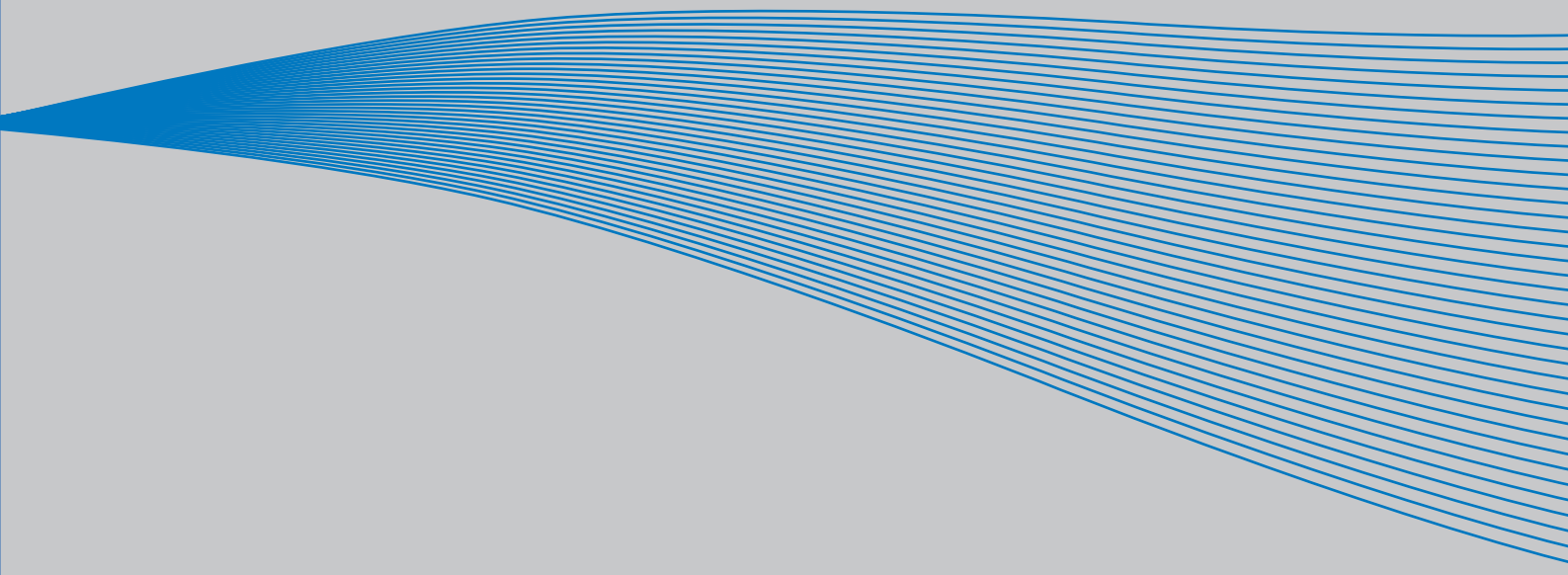
VACON NX
AC DRIVES

OPTC4

LONWORKS OPTION BOARD

USER MANUAL



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INDEX

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1. GENERAL

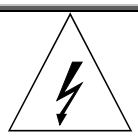
Vacon NX frequency converters can be connected to the LonWorks® network using a fieldbus board. The converter can then be controlled, monitored and programmed from the Host system.

The LonWorks® board shall be installed in slot E on the control board of the frequency converter.

LONWORKS technology has been developed by Echelon Corporation. LONWORKS network is used in applications like industry and building automation, controlling household electronics, medical instrumentation and many others. The target of the LONWORKS network is to provide a common vendor independent communication network for intelligent devices.

In a LONWORKS network, no central control or master-slave architecture is needed. Nodes on a network communicate with each other using LonTalk® protocol. Interoperable nodes use Standard Network Variable Types (SNVT) for communicating over the network. The definition of an SNVT includes units, a range, and an increment. Vacon option board uses only Standard Network Variable Types for the data types.

All network variables are either input (data is coming from the network to the device) or output (data is sent to the network by the device) network variables. When network variables on different nodes on the network have been bound together by an installation tool, passing of data is automatic between the right nodes. Only the same type of network variables can be bound together, so it is very important to have compatible interfaces.



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.

2. LONWORKS OPTION BOARD TECHNICAL DATA

2.1 General

LonWorks connections	Interface	Pluggable connector (5 mm)
Communications	Channel type	TP/FT-10
	Transfer cable	Twisted pair
	Baud rate	78 Kbit/s
Environment	Ambient operating temperature	–10°C...50°C
	Storing temperature	–40°C...70°C
	Humidity	<95%, no condensation allowed
	Altitude	Max. 1000 m
	Vibration	0.5 G at 9...200 Hz
Safety		Fulfils EN50178 standard

Table 2-1. LonWorks technical data

2.2 Physical media and wiring

LONWORKS networks can be implemented on many different physical media. Vacon OPT-C4 option board is equipped with an FT-X1 transceiver supporting the Free Topology transformer coupled network, which allows the network wire to be connected as bus, star, loop or combination of these. This media reaches a communication speed of 78kBits/s. The FT-X1 transceiver is compatible with Echelon's LPT-10 Link Power Transceiver, and these transceivers can communicate with each other on a single twisted pair cable.

