Honeywell

User's Manual

NX series

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

INDEX

1. General information

NX range embodies a wide selection of *expander* and *adapter boards* with which the available I/O of NX frequency converter can be increased and its versatility improved.

The input and output configuration (I/O) of 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 NX User's Manual, Chapter 6.2). The I/O boards are usually interchangeable between different 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 frequency converter types may be restricted.

1.1 Board slots on the control board
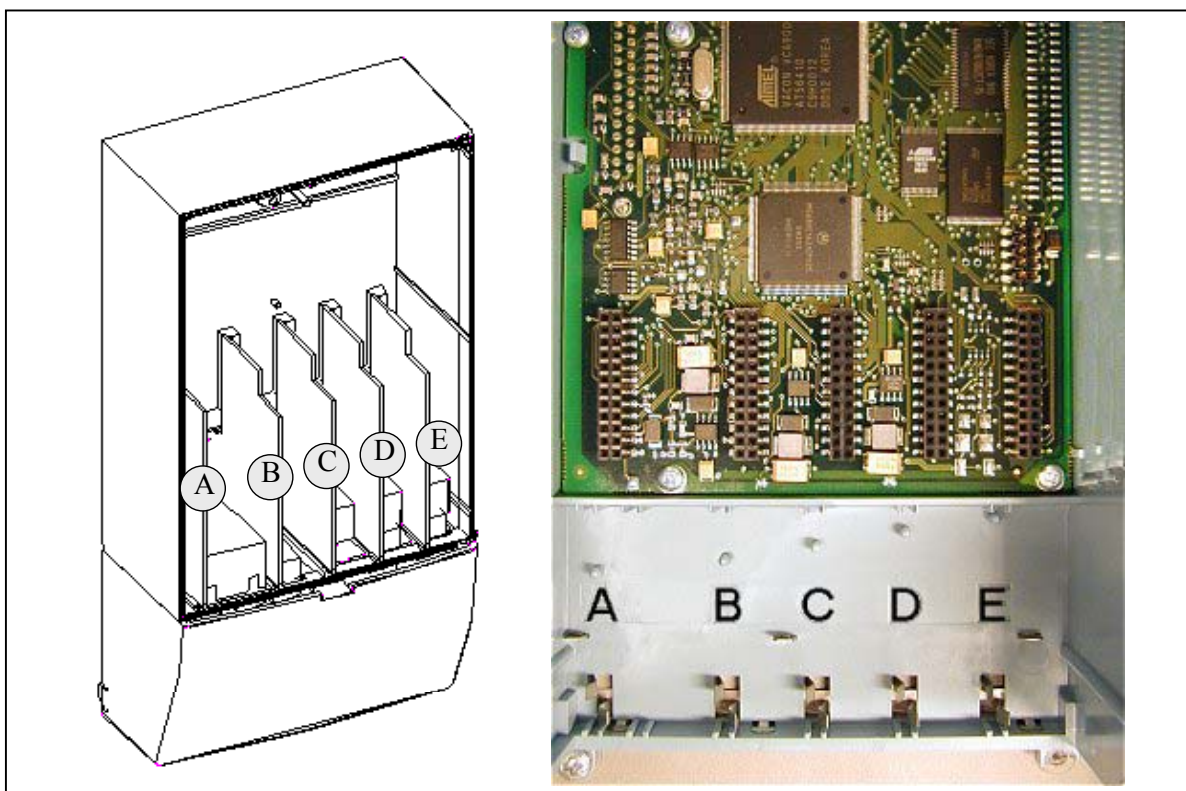
Figure 1. Board slots on control board

The control board is situated inside the *control unit* of the 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 17 to 58.

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 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 16 to 37 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 64.

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

See pages 42 to 50 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 64.

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 the 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 however page 58).

See pages 55 to 58 for a detailed presentation of the boards of this type. See also the principle diagram on the options boards and their equipment on page 64.

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	$0…±10V$, $R_i \geq 200$ kΩ, single-ended; Resolution 10 bits/0.1%, accuracy ±1% of the full display ($-10…+10V$ joystick control)
Analogue inputs (AI), current	$0(4)…20mA$, $R_i = 250\Omega$, differential Resolution 10 bits/0.1%, accuracy ±1% of the full display
Digital inputs (DI), DC voltage controlled	24V: "0"$\leq$10V, "1"$\geq$18V, $R_i > 5$kΩ
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)	$0(4)…20mA$, $R_L<500\Omega$, resolution 10 bits/0.1%, accuracy $\leq$ ±2%
Analogue output (AO), voltage (V)	$0(2)…10V$, RL $\geq$ 1kΩ, resolution 10 bits, accuracy $\leq$ ±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_{trip} = 4.7kΩ (PTC type)
Encoder control voltage (+5V/+15V/+24V)	See NXOPTA4, NXOPTA5, NXOPTA7, NXOPTAE and NXOPTBB technical data
Encoder connections (inputs, outputs)	See NXOPTA4, NXOPTA5, NXOPTA7, NXOPTAE and NXOPTBB technical data

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 6.

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, another jumper block must be set to define the voltage range. 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.
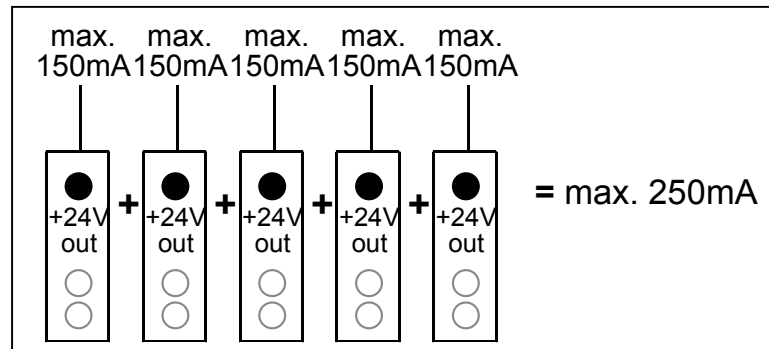

Figure 2. Maximum loads on +24V/EXT+24V output

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 the internal +24V from the frequency converter is used, the following arrangements are possible:
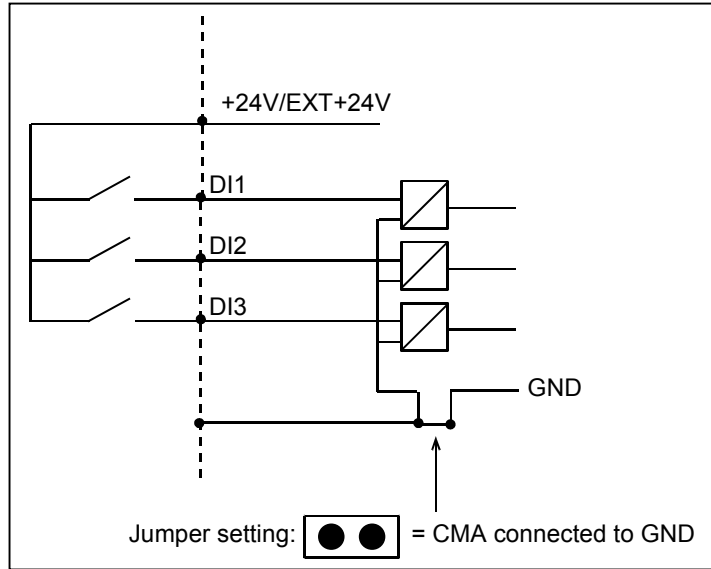
Figure 3. If CMA is connected to GND with inboard jumper the internal +24V is used and the CMA terminal need not be wired

If an external +24V is used the following arrangements are possible:
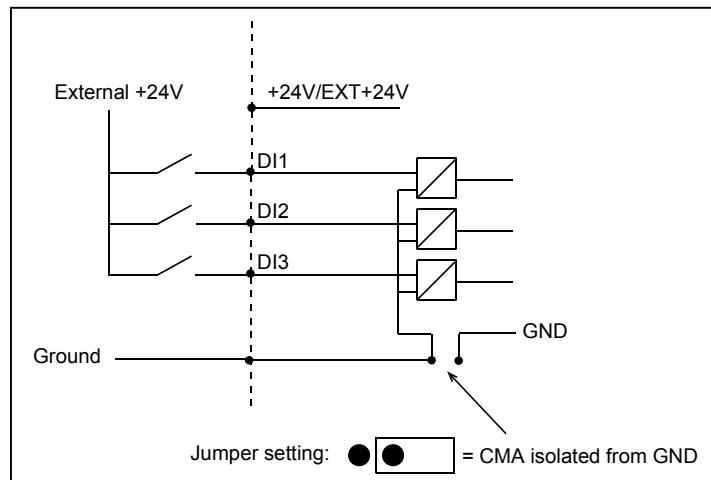
Figure 4. Positive logic with external +24V when CMA is isolated from GND using onboard jumper. The input is active when the switch is closed.
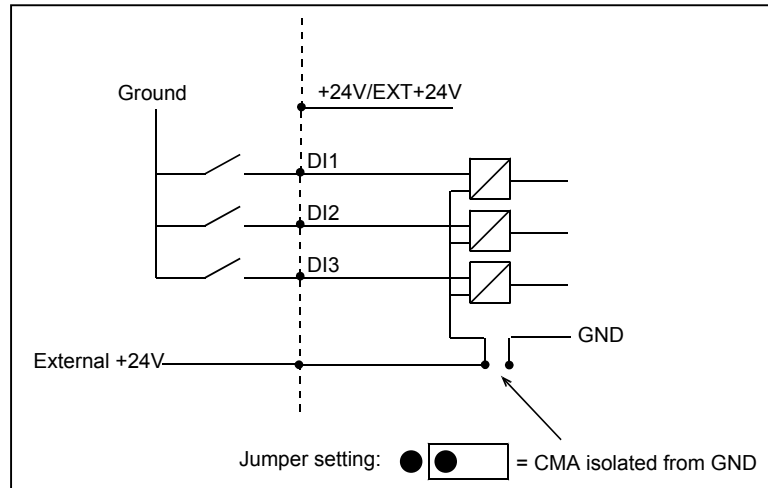
Figure 5. Negative logic with external +24V when CMA is isolated with onboard jumper. The input is active when the switch is closed (0V is the active signal).

The positive and negative logic arrangements can also be made 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

An option board cannot be mounted into any slot. Table 36 and Table 37 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.
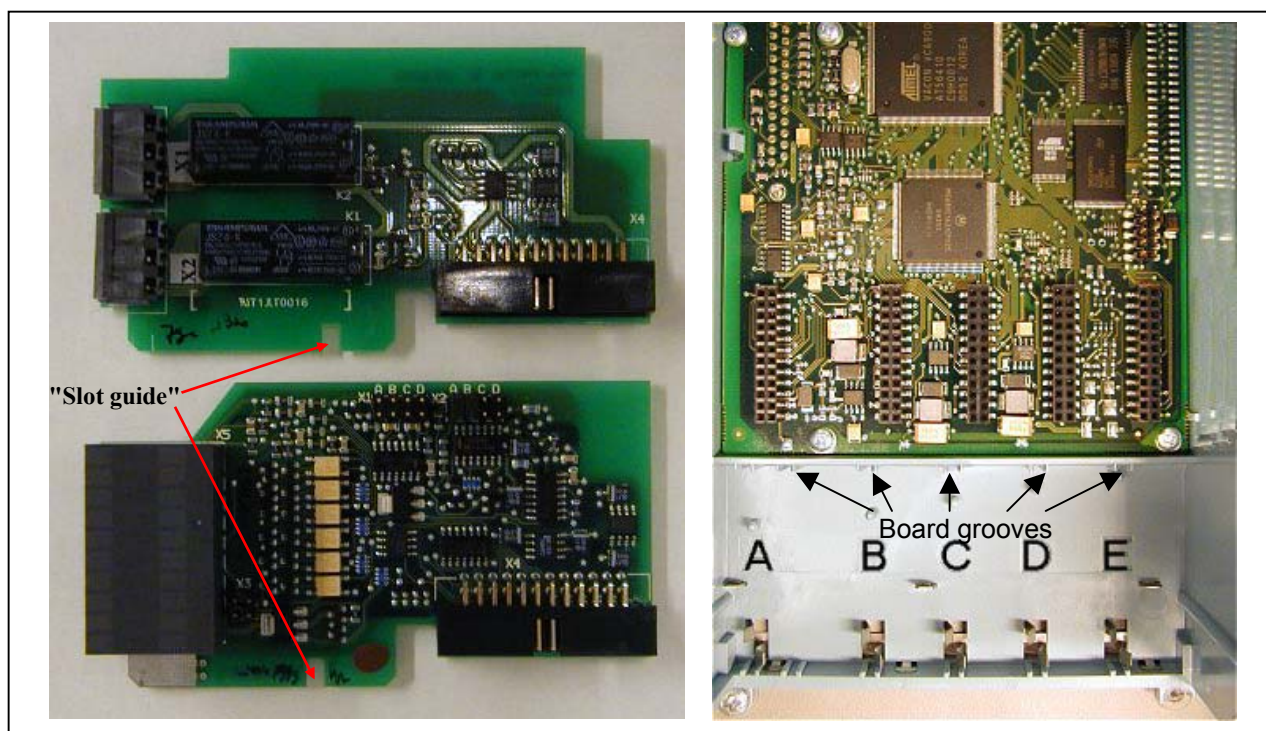

Figure 6. Board guide to prevent incorrect mountings

1.5 Type identification number

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

Each 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 used application. The 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   method to connect functions and the I/O. In the *Function to Terminal Programming Method (FTT)*, there is a fixed input or output for which a certain function is defined. 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 NX control board (see page 3) and the *respective input/output number*. See below.

