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1 Introduction

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1.1 About this User Manual

Conventions

In the two following charts you will find the conventions used in the user manual regarding utilized spellings and symbols.

<table>
<thead>
<tr>
<th>Style</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bold</strong></td>
<td>Blocks, surface elements, window- and dialog names of the software. Accentuation of warnings and advices.</td>
</tr>
<tr>
<td><strong>[OK]</strong></td>
<td>Push buttons in brackets</td>
</tr>
<tr>
<td>**File</td>
<td>Save**</td>
</tr>
<tr>
<td><strong>Microsoft</strong></td>
<td>Legally protected proper names and side notes.</td>
</tr>
<tr>
<td><strong>Source Code</strong></td>
<td>File name and source code.</td>
</tr>
<tr>
<td><strong>Hyperlink</strong></td>
<td>Hyperlinks and references.</td>
</tr>
<tr>
<td><strong>&lt;CTRL&gt;+&lt;S&gt;</strong></td>
<td>Notation for shortcuts.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Symbol</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Warning" /></td>
<td>This symbol calls your attention to warnings.</td>
</tr>
<tr>
<td><img src="image" alt="Information" /></td>
<td>Here you can obtain supplemental information.</td>
</tr>
<tr>
<td><img src="image" alt="Additional Information" /></td>
<td>Here you can find additional information.</td>
</tr>
<tr>
<td><img src="image" alt="Example" /></td>
<td>Here is an example that has been prepared for you.</td>
</tr>
<tr>
<td><img src="image" alt="Instructions" /></td>
<td>Step-by-step instructions provide assistance at these points.</td>
</tr>
<tr>
<td><img src="image" alt="Edit Files" /></td>
<td>Instructions on editing files are found at these points.</td>
</tr>
<tr>
<td><img src="image" alt="Do not Edit" /></td>
<td>This symbol warns you not to edit the specified file.</td>
</tr>
</tbody>
</table>
1.1.1 Certification


1.1.2 Warranty

Restriction of warranty  We reserve the right to change the contents of the documentation and the software without notice. Vector Informatik GmbH assumes no liability for correct contents or damages which are resulted from the usage of the documentation. We are grateful for references to mistakes or for suggestions for improvement to be able to offer you even more efficient products in the future.

1.1.3 Registered Trademarks

Registered trademarks  All trademarks mentioned in this documentation and if necessary third party registered are absolutely subject to the conditions of each valid label right and the rights of particular registered proprietor. All trademarks, trade names or company names are or can be trademarks or registered trademarks of their particular proprietors. All rights which are not expressly allowed are reserved. If an explicit label of trademarks, which are used in this documentation, fails, should not mean that a name is free of third party rights.

► Windows, Windows 7, Windows 8.1, Windows 10 are trademarks of the Microsoft Corporation.
1.2 Important Notes

1.2.1 Safety Instructions and Hazard Warnings

Caution!
In order to avoid personal injuries and damage to property, you have to read and understand the following safety instructions and hazard warnings prior to installation and use of this interface. Keep this documentation (manual) always near the interface.

1.2.1.1 Proper Use and Intended Purpose

Caution!
The interface is designed for analyzing, controlling and otherwise influencing control systems and electronic control units. This includes, inter alia, bus systems like CAN, LIN, K-Line, MOST, FlexRay, Ethernet, BroadR-Reach and/or ARINC 429.

The interface may only be operated in a closed state. In particular, printed circuits must not be visible. The interface may only be operated (i) according to the instructions and descriptions of this manual; (ii) with the electric power supply designed for the interface, e.g. USB-powered power supply; and (iii) with accessories manufactured or approved by Vector.

The interface is exclusively designed for use by skilled personnel as its operation may result in serious personal injuries and damage to property. Therefore, only those persons may operate the interface who (i) have understood the possible effects of the actions which may be caused by the interface; (ii) are specifically trained in the handling with the interface, bus systems and the system intended to be influenced; and (iii) have sufficient experience in using the interface safely.

The knowledge necessary for the operation of the interface can be acquired in work-shops and internal or external seminars offered by Vector. Additional and interface specific information, such as „Known Issues“, are available in the „Vector KnowledgeBase“ on Vector’s website at www.vector.com. Please consult the „Vector KnowledgeBase“ for updated information prior to the operation of the interface.
### 1.2.1.2 Hazards

**Caution!**

The interface may control and/or otherwise influence the behavior of control systems and electronic control units. Serious hazards for life, body and property may arise, in particular, without limitation, by interventions in safety relevant systems (e.g. by deactivating or otherwise manipulating the engine management, steering, airbag and/or braking system) and/or if the interface is operated in public areas (e.g. public traffic, airspace). Therefore, you must always ensure that the interface is used in a safe manner. This includes, inter alia, the ability to put the system in which the interface is used into a safe state at any time (e.g. by „emergency shutdown“), in particular, without limitation, in the event of errors or hazards.