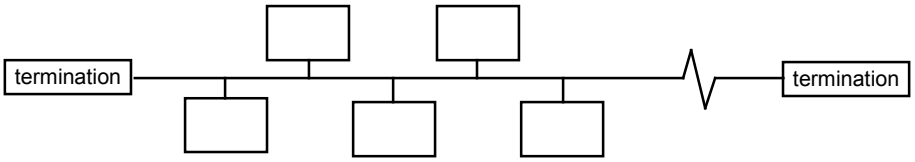


Figure 2-1. Doubly Terminated Bus Topology

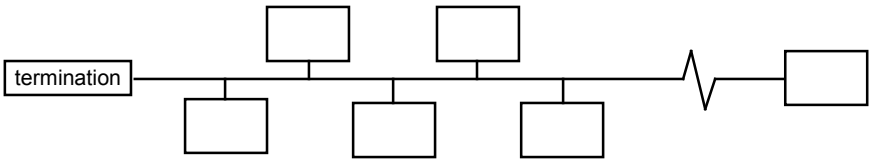


Figure 2-2. Singly Terminated Bus Topology

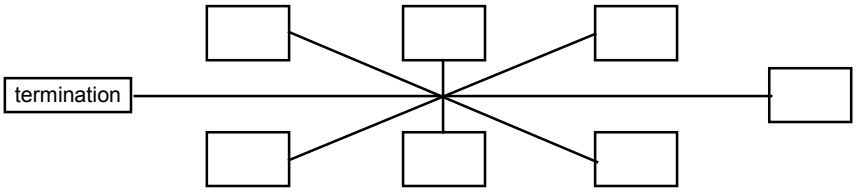


Figure 2-3. Star Topology

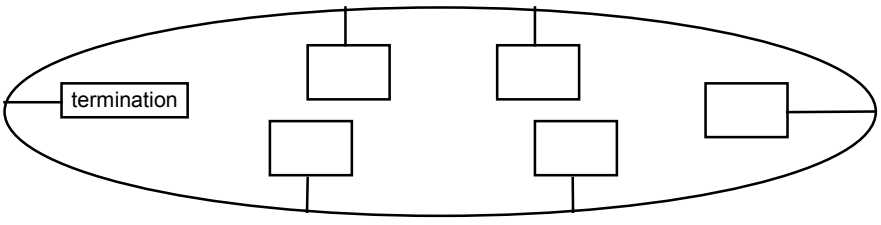


Figure 2-4. Loop Topology

Up to 64 FTT-10 transceiver nodes are allowed per network segment, the individual segments can be connected together by a router. See Table 3-1 for recommended cable types and cable lengths for FTT-10. Even if unshielded cable types are recommended to be used with this type of transceiver, it is still highly recommended to use only shielded cables with frequency

converters. Attention should be paid to proper grounding of the shield to ensure bus operation. Grounding of the shield should be done at both ends of the cable.

Cable type	Max. doubly terminated bus length	Max. free topology wire length	Max. node-to-node distance
Belden 85102 (unshielded)	2700 m	500 m	500 m
Belden 8471 LONAK 2x1,3 (unshielded)	2700 m	500 m	400 m
Level IV, 22AWG LONAK 2x2x0,65 (unshielded)	1400 m	500 m	400 m
JY (St) Y 2x2x0.8mm LONAK 2x2x0,8 (shielded)	900 m	500 m	320 m

Table 2-2. Line length for different transmission speeds

2.3 Profiles

LonMark Functional Profiles describe in detail the application layer interface, including the network variables, configuration properties, and default and power-up behaviors required on LonMark devices for specific, commonly used control functions.

2.3.1 *Variable Speed Drive Profile*

Leading manufacturers of drive technology have jointly defined the LonMark profile. The profile specifies how the drives are to be parameterized and how the setpoints and actual values are to be transmitted. This enables drives from different vendors to be exchanged. The profile contains necessary specifications for speed control and positioning. It specifies the basic drive functions while leaving sufficient freedom for application-specific expansions and further developments.

3. LONWORKS FIELDBUS BOARD LAYOUT AND CONNECTIONS

Vacon LonWorks Fieldbus Board is connected to the fieldbus through 3-pin pluggable bus connector. The communication with the control board takes place through the standard Vacon Interface Board Connector.

3.1 LonWorks OPT-C4 option board

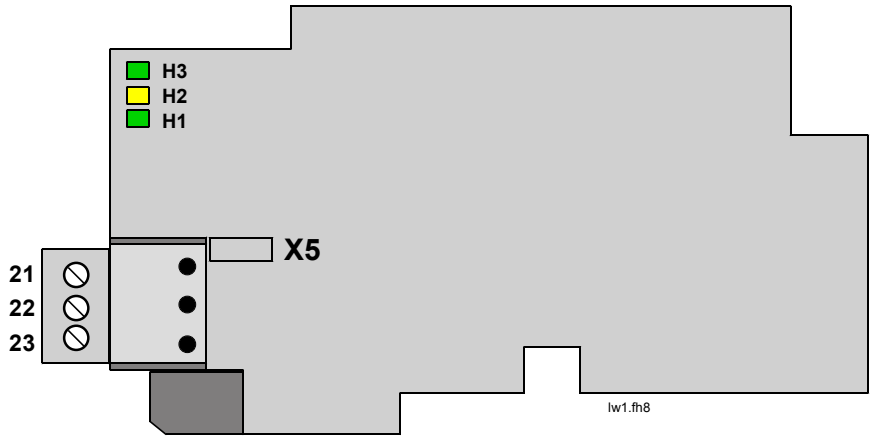


Figure 3-1. Vacon LonWorks option board OPT-C4

Signal	Connector	Description
A1	21	Data
A2	22	Data
0Shield	23	Shield

Table 3-1. OPT-C4 bus connector signals

3.2 Grounding of bus cable shield in OPT-C4

The bus cable shield can be grounded to the frame of the frequency converter through an RC filter located on the OPT-C4 board.

Note: Normally, the option board has already been installed in slot E of the control board. It is not necessary to detach the whole board for the grounding of the bus cable shield. Just detach the terminal block.

3.2.1 *Grounding the bus cable shield directly to the frequency converter frame using the RC-filter*

1 Strip about 5 cm of the cable as shown in the picture.

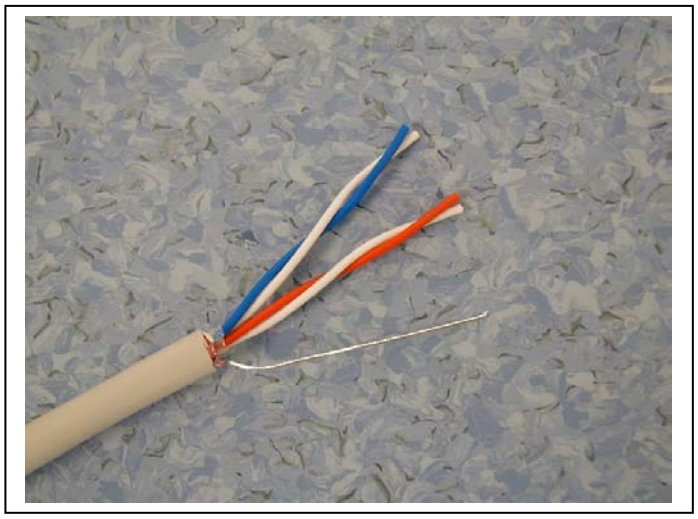


Figure 3-2.

2 Leave no more than 7 mm of the data cable outside the terminal block (Figure 3-3) and strip the data cables at about 5 mm to fit in the terminals (Figure 3-4).