Function name

AI Ref Faul/Warn
DigOUT:B.1

Slot
Terminal number
Terminal type
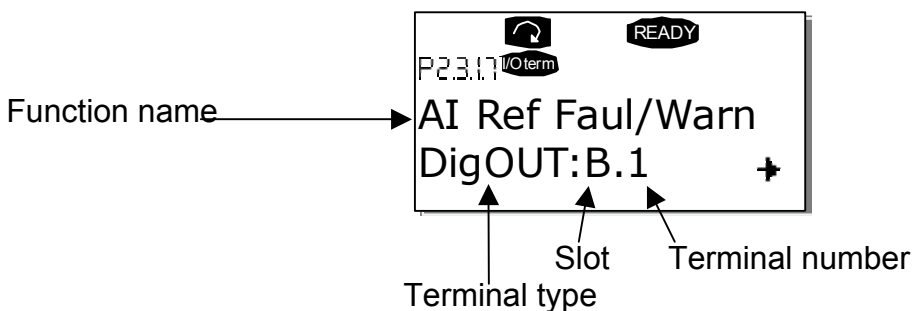
Example: *The Pump and Fan Control Application is used. The user wants to connect the digital output function* Reference fault/warning *(parameter 2.3.1.7) to the digital output DO1 on the basic board NXOPTA1.*

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*, the terminal type is shown 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 the desired code is set, press the *Enter button* once to confirm the change.

AI Ref Faul/Warn
DigOUT:0.0　　　▶　　　AI Ref Faul/Warn
DigOUT:0.0　　　▲　　　AI Ref Faul/Warn
DigOUT:A.1　　　enter
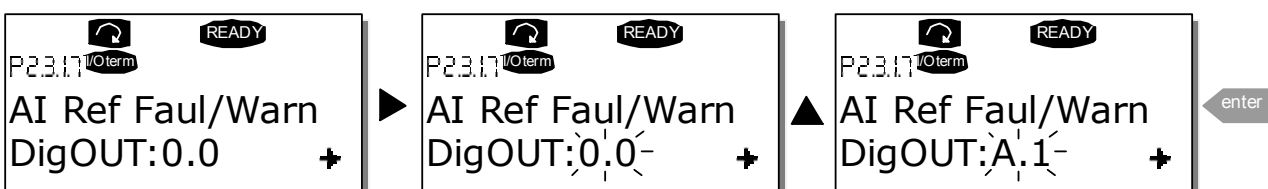
1.7 Defining a terminal for a certain function with NCDrive programming tool

If the NCDrive Programming Tool is used for parametrizing the connection between the function and input/output has to be established 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).
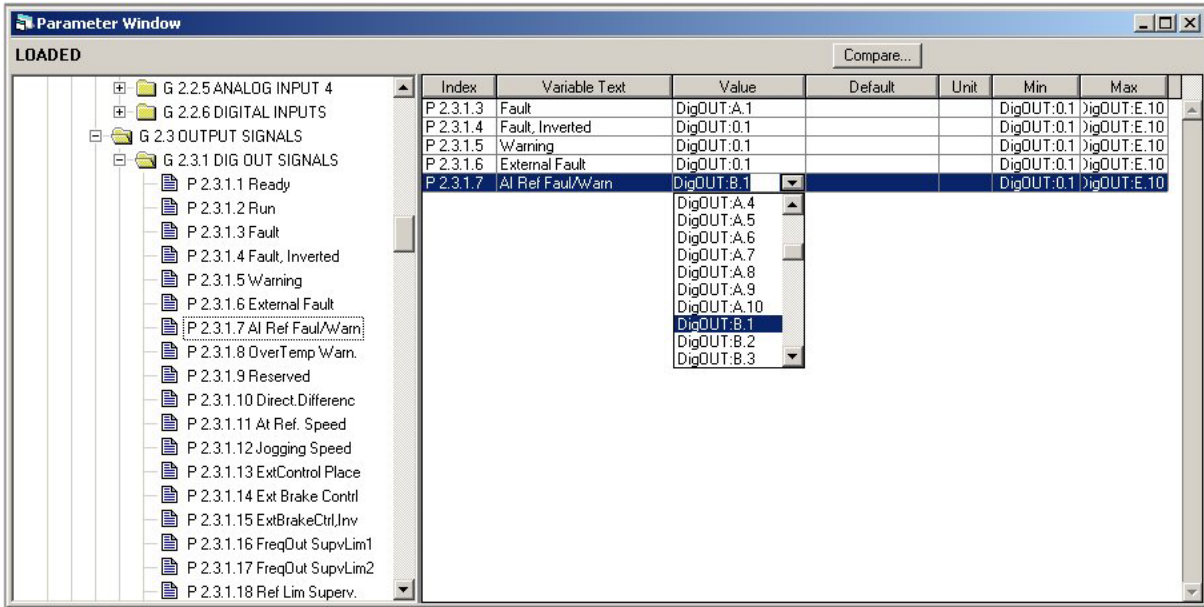
Figure 7. Screenshot of NCDrive programming tool; Entering the address code

⚠ **WARNING**	**Be ABSOLUTELY sure not to connect two functions to one and same <u>output</u> 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

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, the user 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, the number of parameters associated with the board is also shown. Edit the parameter value as shown below. For more information on the keypad operation, see NX User's Manual, Chapter 7. See Figure 8.
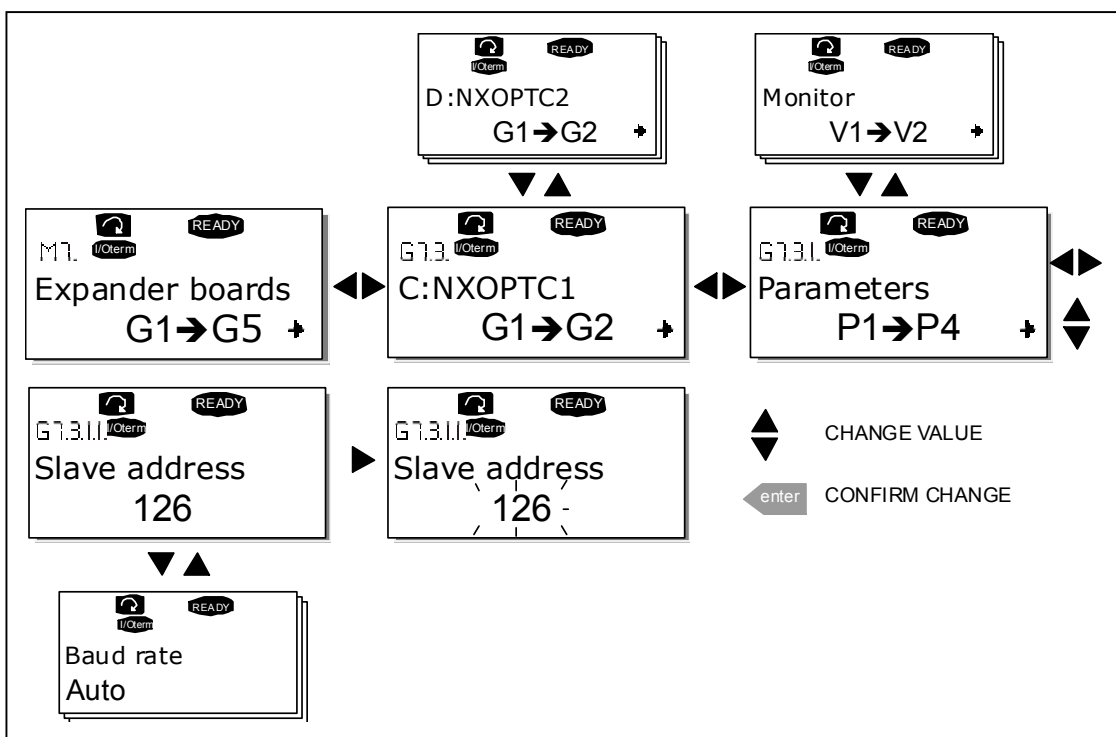
Figure 8. Board parameter value editing

Note: Fieldbus boards (NXOPTC_) also have fieldbus-related parameters. These boards are, however, described in the separate fieldbus board manuals.

2. Installation of Option Boards

⚠ **NOTE**	It is **not allowed** to add or replace option boards or fieldbus boards on a frequency converter with the power switched on. This may damage the boards.
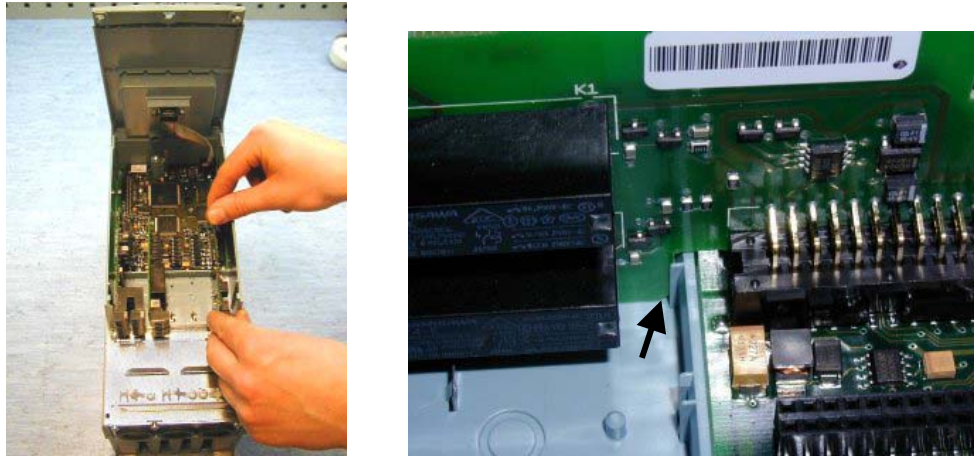
A	NX frequency converter	
B	Remove the cable cover.	
C	Open the cover of the control unit.	

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

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, check the allowed slots for the option board.

Note: Check that the jumper settings on the board correspond to your 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)	0.2	1.8

Table 1. Tightening torques of terminals

Cable type	Level H	Level L
Control cable	4	4

Table 2. Cable types required to meet standards.

Level H = EN 61800-3+A11, 1st environment, restricted distribution
EN 61000-6-4

Level L = EN61800-3, 2nd environment

4 = Screened cable equipped with compact low-impedance shield (NNCABLES /Jamak, SAB/ÖZCuY-O 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 it can be fixed to the frame with the grounding clamp.
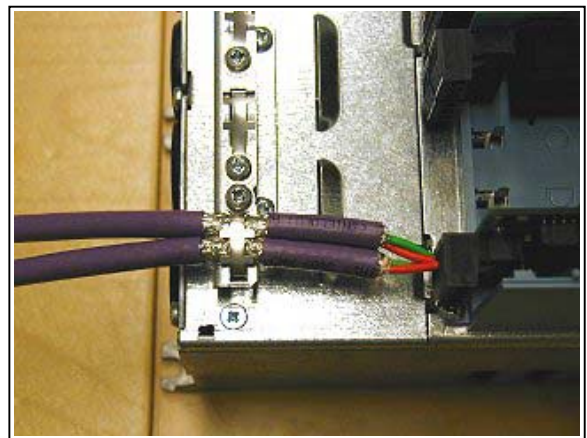
Figure 9. Grounding of control cable

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 frequency converter 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 the drive.

3.   Descriptions of NX 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 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 the operator wishes to have installed in the 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	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/+24V (progr.)
NXP	NXOPTA7	C	6 (enc.)	2 (enc)					+15V/+24V (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
NXS[1] NXP	NXOPTAE	C	3 DI encoder (wide range)	2 (Enc.)					+15V/+24V (progr.)

Table 3. NX Basic boards and their equipment

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

DI = Digital input   **DO** = Digital output
AI = Analogue input   **AO** = Analogue output
TI = Thermistor input   **RO** = Relay output
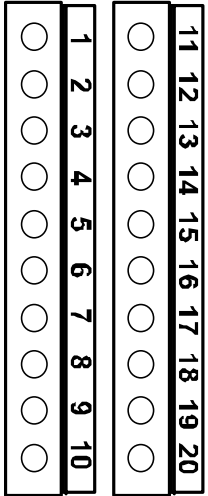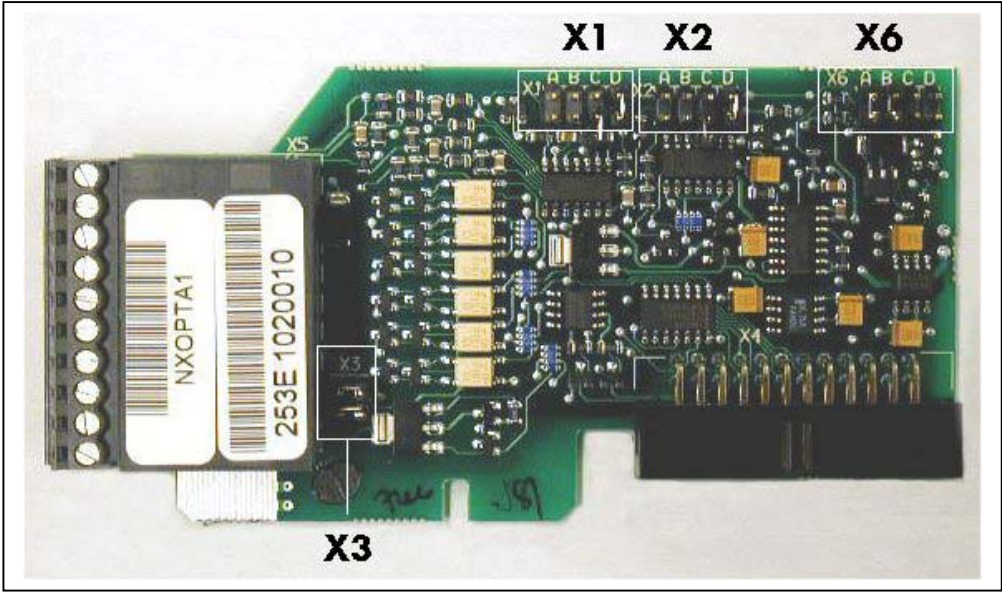
3.1.1 NXOPTA1

Figure 10. 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 11)
Board parameters:	Yes (see page 20)

