VACON® NX

AC DRIVES

ENDAT/SSI, SIN-COS OPTION BOARD, OPTBE
SIN-COS OPTION BOARD, OPTAK
SIN-COS WITH PULSE OUTPUT OPTION BOARD, OPTAR

USER MANUAL

VACON®

INDEX

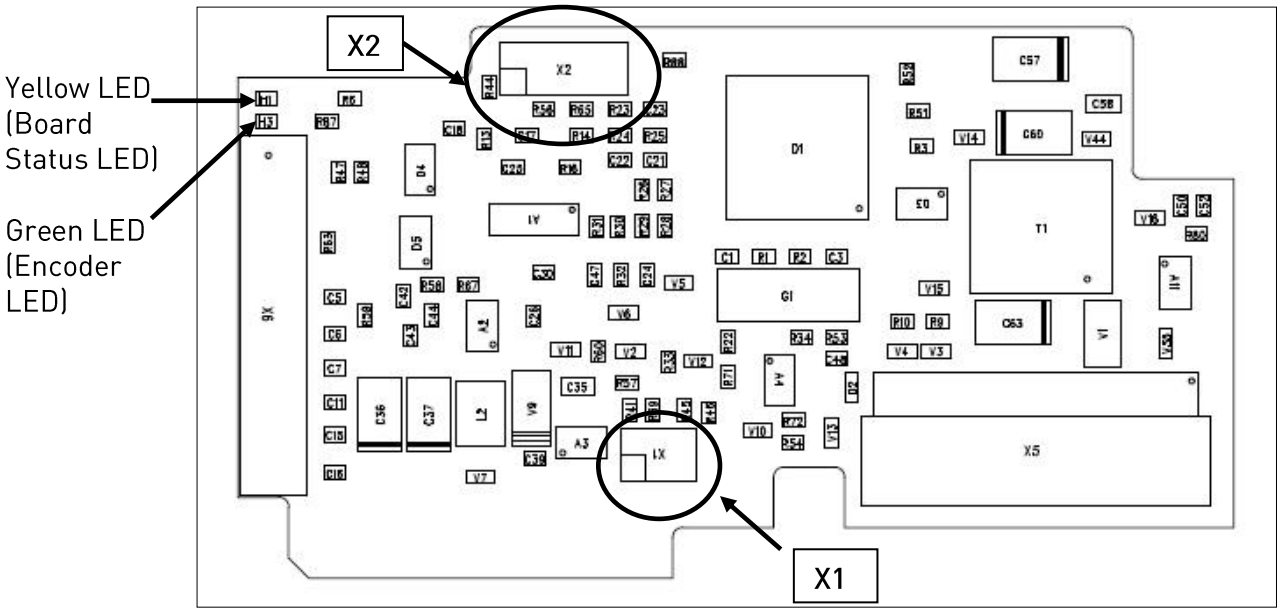
Document code: DPD01174B
Date edited: 16.05.2018

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

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

1. ENDAT/SSI, SIN-COS OPTION BOARD OPTBE

1.1 OPTBE layout and description



Description:	Encoder board for **VACON® NXP** with an input for *EnDat/SSI* absolute encoder and *Sin/Cos* type encoder.
Allowed slots:	C, D, E (Sin/Cos signals can only be used in slot C)
Type ID:	16965
Terminals:	One terminal block; Screw terminals (M2.6); No coding.
Jumpers:	X1 and X2 (see page 5)
Board parameters:	Yes (see page 7)

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 AC drive in motor control and position control applications.

Sin/Cos encoder produces a pair of analog sinusoidal signals. There are several sine cycles (for example 1024 or 2048) per mechanical revolution.

Encoder cable	Heidenhain cable Max. length 100m It is recommended to use a cable which contains individual shield for each twisted pair.
Encoder voltage	5V, 12V or 15V Max. current consumption 300mA
Measuring steps/ revolution	4.2 billion (max. 32bit)
Distinguishable revolutions	0—65535 (max. 16bit)
Sin/Cos signal periods/revolution	1—65535
EnDat and SSI data transfer rate	200 kHz

EnDat is a bidirectional synchronous serial interface for encoders. For example, the absolute 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 2.1.

SSI (Synchronous Serial Interface) is a single directional interface for transmitting absolute position value.

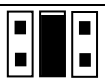
The absolute position value beginning with the Most Significant Bit (MSB first) is transferred on the DATA lines in synchronism with a CLOCK signal transmitted by the control. The SSI standard data word length for single turn absolute encoders is 13 bits, and for multiturn absolute encoders 25 bits.

More information on EnDat/SSI: http://www.heidenhain.com.

