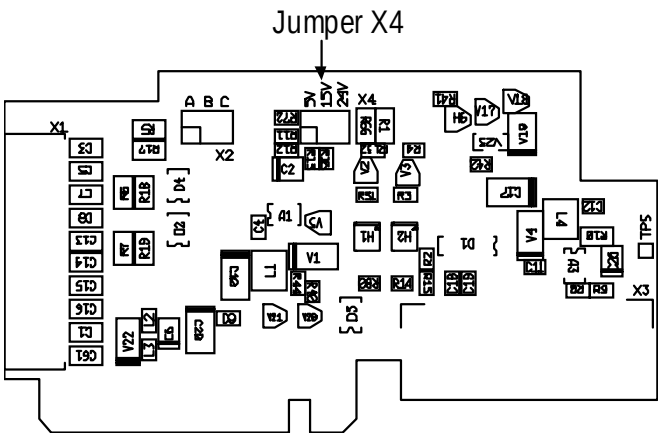
I/O terminals on NXOPTA3

Terminal		Parameter reference on keypad and NCDrive	Technical information
21	RO1/normal closed	DigOUT:**B.1**	Relay output 1 (NO/NC)
22	RO1/common		Switching capacity 24VDC/8A
23	RO1/normal open		250VAC/8A
			125VDC/0.4A
25	RO2/common	DigOUT:**B.2**	Relay output 2 (NO)
26	RO2/normal open		Switching capacity 24VDC/8A
			250VAC/8A
			125VDC/0.4A
28	TI1+	DigIN:**B.1**	
29	TI1–		

Table 7. NXOPTA3 I/O terminals

3.1.4 NXOPTA4





NXOPTA4

Description: Encoder board for **Vacon NXP**. Encoder input board with programmable control voltage for an encoder

The encoder board NXOPTA4 is for TTL type encoders (TTL, TTL(R)) providing input signal levels that meet the RS_422 interface standard. Encoder inputs A, B and Z are not galvanically isolated. The NXOPTA4 board includes, too, the qualifier input ENC1Q (meant to trace the Z-pulse in certain situations) and a special/fast digital input DIC4 (used to trace very short pulses). These two inputs are used in special applications.

The TTL type encoders do not have an internal regulator and use therefore a supply voltage of +5V±5% whereas the TTL(R) type encoders have an internal regulator and the supply voltage can be e.g. +15V±10% (depending on the encoder manufacturer).

Allowed slots: C

Type ID: 16692

Terminals: One terminal block; Screw terminals (M2.6); Coding in terminal #3.

Jumpers: 1; X4 (see page 23)

Board parameters: Yes (see page 25)

I/O terminals on NXOPTA4 (coded terminal painted black)

Terminal		Parameter reference Keypad/NCDrive	Technical information
1	DIC1A+		Pulse input A
2	DIC1A–		
3	DIC2B+		Pulse input B; phase shift of 90 degrees compared to Pulse input A
4	DIC2B–		
5	DIC3Z+		Pulse input Z; one pulse per revolution
6	DIC3Z–		
7	ENC1Q		Reserved for future use
8	DIC4		Reserved for future use
9	GND		Ground for control and inputs ENC1Q and DIC4
10	+5V/+15V/+24V		Control voltage (auxiliary voltage) output to encoder; Output voltage selectable with jumper X4.

Table 8. NXOPTA4 I/O terminals

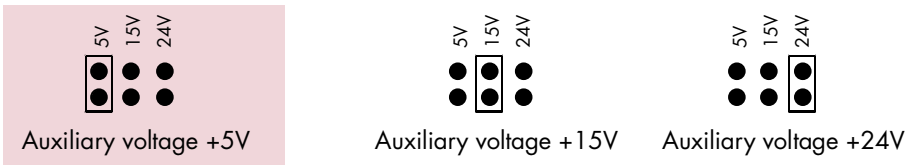
Technical data:

Encoder control voltage, +5V/+15V/+24V	Control voltage selectable with jumper X4.
Encoder input connections, inputs A+, A–, B+, B–, Z+, Z–	Max. input frequency ≤300kHz Inputs A, B and Z are differential Encoder inputs are RS-422 interface compatible Max. load per encoder input $I_{low} = I_{high} \approx 25mA$
Qualifier input ENC1Q Fast digital input DIC1	Max. input frequency ≤10kHz Min. pulse length 50µs Digital input 24V; R_i>5kΩ Digital input is single-ended; connected to GND

Jumper selections

On the NXOPTA4 board, there is one jumper block used to program the control voltage (auxiliary voltage). The factory default and other available jumper selections are presented below.

Jumper block X4:
Auxiliary voltage level



Usage

Closed Loop Vector Control. The NXOPTA4 board is mainly used in applications where encoder cable length is relatively short (max. 5 metres).

Encoder connection – Differential

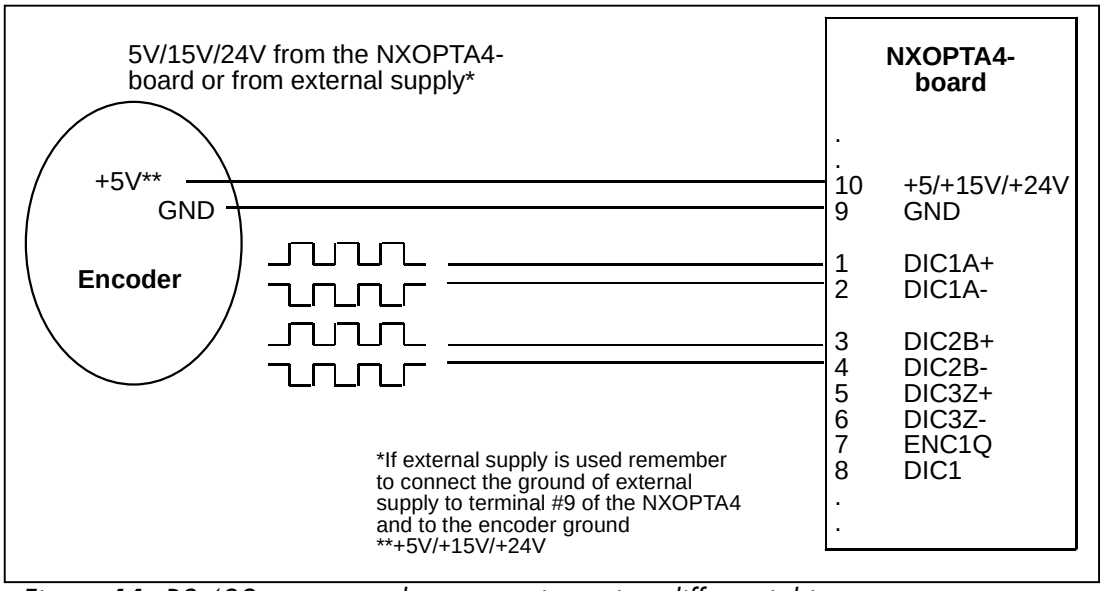
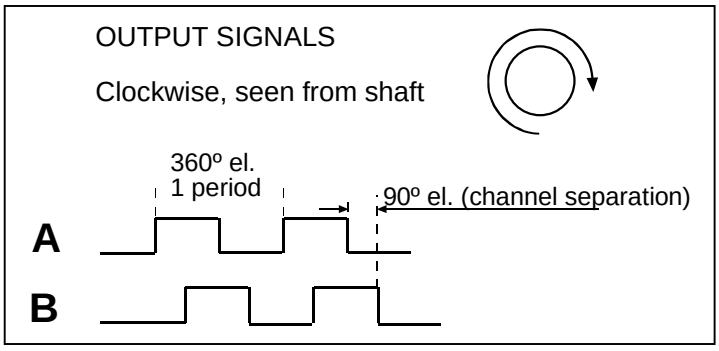