Comply with all safety standards and public regulations which are relevant for the operation of the system. Before you operate the system in public areas, it should be tested on a site which is not accessible to the public and specifically prepared for performing test drives in order to reduce hazards.

### 1.2.1.3 Disclaimer

**Caution!**

Claims based on defects and liability claims against Vector are excluded to the extent damages or errors are caused by improper use of the interface or use not according to its intended purpose. The same applies to damages or errors arising from insufficient training or lack of experience of personnel using the interface.
# 2 Device Description

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2.1 Scope of Delivery

Contents

The delivery includes:

► VN5640 Ethernet/CAN interface
► Vector power supply ODU MINI-SNAP 24 V (part number 05068)
► USB cable 3.0 (A-B, 1.8m) (part number 05092)

2.2 Introduction

About the VN5640

The VN5640 is a Vector network interface which supports the Ethernet physical layer 10BASE-T, 100BASE-T1 (OPEN Alliance BroadR-Reach), 100BASE-TX and 1000BASE-T. 100BASE-T1 is a physical layer especially used in automotive electronics. In addition, the alternative Interface Option 1000BASE-T1 supports 1000BASE-T1.

![VN5640 Ethernet/CAN Interface](image)

The VN5640 enables the transparent monitoring and logging of Ethernet data streams and CAN events with minimal latency times and high resolution time stamps. With this, the VN5640 enables a variety of applications such as simple bus analyses, complex remaining bus simulations as well as diagnostic and calibration (e.g. with CANalyzer.Ethernet/CANoe.Ethernet).

Highlights

Features of the VN5640:

► Support of 16 independent Ethernet ports
► Support of 100BASE-T1 (OPEN Alliance BroadR-Reach)
► Support of standard Ethernet (10BASE-T/100BASE-TX/1000BASE-T)
► Support of 1000BASE-T1 (Interface Option 1000BASE-T1 only)
► Support of two independent CAN/CAN FD channels, available as 1x D-SUB9
► Support of an IO interface for setting or sampling of analog/digital values
► Host connection via USB 3.0
► High resolution time stamps for Ethernet frames
► High resolution time stamps for CAN/CAN FD frames
► Software and hardware time synchronization of multiple Vector network interfaces
► Internal three-way-routing in/monitor/out
► Hardware filtering of Ethernet and CAN data
► Integrated Layer 2 switch for optimized remaining bus simulation with several channels
► Hardware load generators for low jitter and full bandwidth
► Stand-alone mode capability ensures uninterrupted operation
► Robustness, power supply and temperature ranges suitable for automotive and industrial applications
► Open interface for third-party tools with the XL Driver Library (CAN and Ethernet)

2.3 Accessories

Reference
Information on available accessories can be found in the separate accessories manual on the Vector Driver Disk in \Documentation\Accessories.
2.4 Examples of Usage

2.4.1 Transparent Ethernet Monitoring

The VN5640 can be used for Ethernet monitoring between an ECU and a connected sensor without influencing the Ethernet bus (bypassing). In this particular setup the VN5640 receives and forwards incoming data packages from one channel to the other. The VN5640 offers up to six bypassing paths which can be used in parallel.

This allows applications such as CANalyzer.Ethernet or CANoe.Ethernet to trace Ethernet data with accurate time stamps.

**Note**
The bypass can be set only between adjacent channels:
For bypassing, two modes are available which can be used depending on the needed application:

**PHY bypassing**

Use this mode if you want to monitor Ethernet packets without influencing the constant processing time. Sending of additional Ethernet packets is not possible in this mode.

---

**Physical Layer**

<table>
<thead>
<tr>
<th>Physical Layer</th>
<th>Bypassing Latency $\Delta t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>100BASE-T1 ---- 100BASE-T1</td>
<td>3.6 $\mu$s</td>
</tr>
<tr>
<td>100BASE-T1 ---- 100BASE-TX</td>
<td>3.7 $\mu$s</td>
</tr>
<tr>
<td>100BASE-TX ---- 100BASE-TX</td>
<td>4.4 $\mu$s</td>
</tr>
<tr>
<td>1000BASE-T ---- 1000BASE-T</td>
<td>1.5 $\mu$s</td>
</tr>
<tr>
<td>1000BASE-T1 ---- 1000BASE-T1</td>
<td>5.8 $\mu$s</td>
</tr>
</tbody>
</table>
**MAC bypassing**

Use this mode if you want to monitor Ethernet packets and also send additional packets. In this mode, the processing time can be dynamic.