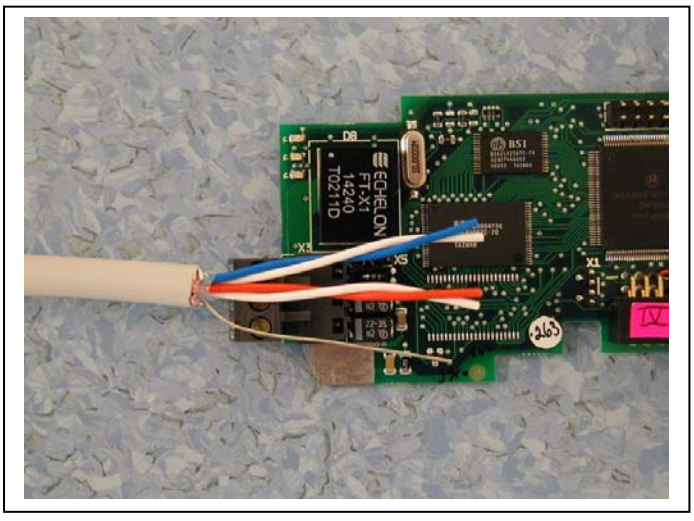


Figure 3-3.

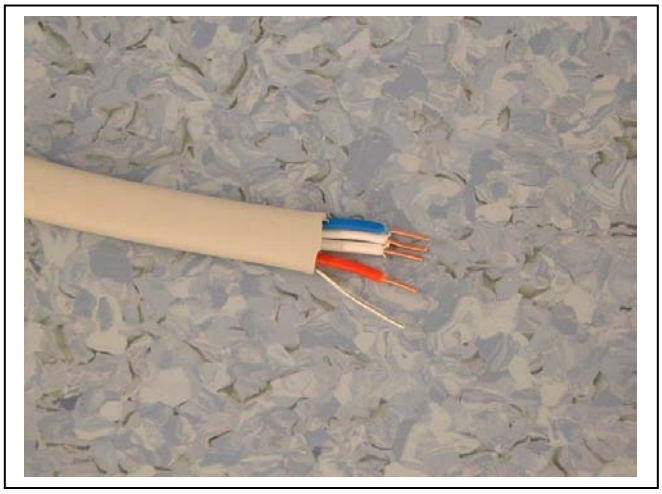


Figure 3-4.

3 Insert the data cables and the shield in their respective terminals. See Table 3-1.

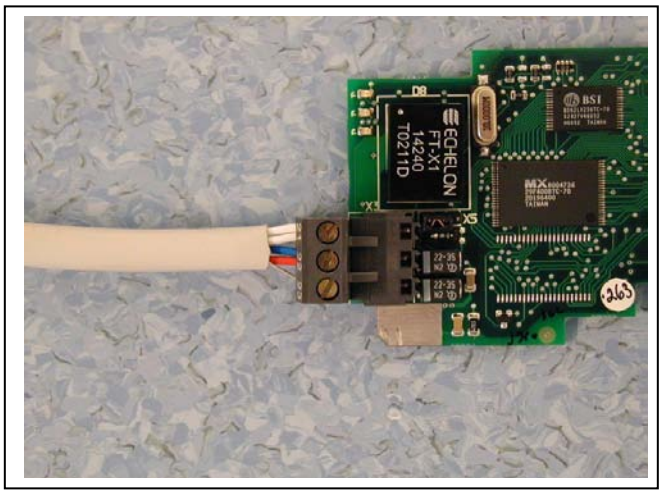


Figure 3-5.

4 If the LonWorks board was detached from the control unit place it into slot E of the control board (see board installation on page 12). Otherwise attach the terminal block. Fix the cable on the frame with the clamp.

Figure 3-6.

3.3 Bus termination resistors

To assure a proper data transmission, termination of the network segments is required. Depending on the type of network, either one or two terminations are necessary. Free topology network segment requires only one termination whereas a doubly terminated bus topology requires two.
The jumper X5 on the Vacon LonWorks board must be set accordingly. Use 94-ohm termination resistance when only one termination is needed and 47-ohm for two terminations.

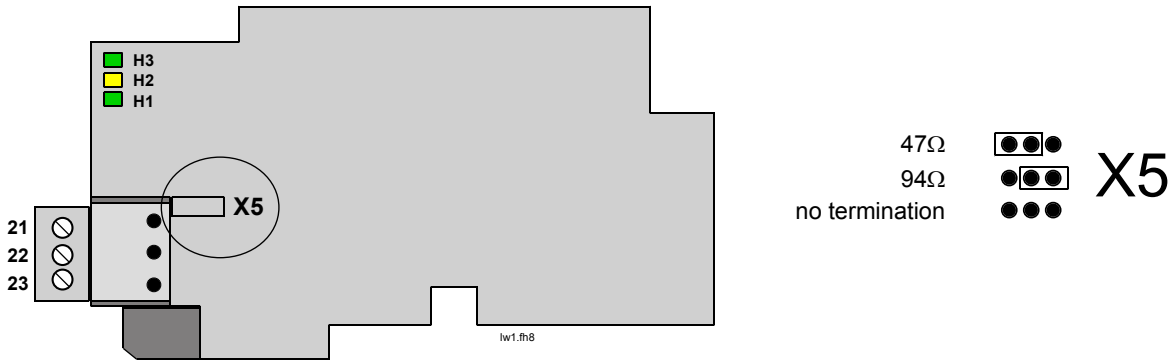
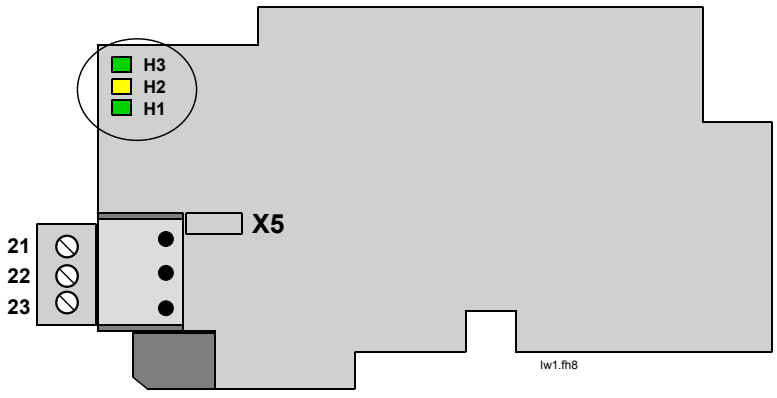


Figure 3-7. Using jumper X5 to set the bus termination.