NXOPTA1

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 19): 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 19): 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 A for DIN1, DIN2 and DIN3. Connection by default to GND. Selection with jumper block X3 (see page 19):
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 B for DIN4, DIN5 and DIN6. Connection by default to GND. Selection with jumper block X3 (see page 19):
18	AO1+	AnOUT:**A.1**	Analogue output
19	AO1–		Output signal range: Current 0(4)–20mA, R_L max 500Ω or Voltage 0—10V, R_L >1kΩ Selection with jumper block X6 (see page 19): Resolution: 0.1% (10 bits); Accuracy ±2%
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.
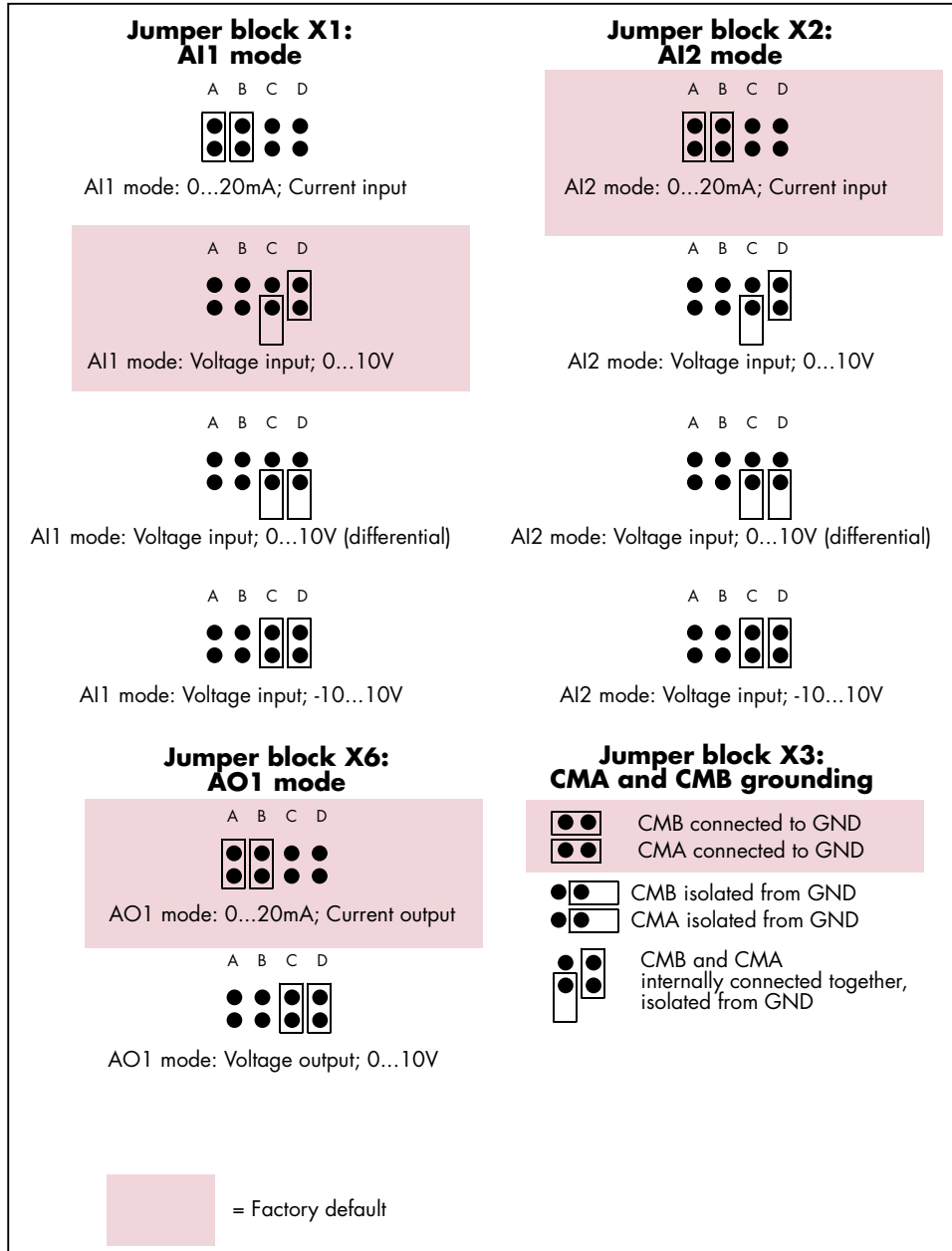
Figure 11. Jumper block selection on NXOPTA1

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
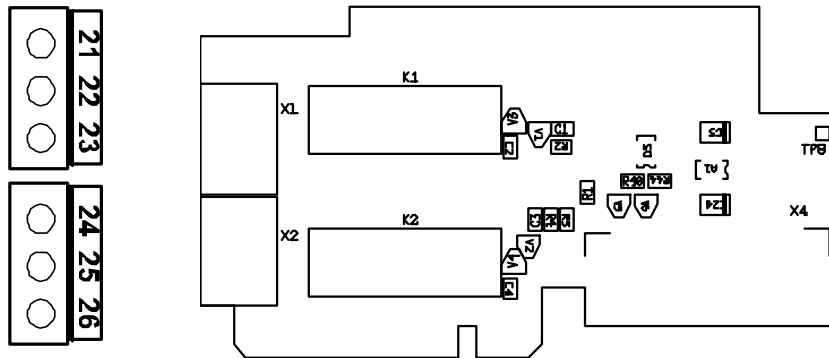
3.1.2 NXOPTA2

Description:	Standard 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 **22** **23**	RO1/normal closed RO1/common RO1/normal open	DigOUT:**B.1**	Relay output 1 (NO/NC) Switching capacity Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA
24 **25** **26**	RO2/normal closed RO2/common RO2/normal open	DigOUT:**B.2**	Relay output 2 (NO/NC) Switching capacity Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA

Table 6. NXOPTA2 I/O terminals

3.1.3 NXOPTA3
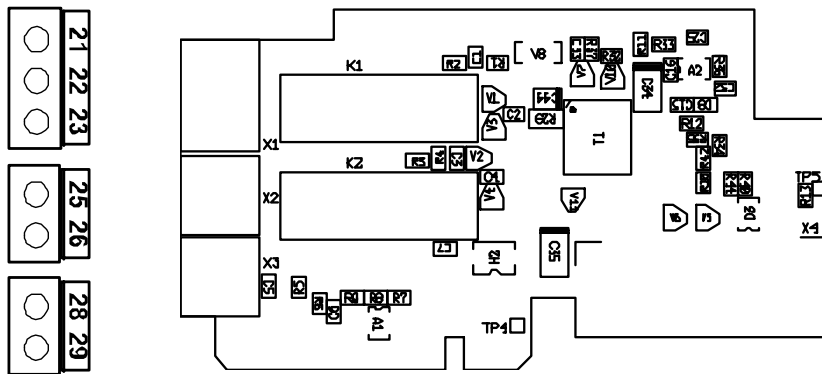
Description:	Relay board with two relay outputs and one thermistor input for NX frequency converter
Allowed slots:	B
Type ID:	16691
Terminals:	Three terminal blocks; Screw terminals (M3); No coding.
Jumpers:	None
Board parameters:	None

I/O terminals on NXOPTA3

<table>
<tr><th colspan="2">Terminal</th><th>Parameter reference
on keypad and NCDrive</th><th colspan="2">Technical information</th></tr>
<tr>
<td>21
22
23</td>
<td>RO1/normal closed
RO1/common
RO1/normal open</td>
<td>DigOUT:B.1</td>
<td>Relay output 1 (NO/NC)
Switching capacity

Min.switching load</td>
<td>24VDC/8A
250VAC/8A
125VDC/0.4A
5V/10mA</td>
</tr>
<tr>
<td>25
26</td>
<td>RO2/common
RO2/normal open</td>
<td>DigOUT:B.2</td>
<td>Relay output 2 (NO)
Switching capacity

Min.switching load</td>
<td>24VDC/8A
250VAC/8A
125VDC/0.4A
5V/10mA</td>
</tr>
<tr>
<td>28
29</td>
<td>TI1+
TI1−</td>
<td>DigIN:B.1</td>
<td colspan="2">Thermistor input; R_{trip} = 4.7 kΩ (PTC)</td>
</tr>
</table>

Table 7. NXOPTA3 I/O terminals

3.1.4 NXOPTA4

Jumper X4
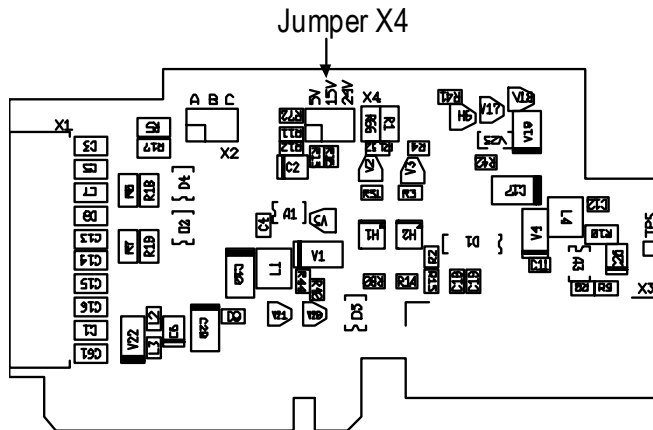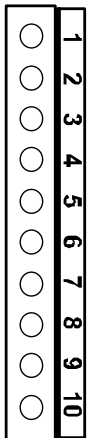
NXOPTA4

Description:	Encoder board for **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:	2; X4 and X5 (see page 24)
Board parameters:	Yes (see page 25)

NXOPTA4

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 $\leq$150kHz 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 $\leq$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 are two jumper blocks. The jumper X2 is used to define the status of the termination resistor (R=135Ω). The jumper X4 is used to program the control voltage (auxiliary voltage). The factory default and other available jumper selections are presented below.

Jumper block X2: Termination resistor

A B C — Termination resistor used
A B C — Termination resistor not used

Jumper block X4: Auxiliary voltage level

5V 15V 24V — Auxiliary voltage +5V
5V 15V 24V — Auxiliary voltage +15V
5V 15V 24V — Auxiliary voltage +24V
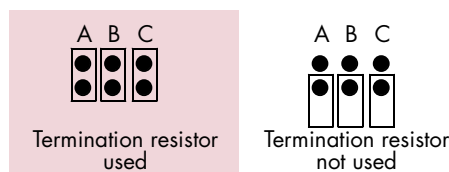
= Factory default

Encoder connection – Differential

5V/15V/24V from the NXOPTA4-
board or from external supply*

**NXOPTA4-
board**

+5V**
GND

Encoder

10   +5/+15V/+24V
9   GND

1   DIC1A+
2   DIC1A-

3   DIC2B+
4   DIC2B-
5   DIC3Z+
6   DIC3Z-
7   ENC1Q
8   DIC1

*If external supply is used remember
to connect the ground of external
supply to terminal #9 of the NXOPTA4
and to the encoder ground
**+5V/+15V/+24V
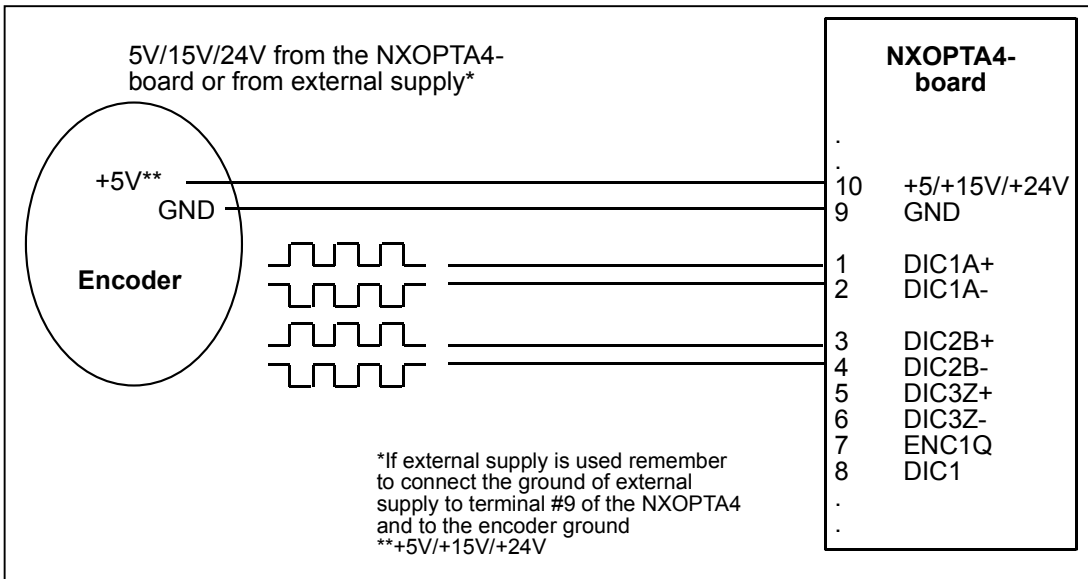
NXOPTA4

Figure 12. RS-422 type encoder connection using differential inputs

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

OUTPUT SIGNALS

Clockwise, seen from shaft

360º el.
1 period   90º el. (channel separation)

A

B
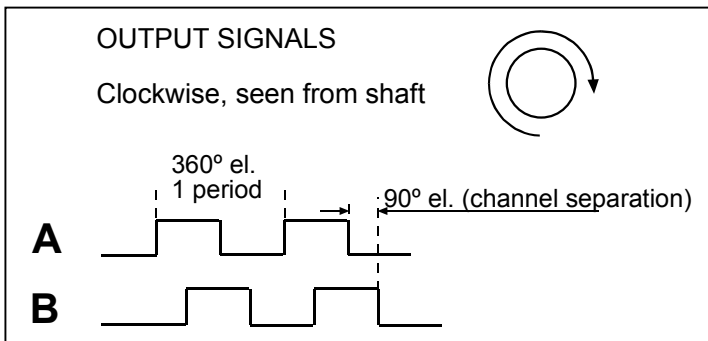
NXOPTA4 parameters

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	Time used to calculate speed actual value. **Note:** Use value **1** in Closed Loop mode. **0** = No **1** = 1 ms **2** = 5 ms **3** = 10 ms **4** = 50 ms