Figure 11. RS-422 type encoder connection using differential inputs

Note:
The encoder pulses are handled by Vacon software as presented below:

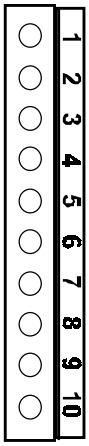


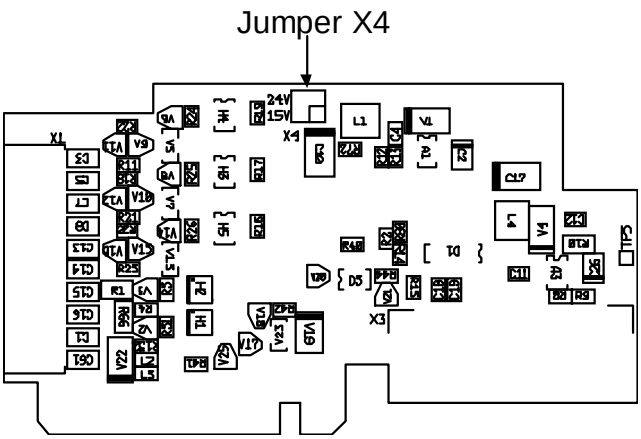
NXOPTA4 parameters

Number	Parameter	Min	Max	Default	Note
7.3.1.1	Pulse/revolution	1	65535	1024	
7.3.1.2	Invert direction	0	1	0	**0** = No **1** = Yes
7.3.1.3	Reading rate	0	4	1	**0** = No **1** = 1 ms **2** = 5 ms **3** = 10 ms **4** = 50 ms

Table 9. NXOPTA4 board-related parameters

3.1.5 NXOPTA5





NXOPTA5

Description: Encoder board for **Vacon NXP**. Encoder input board with programmable control voltage for an encoder.

The NXOPTA5 board is designed for HTL (High voltage Transistor Logic) type encoders (voltage output type push-pull HTL, open collector output type HTL) which provide input signal levels dependent on the supply voltage of the encoder. The encoder inputs A, B and Z are galvanically isolated. The NXOPTA5 board includes, too, the qualifier input ENC1Q (meant to trace the Z-pulse in certain situations) and a fast digital input DIC4 (used to trace very short pulses). These two inputs are used in special applications.

The NXOPTA5 is similar to the NXOPTA4 in connections but the encoder inputs A, B and Z have different signal levels (voltage level). The input levels for A, B and Z of the NXOPTA4 are compatible with RS-422 while those of the NXOPTA5 are more general wide range inputs. Inputs ENC1Q and DIC4 are identical in both boards.

Allowed slots: C

Type ID: 16693

Terminals: One terminal block; Screw terminals (M2.6); Coding in terminal #3.

Jumpers: 1; X4 (see page 27)

Board parameters: Yes (see page 25)

I/O terminals on NXOPTA5 (coded terminal painted black)

Terminal		Parameter reference Keypad/NCDrive	Technical information
1	DIC1A+		Pulse input A (differential); Voltage range 10…24V
2	DIC1A–		
3	DIC2B+		Pulse input B; phase shift of 90 degrees compared to Pulse input A (differential); Voltage range 10…24V
4	DIC2B–		
5	DIC3Z+		Pulse input Z; one pulse per revolution (differential); Voltage range 10…24V
6	DIC3Z–		
7	ENC1Q		Reserved for future use
8	DIC4		Reserved for future use
9	GND		Ground for control and inputs ENC1Q and DIC4
10	+15V/+24V		Control voltage (auxiliary voltage) output to encoder; Output voltage selectable with jumper X4.

Table 10. NXOPTA5 I/O terminals

Note: Encoder inputs are wide range inputs that can be used with encoders using +15V or +24V

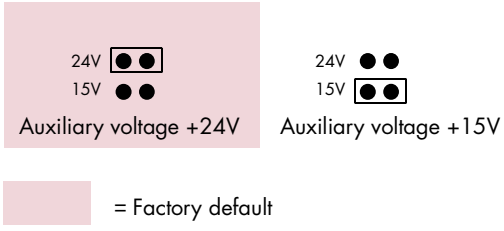
Technical data:

Encoder control voltage, +15V/+24V	Control voltage selectable with jumper X4.
Encoder input connections, inputs A+, A–, B+, B–, Z+, Z–	Max. input frequency ≤300kHz Inputs A, B and Z are differential
Qualifier input ENC1Q Fast digital input DIC1	Max. input frequency ≤10kHz Min. pulse length 50µs Digital input 24V; R_i>5kΩ Digital input is single-ended; connected to GND

Jumper selections

On the NXOPTA5 board, there is one jumper block used to program the control voltage (auxiliary voltage). The factory default and other available jumper selections are presented below.

Jumper block X4:
Auxiliary voltage level



Usage: Closed Loop Vector Control. The NXOPTA5 board is mainly used in conventional industrial applications where encoder cable lengths are relatively long.