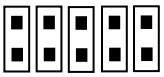
1.2 OPTBE jumpers

NOTE! It is recommended to use a 12 V or 15 V supply voltage instead of 5 V. OPTBE interface does not support "sense" function to compensate voltage drop with a long cabling. Therefore with 5 V supply voltage the cable length limit is about 60 meters with 0.5 mm^2 wire section. With 5 V supply voltage it is recommended to use two or more wires in parallel for the supply connection.

Jumper X1 selects encoder supply voltage on the OPTBE board, see jumper settings below:

		
5V (Default)	12V	15V

Jumper X2 selects Sin/Cos signals connection on the OPTBE board, see jumper settings below:

	
Sin/Cos signals connected **Note!** This setting can only be used in slot C	Sin/Cos signals not connected (Default) **Note!** This setting must be used in slots B, D and E

NOTE! Be careful with the jumper settings, wrong settings may damage the encoder.

1.3 OPTBE LEDs

There are two LEDs on the OPTBE board:

1) Yellow LED (Board Status LED)
Slow blinking -> Board state is ready
Fast blinking -> Board state is faulted

2) Green LED (Encoder LED)
ON -> Encoder serial communication is OK
OFF -> No serial connection to encoder

1.4 I/O terminals on OPTBE, encoder terminal X6

Terminal		Heidenhain colour code	Technical data
1	DATA+	Grey	Data line 120Ω/RS-485
2	DATA–	Pink	
3	CLOCK+	Violet	Clock line 120Ω/RS-485 (200kHz)
4	CLOCK–	Yellow	
5	A+, COS+	Green/black	1Vpp (±0.5V); impedance 120Ω; Max. input 350 kHz
6	A–,COS-	Yellow/black	
7	B+, SIN+	Blue/black	1Vpp (±0.5V); impedance 120Ω; Max. input 350 kHz
8	B–, SIN-	Red/black	
9	GND	White/green	Input ground
10	Encoder voltage	Brown/green	Selectable encoder voltages: 5V, 12V and 15V Max. current consumption 300mA

Analog Sin/Cos signals deserve some more precautions for noise immunity than pulse encoders. It is recommended to use a cable which contains individual shield for each twisted pair. Use one pair for SIN+/SIN- signals, another pair for COS+/COS- signals, another pair for DATA+/DATA- signals and another pair for CLOCK+/CLOCK- signals.

1.5 OPTBE Parameters

Notes for selecting Operating Mode:

In modes "EnDat + Sin/Cos" and "SSI+Sin/Cos" Sin/Cos signals and absolute serial information are used:

- Modes can be used in VACON® NXP option board slot C.
- Closed loop motor control mode can be used.
- Jumper X2 is installed into OPTBE board because Sin/Cos signals are used.

In modes "Endat Only" and "SSI Only", only the absolute serial information is used:

- Modes can be used in VACON® NXP option board slots C, D and E.
- Closed loop motor control mode cannot be used. Usage of closed loop in these modes causes Fault 43 (Encoder fault) with Subcode 10.
- Jumper X2 is removed from OPTBE board because Sin/Cos signals are not used.