3.4 LED indications

The three LED indications next to the connector show the present statuses of the Neuron (green H3), the LonWorks board (yellow H2) and the Fieldbus Module (green H1). From the user's viewpoint, the first two are the most significant.

Figure 3-8. LED indications on the LonWorks board



H3	Neuron Service LED	GREEN
H2	Board Status	YELLOW
H1	Bus Status	GREEN

Neuron status (H3) GREEN

LED is:	Meaning:	State Code
OFF	Configured	4
ON	Applicationless and Unconfigured	3
Flashing	Unconfigured	2

Board status LED (H2) YELLOW

LED is:	Meaning:
OFF	Option board not activated
ON	Option board in initialisation state waiting for activation command from the frequency converter
Blinking fast (once/1 s)	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 on option board

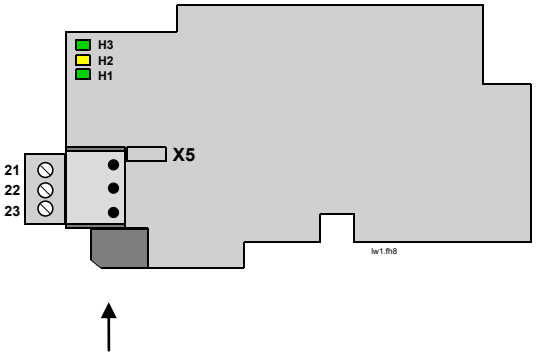
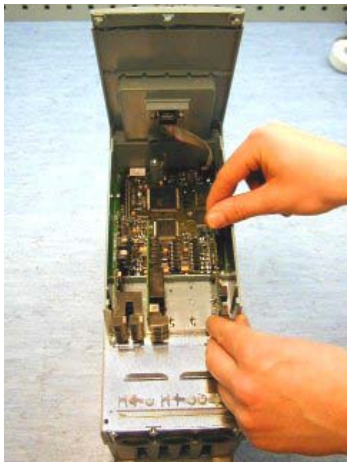
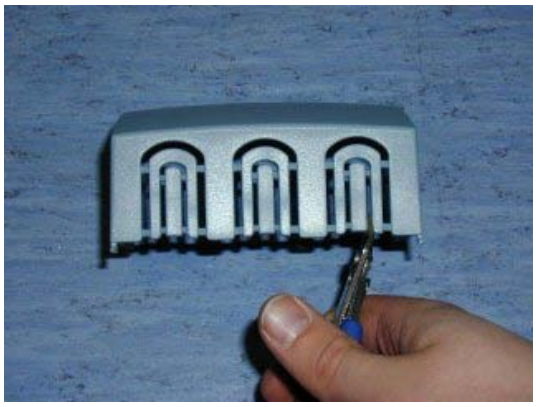
Bus status LED (H1) GREEN

LED is:	Meaning:
OFF	Fieldbus module is waiting for parameters from the frequency converter No external communication
ON	Fieldbus module is activated Parameters received and module activated Module is waiting for messages from the bus
Blinking very fast for 5s (once/0.2 s)	Fieldbus module has received a wink request.
Blinking fast (once/1 s)	Module is activated and receiving messages from the bus
Blinking slow (once/5 s)	Module is in FAULT state No messages from Net within the watchdog time Bus broken, cable loose

4. INSTALLATION OF VACON NX LONWORKS BOARD

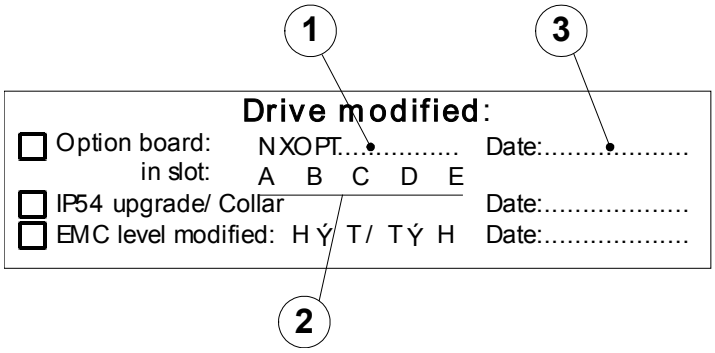
NOTE	MAKE SURE THAT THE FREQUENCY CONVERTER **IS SWITCHED OFF** BEFORE AN OPTION OR FIELDBUS BOARD IS CHANGED OR ADDED!

A	Vacon NX frequency converter	
B	Remove the cable cover.	
C	Open the cover of the control unit.	

D	Install LonWorks option board in slot E on the control board of the frequency converter. Make sure that the grounding plate (see below) fits tightly in the 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.	

4.1 Board information sticker

The LonWorks option board package delivered by the factory includes a sticker (shown below). Please mark the board type (1), the slot into which the board is mounted (2) and the mounting date (3) on the sticker. Finally, attach the sticker on your drive.



5. COMMISSIONING

READ FIRST CHAPTER 8 'COMMISSIONING' IN VACON NX USER'S MANUAL (Document nr. ud00701, please visit http://www.vacon.com/support/documents.html).

5.1 Fieldbus board parameters

The Vacon LonWorks board is commissioned with the control keypad by giving values to appropriate parameters in menu **M7** (for locating the expander board menu, see Vacon NX User's Manual, Chapter 7).

Expander board menu (M7)

The *Expander board menu* makes it possible for the user 1) to see what expander boards are connected to the control board and 2) to reach and edit the parameters associated with the expander board.
Enter the following menu level **(G#)** with the *Menu button right*. At this level, you can browse through slots A to E with the *Browser buttons* to see what expander boards are connected. On the lowermost line of the display you also see the number of parameter groups associated with the board.
If you still press the *Menu button right* once you will reach the parameter group level including one parameter *(Service pin)*.

LonWorks parameters

To commission the LonWorks board, enter the parameter G7.5.1.1 from the *Parameters* group (G7.5.1). Give the desired value to the LonWorks parameter.

#	Name	Default	Range	Description
1	Service Pin	0	0..1	Broadcasts a service pin message to the network.

Table 5-1. LonWorks parameters

5.2 Start-up test

Frequency converter application

Choose Fieldbus *(Bus/Comm)* for the active control place (see Vacon NX User's Manual, Chapter 7.3.3).