Encoder connection – Single-ended

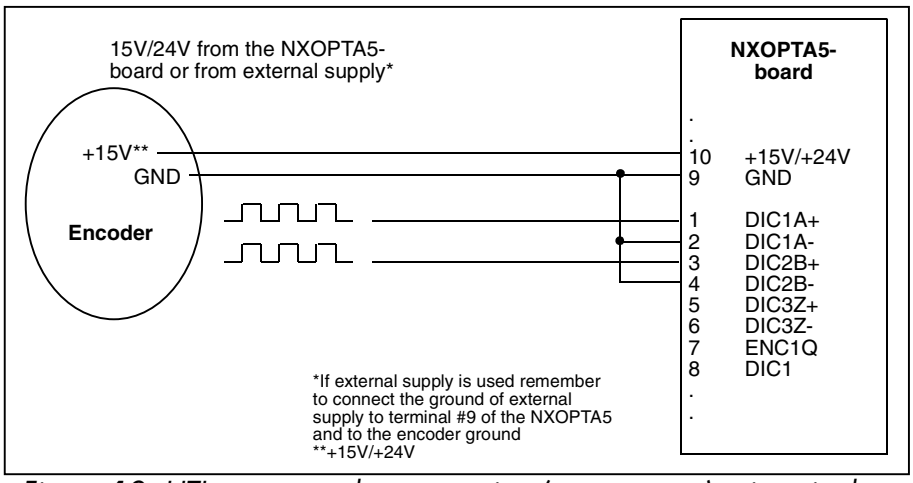


Figure 12. HTL type encoder connection (open source) using single-ended inputs

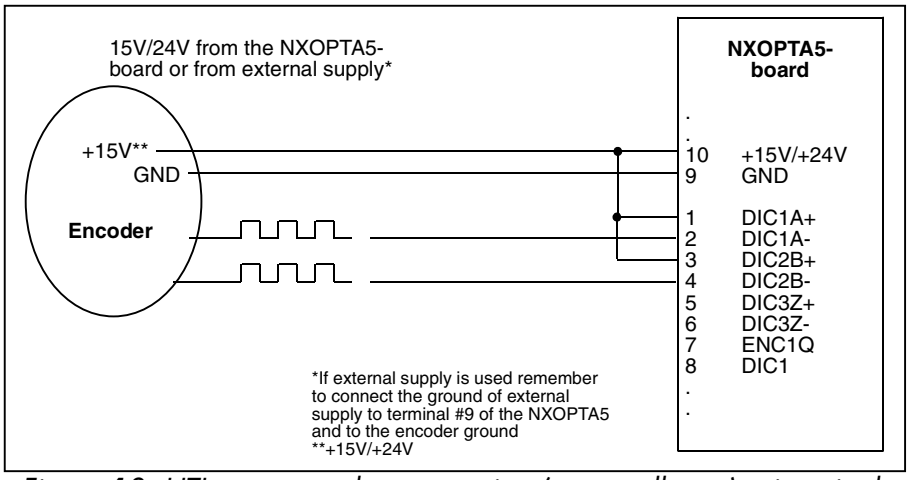


Figure 13. HTL type encoder connection (open collector) using single-ended inputs

Encoder connection – Differential

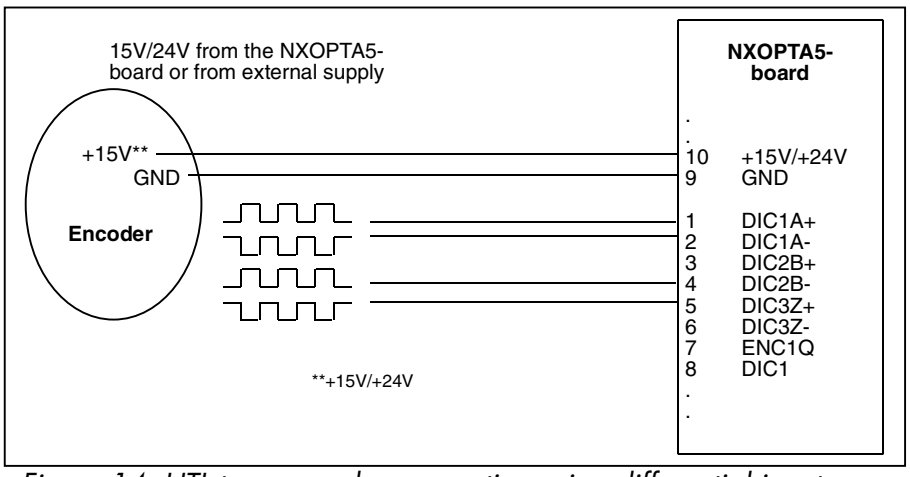
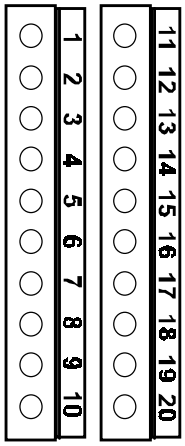


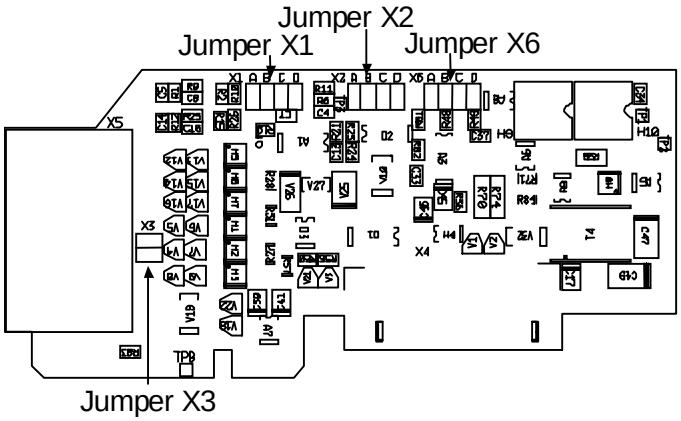
Figure 14. HTL type encoder connection using differential inputs

NXOPTA5 parameters

See page 25.

3.1.6 NXOPTA8





NXOPTA8

Description: Vacon NX basic I/O board similar to NXOPTA1 except that the analogue inputs and output are **galvanically decoupled**.

Allowed slots: A

Type ID: 16696

Terminals: Two terminal blocks; Screw terminals (M2.6); Coding in terminals #1 and #12.

Jumpers: 4; X1, X2, X3 and X6 (see page 32)

Board parameters: Yes (see page 33)

I/O terminals on NXOPTA8 (coded terminals painted black)

Terminal		Parameter reference Keypad/NCDrive	Technical information
1	+10 Vref		Refer.output +10V; Max.current 10mA; Decoupled from FC GND
2	AI1+	An.IN:**A.1**	Selection V or mA with jumper block X1 (see page 32): Default: 0– +10V (Ri = 200 kΩ) (-10V…..+10V Joy-stick control, selected with a jumper) 0– 20mA (Ri = 250 Ω) Resolution 0.1%; Accuracy ±1%
3	AI1– (GND ISOL)		GND ISOL/Voltage input; Connected to GND ISOL (selected with jumper)
4	AI2+	An.IN:**A.2**	Selection V or mA with jumper block X2 (see page 32): Default: 0– 20mA (Ri = 250 Ω) 0– +10V (Ri = 200 kΩ) (-10V…..+10V Joy-stick control, selected with a jumper) Resolution: 0.1%; Accuracy ±1%
5	AI2– (GND ISOL)		GND ISOL/Voltage input; Connected to GND ISOL (selected with jumper)
6	24 Vout (bidirectional)		24V auxiliary voltage output. Short-circuit protected. ±15%, maximum current 150 mA, see 1.3.4 +24Vdc external supply may be connected. Galvanically connected to terminal #12.
7	GND		Ground for reference and controls Galvanically connected to terminal #13.
8	DIN1	DigIN:**A.1**	Digital input 1 (Common CMA); R_i = min. 5kΩ
9	DIN2	DigIN:**A.2**	Digital input 2 (Common CMA); R_i = min. 5kΩ
10	DIN3	DigIN:**A.3**	Digital input 3 (Common CMA); R_i = min. 5kΩ
11	CMA		Digital input common A for DIN1, DIN2 and DIN3. Connection by default to GND. Selection with jumper block X3 (see page 32):
12	24 Vout (bidirectional)		Same as terminal #6 Galvanically connected to terminal #6.
13	GND		Same as terminal #7 Galvanically connected to terminals #7
14	DIN4	DigIN:**A.4**	Digital input 4 (Common CMB); R_i = min. 5kΩ
15	DIN5	DigIN:**A.5**	Digital input 5 (Common CMB); R_i = min. 5kΩ
16	DIN6	DigIN:**A.6**	Digital input 6 (Common CMB); R_i = min. 5kΩ
17	CMB		Digital input common A for DIN4, DIN5 and DIN6. Connection by default to GND. Selection with jumper block X3 (see page 32):
18	AO1+	AnOUT:**A.1**	Analogue output Output signal range: Current 0(4)–20mA, R_L max 350Ω or Voltage 0—10V, R_L >1kΩ Selection with jumper block X6 (see page 32): Resolution: 0.1% (10 bits); Accuracy ±2%;
19	AO1–		
20	DO1	DigOUT:**A.1**	Open collector output; Max. U_{in} = 48VDC; Max. current = 50 mA

Table 11. NXOPTA8 I/O terminals

Jumper selections

There are four jumper blocks on the NXOPTA1 board. The factory defaults and other available jumper selections are presented below.

