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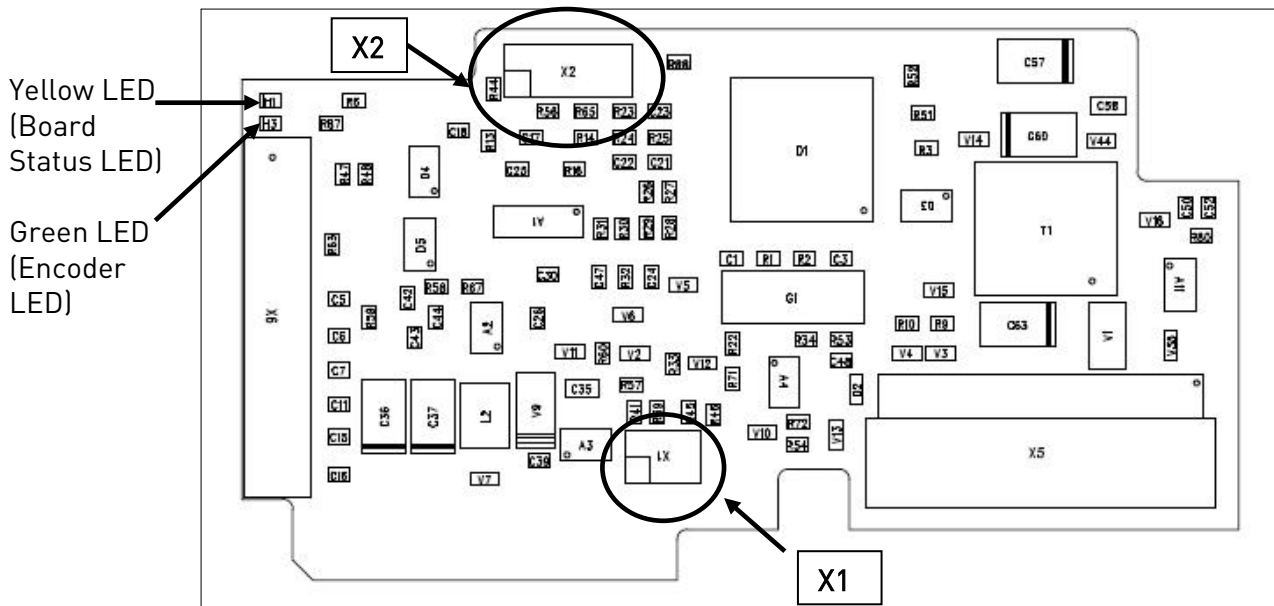
ENDAT/SSI, SIN-COS OPTION BOARD, OPT-BE
SIN-COS OPTION BOARD, OPT-AK
SIN-COS WITH PULSE OUTPUT OPTION BOARD, OPT-AR

USER MANUAL

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1.   ENDAT/SSI, SIN-COS OPTION BOARD OPT-BE

1.1   OPT-BE layout and description

Description:	Encoder board for **Vacon NXP** with an input for *EnDat/SSI* absolute encoder and *Sin/Cos* type encoder.
Allowed slots:	B, 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 4)
Board parameters:	Yes (see page 6)

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 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
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.
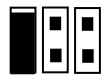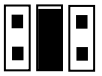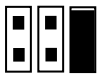
More information on EnDat/SSI: http://www.heidenhain.com.
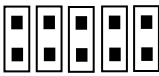
1.2 OPT-BE jumpers

NOTE!
With +5 V supply voltage, voltage drop with long cabling (about 60 m with 0.5 mm^2 wire section) can become too big for reliable operation. Using +12 V or +15 V encoders is recommended in these cases.

Jumper X1 selects encoder supply voltage on the OPT-BE board, see jumper settings below:

5V (Default)	12V	15V

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

Sin/Cos signals connected	Sin/Cos signals not connected (Default)
Note! This setting can only be used in slot C	**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   OPT-BE LEDs

There are two LEDs on the OPT-BE 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 OPT-BE, 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+, SIN+	Green/black	1Vpp (±0,5V); impedance 120Ω; Max. input 350 kHz
6	A–, SIN-	Yellow/black	
7	B+, COS+	Blue/black	1Vpp (±0,5V); impedance 120Ω; Max. input 350 kHz
8	B–, COS-	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. Use of shielded pair cables is recommended. Use one pair for SIN+/SIN- and another pair for COS+/COS- signals.