Table 9. NXOPTA4 board-related parameters

3.1.5 NXOPTA5
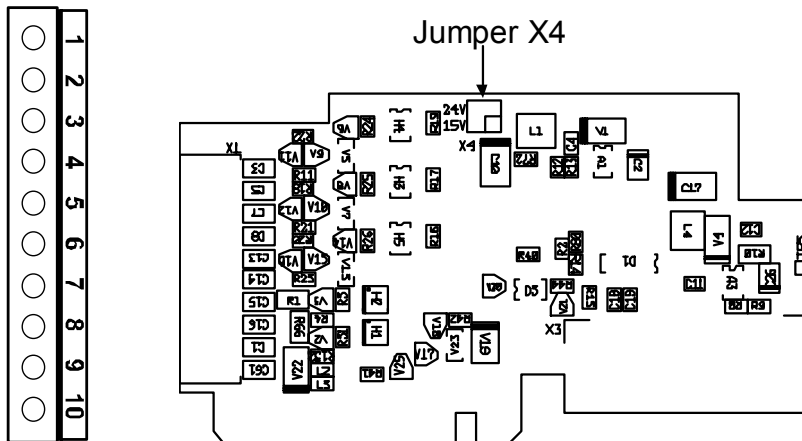
Jumper X4

NXOPTA5

Description:	Encoder board for **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:

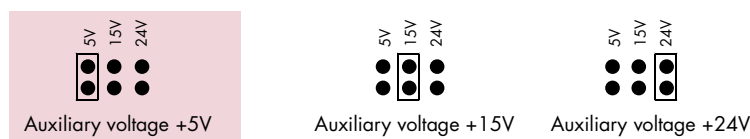|	
Encoder control voltage, +15V/+24V	Control voltage selectable with jumper X4.
Encoder input connections, inputs A+, A–, B+, B–, Z+, Z–	Max. input frequency $\leq$150kHz Inputs A, B and Z are differential
Qualifier input ENC1Q Fast digital input DIC1	Max. input frequency $\leq$10kHz Min. pulse length 50µs Digital input 24V; R_i>5kΩ Digital input is single-ended; connected to GND

Note: A high pulse frequency combined with a great cable capacitance places a considerable load on the encoder. Apply therefore as low a voltage as possible for the encoder supply, rather lower than 24V. The manufacturer also recommends to place jumper X4 to position +15V, if allowed in the voltage range specification of the encoder.

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

24V ●●   24V ● ●
15V ● ●   15V ●●

Auxiliary voltage +24V   Auxiliary voltage +15V

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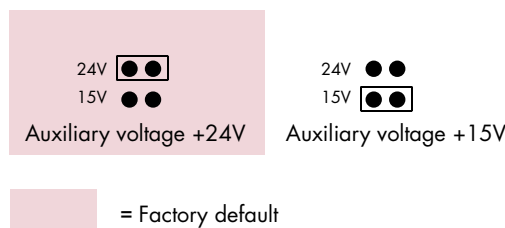
Usage: Closed Loop Vector Control. The NXOPTA5 board is mainly used in conventional industrial applications where encoder cable lengths are relatively long.

Encoder connection – Single-ended
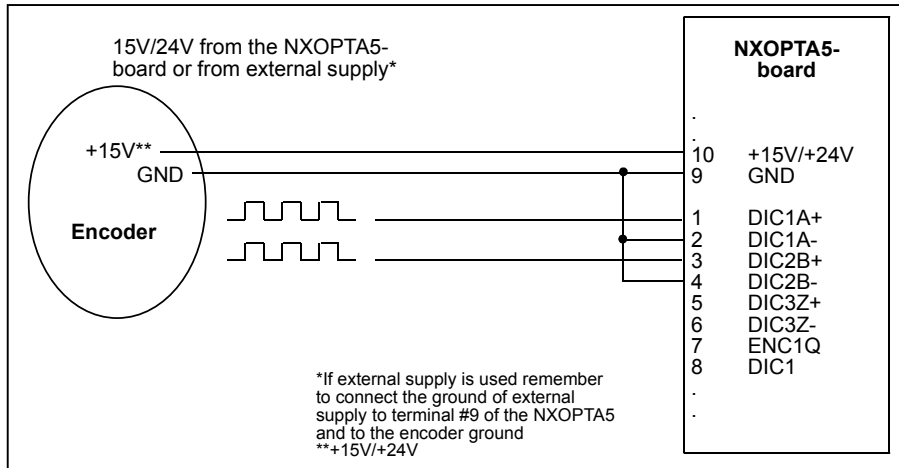
Figure 13. HTL type encoder connection (open source) using single-ended inputs
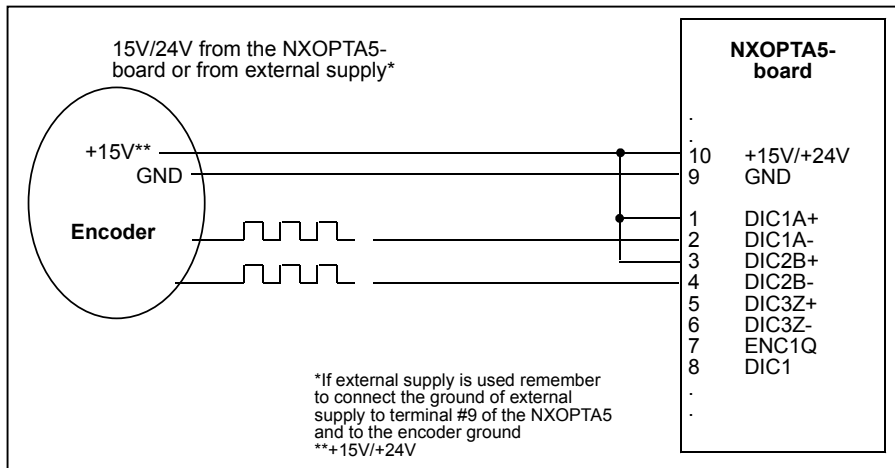
Figure 14. HTL type encoder connection (open collector) using single-ended inputs

Encoder connection – Differential
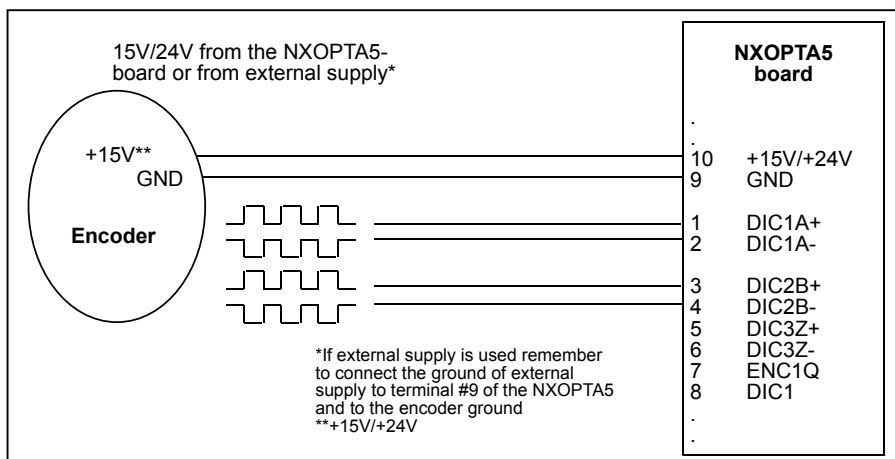
Figure 15. HTL type encoder connection using differential inputs

NXOPTA5 parameters
See page 25.

3.1.6 NXOPTA7

Jumper X4

Jumper X5

Jumpers X15 and X16
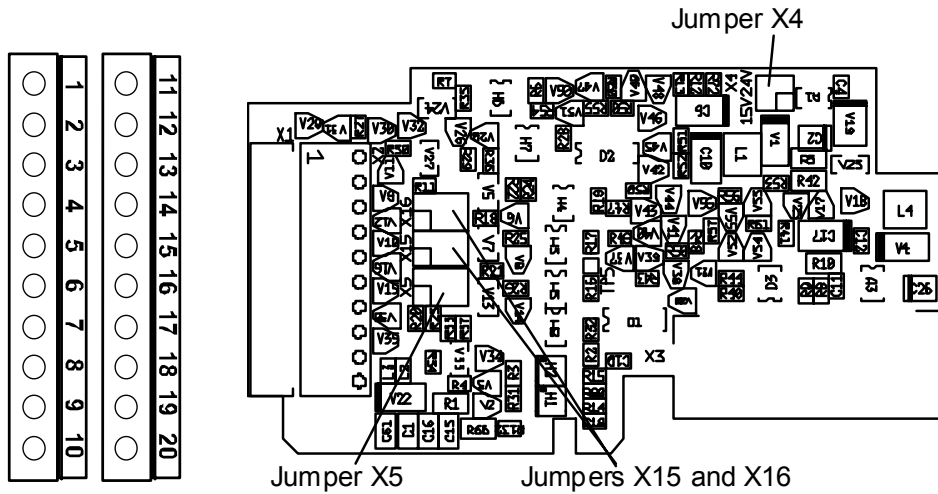
Description:	Duplicate encoder board for **NXP**. Encoder input board with programmable control voltage for the encoder.
	The NXOPTA7 board is designed for HTL (High voltage Transistor Logic) type encoders (voltage output type push-pull HTL, open collector output type HTL) which provide input signal levels dependent on the supply voltage of the encoder. The encoder inputs A, B and Z are galvanically isolated. The NXOPTA7 board includes, too, the qualifier inputs ENC1Q and ENC2Q meant to trace positions in positioning applications.
	The board can be used as both *Master* and *Slave* device. The encoder input signal is repeated on the board and carried to the next device through the digital output.
Allowed slots:	C
Type ID:	16695
Terminals:	Two terminal blocks; Screw terminals (M2.6); Coding in terminals #3 and #14.
Jumpers:	4; X4, X5, X15 and X16 (see page 27)
Board parameters:	None

I/O terminals on NXOPTA7

	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		Qualifier input. Single-ended input with GND
8	ENC2Q		Qualifier input. Single-ended input with GND
9	GND		Ground for control and inputs ENC1Q and ENC2Q
10	+15V/+24V		Control voltage (auxiliary voltage) output to encoder; Output voltage selectable with jumper X4.
11	DID1A+		Pulse input A (differential input), voltage range 10…24V
12	DID1A–		
13	DID2B+		Pulse input B; 90 degrees phase shift compared to the pulse input A (differential input), voltage range 10…24V
14	DID2B–		
15	DID3Z+		Pulse input Z; one pulse per revolution (differential input), voltage range 10…24V
16	DID3Z–		
17	DOD1A+		Pulse output A (differential), output voltage +24V. Pulse input DIC1A or DID1A is internally repeated in the card and connected to the DOD1A output.
18	DOD1A–		
19	DOD2B+		Pulse output B (differential), output voltage +24V. Pulse input DIC2A or DID2A is internally repeated in the card and connected to the DOD2A output.
20	DOD2B–		

Table 11. NXOPTA7 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 ≤150kHz 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

Note: A high pulse frequency combined with a great cable capacitance places a considerable load on the encoder. Apply therefore as low a voltage as possible for the encoder supply, rather lower than 24V. The manufacturer also recommends to place jumper X4 to position +15V, if allowed in the voltage range specification of the encoder.

Jumper selections

On the NXOPTA7 board, there are four jumper blocks.

Jumper **X4** is used to program the control voltage (auxiliary voltage).

The setting of jumper **X5** defines the encoder channel (DIC/DID) used to carry the signal to the repeater.

The setting of jumpers **X15** and **X16** is changed according to whether the board is used as a *Master* or *Slave* device.

The factory default and other available jumper sele ctions are presented below.

**Jumper block X5:
Encoder channel**

Channel DIC selected   Channel DID selected
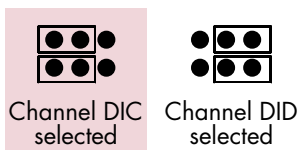
**Jumper blocks
X15 and X16:
Master/Slave
function**
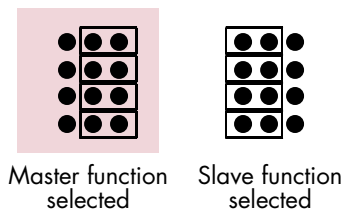
Master function selected   Slave function selected

**Jumper block X4:
Auxiliary voltage level**

24V   24V
15V   15V

Auxiliary voltage +24V   Auxiliary voltage +15V
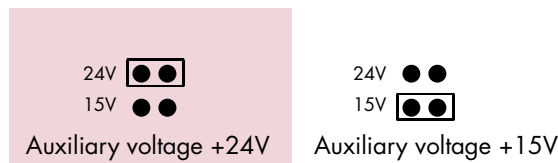
= Factory default

Usage: Closed Loop Vector Control, positioning applications. The NXOPTA7 encoder board is mainly used in demanding system applications, e.g. when measuring the motor speed with two encoders.