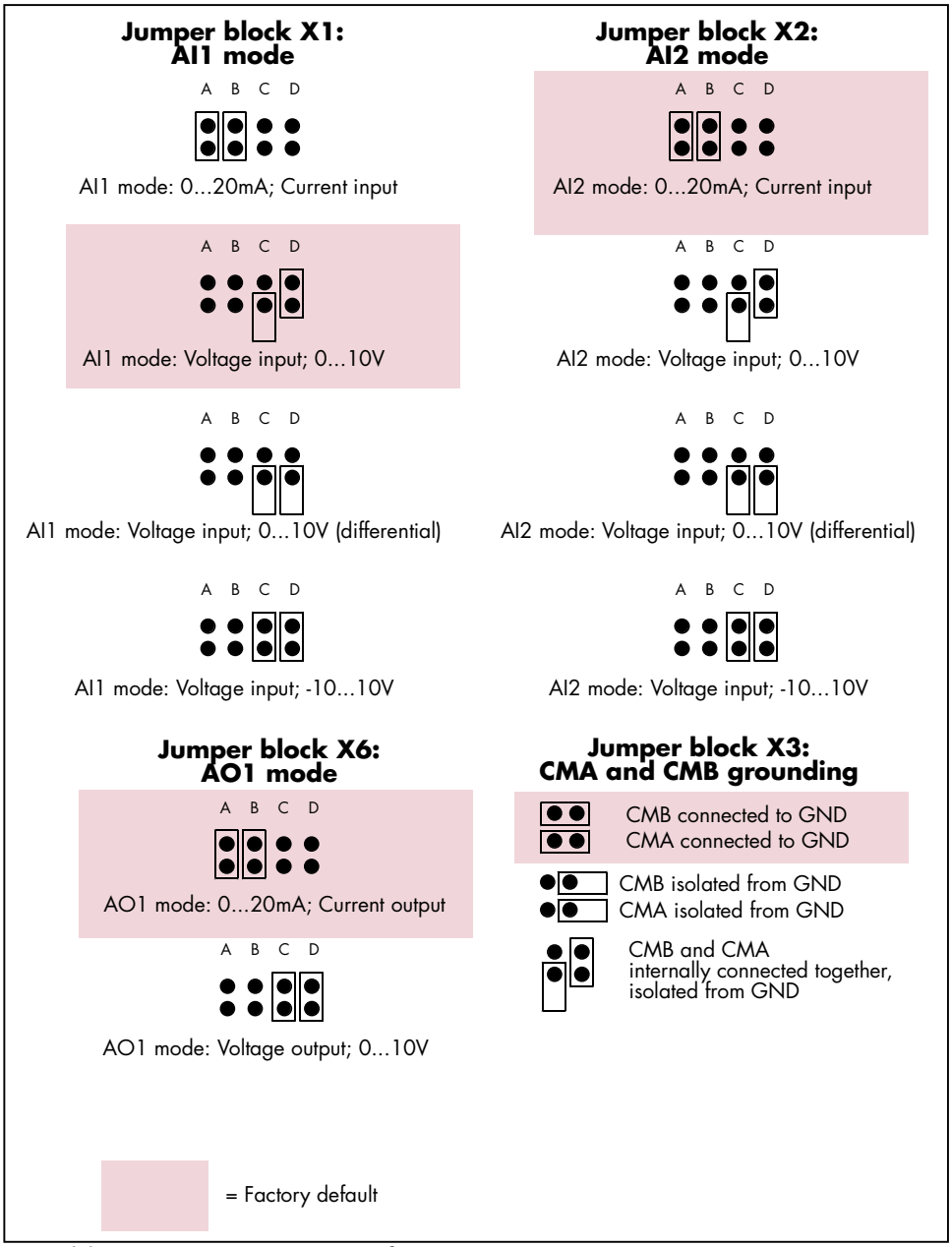


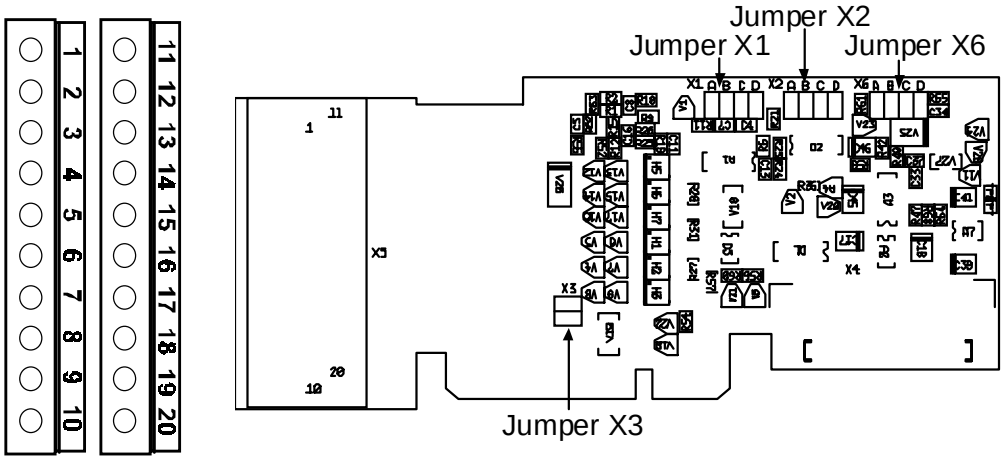
Table 12. Jumper positions for NXOPTA8

NXOPTA8 parameters

Number	Parameter	Min	Max	Default	Note
1	AI1 mode	1	5	3	**1** = 0...20mA **2** = 4...20mA **3** = 0...10V **4** = 2...10V **5** = -10...+10V
2	AI2 mode	1	5	1	**1** = 0...20mA **2** = 4...20mA **3** = 0...10V **4** = 2...10V **5** = -10...+10V
3	AO1 mode	1	4	1	**1** = 0...20mA **2** = 4...20mA **3** = 0...10V **4** = 2...10V

Table 13. NXOPTA8 board-related parameters

3.1.7 NXOPTA9



Description: Vacon NX basic I/O board similar to the NXOPTA1 except that the I/O terminals are bigger (for 2.5mm^2 wires; M3 screws).

Allowed slots: A

Type ID: 16697

Terminals: Two terminal blocks; Screw terminals (M3); Coding in terminals #1 and #12.

Jumpers: 4; X1, X2, X3 and X6 (see page 18)

Board parameters: Yes (see page 19)

NXOPTA9

I/O terminals on NXOPTA9

See page 17.

Jumper selections

See page 18.

NXOPTA9 parameters

See page 19.

3.2 I/O Expander Boards NXOPTB_

- Option boards used for I/O expansion
- This board type can be plugged into slots **B, C, D** or **E**.

The number of control inputs and outputs on your Vacon frequency converter can be increased with the *I/O Expander boards*. This kind of boards can be placed in any board slot inside the frequency converter control unit except for slot A.