Master software

1. Write 100.0 1 to *nviDrvSpeedStpt*.
2. Frequency converter status is RUN and output frequency is 1.00 * *nviDrvSpeedScale*
3. Write 0.0 0 to *nviDrvSpeedStpt*
4. Frequency converter status is STOP.

If nvoDrvStats bit 3 = 1 Status of frequency converter is FAULT.

6. LONWORKS INTERFACE

Features of the LonWorks interface:

- Direct control of Vacon NX (e.g. Run, Stop, Direction, Speed reference, Fault reset)
- Full access to all Vacon NX parameters
- Monitor Vacon NX status (e.g. Output frequency, Output current, Fault code)

6.1 General

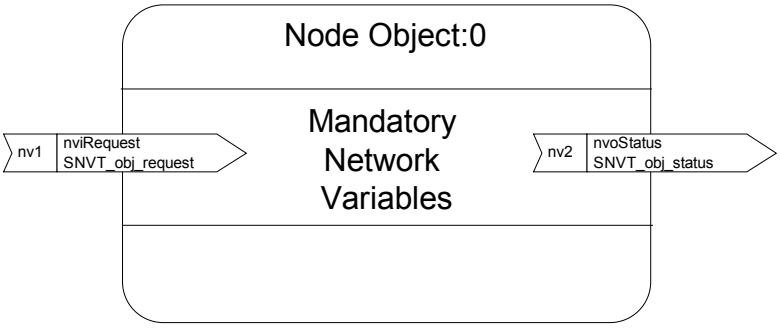


Figure 6-1. The Node object diagram.

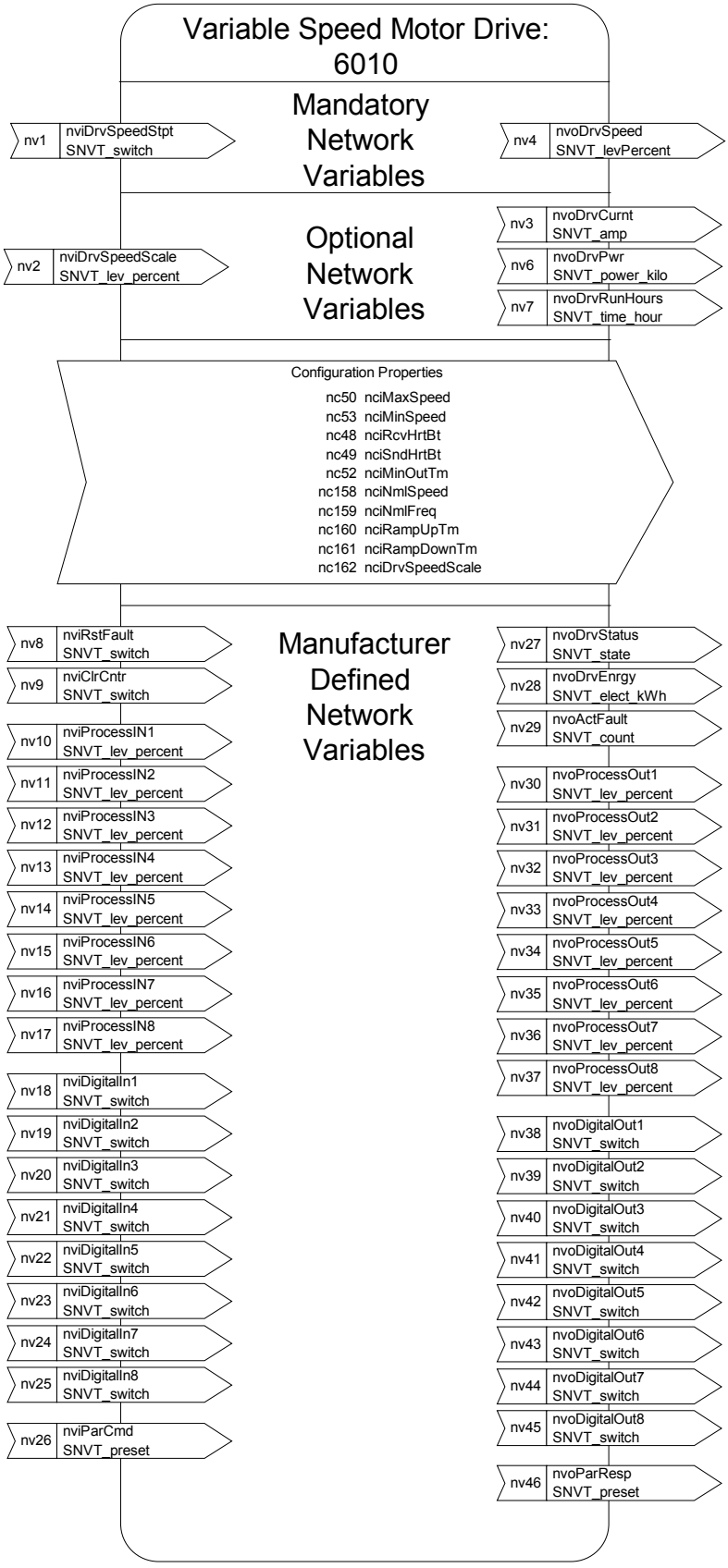


Figure 6-2. The Variable Speed Motor Drive object diagram.

6.2 Input Network Variables

Function	Variable Name	SNVT type	Min. Value	Max. Value
Node Object request	nviRequest	SNVT_obj_request		
Driver speed setpoint	nviDrvSpeedStpt	SNVT_switch	n/a	n/a
Driver set point speed scaling	nviDrvSpeedScale	SNVT_lev_percent	-163.840%	163.830%
Reset fault	nviRstFault	SNVT_switch	n/a	n/a
Clear kWh trip or Drive total running hours trip counters	nviClrCntr	SNVT_switch	1	2
Process In Data	nviProcessIn1..8	SNVT_lev_percent	0	65535
Digital Inputs	nviDigitalIn1..8	SNVT_switch	0	4
Parameter Set	nviParCmd	SNVT_preset	n/a	n/a

Table 6-1. Network input variables

nviRequest

This input network variable provides the mechanism to request a particular mode for the Node object or the Variable Speed Motor Drive object within a node. Supported requests are RQ_NORMAL, RQ_UPDATE_STATUS, RQ_CLEAR_STATUS, RQ_REPORT_MASK, RQ_DISABLED, RQ_ENABLE and RQ_CLEAR_ALARM.