![Diagram](Figure 4: MAC bypassing)

<table>
<thead>
<tr>
<th>Physical Layer</th>
<th>Bypassing Latency $\Delta t^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>100BASE-T1 --- 100BASE-T1</td>
<td>approx. 11 μs</td>
</tr>
<tr>
<td>100BASE-T1 --- 100BASE-TX</td>
<td>approx. 11 μs</td>
</tr>
<tr>
<td>100BASE-TX --- 100BASE-TX</td>
<td>approx. 12 μs</td>
</tr>
<tr>
<td>1000BASE-T --- 1000BASE-T</td>
<td>approx. 2.5 μs</td>
</tr>
<tr>
<td>1000BASE-T1 --- 1000BASE-T1</td>
<td>approx. 6.7 μs</td>
</tr>
</tbody>
</table>

* Processing time without additional frames through the application (CANalyzer.Ethernet/CANoe.Ethernet)

**Note**

The MAC bypassing latency is independent of the frame length (Cut-through mode) if there are no bypassing conflicts (e.g., additional frames sent by an application). If additional frames are sent by an application, the bypass latency depends on the frame length (Store-and-Forward Mode).
The VN5640 uses a common time stamp clock for Ethernet and CAN events. So if the measurement setup is extended by a CAN network, the generated CAN time stamps are always in sync with the Ethernet time stamps which helps analyzing the network.

**Note**
Additional Vector network interfaces can be synchronized by software or hardware (see section Time Synchronization on page 52).
2.4.2 Remaining Bus Simulation

The VN5640 is able to send and receive data packages on separate Ethernet channels as well as events on two separate CAN channels. With this, the VN5640 is a perfect choice for the remaining bus simulation during the development of complex networks.

**Figure 6: Simulated nodes**

**Note**
For the remaining bus simulation CANoe.Ethernet is required.
2.4.3 Standalone Media Converter

The Ethernet channels of the VN5640 can be configured independently. That way the VN5640 can be used as a media converter between an ECU using the 100BASE-T1 physical layer and any standard Ethernet equipment (e.g. loggers) using 100BASE-TX/1000BASE-T. The VN5640 offers up to four media-conversion paths which can be used independently.

Figure 7: Media converter
2.4.4 Diagnostics over IP

For diagnostics over IP, the VN5640 supports, beside the necessary 100BASE-TX channel, an digital IO channel which has a DoIP activation line according to the ISO specification. The activation level can be set by the VN5640 to switch the ECU to diagnostic mode.

**Setup**

![Diagram showing setup for diagnostics over IP]

Figure 8: Simulated nodes

**Note**

Diagnostic over IP is supported by CANoe.Ethernet or CANape (version 16 or higher).
2.4.5 Port Mirroring

**Description**
The VN5640 supports mirroring of incoming packets of selected source channels to a specific target channel. For example, this mirroring feature can be used to attach an Ethernet logger to the target channel.

**Setup**

![Diagram showing VN5640 setup](image)

Figure 9: Ethernet channel 13 configured as target, channel 1...4 as source

**Note**
The configuration is done in Vector Hardware Config.
2.5 Main Connectors

Device connectors

Figure 10: Connectors on the USB side

- **Sync (Binder)**
  The VN5640 has one sync connector (Binder type 711) which can be used for time synchronization of different Vector devices (see section Time Synchronization on page 52).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not connected</td>
</tr>
<tr>
<td>2</td>
<td>Synchronization line</td>
</tr>
<tr>
<td>3</td>
<td>Ground</td>
</tr>
</tbody>
</table>

- **Power (ODU)**
  For power supply, the VN5640 has a two-pin ODU connector (MINI-SNAP size 1, type GG1L0C-P02RP00-0000). Attach the enclosed power cable to power up the unit (matching ODU connector type S11L0C-P02NPL0-6200).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply (8 V ... 50 V)</td>
</tr>
<tr>
<td>2</td>
<td>Ground</td>
</tr>
</tbody>
</table>

**Note**
The VN5640 requires at least 5 V to power up. For continuous operation, use 8 V or higher (typ. 12 V DC, max. 50 V). Temporary voltage drops (< 1 min) down to 5 V are allowed.
**IO 19 (D-SUB)**

The VN5640 has a D-SUB9 connector (CH19) for dedicated digital input/output tasks. The pin assignment is as follows:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analog input</td>
</tr>
<tr>
<td>2</td>
<td>Digital input/output 0</td>
</tr>
<tr>
<td>3</td>
<td>Digital input/output 1</td>
</tr>
<tr>
<td>4</td>
<td>Digital input 0</td>
</tr>
<tr>
<td>5</td>
<td>Digital input 1</td>
</tr>
<tr>
<td>6</td>
<td>Analog GND</td>
</tr>
<tr>
<td>7</td>
<td>Not connected</td>
</tr>
<tr>
<td>8</td>
<td>Digital output</td>
</tr>
<tr>
<td>9</td>
<td>Digital GND</td>
</tr>
</tbody>
</table>

---

**Internal interconnection of digital in/out 0/1**

![Digital input/output internal connection](image1)

Figure 11: Digital input/output

**Internal interconnection of digital input 0/1**

![Digital input 0/1 internal connection](image2)

Figure 12: Digital input 0/1

**Internal interconnection of digital output**

![Digital output internal connection](image3)

Figure 13: Digital output
Internal interconnection of analog input

Extended measuring range of the analog input

In normal operation, voltages up to 18 V can be applied and measured at the analog input. The cutoff frequency $f_c$ (-3 dB) for AC voltages is approx. 7.2 kHz.