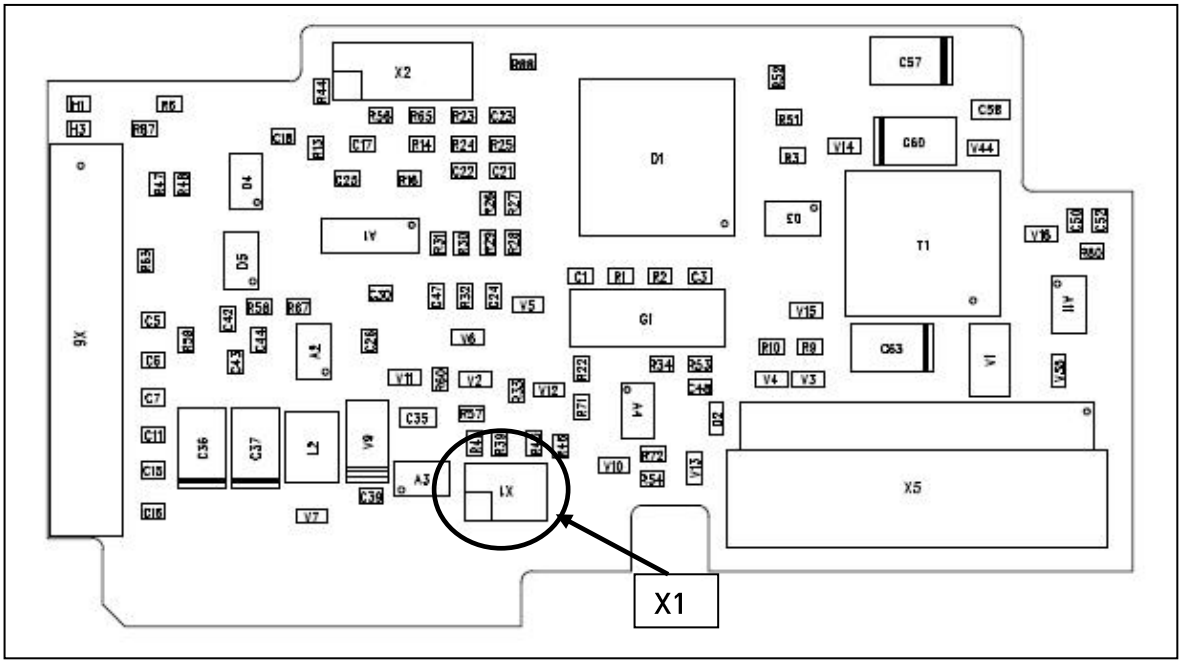
Number	Parameter	Min	Max	Default	Note
7.x.1.1	Operating Mode	4	8	4	**4**= EnDat + Sin/Cos (default) **5**= EnDat Only **6**= SSI+Sin/Cos **7**= SSI Only **8**= Sin/Cos Only
7.x.1.2	Pulse/revolution	1	65535	1024	
7.x.1.3	Invert direction	0	1	0	**0** = No **1** = Yes
7.x.1.4	Reading rate	0	4	1	Time used 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
7.x.1.5	Interpolation	0	1	0	If activated, the sinusoidal incremental pulses are used to calculate the polar angle in order to optimize the encoder accuracy **0**=No **1**=Yes
7.x.1.6	SSI data coding	0	1	1	**0**=Binary **1**=Gray
7.x.1.7	SSI total bits	0	55	13	
7.x.1.8	SSI revol bits	0	16	0	

1.6 OPTBE monitored values

Code	Monitored value	Unit	Description
7.x.2.1	Encoder frequency	Hz	Encoder frequency in Hz
7.x.2.2	Encoder speed	rpm	Encoder Speed in rpm
7.x.2.3	Com Counter		Message counter for serial encoder communication 0-65535
7.x.2.4	Revolution counter		In case multiturn encoders this monitored value counts the revolutions. 0-65535
7.x.2.5	Absolute position Hi word		absolute position up from 16 bits to 32bits
7.x.2.6	Absolute position Lo word		absolute position up to 16 bits

2. SIN-COS OPTION BOARD OPTAK

2.1 OPTAK layout and description



Description:	Encoder board for **VACON® NXP** with an input for *Sin/Cos* type encoder. Programmable control voltage.
Allowed slots:	C (Sin/Cos signals can only be used in slot C)
Type ID:	16715
Terminals:	One terminal block; Screw terminals (M2.6); No coding.
Jumpers:	X1 (see page 9)
Board parameters:	Yes (see page 10)

Sin/Cos encoder produces a pair of analog sinusoidal signals. There are several sine cycles (for example 1024 or 2048) per mechanical revolution.

2.2 OPTAK jumper settings

NOTE! It is recommended to use a 12 V or 15 V supply voltage instead of 5 V. OPTAK interface does not support "sense" function to compensate voltage drop with a long cabling. Therefore with 5 V supply voltage the cable length limit is about 60 meters with 0.5 mm2 wire section. With 5 V supply voltage it is recommended to use two or more wires in parallel for the supply connection.

Jumper X1 selects encoder supply voltage on the OPTAK board, see jumper settings below:

		
5V (Default)	12V	15V

NOTE! Be careful with the jumper setting, wrong voltage may damage the encoder.

2.3 I/O terminals on OPTAK, encoder terminal X6

Terminal		Technical data
1	N.C.	Not Connected
2	N.C.	
3	R+	Max 10Vpp (±5V), Min 1Vpp (±0.5V). Typically signal is ~2.5Vpp (±1.25V): at reference mark moment positive signal, other time negative signal. Impedance 120Ω Max input 350 kHz Reference mark signal
4	R-	
5	SIN+	1Vpp (±0.5V); impedance 120Ω; Max. input 350 kHz,
6	SIN-	
7	COS+	1Vpp (±0,5V); impedance 120Ω; Max. input 350 kHz
8	COS-	
9	GND	Input ground
10	Encoder voltage	Selectable encoder voltages: 5V, 12V and 15V Max. current consumption 300mA

NOTE! Analog Sin/Cos signals deserve some more precautions for noise immunity than pulse encoders. It is recommended to use a cable which contains individual shield for each twisted pair. Use one pair for SIN+/SIN- signals, another pair for COS+/COS- signals and another pair for R+/R- signals.

