



# VN7640 Manual

Version 1.9 | English

## **Imprint**

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# 1 Introduction

In this chapter you find the following information:









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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.

Style	Utilization
<b>bold</b>	Blocks, surface elements, window- and dialog names of the software. Accentuation of warnings and advices. <b>[OK]</b> Push buttons in brackets <b>File Save</b> Notation for menus and menu entries
Source Code	File name and source code.
Hyperlink	Hyperlinks and references.
<CTRL>+<S>	Notation for shortcuts.

Symbol	Utilization
	This symbol calls your attention to warnings.
	Warning of damages by electrostatic discharge (ESD = Electrostatically Sensitive Device).
	Here you can obtain supplemental information.
	Here you can find additional information.
	Here is an example that has been prepared for you.
	Step-by-step instructions provide assistance at these points.
	Instructions on editing files are found at these points.
	This symbol warns you not to edit the specified file.

## 1.1.1 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.

## 1.1.2 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, Windows 11 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](http://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.

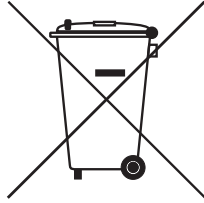
### 1.2.2 Disclaimer

**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.

## 1.2.3 Disposal of Vector Hardware

Please handle old devices responsibly and observe the environmental laws applicable in your country. Please dispose of the Vector hardware only at the designated places and not with the household waste.



Within the European Community, the Directive on Waste Electrical and Electronic Equipment (WEEE Directive) and the Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive) apply.

For Germany and other EU countries, we offer free take-back of old Vector hardware.

Please carefully check the Vector hardware to be disposed of before shipping. Please remove all items that are not part of the original scope of delivery, e.g. storage media. The Vector hardware must also be free of licenses and must no longer contain any personal data. Vector does not perform any checks in this regard. Once the hardware has been shipped, it cannot be returned to you. By shipping the hardware to us, you have relinquished your rights to the hardware.

Before shipping, please register your old device via:

<https://www.vector.com/int/en/support-downloads/return-registration-for-the-disposal-of-vector-hardware/>

# 2 Device Description

In this chapter you find the following information:

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## 2.1 Scope of Delivery

### Contents

The delivery includes:

- ▶ VN7640
- ▶ Vector Power Supply 12 V / 1.25 A (part number 05024)
- ▶ USB2.0 cable (part number 05011)

## 2.2 Introduction

### About the VN7640

The VN7640 interface is a flexible solution for FlexRay, CAN, CAN FD, LIN, K-Line and J1708 applications.

Main use cases\*:

- ▶ Remaining bus simulation
- ▶ Bus analysis (full bus load, advanced analysis and stimulation features)
- ▶ Measurement and calibration via CAN/LIN/FlexRay
- ▶ Diagnostics
- ▶ ECU flash programming (high performance, sending with minimum delay, out of spec baud rates, several parallel streams)
- ▶ Simple analog/digital IO tasks

\* The support of further features of the RJ45 Ethernet port has been discontinued as of device driver V22.20.20.



Figure 1: VN7640

Main features of the VN7640:

- ▶ 4x plug-in location for Piggybacks (see section [Bus Configuration](#) on page 22)
- ▶ Full featured support of
  - FlexRay
  - CAN (FD)
  - LIN
  - K-Line
- ▶ IO port
  - Digital/analog in/out
  - DoIP Activation Line
- ▶ Trigger-out (via pin 5 of FRpiggyC 1082cap)

- ▶ CAPL-On-Board for
  - CAN (FD)
  - FlexRay
  - LIN
  - IO
- ▶ Support of customer applications via XL Driver Library (XL-API)
- ▶ Multi-application support (simultaneous operation of different applications on one channel, e. g. CANoe and CANape)
- ▶ High time stamp accuracy
- ▶ Time synchronization of multiple devices and with other bus systems (CAN, CAN FD, LIN, FlexRay, MOST, Ethernet)
  - Software time synchronization
  - Hardware time synchronization
  - IEEE 1588 (PTP) with Ethernet host port; from driver version 22.20 on
- ▶ Connection to host PC via USB 2.0 or Ethernet (1000BASE-T)
- ▶ LEDs indicating status and activities
- ▶ External power supply, galvanically isolated
- ▶ Robust Bopla housing

### Bus types

The bus types CAN, LIN and FlexRay are configurable via exchangeable plug-in boards (Piggybacks). The supported combinations are described in section [Bus Configuration](#) on page 22. A list of compatible Piggybacks can be found in the accessories manual or on our website.