For measurements above 18 V (max. 50 V), an external series resistor has to be applied to the analog input. The series resistor $R_{ext}$ depends on the maximum input voltage $U_{input}$ to be measured and can be calculated as follows:

$$R_{ext} [k\Omega] = [(U_{input} \times 0.61111) - 11] \times 100$$

with $18 \, V < U_{input} \leq 50 \, V$

The cutoff frequency for AC voltages is also affected by the external series resistor:

$$f_c [Hz] = \frac{1}{2.33 \times 10^{-4} \times R_{ext} [k\Omega]}$$

Examples

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>24 V</th>
<th>32 V</th>
<th>36 V</th>
<th>48 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{ext}$</td>
<td>367 kΩ</td>
<td>856 kΩ</td>
<td>1100 kΩ</td>
<td>1833 kΩ</td>
</tr>
<tr>
<td>$R_{ext}$ (E96)</td>
<td>374 kΩ (24.12 V)</td>
<td>866 kΩ (32.17 V)</td>
<td>1100 kΩ (36.00 V)</td>
<td>1870 kΩ (48.60 V)</td>
</tr>
<tr>
<td>$f_c$ (-3 dB)</td>
<td>1148 Hz</td>
<td>496 Hz</td>
<td>390 Hz</td>
<td>230 Hz</td>
</tr>
</tbody>
</table>
► CAN CH17/18 (D-SUB)
D-SUB connector with two CAN channels. Use the CANcable 2Y to access both channels on separate D-SUB9 connectors (see accessories manual, part number 05075).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CH18 CAN Low</td>
</tr>
<tr>
<td>2</td>
<td>CH17 CAN Low</td>
</tr>
<tr>
<td>3</td>
<td>CH17 GND</td>
</tr>
<tr>
<td>4</td>
<td>Reserved. Please do not use.</td>
</tr>
<tr>
<td>5</td>
<td>Not connected</td>
</tr>
<tr>
<td>6</td>
<td>CH18 GND</td>
</tr>
<tr>
<td>7</td>
<td>CH17 CAN High</td>
</tr>
<tr>
<td>8</td>
<td>CH18 CAN High</td>
</tr>
<tr>
<td>9</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

► USB
Connect your PC and the VN5640 over USB to install and to use the device with measurement applications (CANoe, CANalyzer). Use the USB 3.0 compliant cable found in the delivery (USB extension cables may generate faults between the PC and the device). Connect the device directly to a USB port at your PC or use a USB hub with its own power supply (self-powered).

► Ethernet 13...16 (Ethernet)
Standard Ethernet connector for 10BASE-T, 100BASE-TX and 1000BASE-T.
2.6 LEDs

Top LEDs

> Act (Ethernet CH13...CH16)
LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at the according channel.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>1000 MBit.</td>
</tr>
<tr>
<td>Orange</td>
<td>100 MBit.</td>
</tr>
</tbody>
</table>

> CAN (CH17/CH18)
Multicolored channel LEDs, each indicating the bus activity for CAN.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Data frames have been sent or received correctly. The flashing frequency varies according to the message rate.</td>
</tr>
<tr>
<td>Orange</td>
<td>Error frames have been sent or received. The flashing frequency varies according to the message rate.</td>
</tr>
<tr>
<td>Red</td>
<td>BUS off.</td>
</tr>
</tbody>
</table>

> Status
Multicolored LED indicating the status.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Blinks 4x at power up and illuminates afterwards. Blinks quicker during an update progress. Please wait for the automatic reboot of the device (approx. 60 seconds) after the update has been finished.</td>
</tr>
<tr>
<td>Red</td>
<td>An error has occurred. Please disconnect the power supply as well as the USB cable. Re-connect the power supply and the USB cable and try again.</td>
</tr>
</tbody>
</table>

Bottom LEDs

> M (Ethernet CH1...CH12)
Illuminates if the according channel is configured as master.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>PHY is configured as master.</td>
</tr>
<tr>
<td>Off</td>
<td>PHY is configured as slave.</td>
</tr>
</tbody>
</table>
**Act (Ethernet CH1...CH12)**
LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at the according channel.

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>1000 MBit.</td>
</tr>
<tr>
<td>Orange</td>
<td>100 MBit.</td>
</tr>
</tbody>
</table>

**Note**
If you select a segment or a hardware channel in the Vector Hardware Config tool, the according activation LED twinkles a couple of times.