nviDrvSpeedStpt

This input network variable provides control and a low resolution speed setpoint

state	value	command
0	NA	Stop
1	0	0%
1	1 to 200	0.5 to 100%
1	201 to 255	100.0%
0xFF	NA	Auto

Table 6-2.

nviDrvSpeedScale

This input netork variable provides scaling for *nviDrvSpeedStpt*. Negative values indicate a motor direction in reverse. For example, if the *nviDrvSpeedStpt* value is 50% and *nviDrvSpeedScale* -150%, then the actual speed setpoint is –75%, or 0.75 times the nominal speed in reverse direction. The valid range is –163,840% to 163,830. The value *0x7FFF* (+163,835%) will be handled as an invalid value. Default value is determined by *nciDrvSpeedScale*. This value will be adopted at power-up and in case of not receiving an update within the specified Receive Heartbeat time.

nviRstFault

This input network variable provides a fault reset. Setting value 1 for State and a non-zero value for Value will reset an active fault in Vacon NX. Default value is 0; 0.

State	Value	Command
0	any	no action (0; 0)
1	0	no action (0; 1)
1	> 0	reset fault (200 ; 0)
-1 (0xFF)	any	invalid (no action)

Table 6-3.

nviClrCntr

This input network variable provides a mechanism to clear the kWh trip counter or the Drive total running hours trip counter.

1 MWh trip counter
2 Operation day trip counter

nviProcessIn1..8

These input network variables are sent directly to the application (see more detailed explanation in chapter 6.5 Process data) The valid range is 0 to 65535 (-163,840 to 163,835).

nviDigitalIn1..8

These input network variables are sent directly to the application (see more detailed explanation in chapter 6.5 Process data) Default value is 0; 0.

state	value	command
0	any	off (0; 0)
1	0	off (0; 1)
1	> 0	on (200; 1)
-1 (0xFF)	any	invalid (no action)

Table 6-4.

nviParCmd

This input network variable is used to read and write the parameters. The parameter addresses are determined in the application. Every parameter and actual value has been given an ID number in the application. The ID numbering of the parameter as well as the parameter ranges and steps can be found in the application manual in question. The parameter value must be given without decimals. Find the ID numbers of each parameter/actual value in the application manual. The ID numbers are grouped as follows:

Parameter ID	Group	Description
0	Not used	
1 ... 98	**Actual Values**	
99	**Active Fault Code**	
100	Not Used	
101... 899	**Parameter**	
900 ... 999	Reserved	Reserved for LonWorks board internal usage
1000	Not Used	
1001...1999	**Parameter**	

Table 6-5. Grouping of ID numbers

Examples

Data format in examples is:
- learn selector <byte(3) byte(2) byte(1) byte(0)> day hour minute second millisecond
x = meaningless.

Example1

Write to parameter number 102 (Max frequency "Basic Application par. ID102") value 4500 (45Hz).

Write command to nviParSet
- LN_LEARN_CURRENT 102 <x x 11 94> x x x x

If the write command is successful then nvoParOut value is
- LN_LEARN_CURRENT 102 <0 0 11 94> 0 0 0 0

If the write command fails then nvoParOut value is
- LN_NUL 102 <0 0 11 94> 0 0 0 0

Example2

Read parameter number 112 (Nominal speed of the motor "Basic Application par. ID112") default value 1440 (1440 rpm).
Read command to nviParSet
- LN_RECALL 112 <x x x x> x x x x

If the read command is successful then nvoParOut value is
- LN_RECALL 112 <0 0 5 A0> 0 0 0 0

If the read command fails then nvoParOut value is
- LN_ LN_NUL 112 <0 0 0 0> 0 0 0 0

6.3 Output Network Variables

Function	Variable Name	SNVT type	Min.	Max. Value
Node Object status	nvoStatus	SNVT_obj_status		
Drive speed feedback	nvoDrvSpeed	SNVT_lev_percent	-163.840%	+163.830%
Actual motor current	nvoDrvCurnt	SNVT_amp	0.0A	3276.7A
Actual drive power	nvoDrvPwr	SNVT_power_kilo	0,0 kW	6553,5 kW
Drive total	nvoDrvRunHours	SNVT_time_hour	0 h	65535
Status word	nvoDrvStatus	SNVT_state	n/a	n/a
kWh trip counter	nvoDrvEnrgy	SNVT_elect_kwh	0kWh	65535kWh
Active fault code	nvoActFault	SNVT_count	0	41
Process Out	nvoProcessOut1..8	SNVT_ lev_percent	0	65535
Digital Out	nvoDigitalOut1..8	SNVT_switch	0	4
Parameter Out	nvoParResp	SNVT_preset	-	-

Table 6-6. Network output variables

NvoStatus
This output network variable reports the status for Node object or Variable Speed Motor Drive object.

Field	Description
object_id	ID of object within node
invalid_id	1 means requested ID is not implemented in this node
invalid_request	1 means request for unimplemented function
disabled	1 means object disabled
electrical_fault	1 means drive is faultefd
in_alarm	1 means drive is in alarm
report_mask	1 means status is an event mask

Table 6-7.

nvoDrvSpeed
This output network variable provides the speed of the drive as a percentage of the nominal speed.

nvoDrvCurnt
This output network variable provides the drive output current in amperes.

nvoDrvPwr
This output network variable provides the drive output power in kW.

nvoDrvRunHours
This output network variable provides the drive resettable operation time counter for the motor in running hours. The maximum value for used SNVT is 65535 h. On the frequency converter the value can go much higher. If the counter exceeds the SNVT's maximum value, the network variable stays at its maximum. In such cases the real value can be seen on Vacon NX's operating keypad.

nvoDrvStatus
This output network variable provides the drive status.

Bit	Description	
	Value = 0	Value = 1
0	Not Ready	Ready
1	FC stopped	Running
2	Clockwise	Counterclockwise
3	No fault	Fault active
4	No warning	Warning active
5	Reference ≠ Actual value	Reference = Actual value

Table 6-8. Status word bit descriptions

nvoDrvEnrgy
This output network variable provides the drive resettable energy consumption counter. The maximum value for used SNVT is 65535 kWh. On the frequency converter the value can go much higher. If the counter exceeds the SNVT's maximum value, the network variable stays at its maximum. In such cases the real value can be seen on Vacon NX's operating keypad.

nvoActFault
This output network variable provides the drive active fault code. If the value is 0 the frequency converter has no fault. See the fault code list in Vacon NX Frequency Converter User's Manual for fault identification.

nvoProcessOut1..8
These output network variables are sent directly from the application (see more detailed explanation in chapter 6.5 Process data) The valid range is 0 to 65535 (-163,840 to 163,835).

nvoDigitalOut1..8
These output network variables are sent directly from the application (see more detailed explanation in chapter 6.5 Process data).

state	value	command
0	0	off (0; 0)
1	200 (0xC8)	on (200; 1)
-1 (0XfF)	any	invalid (NULL)

Table 6-9.

nvoParResp
explained in chapter nviParSet.