There are no board-related parameters for NXOPTB_ I/O expander boards.

The boards you wish to have installed in your frequency converter have to be defined in the type designation code of the frequency converter when ordering it from the factory.

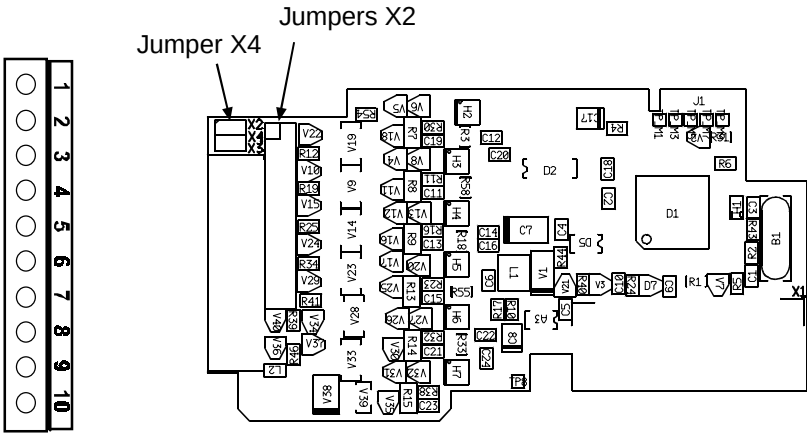
Click on the board name to go to its detailed description.

FC type	I/O board	Allowed slots	DI	AI	TI	AO	DO	RO	Pt-100	42-240 VAC input	Other
NXS NXP	NXOPTB1	B,C,D,E	(6)				(6)				
NXS NXP	NXOPTB2	B,C,D,E			1			2			
NXS NXP	NXOPTB4	B,C,D,E		1 (isolated); (mA)		2 (isolated mA)					+24V/ EXT+24V
NXS NXP	NXOPTB5	B,C,D,E						3			
NXS NXP	NXOPTB9	B,C,D,E						1		5	

Table 14. Vacon NX I/O Expander boards and their equipment

DI = Digital input
AI = Analogue input
TI = Thermistor input
Pt-100 = Sensor input for Pt-100
AO = Analogue output
RO = Relay output

3.2.1 NXOPTB1



Description: Vacon NX I/O expander board with six bidirectional terminals.

Allowed slots: B, C, D, E

Type ID: 16945

Terminals: One terminal block; Screw terminals (M2.6); No coding

Jumpers: 2; X2 and X4 (see page 37)

Board parameters: None

NXOPTB1

I/O terminals on NXOPTB1

Terminal		Parameter reference Keypad/NCDrive	Technical information
1	DIO1	DigIN: **X.1** DigOUT: **X.1**	Digital input: 24V; R_i>5kΩ Digital output: Open collector, 50mA/48V
2	DIO2	DigIN: **X.2** DigOUT: **X.2**	See above.
3	DIO3	DigIN: **X.3** DigOUT: **X.3**	See above.
4	CMA		Common for DIO1…DIO3. **Note:** CMA is internally connected to GND with jumper by default.
5	DIO4	DigIN: **X.4** DigOUT: **X.4**	Digital input: 24V; R_i>5kΩ Digital output: Open collector, 50mA/48V
6	DIO5	DigIN: **X.5** DigOUT: **X.5**	See above.
7	DIO6	DigIN: **X.6** DigOUT: **X.6**	See above.
8	CMB		Common for DIO4…DIO6
9	GND		I/O ground; Ground for reference and controls.
10	+24V		Control voltage output; Voltage for switches etc.; max. current 150mA; Short-circuit protected.

Table 15. NXOPTB1 I/O terminals

Jumper selections

On the NXOPTB1 board, there are two jumper blocks. The jumper block **X2** is used to define the bidirectional terminal as either input or output. The other jumper block, **X4**, is used to connect the common terminals to GND. The factory default and other available jumper selections are presented below.

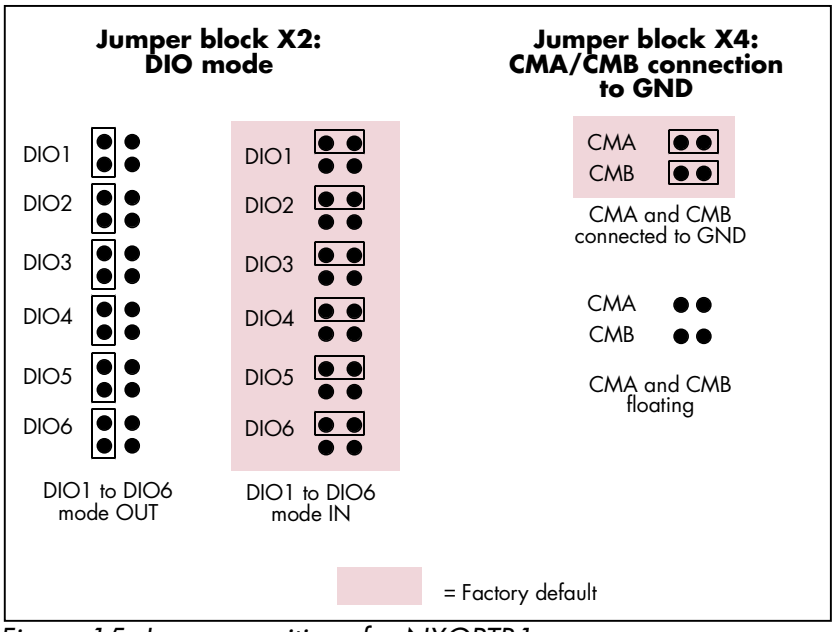
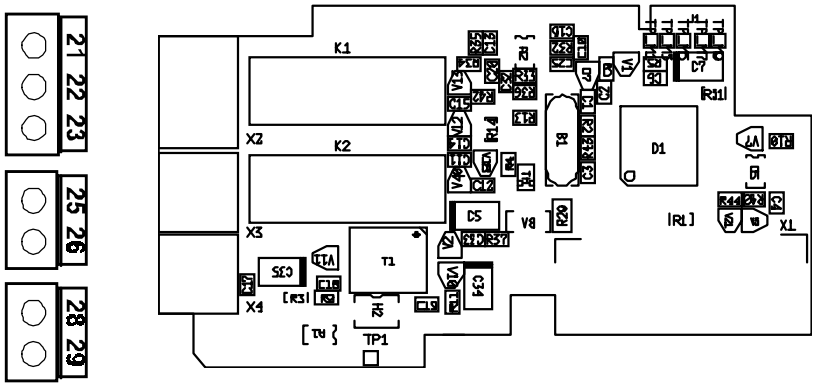


Figure 15. Jumper positions for NXOPTB1

3.2.2 NXOPTB2



Description: Vacon NX I/O expander board with a thermistor input and two relay outputs.