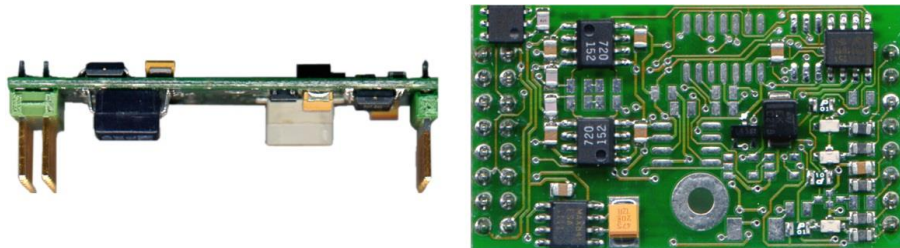


Figure 2: Piggyback

## 2.3 Accessories



### Reference

Information on available accessories can be found in the separate accessories manual on our [website](#).

## 2.4 Use Cases

The following picture shows possible use cases of the VN7640.

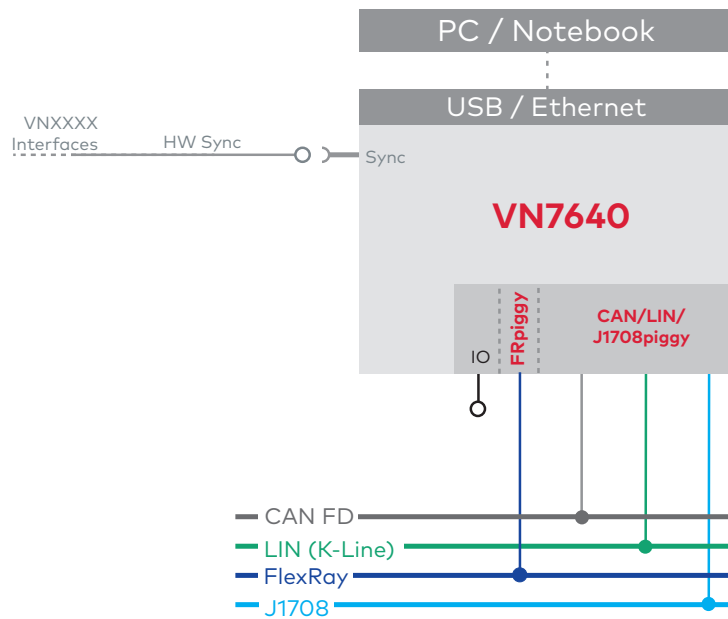


Figure 3: Connection options

## 2.5 Connectors Bus Side

Front side

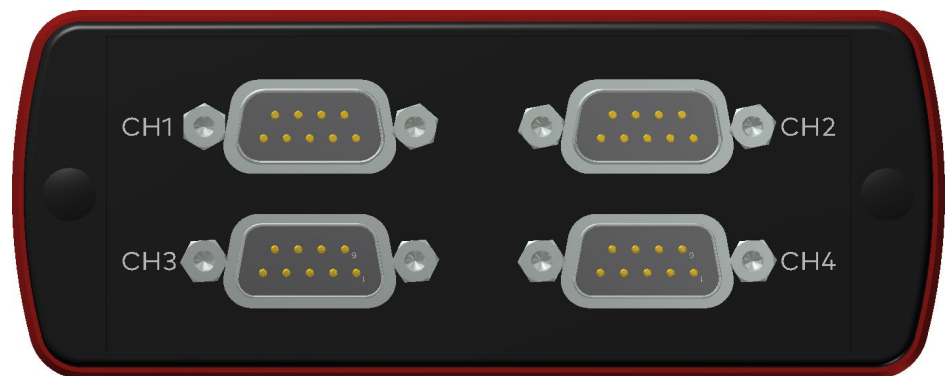


Figure 4: VN7640 with D-SUB9 connectors

### ► D-SUB9 (CH1...4)

The VN7640 has four D-SUB9 connectors, each assigned to a dedicated Piggyback plug-in location. The pin assignments depend on the inserted Piggybacks. A list of compatible Piggybacks can be found in the accessories manual or on our [website](#).