**Note**
During a firmware update process, the LEDs of channel 1...12 turns into a progress bar.
2.7 Interface Option 100BASE-T1

2.7.1 Connectors

Device connectors

![Device Connectors Diagram]

Ethernet CH1...CH12 (D-SUB9)
D-SUB9 connector for 100BASE-T1. Use the BRcable 2Y to access both channels on separate D-SUB9 connectors (see accessories manual, part number 05103).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CH2 P</td>
</tr>
<tr>
<td>2</td>
<td>CH2 N</td>
</tr>
<tr>
<td>3</td>
<td>Not connected</td>
</tr>
<tr>
<td>4</td>
<td>CH1 P</td>
</tr>
<tr>
<td>5</td>
<td>CH1 N</td>
</tr>
<tr>
<td>6</td>
<td>Not connected</td>
</tr>
<tr>
<td>7</td>
<td>Not connected</td>
</tr>
<tr>
<td>8</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

Reference
The Ethernet configuration can be done in Vector Hardware Config (see section Device Configuration on page 42).
### 2.7.2 Technical Data

| **Ethernet channels** | 12x NXP TJA1100  
|                       | (IEEE 100BASE-T1)  
|                       | 4x Atheros AR8031  
|                       | (IEEE 100BASE-TX/1000BASE-T) |
| **CAN/CAN FD channels** | 2x NXP TJA1051 |
| **Analog input** | 10 bit  
|                   | Input 0 V...18 V (Ri = 1.1 MΩ)  
|                   | Voltage tolerance up to 30 V |
|                   | Details on the extended measuring range  
|                   | see on page 23. |
| **Digital input** | Range 0 V...32 V  
|                   | Schmitt trigger high 2.8 V, low 2.3 V  
|                   | Input frequencies up to 1 kHz |
| **Digital output** | Open Drain  
|                   | External supply up to 32 V  
|                   | Output frequency up to 1 kHz  
|                   | Current max. 500 mA  
|                   | Short circuit / over voltage protected |
| **Digital input/output** | Push/Pull mode (e.g. DoIP Activation Line)  
|                   | or only  
|                   | Push-Mode (e.g. Wake-up Triggers)  
|                   | Output high (no load): 13 V  
|                   | Output high (load 346 Ω): 5.3 V  
|                   | Output low: 0 V |
|                   | Input range: 0 V...16 V  
|                   | Input Schmitt trigger high: 3.4 V  
|                   | Input Schmitt trigger low: 2.5 V  
|                   | Rout: approx. 500 Ω |
| **Time stamps** | Resolution: 8 ns  
|                   | Accuracy (in device): 1 µs  
|                   | Accuracy software sync: typ. 50 µs  
|                   | Accuracy hardware sync: typ. 1 µs |
| **PC interface** | USB 3.0 |
| **Input voltage** | Power-up: min. 5 V  
|                   | Continuous operation: 8 V ... 50 V (typ. 12 V)  
|                   | Temporary voltage drop down (< 1 min) to 5 V |
| **Power consumption** | Approx. 18 W |
| **Temperature range** | Operation: -40 °C ... +60 °C  
| (ambient temp. of the device) | Storage: -40 °C ... +85 °C |
| **Relative humidity** | 15 %...95 %, non-condensing  
| of ambient air | |
| **Dimensions (LxWxH)** | Approx. 186 mm x 172 mm x 55 mm |
| **Weight** | 1300 g |
| **Operating system requirements** | Windows 7 SP1 (32 bit / 64 bit)  
|                          | Windows 8.1 (32 bit / 64 bit)  
|                          | Windows 10 (64 bit) |
Electrical isolation of the connectors

Note
Please note that shielded cables and the USB connector on the device share the same potential (see picture above) while the host shield is connected to GND. This can lead to ground loops and to damages on the host because of currents when using a 12 V notebook power supply without electrical isolation. Please always use an electrical isolated power supply for the host.
2.8 Interface Option 1000BASE-T1

2.8.1 Connectors

The Ethernet configuration can be done in Vector Hardware Config (see section Device Configuration on page 42).

![Figure 18: Ethernet CH1...CH12](image)

**Ethernet CH1...CH6 (ix Industrial®)**

ix Industrial® connectors for 100BASE-T1/1000BASE-T1 (e.g., Harting ix Industrial® type 10A-1). Each connector has two Ethernet channels (A and B).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CH2 P</td>
</tr>
<tr>
<td>2</td>
<td>CH2 N</td>
</tr>
<tr>
<td>3</td>
<td>Not connected</td>
</tr>
<tr>
<td>4</td>
<td>Not connected</td>
</tr>
<tr>
<td>5</td>
<td>Not connected</td>
</tr>
<tr>
<td>6</td>
<td>CH1 P</td>
</tr>
<tr>
<td>7</td>
<td>CH1 N</td>
</tr>
<tr>
<td>8</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

**Ethernet CH7...CH12 (D-SUB9)**

D-SUB9 connector for 100BASE-T1. Use the BRcable 2Y to access both channels on separate D-SUB9 connectors (see accessories manual, part number 05103).