6.4 Network Configuration Variables

Function	Variable Name	SNVT type
Maximum motor speed	nciMaxSpeed	SCPTmaxSetpoint
Minimum motor speed	nciMinSpeed	SCPTminSetpoint
Receive heartbeat time	nciRcvHrtBt	SCPTmaxRcvTime
Send heartbeat time	nciSndHrtBt	SCPTmaxSndTime
Minimum output time	nciMinOutTime	SCPTminSndTime
Nominal motor speed in RPM	nciNmlSpeed	SCPTnomRPM
Nominal motor frequency	nciNmlFreq	SCPTnomFreq
Minimum ramp up time	nciRampUpTm	SCPTrampUpTm
Minimum ramp down time	nciRampDownTm	SCPTrampDownTm
Default value for nviDrvSpeedScale	nciDrvSpeedScale	SCPTdefScale

Table 6-10. Network configuration variables

nciMaxSpeed

This configuration property is used to define the maximum speed of a motor. The value is entered as a percentage of nominal speed in RPM, as defined by the Nominal Speed (nciNmlSpeed) configuration value. The value of the maximum speed must be validated against the value of the minimum speed as follows:

-163.840 ≤ minimum speed ≤ maximum speed ≤ 163.830

nciMinSpeed

This configuration property is used to define the minimum speed of the motor. The value is entered as a percentage of nominal speed in RPM, as defined by the Nominal Speed (nciNmlSpeed) configuration value. The value of the minimum speed must be validated against the value of the maximum speed as follows:

-163.840 ≤ minimum speed ≤ maximum speed ≤ 163.830

nciRcvHrtBt

This configuration property is used to control the maximum time that elapses after the last update of the network variables nviDrvSpeedStpt or nviDrvSpeedScale before the VSD object starts to use the default values.

nciSndHrtBt

This configuration property defines the maximum period that expires before the network variables nvoDrvSpeed, nvoDrvCurnt and nvoDrvPwr are automatically updated.

nciMinOutTime
This configuration property defines the minimum period of automatic network variable tansmission.

nciNmlSpeed
This configuration property is used to provide the nominal speed of the motor in RPM. This value is necessary to determine the minimum and maximum speeds for the motor, based on the configuration properties nciMinSpeed, nciMaxSpeed (entered as a percentage of nominal speed).

nciNmlFreq
This configuration property is used to provide the nominal frequency for the motor.

nciRampUpTm
Defines the acceleration time for Vacon NX. The valid range is 0.0 to 6,553.4 sec (0.1 sec).

nciRampDownTm
Defines the deceleration time for Vacon NX. The valid range is 0.0 to 6,553.4 sec (0.1 sec).

nciDrvSpeedScale
This configuration property is used as the default value for *nviDrvSpeedScale*. This value will be adopted at power-up and in case no input variable within the specified Receive Heartbeat time is received.