## 2.6 Connectors USB Side

Back side

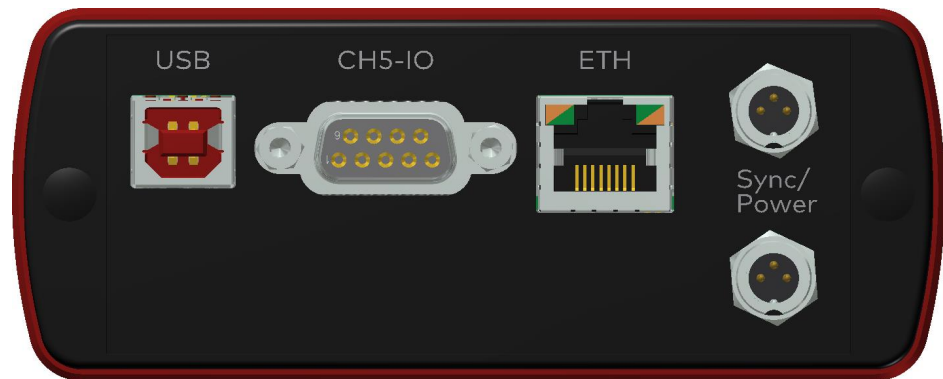


Figure 5: Connectors on the USB side

Device connectors

► **USB**

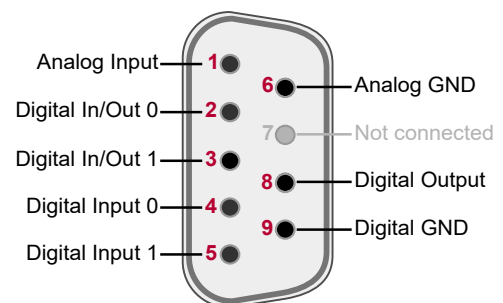
Connect your PC and the VN7640 via USB to install and to use the device with measurement applications (e. g. CANoe, CANalyzer). Use the USB2.0 compliant cable found in the delivery (USB extension cables may generate faults between the PC and the device). Connect the device directly to USB at your PC or use a USB hub.

► **D-SUB9 (CH5)**

The VN7640 has a D-SUB9 connector (CH5) for dedicated digital-analog input/output tasks. For DoIP (Diagnostics over Internet Protocol), pin 2 and pin 3 can be used as DoIP Activation Line according to ISO 13400-3:2011-12.

The pin assignment for CH5 is as follows:

Pin	Assignment
1	Analog input
2	Digital input/output 0
3	Digital input/output 1
4	Digital input 0
5	Digital input 1
6	Analog GND
7	Not connected
8	Digital output
9	Digital GND



**Reference**

Details on the internal interconnection of the input/output pins can be found on the next page.



Details on CH5

Internal interconnection of digital in/out 0/1

The internal interconnection of the input/output pins is as follows:

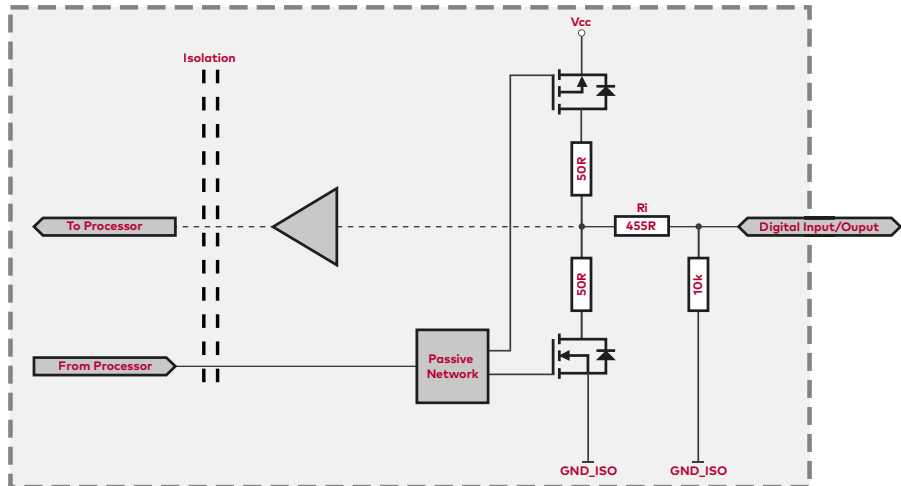


Figure 6: Digital input /output

Internal interconnection of digital input 0/1

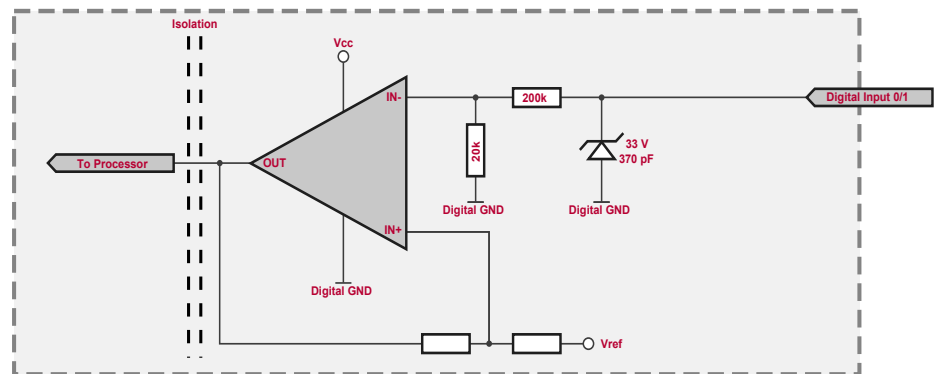


Figure 7: Digital input 0/1

Internal interconnection of digital output

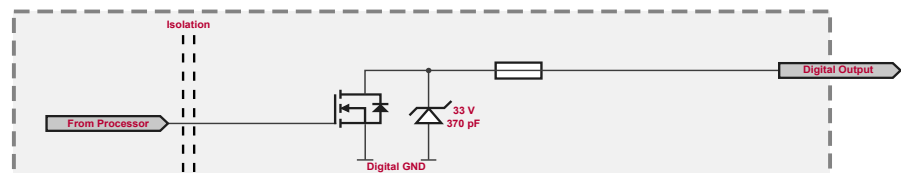


Figure 8: Digital output

Internal interconnection of analog input

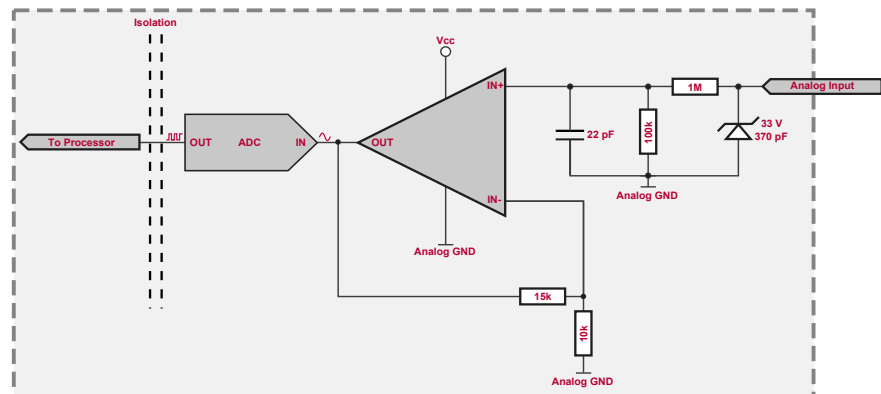


Figure 9: Analog input

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:

$$R_{ext} [kOhm] = [(U_{input} * 0.611111) - 11] * 100$$

*with 18 V < U<sub>input</sub> ≤ 50 V*

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

$$f_c [Hz] = \frac{1}{2.33 * 10^{-6} * R_{ext} [kOhm]}$$

Examples

	24 V	32 V	36 V	48 V
<b>R<sub>ext</sub></b>	367 kΩ	856 kΩ	1100 kΩ	1833 kΩ
<b>R<sub>ext</sub> (E96)</b>	374 kΩ (24.12 V)	866 kΩ (32.17 V)	1100 kΩ (36.00 V)	1870 kΩ (48.60 V)
<b>f<sub>c</sub> (-3 dB)</b>	1148 Hz	496 Hz	390 Hz	230 Hz

Device connectors (continued)

► **Ethernet (RJ45)**

RJ45 port for connecting the VN7640 to a host computer via Ethernet. LED description see section [LEDs](#) on page 20.

► **2x Power/Sync (Binder connector)**

The VN7640 has two power/sync connectors (Binder type 711) which can be used for time synchronization of different Vector devices (see section **Time Synchronization** on page 37) or for power. It does not matter which connector is used to supply the device. For proper operation of the VN7640, an external power supply is required.

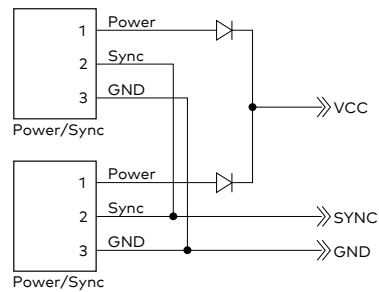


Figure 10: Internal wiring of the power/sync connector

Pin	Assignment
1	Power supply
2	Synchronization line
3	Ground



## 2.7 LEDs

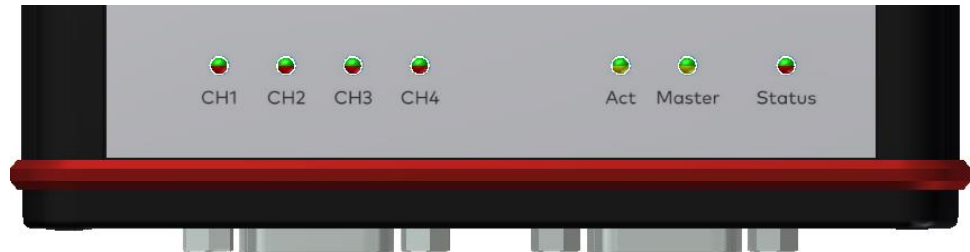


Figure 11: Top LEDs on VN7640

► **CH1 ... CH4 (with CAN-/LINpiggies)**

Multicolored channel LEDs, each indicating the bus activity for CAN or LIN.

Color	Description
Green	Data frames have been sent or received correctly. The flashing frequency varies according to the message rate.
Orange	Error frames have been sent or received. The flashing frequency varies according to the message rate.
Red	Bus off.

► **CH1 (with FRpiggyC)**

Multicolored channel LED which indicates the sync state of FlexRay.

Color	Description
Off	FlexRay Communication Controller offline.
Green	FlexRay Communication Controller synchronized.
Orange	On: FlexRay Communication Controller not synchronized. Flashing: FlexRay error frames and normal frames have been received.
Red	On: FlexRay Communication Controller in halt state. Flashing: FlexRay error frames on bus.

► **Activity**

LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at the according channel.

Color	Description
Green	On: Link with 1 Gbit. Flashing: Link with 1 Gbit and traffic.
Orange	On: Link with 100 MBit. Flashing: Link with 100 Mbit and traffic.
Off	No Link.

► **Master**

Color	Description
Off	-

▶ **Status**

Multicolored LED indicating the status.

Color	Description
Green	On: Running measurement. Flashing: Device is ready for operation.
Orange	On: Device start up. Flashing: Device executes update.
Red	Error. Device not working.