NXOPTA7

Encoder connection

The figures below present examples of a chain connection of several NXOPTA7 boards (Figure 16) and a connection of two encoders to the NXOPTA7 option board (Figure 17).
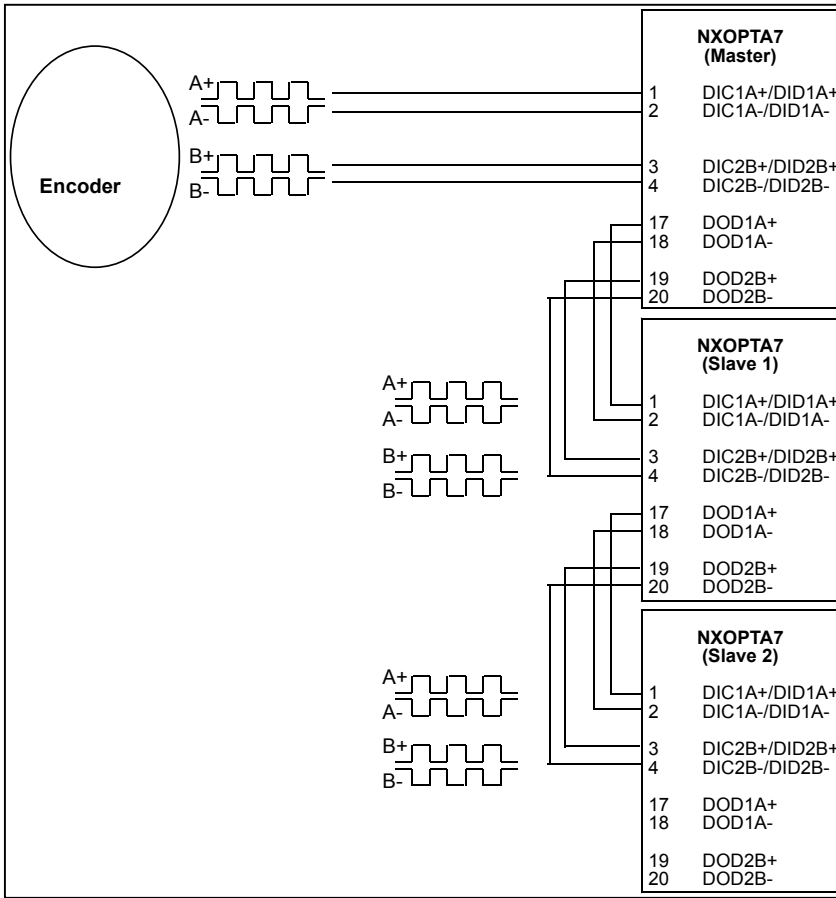
Figure 16. Connection of encoder and three NXOPTA7 boards
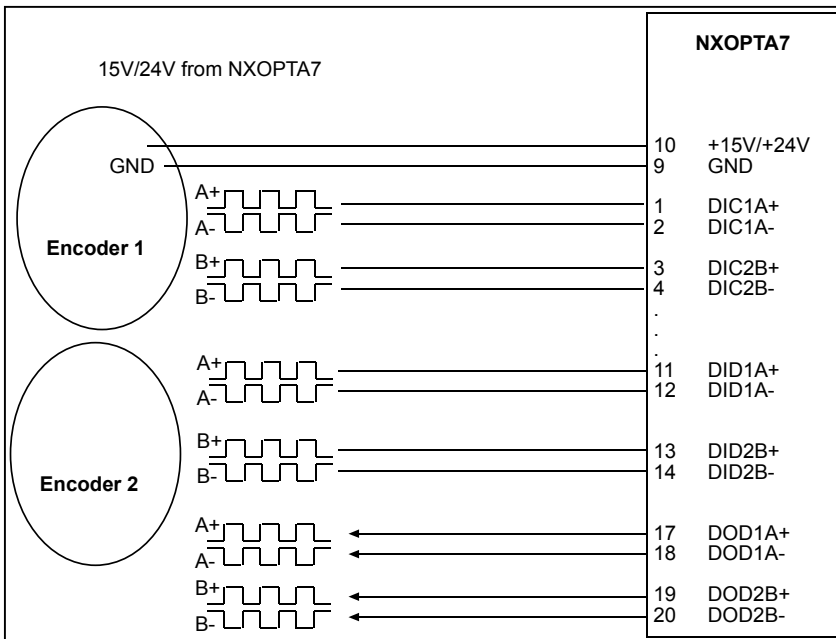
Figure 17. Connection of two encoders to NXOPTA7 board

3.1.7 NXOPTA8

Jumper X1, Jumper X2, Jumper X6, Jumper X3
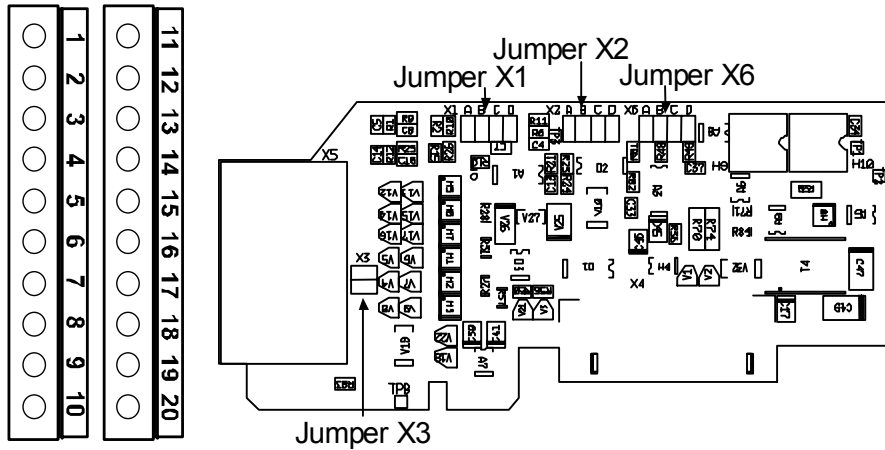
Description:	NX basic I/O board similar to NXOPTA1 except that the analogue inputs and output are **galvanically isolated**.
Allowed slots:	A
Type ID:	16696
Terminals:	Two terminal blocks; Screw terminals (M2.6); Coding in terminals #1 and #12.
Jumpers:	4; X1, X2, X3 and X6 (see page 35)
Board parameters:	Yes (see page 36)

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 35): 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 35): 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 35):
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 35):
18	AO1+	AnOUT:**A.1**	Analogue output
19	AO1–		Output signal range: Current 0(4)–20mA, R_L max 500Ω or Voltage 0—10V, R_L >1kΩ Selection with jumper block X6 (see page 35): Resolution: 0.1% (10 bits); Accuracy ±2%;
20	DO1	DigOUT:**A.1**	Open collector output; Max. U_{in} = 48VDC; Max. current = 50 mA

Table 12. NXOPTA8 I/O terminals

NXOPTA8

Jumper selections

There are four jumper blocks on the NXOPTA8 board. The factory defaults and other available jumper selections are presented below.

**Jumper block X1:
AI1 mode**

A B C D

AI1 mode: 0...20mA; Current input

A B C D

AI1 mode: Voltage input; 0...10V

A B C D

AI1 mode: Voltage input; 0...10V (differential)

A B C D

AI1 mode: Voltage input; -10...10V

**Jumper block X2:
AI2 mode**

A B C D

AI2 mode: 0...20mA; Current input

A B C D

AI2 mode: Voltage input; 0...10V

A B C D

AI2 mode: Voltage input; 0...10V (differential)

A B C D

AI2 mode: Voltage input; -10...10V

**Jumper block X6:
AO1 mode**

A B C D

AO1 mode: 0...20mA; Current output

A B C D

AO1 mode: Voltage output; 0...10V

**Jumper block X3:
CMA and CMB grounding**

CMB connected to GND
CMA connected to GND

CMB isolated from GND
CMA isolated from GND

CMB and CMA
internally connected together,
isolated from GND

= Factory default

Table 13. Jumper positions for NXOPTA8

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 14. NXOPTA8 board-related parameters

NXOPTA8

3.1.8 NXOPTA9
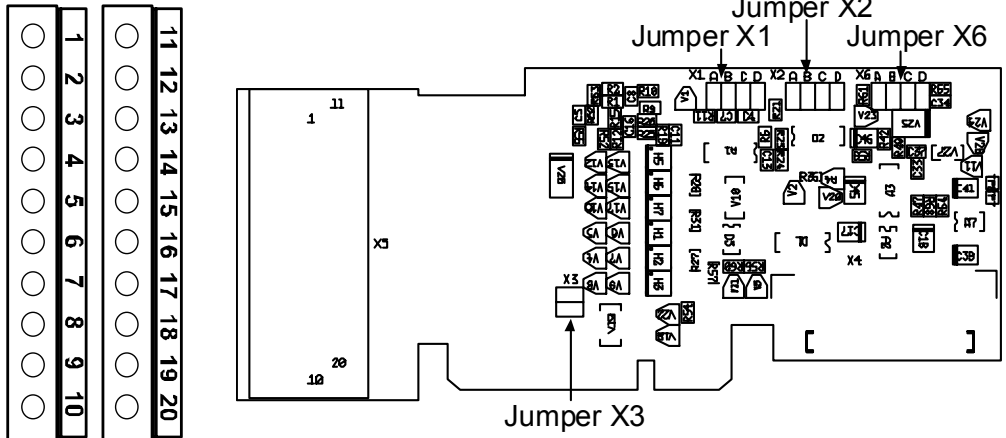
Jumper X3

Description:	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 19)
Board parameters:	Yes (see page 20)

I/O terminals on NXOPTA9

See page 18.

Jumper selections

See page 19.

NXOPTA9 parameters

See page 20.
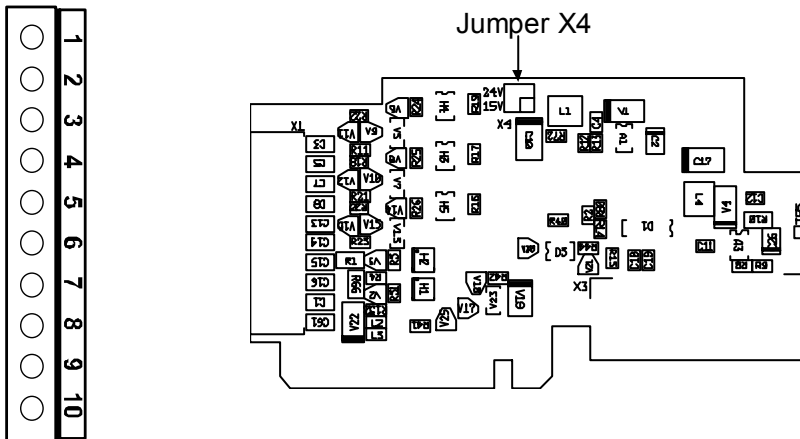
NXOPTA9

3.1.9 NXOPTAE

Jumper X4

Description:	Encoder board for **NXP**. Encoder input board with programmable control voltage for an encoder.
	The NXOPTAE 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. In addition, the board includes an Encoder Direction Signal and an Encoder Pulse Output Signal. The Encoder Direction Signal value '1' indicates a backward motor direction and '0' a forward motor direction. The Encoder Pulse Output signal is produced from The Encoder input signals (channel A) divided by the divider parameter 41.
Allowed slots:	C
Type ID:	16709
Terminals:	One terminal block; Screw terminals (M2.6); Coding in terminal #3.
Jumpers:	1; X4 (see page 39)
Board parameters:	Yes

I/O terminals on NXOPTAE (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	DO1		Encoder divider output. Encoder input signals are divided by divider paramater (see parameter list on page 41)
8	DO2		Encoder direction output. The signal value '1' means that the motor direction is backward and '0' is forward.
9	GND		Ground for control
10	+15V/+24V		Control voltage (auxiliary voltage) output to encoder; Output voltage selectable with jumper X4.

Table 15. NXOPTAE 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 ≤150kHz Inputs A, B and Z are differential
Encoder divider output DO1, Encoder direction output DO2	Max.load voltage 60Vdc Max. load current 50mA Max. output frequency ≤300kHz

Note: A high pulse frequency combined with a great cable capacitance places a considerable load on the encoder. Apply therefore as low a voltage as possible for the encoder supply, rather lower than 24V. The manufacturer also recommends to place jumper X4 to position +15V, if allowed in the voltage range specification of the encoder.

Jumper selections

On the NXOPTAE 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

Auxiliary voltage +24V   Auxiliary voltage +15V
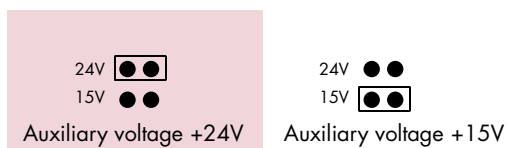
= Factory default

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

NXOPTAE

Encoder connection - single-ended
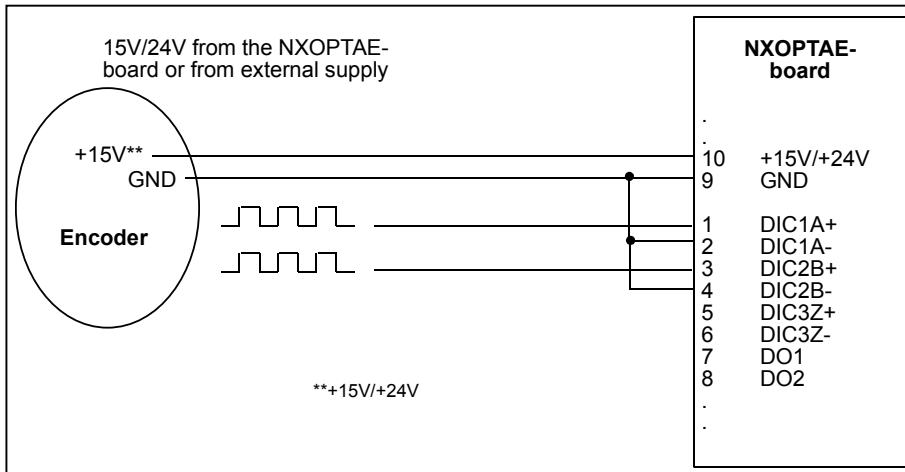
Figure 18. HTL type encoder connection (open source) using single-ended inputs
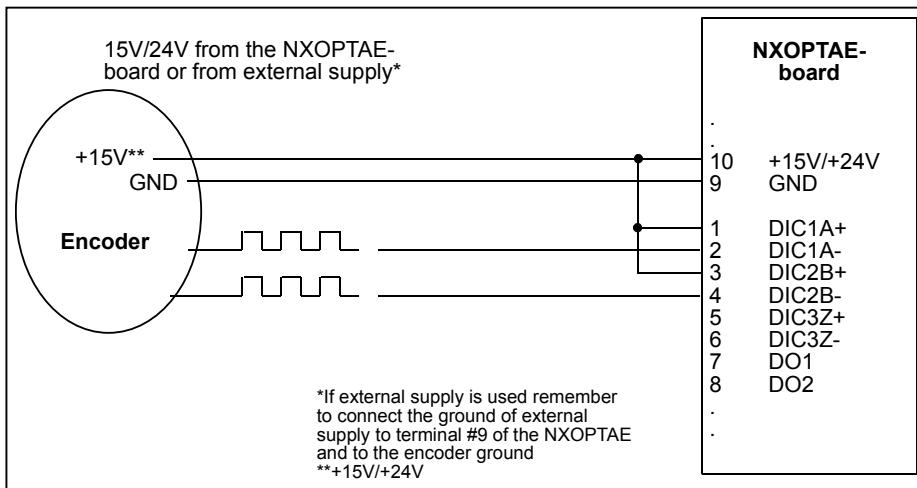
Figure 19. HTL type encoder connection (open collector) using single-ended inputs