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CH2 P</td>
</tr>
<tr>
<td>2</td>
<td>CH2 N</td>
</tr>
<tr>
<td>3</td>
<td>Not connected</td>
</tr>
<tr>
<td>4</td>
<td>CH1 P</td>
</tr>
<tr>
<td>5</td>
<td>CH1 N</td>
</tr>
<tr>
<td>6</td>
<td>Not connected</td>
</tr>
<tr>
<td>7</td>
<td>Not connected</td>
</tr>
<tr>
<td>8</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>Not connected</td>
</tr>
</tbody>
</table>
## 2.8.2 Technical Data

| Ethernet channels | 6x Marvell 88Q2112 (IEEE 100BASE-T1/1000BASE-T1)  
| | 6x Broadcom BCM89811 (IEEE 100BASE-T1)  
| | 4x Atheros AR8031 (IEEE 100BASE-TX/1000BASE-T)  
| CAN/CAN FD channels | 2x NXP TJA1051  
| Analog input | 10 bit  
| | Input 0 V...18 V (Ri = 1.1 MΩ)  
| | Voltage tolerance up to 30 V  
| | Details on the extended measuring range see on page 23.  
| Digital input | Range 0 V...32 V  
| | Schmitt trigger high 2.8 V, low 2.3 V  
| | Input frequencies up to 1 kHz  
| Digital output | Open Drain  
| | External supply up to 32 V  
| | Output frequency up to 1 kHz  
| | Current max. 500 mA  
| | Short circuit / over voltage protected  
| Digital input/output | Push/Pull mode (e.g. DoIP Activation Line)  
| | or only  
| | Push-Mode (e.g. Wake-up Triggers)  
| | Output high (no load): 13 V  
| | Output high (load 346 Ω): 5.3 V  
| | Output low: 0 V  
| | Input range: 0 V...16 V  
| | Input Schmitt trigger high: 3.4 V  
| | Input Schmitt trigger low: 2.5 V  
| | Rout: approx. 500 Ω  
| Time stamps | Resolution: 8 ns  
| | Accuracy (in device): 1 μs  
| | Accuracy software sync: typ. 50 μs  
| | Accuracy hardware sync: typ. 1 μs  
| PC interface | USB 3.0  
| Input voltage | Power-up: min. 5 V  
| | Continuous operation: 8 V ...50 V (typ. 12 V)  
| | Temporary voltage drop down (< 1 min) to 5 V  
| Power consumption | Approx. 18 W  
| Temperature range (ambient temp. of the device) | Operation: -40 °C ... +60 °C  
| | Storage: -40 °C ... +85 °C  
| Relative humidity of ambient air | 15 %...95 %, non-condensing  
| Dimensions (LxWxH) | Approx. 186 mm x 172 mm x 55 mm
<table>
<thead>
<tr>
<th>Weight</th>
<th>1300 g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating system requirements</strong></td>
<td><strong>Windows 7 SP1 (32 bit / 64 bit)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Windows 8.1 (32 bit / 64 bit)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Windows 10 (64 bit)</strong></td>
</tr>
</tbody>
</table>
Electrical isolation of the connectors

Note
Please note that shielded cables and the USB connector on the device share the same potential (see picture above) while the host shield is connected to GND. This can lead to ground loops and to damages on the host because of currents when using a 12 V notebook power supply without electrical isolation. Please always use an electrical isolated power supply for the host.
2.9 Hardware Channels and Segments

2.9.1 General Information

Working with segments

The hardware channels of the VN5640 can be accessed in CANoe/CANalyzer.Ethernet via so called segments. A segment represents either a single or a group of hardware channels depending on the operation mode.

![VN5640 Segments](image)

Figure 19: VN5640 for measurement use case

The operation mode as well as the settings for segments and hardware channels can be changed in the Vector Hardware Config tool (see section Device Configuration on page 42).

![Edit channel mode](image)

Figure 20: Edit channel mode

The available operation modes are described in the following sections.
2.9.2 Simulation

**Single segment**

This operation mode offers a single segment that includes all Ethernet channels of the VN5640. Use this operation mode for simulation use cases where the network topology can be changed. The VN5640 has an intelligent internal switch that collects MAC addresses at runtime, i.e., all Ethernet packets sent by CANoe. Ethernet will be forwarded to the correct destination (connected Ethernet device). If no MAC address is known by the switch (e.g., at the beginning of a simulation), the Ethernet packets are sent through all hardware channels that are included in the segment.

![VN5640 for simulation use case](image)

2.9.3 Measurement

**Eight segments**

This operation mode offers eight segments while each segment includes two hardware channels. Use this operation mode if an existing network topology must not be modified. With each segment in this mode, the VN5640 offers an access point to tap into one existing network. Each segment can individually operate in MAC or PHY bypass mode as well as operate without bypassing (e.g., to modify transmitted packets before forwarding).

![VN5640 for measurement use case](image)
2.9.4 Direct Connection

**Sixteen segments**

This operation mode offers sixteen segments with each segment linked to a single hardware channel. Use this operation mode if you want to access each hardware channel independently.