▶ **RJ45 connector**

Multicolored LEDs indicating the status of the Ethernet connection.

Color Left	Description
Green	Activity.
Off	No Activity.

Color Right	Description
Green	1 GBit link is active.
Orange	10 MBit / 100 MBit link is active.

## 2.8 Bus Configuration

### Piggybacks

An advantage of the VN7640 are its four Piggyback plug-in locations (CH1...CH4). Depending on requirements, electrically decoupled FlexRay, CAN High-Speed, CAN Low-Speed, CAN Single Wire, J1708 or LIN transceivers may be used. CH5 is reserved for dedicated IO tasks.

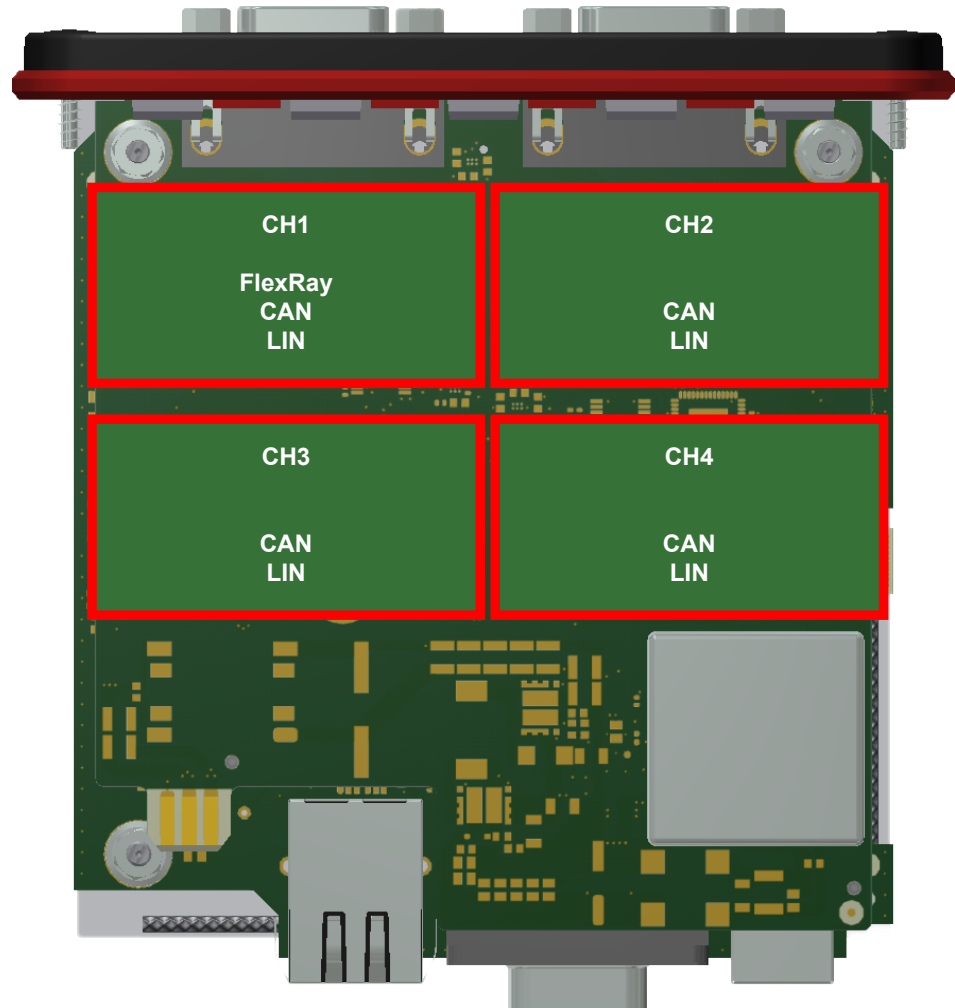


Figure 12: Piggyback plug-in locations for CH1...CH4

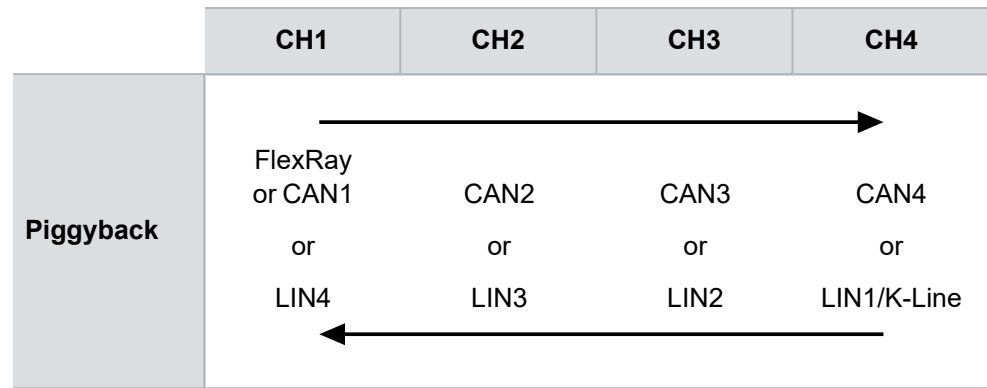
In the plug-in location for channel 1, an FRpiggyC can be inserted for a FlexRay channel A and B connection. Alternatively, a CANpiggy or LINpiggy can be used. Channels 2...4 are reserved for CANpiggies and LINpiggies. **CANpiggies must be populated in ascending order; LINpiggies in descending order** (see examples). J1708 should be handled like CAN.



#### Note

- ▶ Inserting order for FRpiggyC: CH1.
- ▶ Inserting order for LINpiggies: CH4...CH1. If an FRpiggyC is used, only one LINpiggy can be used.