Encoder connection – differential
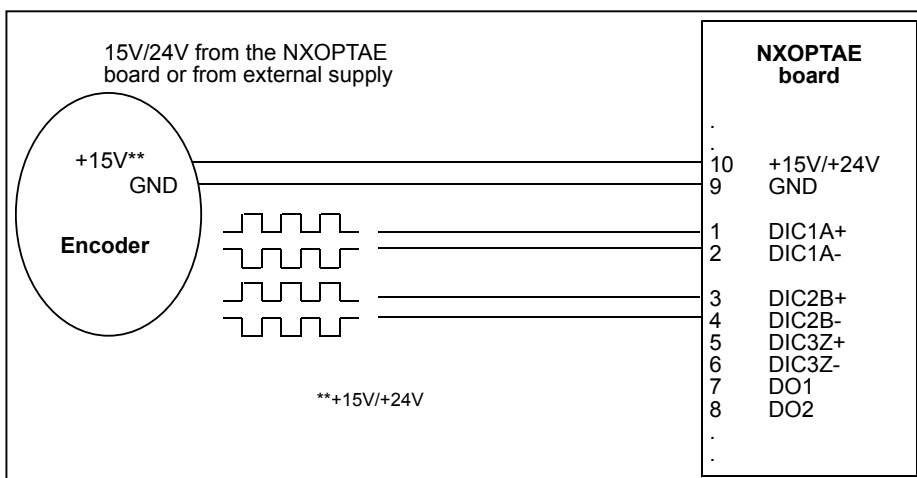
Figure 20. HTL type encoder connection using differential inputs

NXOPTAE 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	Time used to calculate speed actual value. **Note:** Use value **1** in Closed Loop mode. **0** = No calculation **1** = 1 ms **2** = 5 ms **3** = 10 ms **4** = 50 ms
7.3.1.4	Divider Value	1	2048	64	Input pulses / Divider = Divider Output
7.3.1.5	Hysteresis for Direction Out	0	511	8	Number of pulses before direction signal change state

Table 16. NXOPTAE board-related parameters

NXOPTAE

3.2   I/O Expander Boards NXOPTB_

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

The number of control inputs and outputs on the frequency converter can be increased with the *I/O Expander boards.* This kind of boards can usually 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 (except for board NXOPTBB.

The boards the operator wishes to have installed in the 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	NXOPTB8	B,C,D,E							3		
NXS NXP	NXOPTB9	B,C,D,E						1	5		
NXS NXP	NXOPTBB	C	2 (enc)								

Table 17. NX I/O Expander boards and their equipment

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

3.2.1 NXOPTB1

Jumper X4
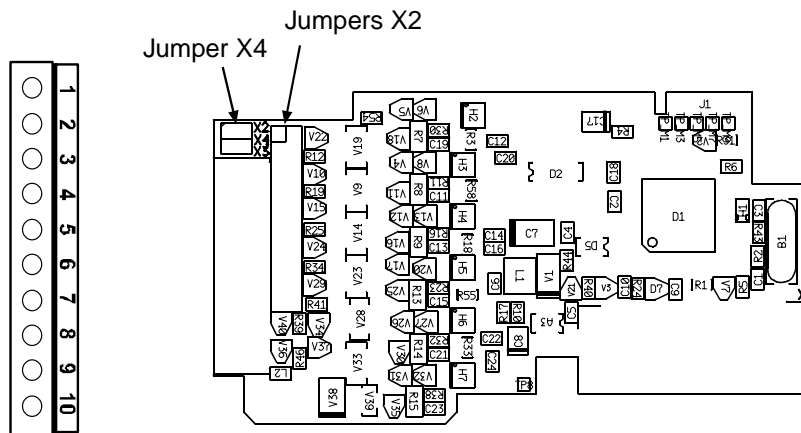
Jumpers X2

Description:	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 44)	
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; $R_i>5k\Omega$ 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; $R_i>5k\Omega$ 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 18. 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.
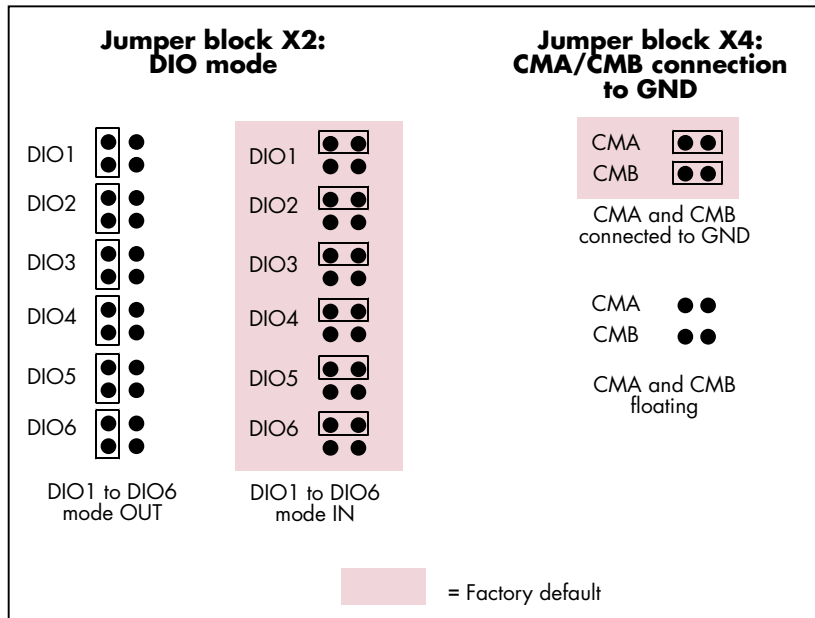
Figure 21. Jumper positions for NXOPTB1

3.2.2 NXOPTB2
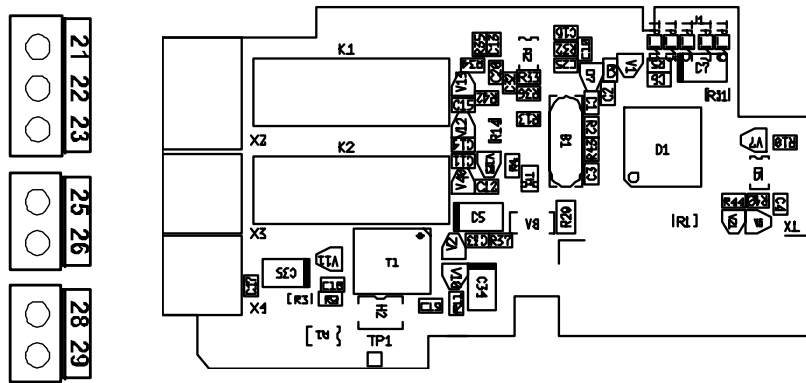
Description:	NX I/O expander board with a thermistor input and two relay outputs.
Allowed slots:	B, C, D, E
Type ID:	16946
Terminals:	Three terminal blocks; Screw terminals (M3); No coding
Jumpers:	None
Board parameters:	None

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 Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA
25 **26**	RO2/common RO2/normal open	DigOUT:**X.2**	Switching capacity Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA
28 **29**	TI1+ TI1–	DigIN:**X.1**	Thermistor input (galvanically isolated) R_{trip} = 4.7kΩ	

Table 19. 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
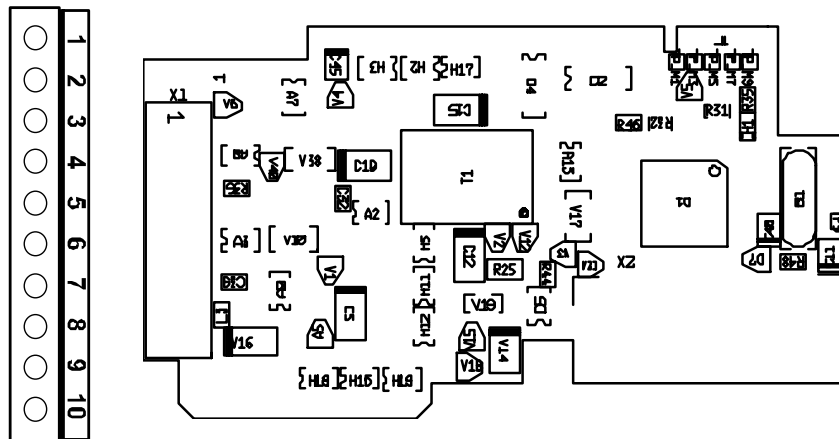
Description:	NX I/O expander board with one galvanically isolated analogue input and two galvanically isolated analogue outputs (standard signals 0(4)…20mA).
Allowed slots:	B, C, D, E
Type ID:	16948
Terminals:	One terminal block; Screw terminals (M2.6); No coding
Jumpers:	None
Board parameters:	None

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 $\leq$ ±2% (galvanically isolated)
4	AO1−		
5	AO2+	AnOUT:**X.2**	0(4)…20mA; R_L<500Ω; Resolution 10 bits/0.1%; Accuracy $\leq$ ±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 20. 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
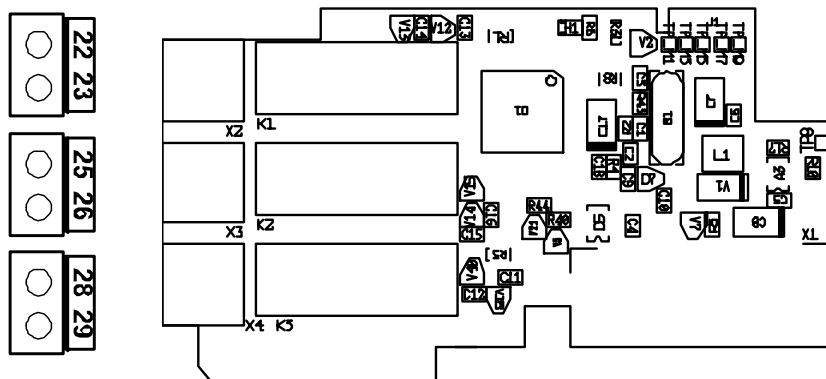
Description:	I/O expander board with three relay outputs.
Allowed slots:	B, C, D, E
Type ID:	16949
Terminals:	Three terminal blocks; Screw terminals (M3); No coding
Jumpers:	None
Board parameters:	None

I/O terminals on NXOPTB5

Terminal		Parameter reference Keypad/NCDrive	Technical information	
22 **23**	RO1/common RO1/normal open	DigOUT:**X.1**	Switching capacity Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA
25 **26**	RO2/common RO2/normal open	DigOUT:**X.2**	Switching capacity Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA
28 **29**	RO3/common RO3/normal open	DigOUT:**X.3**	Switching capacity Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA

Table 21. 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 NXOPTB8

Jumper block X2
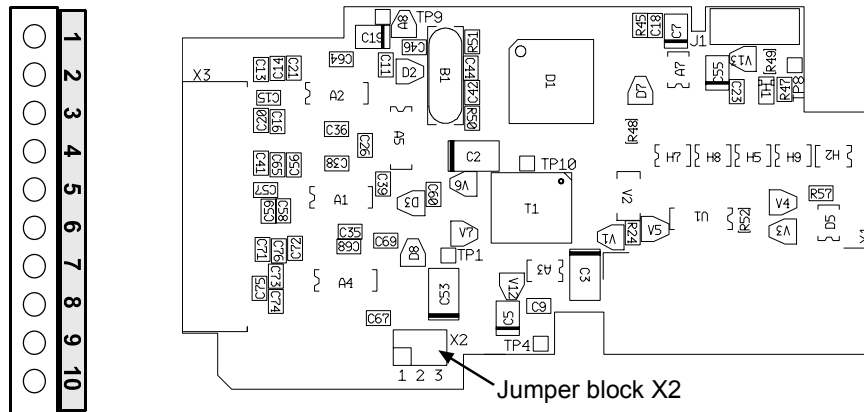
Description:	Temperature measuring board with three Pt-100 sensor (3-wire) inputs. The measurable temperature range is –30...200 C° on Pt-100 input. Both 3-wire and 2-wire elements can be used.
Allowed slots:	B, C, D, E
Type ID:	16952
Terminals:	One terminal block; Screw terminals (M2.6); No coding
Jumpers:	X2
Board parameters:	None

I/O terminals on NXOPTB8

Terminal		Parameter reference Keypad/NCDrive	Technical information
1	R1 +	AnIN:**X.1**	PT100 Input, -30 … 200°C, one sensor. Accuracy $\leq$ 1°C. Sensor current 10 mA.
2	R_m1		
3	R1 -		
4	R2 +	AnIN:**X.2**	PT100 Input, -30 … 200°C, one sensor. Accuracy $\leq$ 1°C. Sensor current 10 mA.
5	R_m2		
6	R2-		
7	R3 +	AnIN:**X.3**	PT100 Input, -30 … 200°C 1 - 3 sensors (see X2 jumper selections). Accuracy $\leq$ 1°C. Sensor current 10 mA.
8	R_m3		
9	R3 -		
10	NC		Not connected

Table 22. NXOPTB8 I/O terminals

Connection of PT100 sensors

One PT100-sensor can be connected to the first two inputs (terminals 1 to 3 and 4 to 6) and up to three sensors to the third input (terminals 7 to 9). The sensors must be connected in **series** with a two- or three-wire connection. See Chapter Jumper selections below.