Allowed slots: B, C, D, E

Type ID: 16946

Terminals: Three terminal blocks; Screw terminals (M3); No coding

Jumpers: None

Board parameters: None

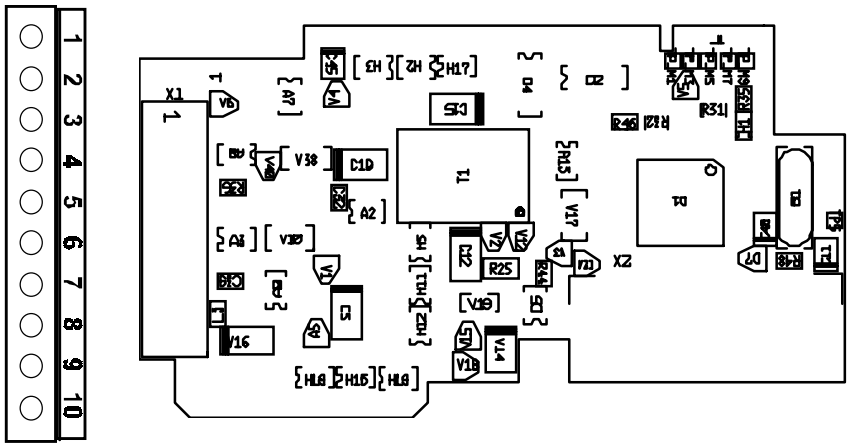
I/O terminals on NXOPTB2

Terminal		Parameter reference Keypad/NCDrive	Technical information	
21 **22** **23**	RO1/normal closed RO1/common RO1/normal open	DigOUT:**X.1**	Switching capacity	24VDC/8A 250VAC/8A 125VDC/0.4A
25 **26**	RO2/common RO2/normal open	DigOUT:**X.2**	Switching capacity	24VDC/8A 250VAC/8A 125VDC/0.4A
28 **29**	TI1+ TI1–	DigIN:**X.1**	Thermistor input (galvanically isolated) R_{trip} = 4.7kΩ	

Table 16. NXOPTB2 I/O terminals

Note: This expander board can be placed into four different slots on the control board. Therefore, the '**X**' given in the Parameter reference shall be replaced by the slot letter (B, C, D, or E) depending on the slot which the expander board is plugged into. See Chapter 1.6.

3.2.3 NXOPTB4



Description: Vacon NX I/O expander board with one galvanically isolated analogue input and two galvanically isolated analogue outputs (standard signals 0(4)…20mA).

Allowed slots: B, C, D, E

Type ID: 16948

Terminals: One terminal block; Screw terminals (M2.6); No coding

Jumpers: None

Board parameters: None

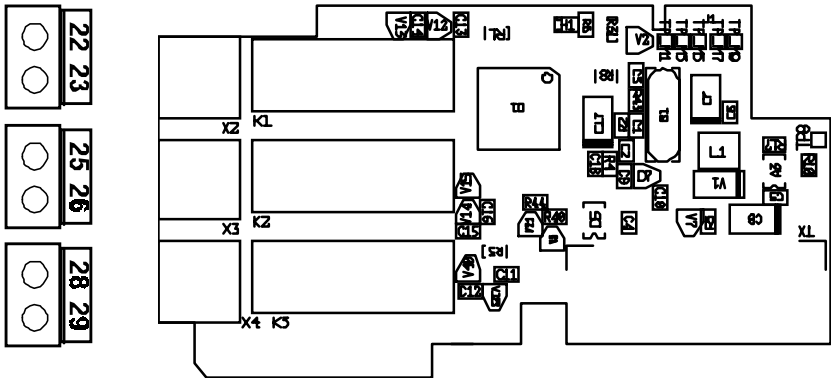
I/O terminals on NXOPTB4

Terminal		Parameter reference Keypad/NCDrive	Technical information
1	AI1+	AnIN:**X.1**	0(4)…20mA; R_i=250Ω, differential; Resolution 10 bits/0.1%; Accuracy ±1% of the full display
2	AI1–		
3	AO1+	AnOUT:**X.1**	0(4)…20mA; R_L<500Ω; Resolution 10 bits/0.1%; Accuracy ≤ ±2% (galvanically isolated)
4	AO1–		
5	AO2+	AnOUT:**X.2**	0(4)…20mA; R_L<500Ω; Resolution 10 bits/0.1%; Accuracy ≤ ±2% (galvanically isolated)
6	AO2–		
7	GND		24V (±15%); Max. load 250mA (total load from EXT+24V outputs), max. 150mA from one board. See Figure 2 on page 6.
8	GND		
9	GND		24V (±15%), in special applications where PLC type functions are included in the control module, this input can be used as external auxiliary power supply for control boards as well as for I/O boards.
10	+24V		

Table 17. NXOPTB4 I/O terminals

Note: This expander board can be placed into four different slots on the control board. Therefore, the '**X**' given in the Parameter reference shall be replaced by the slot letter (B, C, D, or E) depending on the slot which the expander board is plugged into. See Chapter 1.6.

3.2.4 NXOPTB5



Description: I/O expander board with three relay outputs.

Allowed slots: B, C, D, E

Type ID: 16949

Terminals: Three terminal blocks; Screw terminals (M3); No coding

Jumpers: None

Board parameters: None

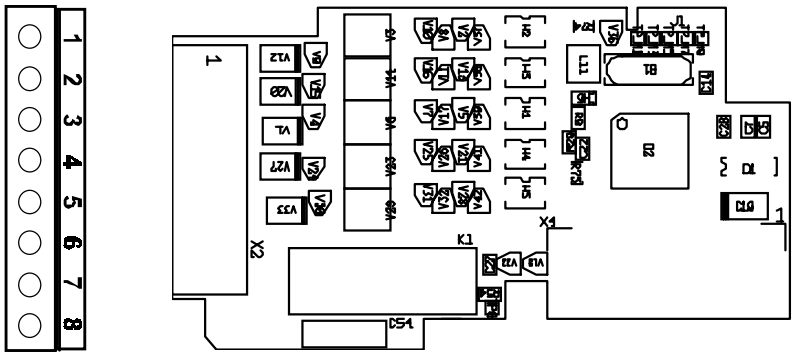
I/O terminals on NXOPTB5

Terminal		Parameter reference Keypad/NCDrive	Technical information	
22 **23**	RO1/common RO1/normal open	DigOUT:**X.1**	Switching capacity	24VDC/8A 250VAC/8A 125VDC/0.4A
25 **26**	RO2/common RO2/normal open	DigOUT:**X.2**	Switching capacity	24VDC/8A 250VAC/8A 125VDC/0.4A
28 **29**	RO3/common RO3/normal open	DigOUT:**X.3**	Switching capacity	24VDC/8A 250VAC/8A 125VDC/0.4A

Table 18. NXOPTB5 I/O terminals

Note: This expander board can be placed into four different slots on the control board. Therefore, the '**X**' given in the Parameter reference shall be replaced by the slot letter (B, C, D, or E) depending on the slot which the expander board is plugged into. See chapter 1.6.

3.2.5 NXOPTB9



Description: I/O expander board with five 42…240 VAC digital inputs and one normal relay output.

Allowed slots: B, C, D, E

Type ID: 16953

Terminals: One terminal block; Screw terminals (M2.6); No coding

Jumpers: None

Board parameters: None

I/O terminals on NXOPTB9

Terminal		Parameter reference Keypad/NCDrive	Technical information
1	ACIN1	DigIN:**X.1**	Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V
2	ACIN2	DigIN:**X.2**	Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V
3	ACIN3	DigIN:**X.3**	Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V
4	ACIN4	DigIN:**X.4**	Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V
5	ACIN5	DigIN:**X.5**	Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V
6	COMA		Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V
7 **8**	RO1/common RO1/normal open	DigOUT:**X.1**	Switching capacity 24VDC/8A 250VAC/8A 125VDC/0.4A

Table 19. NXOPTB9 I/O terminals

Note: This expander board can be placed into four different slots on the control board. Therefore, the '**X**' given in the Parameter reference shall be replaced by the slot letter (B, C, D, or E) depending on the slot which the expander board is plugged into. See chapter 1.6.