2.4 OPTAK parameters

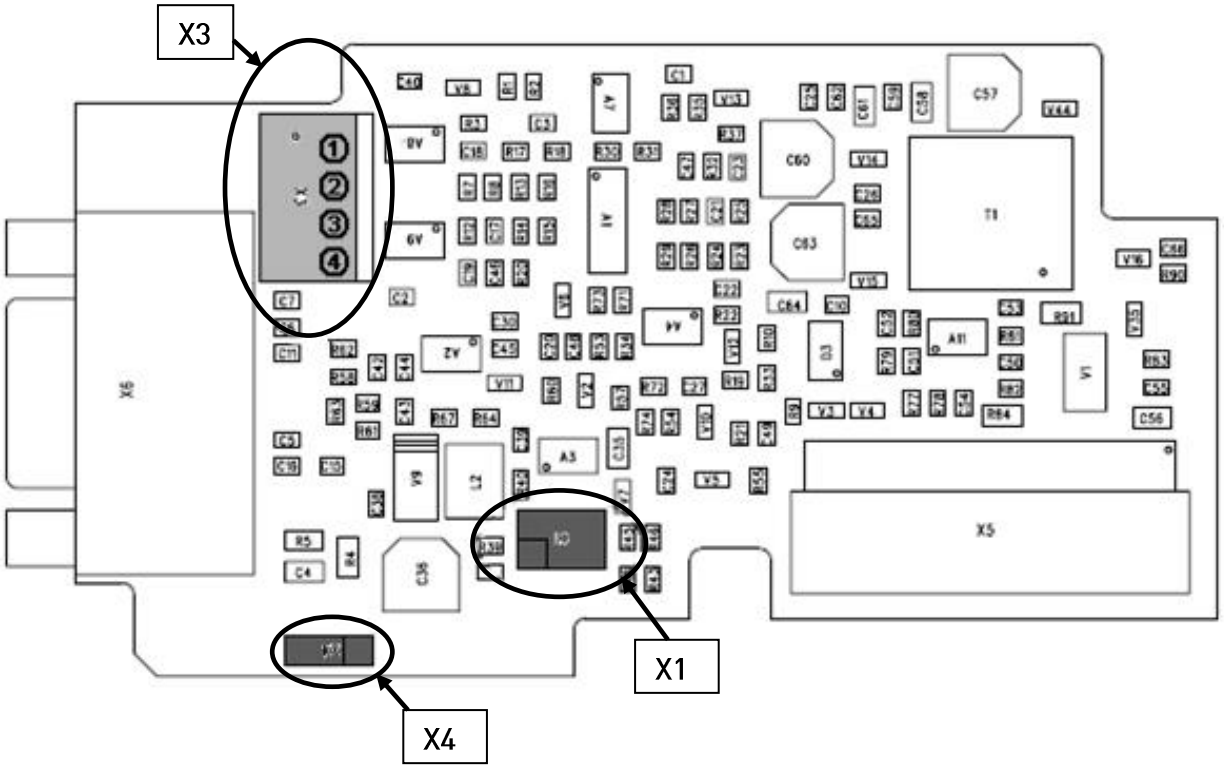
Number	Parameter	Min	Max	Default	Note
7.3.1.1	Pulse/revolution	1	65535	1024	
7.3.1.2	Invert direction	0	1	0	**0** = No **1** = Yes
7.3.1.3	Reading rate	0	4	1	Time used to calculate speed actual value. **Note:** Use value **1** in Closed Loop mode. **0** = No **1** = 1 ms **2** = 5 ms **3** = 10 ms **4** = 50 ms
7.3.1.3	Interpolation	0	1	0	If activated, the sinusoidal incremental pulses are used to calculate the polar angle in order to optimize the encoder accuracy **0**=No **1**=Yes

2.5 OPTAK monitored values

Code	Monitored value	Unit	Description
7.3.2.1	Encoder frequency	Hz	Encoder frequency in Hz
7.3.2.2	Encoder speed	rpm	Encoder Speed in rpm

2. SIN-COS WITH PULSE OUTPUT OPTION BOARD OPTAR

2.1 OPTAR layout and description



Description:	Encoder board for **VACON® NXP** with an input for *Sin/Cos* type encoder.
	Programmable control voltage for encoder. Differential two channel pulse output.
Allowed slots:	C (Sin/Cos signals can only be used in slot C)
Type ID :	16722
Terminals:	X6 D-sub 15-pin male connector with female screw lock for Sin/Cos input
	X3 4-pin screw terminal for pulse output
Jumpers:	X1 and X4 (see page 11)
Board parameters:	Yes (see page 12)

A Sin/Cos encoder produces pair of analog sinusoidal signals. There are several sine cycles (for example 1024 or 2048) per mechanical revolution.