Connection of one sensor
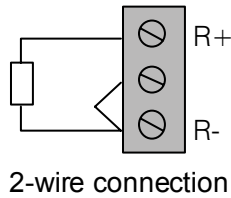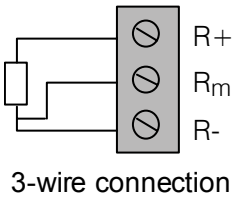
Connection of several sensors
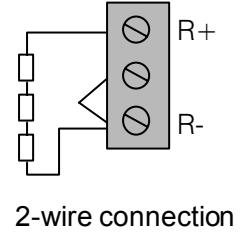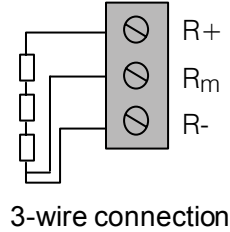
R+	R+		R+	R+
Rm			Rm	
R-	R-		R-	R-

3-wire connection   2-wire connection   3-wire connection   2-wire connection

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
- Insulation level 4kV/sqrt(2) (DIN VDE 01 10-1). 2kV in sensor and 2kV in option board.

Jumper selections

Up to three PT100 sensors can be connected to the third PT100 input. The number of sensors in use can be selected with jumper block X2:

1 2 3   1 2 3   1 2 3
1 Sensor   2 Sensors   3 Sensors

= Factory default

3.2.6 NXOPTB9
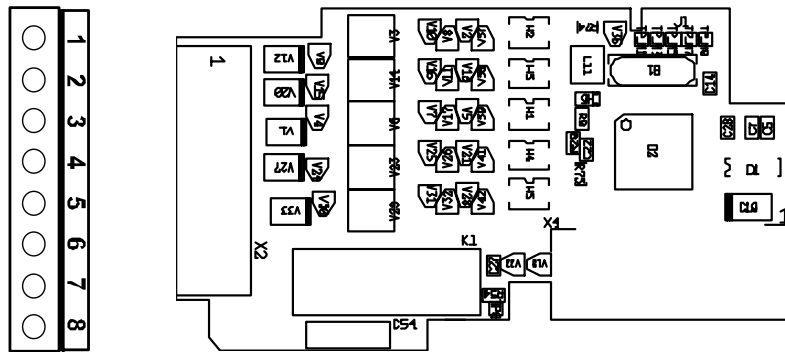
Description:		I/O expander board with five 42…240 VAC digital inputs and one normal relay output.
Allowed slots:		B, C, D, E
Type ID:		16953
Terminals:		One terminal block; Screw terminals (M2.6); No coding
Jumpers:		None
Board parameters:		None

I/O terminals on NXOPTB9

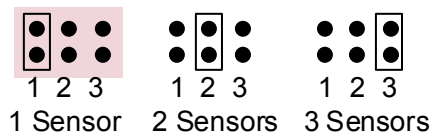|	Terminal	Parameter reference Keypad/NCDrive	Technical information		
1	ACIN1	DigIN:**X.1**	Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V		
2	ACIN2	DigIN:**X.2**	Digital input, 42…240 VAC (threshold 35V) Control voltage: "0"<33V, "1">35V		
3	ACIN3	DigIN:**X.3**	Digital input, 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 Min.switching load	24VDC/8A 250VAC/8A 125VDC/0.4A 5V/10mA	

Table 23. 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.

3.2.7 NXOPTBB

Jumper block X11   Main board   Secondary board
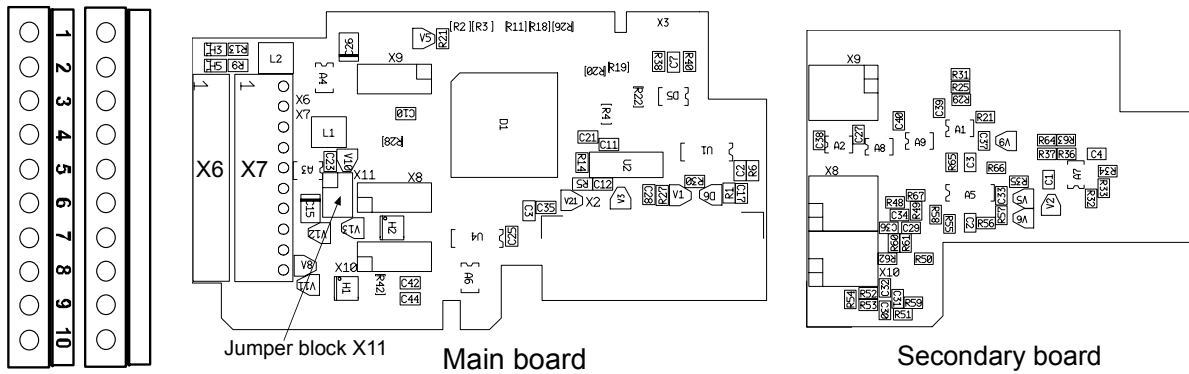
Description:	Absolute encoder board for **NXP** with inputs for an *Endat* type encoder. Programmable control voltage, fast digital inputs and simulation pulse output.
	The output pulse is produced from sinusoidal input signals.
	The galvanically isolated fast digital inputs are used to trace very short pulses.
Allowed slots:	C
Type ID:	16962 (main board), 16963 (secondary board); The secondary board is mounted on top of the main board
Terminals:	Two terminal blocks; Screw terminals (M2.6); No coding
Jumpers:	1; X11 (see page 53)
Board parameters:	Yes (see pages 53 to 54)

An **absolute encoder** is a type of encoder capable of specifying its absolute position. The position data is retained even during a power failure or breakdown. The position data carried by the absolute encoder can be used by the frequency converter motor control in the control of a synchronous motor.

Encoder cable	Heidenhain cable; Max. length 100m
Encoder voltage	5V, 12V or 15V Max. current consumption 300mA
Measuring steps/ revolution	4,2 billion (max. 32bit)
Distiguishable revolutions	0—65535 (max. 16bit)
Signal periods/ revolution	1—65535

ENDAT is a bidirectional synchronic serial interface for absolute encoders. For example, the encoder position data can be read and encoder parameters can be set via the ENDAT connection. It also forwards the messages related to the encoder functions.
All Endat connections are available in terminal X6. The board uses Endat version 2.

NXOPTBB

I/O terminals on NXOPTBB, encoder terminal X6

	Terminal	Heidenheim colour code	Technical data
1	DATA+	Grey	Data line 120Ω/RS-485
2	DATA–	Pink	
3	CLOCK+	Violet	Clock line 120Ω/RS-485 (200—400kHz)
4	CLOCK–	Yellow	
5	A+	Green/black	1Vpp (±0,5V); impedance 120Ω; Max.input 350 kHz
6	A–	Yellow/black	
7	B+	Blue/black	1Vpp (±0,5V); impedance 120Ω; Max.input 350 kHz
8	B–	Red/black	
9	GND	White/green	Input ground
10	Encoder voltage	Brown/green	Selectable encoder voltages: 5V, 12V and 15V Max.current consumption 300mA

Table 24. I/O terminals on NXOPTBB, terminal X6

I/O terminals on NXOPTBB, terminal X7

	Terminal	Technical data
1	SimA+	Incremental pulse output A (differential), 0° (square wave, signal level RS-422); Impedance 120Ω; Input hysteresis ±5mV
2	SimA–	
3	SimB+	Incremental pulse output B (differential), 0° (square wave, signal level RS-422); Impedance 120Ω; Input hysteresis ±5mV
4	SimB–	
5	Not used	
6	Not used	
7	FDIN1	Fast digital input 1; HTL; Min.pulse length 50µs
8	CMA	Common FDIN1
9	FDIN2	Fast digital input 2; HTL; Min.pulse length 50µs
10	CMB	Common FDIN2

Table 25. I/O terminals on NXOPTBB, terminal X7

NXOPTBB

Jumper selections

On the NXOPTBB 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 X11
Auxiliary voltage level
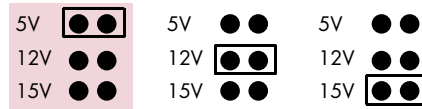
= Factory default

NXOPTBB board parameters

Code	Parameter	Min	Max	Default	Selections	Description
7.3.1.1	Reverse	0	1	0	**0**=No **1**=Yes	Manually selectable rotation direction
7.3.1.2	Reading rate	0	4	1	**0**=Not used **1**=1 ms **2**=5 ms **3**=10 ms **4**=50 ms	Incremental pulse reading rate. **Note:** Use value **1** in Closed Loop mode.
7.3.1.3	Interpolation	0	1	0	**0**=No **1**=Yes	If activated, the sinusoidal incremental pulses are used to calculate the polar angle in order to optimize the encoder accuracy

Table 26. NXOPTBB board parameters

NXOPTBB board monitoring values

Code	Monitored value	Unit	Description
7.3.2.1	Reverse	Hz	Motor speed in Hz calculated from encoder pulses
7.3.2.2	Encoder speed	rpm	Motor speed in rpm calculated from encoder pulses
7.3.2.3	Encoder position	-	Absolute position of encoder read from Endat
7.3.2.4	Encoder revolution		
7.3.2.5	Encoder fault		
7.3.2.6	Encoder warning		
7.3.2.7	Encoder messages		Number of messages between encoder and NXOPTBB

Table 27. NXOPTBB board monitoring values

NXOPTBB board information pages

Code	Information	Unit	Description
7.3.3.1	Encoder type		0 = No encoder connected 1—4 = Incremental linear encoder 5 = Linear absolute encoder 6 = Unknown 7 = Linear absolute encoder 8 = Unknown 9—12 = Rotational incremental/angular encoder 13 = Absolute encoder (singleturn) 14 = Unknown 15 = Absolute encoder (multiturn) 16 = Unknown
7.3.3.2	Pulses/Revolution		Sinusoidal pulses/revolution
7.3.3.3	Position bits	bit	Accurate position 1—1024 (10bit = 2^{10} = 1024)
7.3.3.4	Revolution bits	bit	Accurate number of revolutions 1—1024 (10bit = 2^{10} = 1024)

Table 28. NXOPTBB board information pages

NXOPTBB option board status LEDs

Yellow LED

LED:	Meaning
OFF	Option board not activated
ON	Option board in initialisation state waiting for activation command from the frequency converter
Blinking fast (once/sec)	Option board is activated and in RUN state • Option board is ready for external communication
Blinking slow (once/5 s)	Option board is activated and in FAULT state • Internal fault of option board

Green LED

LED:	Meaning
OFF	Option board not activated
ON	Encoder is being initialised Option board is reading encoder parameters
Blinking fast (once/s)	Encoder detected by option board Option board receives data from encoder
Blinking slow (once/5 s)	Encoder detected by option board Option board cannot read encoder data or data is invalid (CRC error, broken cable etc.)

NXOPTBB

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 communication bus (System Bus, SPI, CAN). Note that if any of the major *fieldbuses* (Profibus, Modbus etc.) is used for communication a corresponding *fieldbus board* is also needed. 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.
Click on the board name to go to its detailed description.

FC type	I/O board	Allowed slots	Description
NXP	NXOPTD1	D,E	System Bus adapter board
NXP	NXOPTD2	(B,)D,E	System Bus adapter board with interface to fastmonitoring bus
NXS NXP	NXOPTD3	D,E	RS-232 adapter board
NXP	NXOPTD6	B,D,E	Monitor Bus adapter board for NXP

Table 29. NX adapter boards

3.3.1 *NXOPTD1*
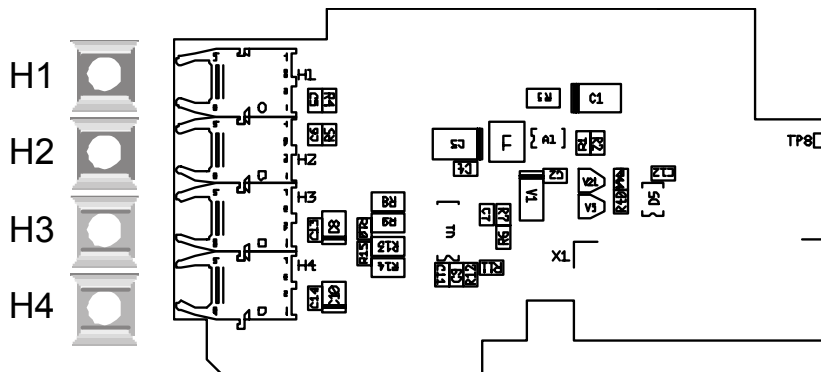
Description:	System Bus adapter board for NXP
Allowed slots:	D, E
Type ID:	17457
Terminals:	Double optical input and output terminals
Jumpers:	None
Board parameters:	None

I/O terminals on NXOPTD1

	Terminal	Technical information
1	H1	System Bus optical input 1 (RX1) Use 1-mm optical cable (e.g. Agilent HFBR-RUS500)
2	H2	System Bus optical input 2 (RX2) Use 1-mm optical cable (e.g. Agilent HFBR-RUS500)
3	H3	System Bus optical output 1 (TX1) Use 1-mm optical cable (e.g. Agilent HFBR-RUS500)
4	H4	System Bus optical output 2 (TX2) Use 1-mm optical cable (e.g. Agilent HFBR-RUS500)

Table 30. 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.

NXOPTD1

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.

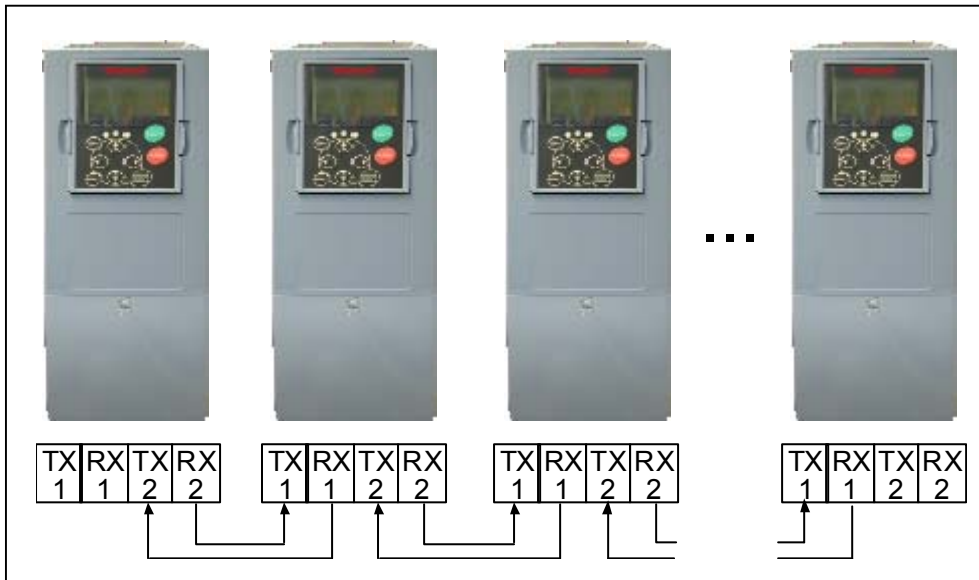| Max. number of devices in line	Max. speed achieved [Mbit/s]
3	12
6	6
12	3
24	1.5

Table 31.