3.3 Adapter Boards NXOPTD_

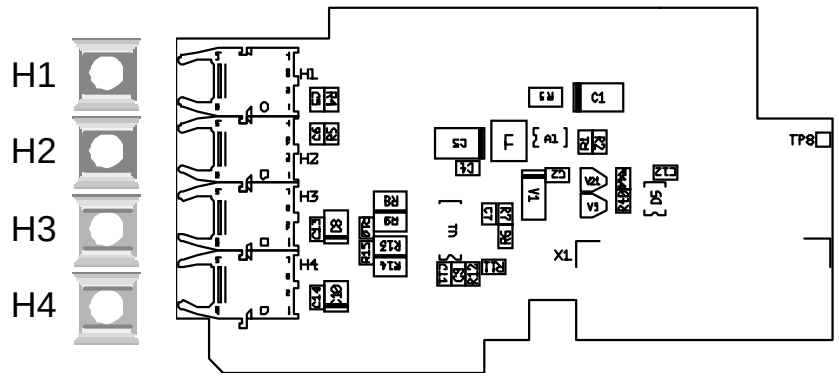
The adapter boards do not provide any additional I/O but are used to connect the frequency converter to a Vacon communication bus (System Bus, SPI, CAN). Note that if you use any of the major *fieldbuses* (Profibus, Modbus etc.) for communication you will need a corresponding *fieldbus board*. For more information, see the specific fieldbus board manual.

Note: Do not plug two adapter boards into the same control board in order to avoid incompatibility problems.

FC type	I/O board	Allowed slots	Description
NXP	NXOPTD1	D,E	System Bus adapter board
NXP	NXOPTD2	D,E	System Bus adapter board with interface to NCSysDriveBus

Table 20. Vacon NX adapter boards

3.3.1 NXOPTD1



Description: System Bus adapter board for Vacon NXP

Allowed slots: D, E

Type ID: 17457

Terminals: Double optical input and output terminals

Jumpers: None

Board parameters: None

I/O terminals on NXOPTD1

Terminal		Technical information
1	H1	System Bus optical input 1 (RX1)
2	H2	System Bus optical input 2 (RX2)
3	H3	System Bus optical output 1 (TX1)
4	H4	System Bus optical output 2 (TX2)

Table 21. NXOPTD1 I/O terminals

Note: The terminals of the board are protected with a rubber pin. Be sure to leave the pin in the unused terminals in order to avoid disturbances.

Connections between frequency converters with NXOPTD1

Basic connection:
Connect the output 1 of Device 1 to the input 2 of Device 2 and the input of Device 1 to the output 2 of Device 2. Note that in the end devices one terminal pair remains unused.

Max. number of devices in line	**Max. speed achieved** [Mbit/s]
3	12
6	6
12	3
24	1.5

Table 22.

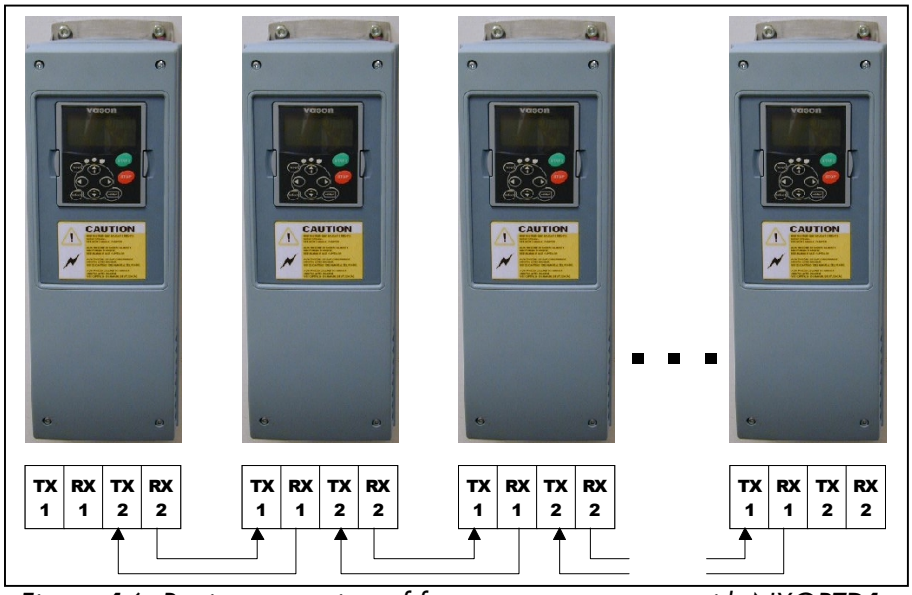
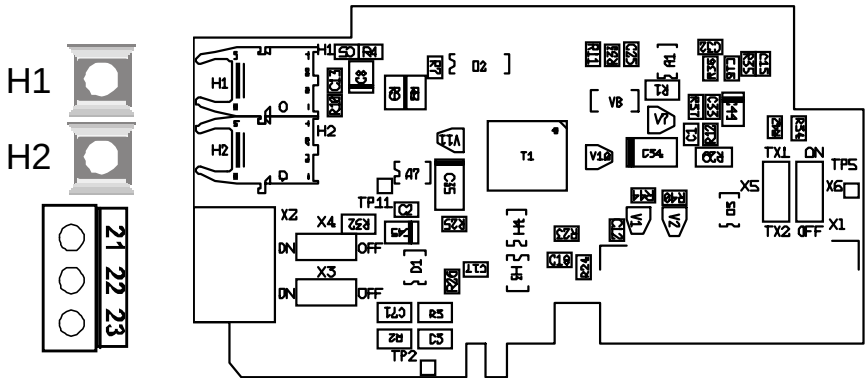


Figure 16. Basic connection of frequency converters with NXOPTD1

3.3.2 NXOPTD2



Description: System Bus adapter board for Vacon NXP with single optical input and output; Interface to fast monitor bus used by the NCSYSDRIVE PC tool.

Allowed slots: D, E

Type ID: 17458

Terminals: Single optical input and output; one screw terminal block (M3)

Jumpers: 4; X3, X4, X5 and X6. See page 46

Board parameters: None

I/O terminals on NXOPTD2

Terminal		Technical information
1	H1	System Bus optical input 1 (RX1)
2	H2	System Bus optical output 1/2 (TX1/TX2); Selected with jumper X5
21	CAN_L	Monitor Bus negative data
22	CAN_H	Monitor Bus positive data
23	CAN_GND	Monitor Bus ground

Table 23. NXOPTD2 I/O terminals

Jumper selections

There are four jumper blocks on the NXOPTD2 board. The factory defaults and other available jumper selections are presented below.