2.2 OPTAR jumper settings

NOTE! It is recommended to use a 12 V or 15 V supply voltage instead of 5 V. OPTAR interface does not support "sense" function to compensate voltage drop with a long cabling. Therefore with 5 V supply voltage the cable length limit is about 60 meters with 0.5 mm2 wire section. With 5 V supply voltage it is recommended to use two or more wires in parallel for the supply connection.

Jumper X1 selects encoder supply voltage on the OPTAR board, see jumper settings below:

		
5V (Default) Left(top-view)	12V middle(top-view)	15V right(top-view)

NOTE! Be careful with the jumper setting, wrong voltage may damage the encoder.

Jumper X4 selects grounding mode for cable shield of encoder on the OPTAR board, see jumper settings below:

		
Left(top-view) (default, directly to ground)	Right(top-view) (Through RC-circuit to ground)	Without X4 (floating)

2.3 I/O terminals on OPTAR, encoder terminal X6

Terminal		Technical data
1	COS-	Same as SIN-
2	N.C.	
3	R+	1Vpp (±0.5V); impedance 120Ω; Max. input 350 kHz, Reference mark signal
4	R-	
5	SIN+	1Vpp (±0.5V); impedance 120Ω; Max. input 350 kHz,
6	SIN-	
7	GND	Input ground
8	COS+	Same as SIN+
9	Encoder voltage	Selectable encoder voltages: 5V, 12V and 15V Max. current consumption 300mA
10 | 15	N.C	
	Shield	

NOTE! It is recommended to use a cable which contains individual shield for each twisted pair. Use one pair for SIN+/SIN- signals, another pair for COS+/COS- signals and another pair for R+/R- signals.

2.4 I/O terminals on OPTAR, pulse output X3

Terminal		Technical data
1	A+	Incremental differential pulse output square wave, signal level RS-422 Impedance 120Ω Output current max. 50mA Max. output frequency 200KHz Output short/grounding protection
2	A-	
3	B+	Same as A+/A-
4	B-	

2.5 OPTAR 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
7.3.1.3	Interpolation	0	1	0	If activated, the sinusoidal incremental pulses are used to calculate the polar angle in order to optimize the encoder accuracy **0**=No **1**=Yes

2.6 OPTAR monitored values

Code	Monitored value	Unit	Description
7.3.2.1	Encoder frequency	Hz	Encoder frequency in Hz
7.3.2.2	Encoder speed	rpm	Encoder Speed in rpm

3. INSTALLATION

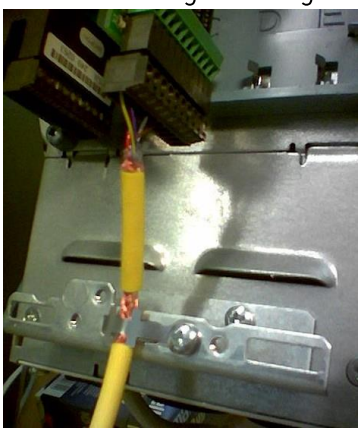
WARNING!	*Internal components and circuit boards are at high potential when the AC drive is connected to the power source. This voltage is extremely dangerous and may cause death or severe injury if you come into contact with it.*

3.1 Installing option boards

Option boards OPTBE, OPTAK and OPTAR can only be used with VACON® **NXP** drives.

OPTAK and OPTAR can be connected to **slot C**. OPTBE board can be connected to **slots C, D or E**, but Sin/Cos signals can only be used in slot C. If OPTBE board is connected to slots D or E, the Sin/Cos signals have to be disconnected using the jumpers (see chapter 1.2).
Disconnect the drive from the mains before starting the installation.

A	VACON® NXP AC drive 
B	Remove the cable cover. 

C	Open the cover of the control unit. 
D	Install the option board in correct slot on the control board of the AC drive. Make sure that the grounding plate fits tightly in the clamp. Strip the cable at such distance from the terminal that you can fix it to the frame with the grounding clamp. 

E	Make a sufficiently wide opening for your cable by cutting the grid as wide as necessary. 
F	Close the cover of the control unit and the cable cover. 

VACON®

www.danfoss.com

Document ID:
DPD01174B
Rev. B

Sales code: DOC-OPTBE/AR/AK+DLUK

Vacon Ltd
Member of the Danfoss Group
Runsorintie 7
65380 Vaasa
Finland