![Figure 23: VN5640 with single access to hardware channels](image)

2.9.5 Media Conversion

**Eight segments**

This operation mode offers eight segments while each segment includes two hardware channels. Use this operation mode if you want to connect Ethernet devices with different physical layers. The VN5640 provides four media converters and four additional network access points. Each segment can individually operate in MAC or PHY bypass mode as well as operate without bypassing (e.g., to modify transmitted packets before forwarding).

![Figure 24: VN5640 for media conversion use case (Interface Option 100BASE-T1)](image)

![Figure 25: VN5640 for media conversion use case (Interface Option 1000BASE-T1)](image)
2.9.6 Direct Connection with TAP (Legacy)

**Note**
Use this operation mode only for existing projects. For new projects, please use one of the other available operation modes.

**Sixteen segments**
This operation mode offers sixteen segments while each segment is linked to a single hardware channel. The behavior of this mode is identical to VN5610(A). This operation mode supports two media converters and twelve access points.

![VN5640 with single access to hardware channels](image)

Figure 26: VN5640 with single access to hardware channels
3 Getting Started

In this chapter you find the following information:

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<td>3.3 Loop Tests</td>
<td>45</td>
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<tr>
<td>3.3.1 Ethernet</td>
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</tr>
</tbody>
</table>
3.1 Driver Installation

General information

The Vector Driver Disk offers a driver setup which allows the installation or the removal of Vector devices.

Note
Please note that you will need Administrator Rights for the following steps.

Step by Step Procedure

1. Execute the driver setup from the autostart menu or directly from \Drivers\Setup.exe before the device is connected to the PC with the included USB cable.

If you have already connected the device to the PC, the Windows found new Hardware wizard appears. Close this wizard and then execute the driver setup.

2. Click [Next] in the driver setup dialog. The initialization process starts.
3. In the driver selection dialog, select your devices to be installed (or to be uninstalled).

4. Click [Install] to execute the driver installation, or [Uninstall] to remove existing drivers.

5. A confirmation dialog appears. Click [Close] to exit. After successful installation, the device is ready for operation and can be connected to the PC with the included USB cable.
3.2 Device Configuration

Device configuration

Before the installed device can be used in an application, it must be properly configured for the needed use case. This configuration is done with the Vector Hardware Config tool which comes with the driver installation. The tool can be found in Windows | Start | Settings | Control Panel | Vector Hardware and manages all installed Vector devices.

Reference

Further details on Vector Hardware Config can be found in the installation instructions (see section Vector Hardware Configuration on page 46).

Device configuration

If you want to change the Ethernet configuration, select a connected VN5640 from the list and double-click on Device Configuration.

Click on a given segment to select the bypass mode (not available for the operation modes Simulation and Direct Connection).
In order to edit the channel mode, click on a given hardware channel number to select the bypass mode.

Figure 29: Select a hardware channel

**Note**

In order to get a working 100BASE-TX Ethernet link between the VN5640 and another Ethernet device, the auto negotiation has to be activated in both devices.

Alternatively, both devices can be manually configured with the same parameters (only full duplex mode).

Please note that the Ethernet link will run in half duplex mode if one device uses auto negotiation while the other one is manually configured. **The VN5640 supports only full duplex mode.**
Note
You can also change the Ethernet settings in the **Network Hardware Configuration** of CANoe.Ethernet / CANalyzer.Ethernet:

Figure 30: Network Hardware Configuration

Figure 31: Network Hardware Configuration
3.3 Loop Tests

Operation test

The test described here can be performed to check the functional integrity of the driver and the device. This test is identical for Windows 7 / Windows 8.1 / Windows 10 and independent of the used application.

3.3.1 Ethernet

Device test

The operating test for Ethernet can be executed with the following devices:

► VN5610
► VN5610A
► VN5640

Step by Step Procedure

1. Connect both Ethernet channels of the device with an Ethernet cable.
2. Connect both BroadR-Reach channels at the D-SUB9 connector as follows (e.g. with the BRcable 2Y, part number 05103):

   ![D-SUB9 Connector Diagram]

3. Start \Drivers\Common\ETHloop.exe from the Vector Driver Disk.
4. Select the connected channels from the list.
5. Press [Twinkle] and check if the LED Status blinks.
6. Start the test by pressing the button [Start Test]. The test is successful if no error messages occur.
4  Vector Hardware Configuration

In this chapter you find the following information:

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<td>49</td>
</tr>
</tbody>
</table>
4.1 General Information

Executing Vector Hardware Config

After the successful driver installation you will find the configuration application Vector Hardware in the Control Panel (see below). The tool gives you information about the connected and installed Vector devices. There are also several settings that can be changed.

Figure 32: Icon in Control Panel

Control Panel
Windows 7

- Category view
  Windows Start | Control Panel | Hardware and Sound, click Vector Hardware in the list.

- Symbols view
  Windows Start | Control Panel, click Vector Hardware in the list.