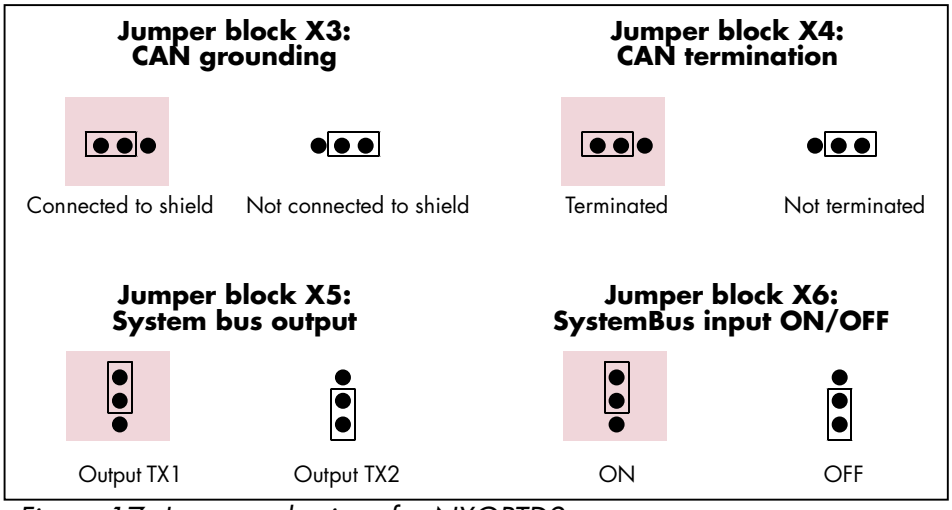


Figure 17. Jumper selections for NXOPTD2

Connections between frequency converters with NXOPTD2

Special connection: (See next page)

In this connection example, the leftmost device is the Master and the others are slaves. The Master can send and receive data from the slaves. The slaves cannot communicate with each other. Changing of masters is not possible, the first device is always the Master.

The NXOPTD2 board in the Master has the default jumper selections, i.e. X6:1-2, X5:1-2. The jumper positions have to be changed for the slaves: X6: 1-2, **X5:2-3**.

Max. number of devices in line	**Max. speed achieved** [Mbit/s]
3	12
6	6
12	3
24	1.5

Table 24.

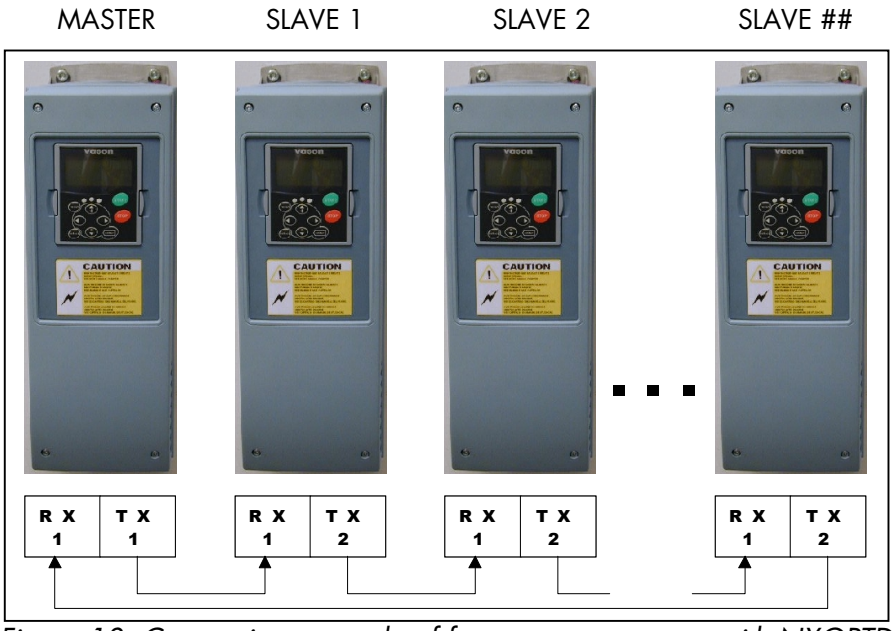


Figure 18. Connection example of frequency converters with NXOPTD2

4. Vacon Option Boards – operational details

Board type	Slots allowed	ID	DI	DO	AI (mA/V)	AI (mA), isol.	AO (mA/V)	AO (mA), isol.	RO (no/nc)	RO (no)	+10V ref	TI	+24V/ EXT +24V	42-240 VAC	DI (Enc. 10-24V)	DI (Enc. RS-422)	Out +5/ +15V/ +24V	Out +15/+24V
Basic boards NXOPTA_																		
NXOPTA1	A	16689	6	1	2		1				1		2					
NXOPTA2	B	16690							2									
NXOPTA3	B	16691							1	1		1						
NXOPTA4[4]	C	16692														3	1	
NXOPTA5[4]	C	16693													3			1
NXOPTA8	A	16696	6	1	2[1]		1[1]				1[1]		2					
NXOPTA9[3]	A	16697	6	1	2		1				1		2					
I/O expander boards NXOPTB_																		
NXOPTB1	BCDE	16945	6[5]	6[5]														
NXOPTB2	BCDE	16946							1	1		1						
NXOPTB4	BCDE	16948				1[2]		2[2]					1					
NXOPTB5	BCDE	16949								3								
NXOPTB9	BCDE	16953								1			1		2			1
Adapter boards NXOPTD_																		
NXOPTD1	DE	17457	System Bus adapter board: 2 x fiber optic pairs															
NXOPTD2	DE	17458	System Bus adapter board: 1 x fiber optic pair & CAN bus adapter (galvanically decoupled)															

Table 25. Vacon option boards

Explanations:

1) Analogue inputs AI1 and AI2, analogue output AO1 and voltage reference +10Vref galvanically decoupled (all these in same potential)
2) Analogue input AI1 and analogue outputs AO1 and AO2 galvanically decoupled from each other and other electronics
3) Similar to NXOPTA1 only with bigger terminals for 2.5mm^2 wires
4) Special application required for use in NXS
5) Bidirectional terminals

Board type **Basic boards NXOPTA_**	**Basic** NXFIFF01	**Standard** NXFIFF02	**Local-Remote** NXFIFF03	**Multi-step speed** NXFIFF04	**PID** NXFIFF05	**Multi-purpose** NXFIFF06	**PFC** NXFIFF07
NXOPTA1	●	●	●	●	●	●[6)]	●[6)]
NXOPTA2	●	●	●	●	●	●[6)]	●[6)]
NXOPTA3		●	●	●	●	●[6)]	●[6)]
NXOPTA4 (NXP only)	■	■	■	■	■	■	■
NXOPTA5 (NXP only)	■	■	■	■	■	■	■
NXOPTA8	●	●	●	●	●	●[6)]	●[6)]
NXOPTA9[3)]	●	●	●	●	●	●[6)]	●[6)]
I/O expander boards NXOPTB_							
NXOPTB1						●[6)]	●[6)]
NXOPTB2						●[6)]	●[6)]
NXOPTB4						●[6)]	●[6)]
NXOPTB5						●[6)]	●[6)]
NXOPTB9						●[6)]	●[6)]
Adapter boards NXOPTD_							
NXOPTD1 (NXP only)							
NXOPTD2[7)] (NXP only)	■	■	■	■	■	■	■

Table 26. All in One applications and supported Vacon NX option boards

● = Used with this application (NXS)
■ = Used with this application (NXP)
6) = Digital inputs, digital outputs, analogue inputs and analogue outputs can be programmed
7) = This board is supported by specified applications if program NC_{Sys}Drive is used

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