1.5   OPT-BE Parameters

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 **Note:** In modes **5** and **7**, only the absolute serial information is used. In modes **4** and **6**, also Sin/Cos signals are used. The selection of the correct mode depends on the control mode. E.g. Closed Loop motor control requires Sin/Cos information.
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   OPT-BE 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 mutliturn 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 OPT-AK

2.1   OPT-AK layout and description
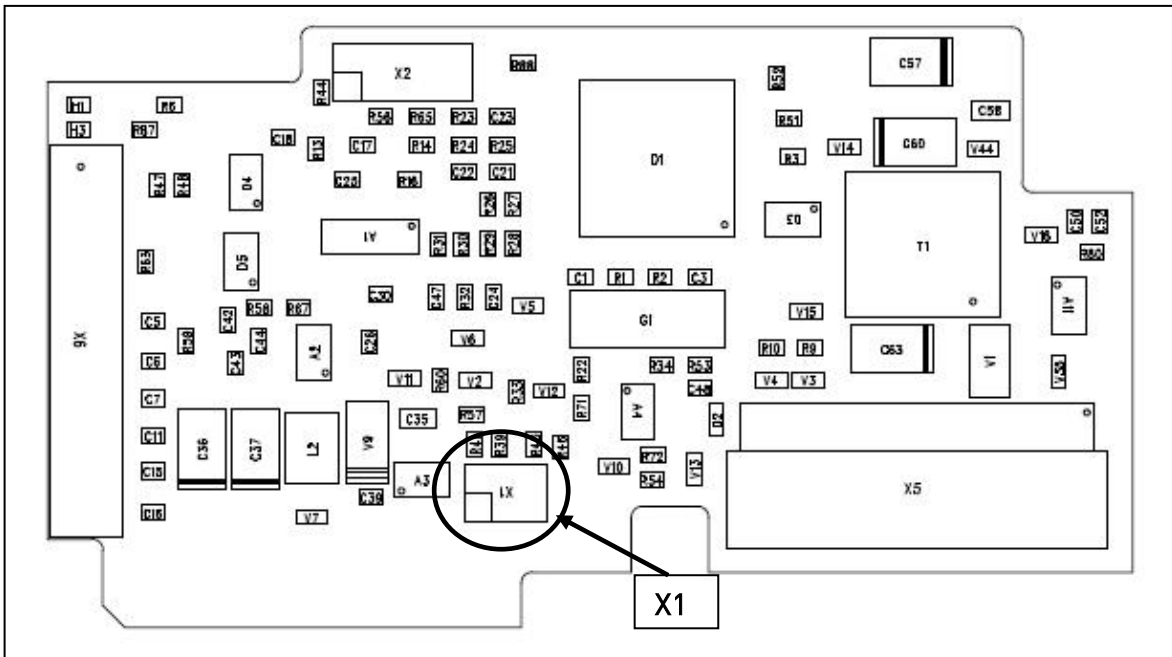
X1

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 8)

Board parameters: Yes (see page 9)

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   OPT-AK jumper settings

NOTE! With +5 V supply voltage, voltage drop with long cabling (about 60 m with 0.5 mm^2 wire section) can become too big for reliable operation. Using +12 V or +15 V encoders is recommended in these cases.

Jumper X1 selects encoder supply voltage on the OPT-AK 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 OPT-AK, encoder terminal X6

Terminal		Technical data
1	N.C.	Not Connected
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	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. Use of shielded pair cables is recommended. Use one pair for SIN+/SIN- , one pair for COS+/COS- and another pair for R+/R- signals.

2.4   OPT-AK 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   OPT-AK 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.   SIN-COS WITH PULSE OUTPUT OPTION BOARD OPT-AR