6.5 Process data

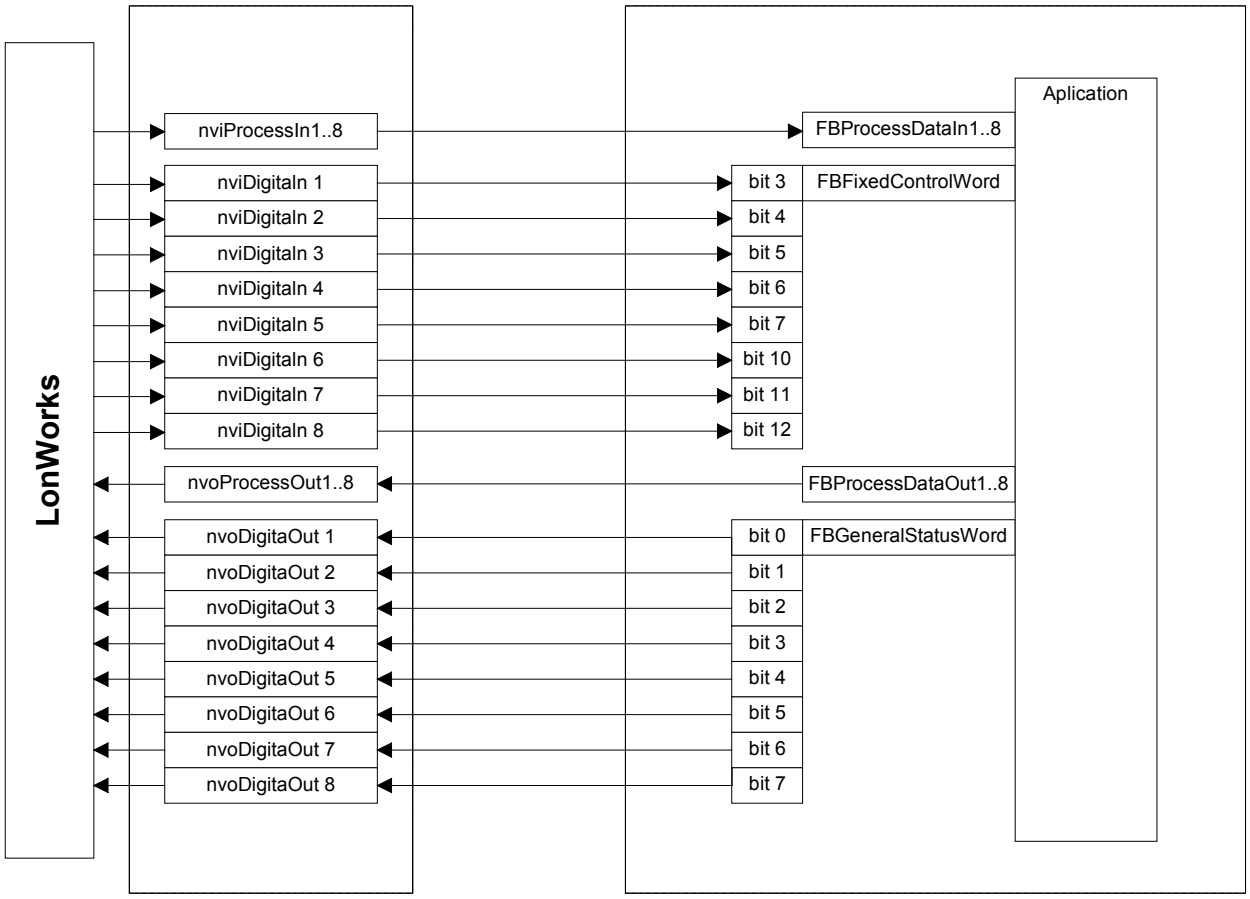


Figure 6-3. Control of frequency converter through LonWorks

7. FAULT TRACKING

The table below presents the faults related to the LonWorks option board. For more information, see also Vacon NX User's Manual, Chapter 9.
The **LonWorks option board status LEDs** are described in more detail in Chapter 3.4.

Fault code	Fault	Possible cause	Correcting measures
37	Device change	Option board changed.	Reset
38	Device added	Option board added.	Reset
39	Device removed	Option board removed.	Reset
40	Device unknown	Unknown option board.	
53	Fieldbus fault	The received heartbeat time has expired.	Check the installation. If installation is correct contact the nearest Vacon distributor.
54	Slot fault	Defective option board or slot	Check the board and slot. Contact the nearest Vacon distributor.

Table 7-1. LonWorks option board faults

You can define with parameters how the frequency converter shall react to certain faults:

Code	Parameter	Min	Max	Unit	Step	Default	ID	Note
P2.7.22	Response to fieldbus fault	0	3		1	0	733	0=No response 1=Warning 2=Fault,stop acc. to 2.4.7 3=Fault,stop by coasting
P2.7.23	Response to slot fault	0	3		1	0	734	0=No response 1=Warning 2=Fault,stop acc. to 2.4.7 3=Fault,stop by coasting

Table 7-2. Frequency converter responses to faults

8. APPENDIX 1

Process Data OUT

The nodes can read the frequency converter's actual values using process data variables. *Basic, Standard, Local/Remote, Multi-Step, PID control and Pump and fan control* applications use process data as follows:

Data	Value	Unit	Scale
Process data OUT 1	Output Frequency	Hz	0,01 Hz
Process data OUT 2	Motor Speed	rpm	1 rpm
Process data OUT 3	Motor Current	A	0,1 A
Process data OUT 4	Motor Torque	%	0,1 %
Process data OUT 5	Motor Power	%	0,1 %
Process data OUT 6	Motor Voltage	V	0,1 V
Process data OUT 7	DC link voltage	V	1 V
Process data OUT 8	Active Fault Code	-	-

The *Multipurpose Control Application* has a selector parameter for every Process Data. The monitoring values and drive parameters can be selected using the ID number (see NX All in One Application Manual, Tables for monitoring values and parameters). Default selections are as in the table above.

Process Data IN

Process Data is used with All-inOne applications as follows:

Basic, Standard, Local/Remote, Multi-Step applications

Data	Value	Unit	Step
PD1 – PD8	Not used	-	-

Multipurpose control application

Data	Value	Unit	Step
Process Data IN1	Torque Reference	%	0.1%
Process Data IN2	Free Analogue INPUT	%	0.01%
Process Data IN3	Adjust Input	%	0.01%
PD3 – PD8	Not Used	-	-

PID control and Pump and fan control applications

Data	Value	Unit	Step
Process Data IN1	Reference for PID controller	%	0.01%
Process Data IN2	Actual Value 1 to PID controller	%	0.01%
Process Data IN3	Actual Value 2 to PID controller	%	0.01%
PD4–PD8	Not Used	-	-

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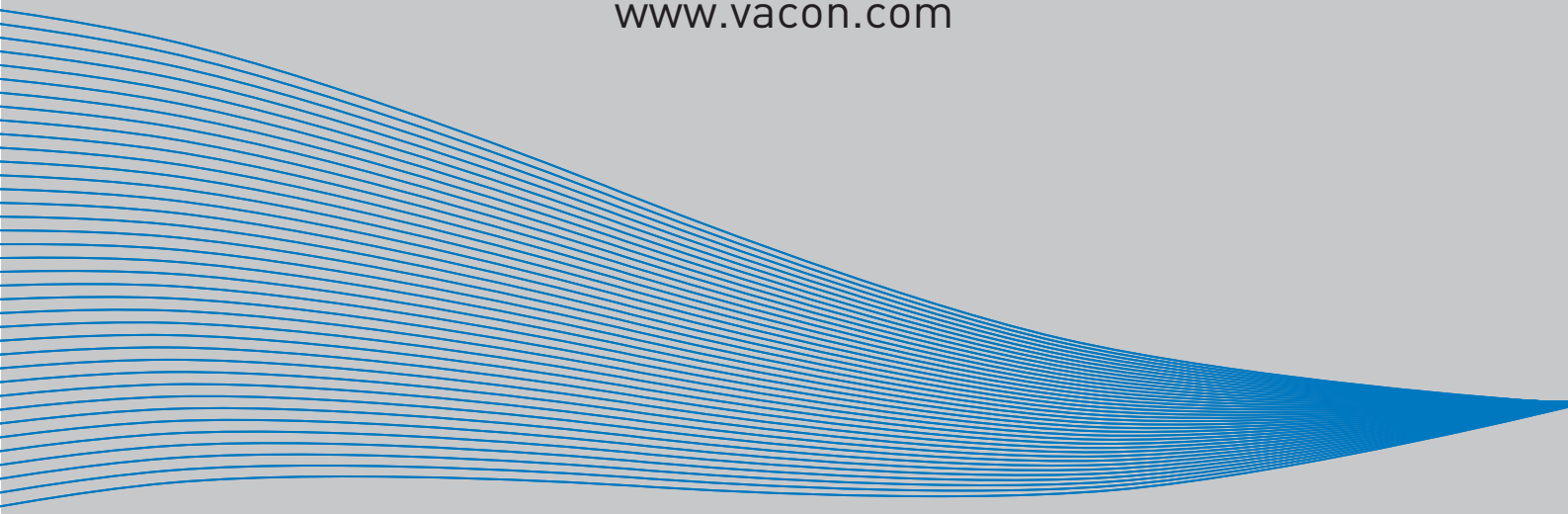

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