Control Panel
Windows 8.1

- Category view
  <Windows key>+<X> | Control Panel | Hardware and Sound, click Vector Hardware in the list.

- Symbols view
  <Windows key>+<X> | Control Panel, click Vector Hardware in the list.

Control Panel
Windows 10

- Category view
  <Windows key>+<X> | Control Panel | Hardware and Sound, click Vector Hardware in the list.

- Symbols view
  <Windows key>+<X> | Control Panel, click Vector Hardware in the list.
4.2 Tool Description

4.2.1 Introduction

Vector Hardware Config enables the channel configuration between installed Vector devices and applications. Applications use so-called logical channels which are hardware independent and have to be assigned to real hardware channels.

Logical and physical channels

![Figure 33: General view of Vector Hardware Config](image)

![Figure 34: Concept of channel assignments](image)

![Figure 35: Channel assignment in Vector Hardware Config](image)
4.2.2 Tree View

Accessing Vector devices

The tool is split into two windows. The left window has a tree view and lets you access the installed Vector devices, the right window displays the details of the selection. The following nodes are available in the tree view:

Hardware

The Hardware section lists the installed Vector devices. Each device item has physical channels which can be assigned to any number of logical channels (e.g., CANalyzer CAN 1). A logical channel can be assigned to only one physical channel.

![Figure 36: Hardware](image)

Application

In Application, all available applications are displayed in a tree view. According to each application, the assignments of logical and physical channels are displayed in the right part of the window. If no assignment exists, the information Not assigned appears. The assignment can be edited via a right-click.

![Figure 37: Application](image)
Global settings

**Global settings** contains global device configuration possibilities, e.g. software time synchronization, transmit queue size, configuration flags or the number of virtual CAN devices.

![Global settings](image)

Figure 38: Global settings

Driver status

**Driver status** offers an overall status information of devices and applications currently in use. You can see whether the channels are connected to the bus (online/off-line) and whether the time synchronization is activated or not (Time-Sync-On/Time-Sync-Off).

![Driver status](image)

Figure 39: Driver status
The License section contains information on all current available licenses (Vector bus devices, Vector License USB dongle devices).

Figure 40: License

Reference
You will find a detailed description of Vector Hardware Config in the online help (Help | Contents).
5 Time Synchronization

In this chapter you find the following information:

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<td>55</td>
</tr>
<tr>
<td>5.3 Hardware Sync</td>
<td>56</td>
</tr>
</tbody>
</table>
5.1 General Information

Time stamps and events

Time stamps are useful when analyzing incoming or outgoing data or event sequences on a specific bus.

![Figure 41: Time stamps of two CAN channels in CANalyzer](image)

Generating time stamps

Each event which is sent or received by a Vector network interface has an accurate time stamp. Time stamps are generated for each channel in the Vector network interface. The base for these time stamps is a common hardware clock in the device.

![Figure 42: Common time stamp clock for each channel](image)

If the measurement setup requires more than one Vector network interface, a synchronization of all connected interfaces and their hardware clocks is needed.

Due to manufacturing and temperature tolerances, the hardware clocks may vary in speed, so time stamps of various Vector devices drift over time.
Figure 43: Example of unsynchronized network interfaces. Independent time stamps drift apart.

To compensate for these time stamp deviations between the Vector network interfaces, the time stamps can be either synchronized by software or by hardware (see next section).

**Note**

The accuracy of the software and hardware sync depends on the interface. Further information on specific values can be found in the technical data of the respective devices.
5.2 Software Sync

The software time synchronization is driver-based and available for all applications without any restrictions. The time stamp deviations from different Vector network interfaces are calculated and synchronized to the common PC clock. For this purpose no further hardware setup is required.

![Diagram showing time stamps synchronization](image)

Figure 44: Time stamps of devices are synchronized to the PC clock

The setting of the software time synchronization can be changed in the Vector Hardware Config tool in General information | Settings | Software time synchronization.

![Software Hardware Config](image)

Figure 45: Switching on the software synchronization

- **YES**
  The software time synchronization is active.

- **NO**
  The software time synchronization is not active. Use this setting only if the Vector network interfaces are being synchronized over the sync line or if only a single device is used.
5.3 Hardware Sync

A more accurate time synchronization of multiple devices is provided by the hardware synchronization which has to be supported by the application (e.g. CANalyzer, CANoe). Two Vector network interfaces can therefore be connected with the SYNCableXL (see accessories manual, part number 05018).

In order to synchronize up to five devices at the same time, a distribution box is available (see accessories manual, part number 05085).

At each falling edge on the sync line which is initiated by the application, the Vector network interface generates a time stamp that is provided to the application. This
allows the application to calculate the deviations between the network interfaces and to synchronize the time stamps to a common time base (master clock) which is defined by the application.

**Note**
The hardware synchronization must be supported by the application. For further information please refer to the relevant application manual. Please note that the software synchronization must be disabled (see Vector Hardware Config | General information | Settings | Software time synchronization) if the hardware synchronization is used.
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