3.1   OPT-AR layout and description
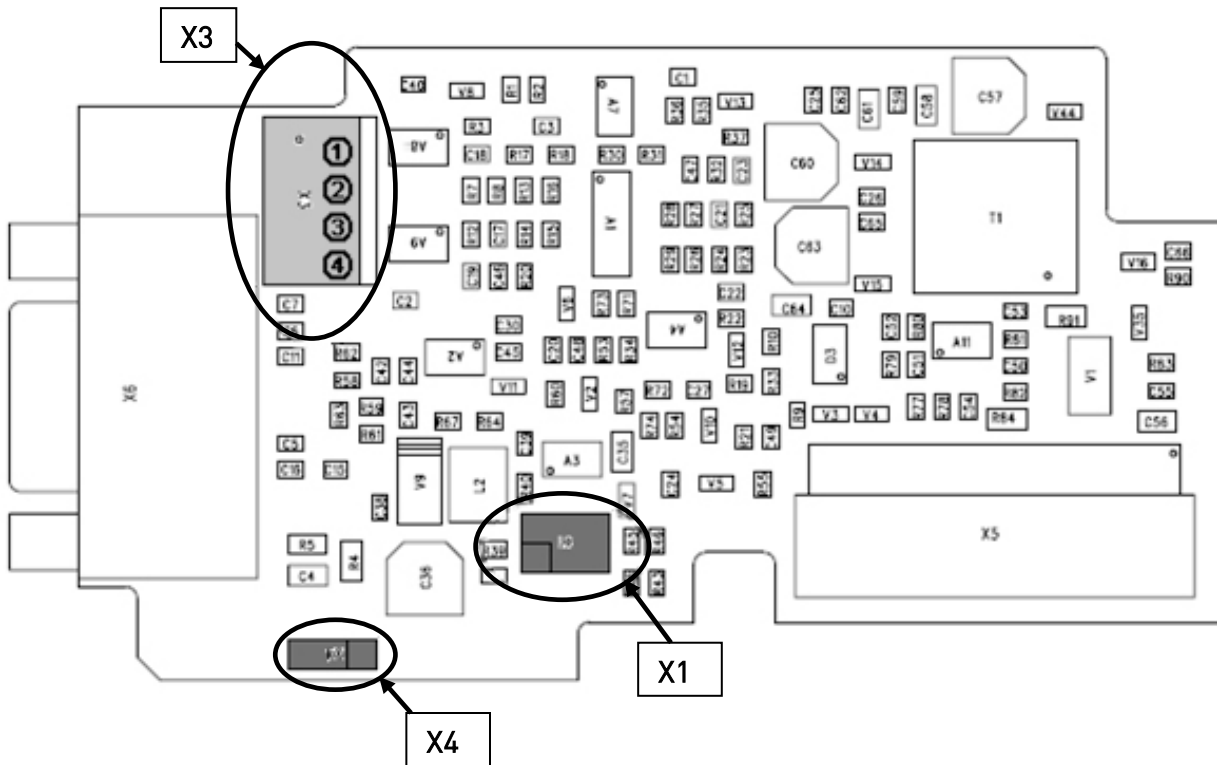
Description:	Encoder board for **Vacon NXP** with an input for *Sin/Cos* type encoder.
	Programmable control voltage for encoder. Differential two channel pulse output.
Allowed slots:	C (Sin/Cos signals can only be used in slot C)
Type ID:	16722
Terminals:	X6 D-sub 15-pin male connector with female screw 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.

3.2   OPT-AR jumper settings

NOTE! With +5 V supply voltage, voltage drop with long cabling (about 60 m with 0.5 mm^2 wire section) can become too big for reliable operation. Using +12 V or +15 V encoders is recommended in these cases.

Jumper X1 selects encoder supply voltage on the OPT-AR board, see jumper settings below:

5V (Default)	12V	15V
Left(top-view)	middle(top-view)	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 OPT-AR board, see jumper settings below:

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

3.3   I/O terminals on OPT-AR, 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! Analog Sin/Cos signals deserve some more precautions for noise immunity than pulse encoders. Use of shielded pair cables is recommended. Use one pair for SIN+/SIN- , one pair for COS+/COS- and another pair for R+/R- signals.

3.4 I/O terminals on OPT-AR, 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-	

3.5 OPT-AR 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

3.6 OPT-AR 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

4.   INSTALLATION

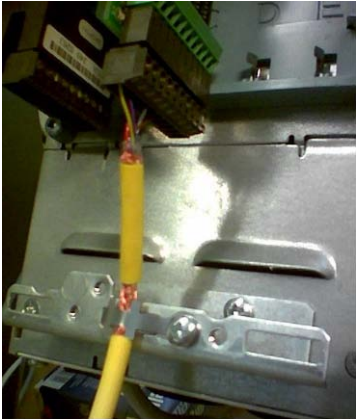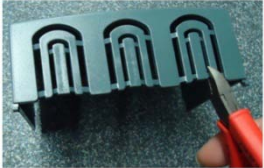| ⚠️ **WARNING!**	*Internal components and circuit boards are at high potential when the frequency converter is connected to the power source. This voltage is extremely dangerous and may cause death or severe injury if you come into contact with it.*

4.1   Installing option boards

Option boards OPT-BE, OPT-AK and OPT-AR can only be used with Vacon **NXP** drives.

OPT-AK and OPT-AR can be connected to **slot C**. OPT-BE board can be connected to **slots B, E, C or D**, but Sin/Cos signals can only be used in slot C. If OPT-BE board is connected to slots B, E or D, 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 frequency converter
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 frequency converter. 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.	

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