Figure 22. Basic connection of frequency converters with NXOPTD1

NXOPTD1

3.3.2 *NXOPTD2*
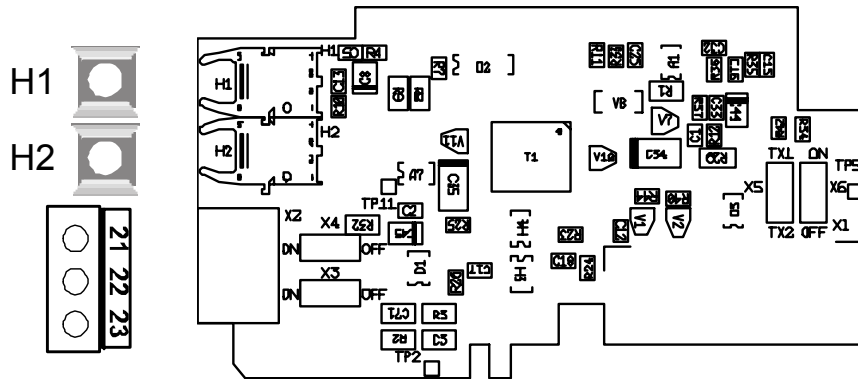
Description: System Bus adapter board for NXP with single optical input and output; Interface to fast monitor bus used by the NCSYSDRIVE PC Tool.

Allowed slots: (B,) D, E; ***Note:*** *If only the Monitor Bus (terminals 21 to 23) will be used, the board can also be placed in slot B. The System Bus is then unavailable. Remove therefore jumpers X5 and X6. See page 59.*

Type ID: 17458

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

Jumpers: 4; X3, X4, X5 and X6. See page 59

Board parameters: None

I/O terminals on NXOPTD2

	Terminal	Technical information
1	H1	System Bus optical input 1 (RX1); Use 1-mm optical cable (e.g. Agilent HFBR-RUS500) **Note:** Not available if the board is placed in slot B
2	H2	System Bus optical output 1/2 (TX1/TX2); Selected with jumper X5 Use 1-mm optical cable (e.g. Agilent HFBR-RUS500) **Note:** Not available if the board is placed in slot B
21	CAN_L	Monitor Bus negative data
22	CAN_H	Monitor Bus positive data
23	CAN_SHIELD	Monitor Bus shield

Table 32. NXOPTD2 I/O terminals

NXOPTD2

Jumper selections

There are four jumper blocks on the NXOPTD2 board. The factory defaults and other available jumper selections are presented below.
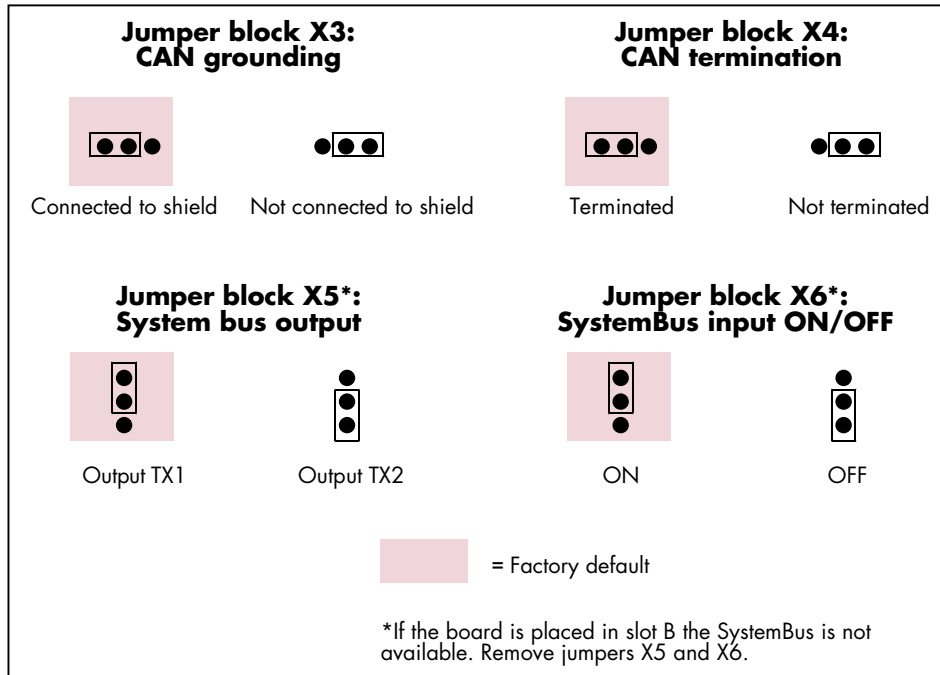
Figure 23. Jumper selections for NXOPTD2

Connections between frequency converters with NXOPTD2

<u>Special connection: (See next page)</u>

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 33.

I/O Boards
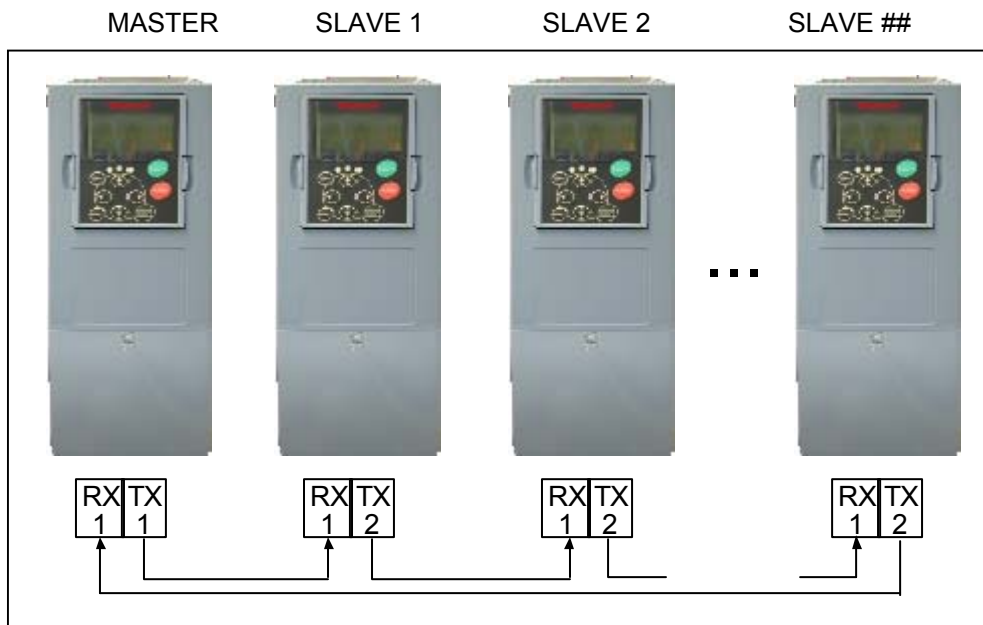
Figure 24. Connection example of frequency converters with NXOPTD2

3.3.3   NXOPTD3

LED 2
LED 1

Jumper block X3

Description:	RS-232 adapter board. Galvanically decoupled. Used mainly for application engineering to connect another keypad.
Allowed slots:	**D**, E
Type ID:	17459
Terminals:	9-pin female sub-D-connector
Jumpers:	1; X3
Board parameters:	None

I/O terminals on NXOPTD3

Terminal		Technical information
1		
2	TxD	Transmit data
3	RxD	Receive data
4		
5	GND	Ground isolated
6	+9V	+9V isolated
7		
8		
9		

Table 34. NXOPTD3 I/O terminals

Jumper selections

There is one jumper block on the NXOPTD3 board. The factory defaults and other available jumper selections are presented below:

Jumper block X3:
Connector connection to GND
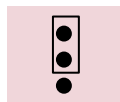
Connected to GND
through RC filter

Connected
directly to GND

NXOPTD3 option board status LEDs

LED:	Meaning
Green (LED 1)	Receiving data
Red (LED 2)	Transmitting data

NXOPTD3

3.3.4 NXOPTD6
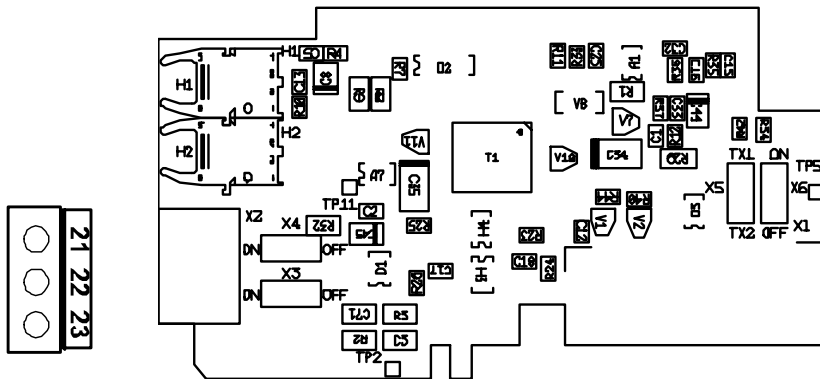
Description:	Monitor Bus adapter board for NXP. Interface to fast monitor bus used by the NCSYSDRIVE PC tool.
Allowed slots:	B, D, E.
Type ID:	17462
Terminals:	One screw terminal block (M3)
Jumpers:	2; X3, X4.
Board parameters:	None

I/O terminals on NXOPTD6

Terminal		Technical information
21	CAN_L	Monitor Bus negative data
22	CAN_H	Monitor Bus positive data
23	CAN_GND	Monitor Bus ground

Table 35. NXOPTD6 I/O terminals

Jumper selections

There are two jumper blocks on the NXOPTD6 board. The factory defaults and other available jumper selections are presented below:

Jumper block X3:
CAN grounding

Connected to shield   Not connected to shield

Jumper block X4:
CAN termination

Terminated   Not terminated
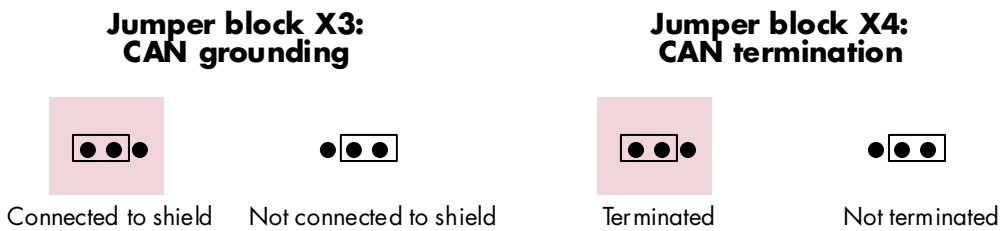
4.   Option Boards – operational details

Board type	Slots allowed[6]	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	Pt-100
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	
NXOPTA7	C	16695		2												6			1	
NXOPTA8	A	16696	6	1	2[1]		1[1]				1[1]		2						
NXOPTA9[3]	A	16697	6	1	2		1				1		2						
NXOPTAE[4]	A	16709		2												3			
I/O expander boards NXOPTB_																			
NXOPTB1	BC**D**E	16945	6[5]	6[5]															
NXOPTB2	BC**D**E	16946							1	1		1							
NXOPTB4	BC**D**E	16948				1[2]		2[2]						1					
NXOPTB5	BC**D**E	16949								3									
NXOPTB8	BC**D**E	16952																		3
NXOPTB9	BC**D**E	16953								1					5				
NXOPTBB	C	16962 16963														2			

Table 36. NX option boards, types A and B

Adapter boards NXOPTD_			
NXOPTD1	**D**E	17457	System Bus adapter board: 2 x fiber optic pairs
NXOPTD2[7]	(B)**D**E	17458	System Bus adapter board: 1 x fiber optic pair & CAN bus adapter (galvanically decoupled)
NXOPTD3	**D**E	17459	RS232 adapter card (galvanically decoupled)
NXOPTD6	B**D**E	17462	CAN bus adapter (galvanically decoupled)

Table 37. NX option boards, Type D

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

6) In case of several optional slots, the bold slot letter indicates the factory default slot (NOTE: not applicable if several boards with the same default slot are installed)

7) If the board is placed in slot B the SystemBus is not available; only the Monitor Bus can be used. Remove jumpers X5 and X6.

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)	■	■	■	■	■	■	■
NXOPTA7 (NXP only)	▲	▲	▲	▲	▲	▲	▲
NXOPTA8	●	●	●	●	●	●[6]	●[6]
NXOPTA9	●	●	●	●	●	●[6]	●[6]
NXOPTAE (NXP only)	■	■	■	■	■	■	■
I/O expander boards NXOPTB_							
NXOPTB1						●[6]	●[6]
NXOPTB2						●[6]	●[6]
NXOPTB4		●	●	●	●	●[6]	●[6]
NXOPTB5						●[6]	●[6]
NXOPTB8					●	●	●
NXOPTB9						●[6]	●[6]
Adapter boards NXOPTD_							
NXOPTD1 (NXP only)	■	■	■	■	■	■	■
NXOPTD2[7] (NXP only)	■	■	■	■	■	■	■
NXOPTD3	■●	■●	■●	■●	■●	■●	■●
NXOPTD6[7] (NXP only)	■	■	■	■	■	■	■

Table 38. All in One applications and supported NX option boards

● = Used with this application (NXS)
■ = Used with this application (NXP)
▲ = Used with special applications only

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