- ▶ Inserting order for CAN/J1708piggies: CH1...CH4, but after FRpiggyC and before LINpiggies.

Piggyback order



**Examples**

The following tables show examples of possible configurations:

4x CAN

CH1	CH2	CH3	CH4
CANpiggy 1	CANpiggy 2	CANpiggy 3	CANpiggy 4

1x FR  
3x CAN

CH1	CH2	CH3	CH4
FRpiggyC	CANpiggy 1	CANpiggy 2	CANpiggy 3

1x FR  
2x CAN  
1x LIN

CH1	CH2	CH3	CH4
FRpiggyC	CANpiggy 1	CANpiggy 2	LINpiggy 1

3x CAN  
1x LIN

CH1	CH2	CH3	CH4
CANpiggy 1	CANpiggy 2	CANpiggy 3	LINpiggy 1

1x CAN  
1x LIN

CH1	CH2	CH3	CH4
CANpiggy 1	-	-	LINpiggy 1

1x CAN  
2x LIN

CH1	CH2	CH3	CH4
CANpiggy 1	-	LINpiggy 2	LINpiggy 1

## 2.9 Replacing Piggybacks



**Caution!**

Ensure an ESD safe working environment during disassembly and assembly. Avoid touching the top, bottom or connectors of the boards during this process to avoid ESD damage.



**Step by Step Procedure**

1. First, loosen the VN7640 housing screws on the side with the four D-SUB9 connectors. This requires removing the two black decorative caps. Then carefully pull the PC-board out of the housing.

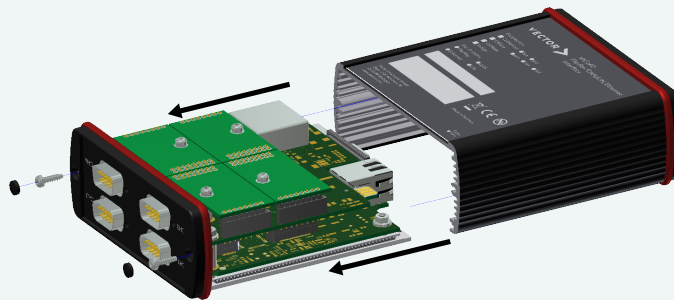


Figure 13: Opening the housing

2. You will find the plug-in location as follows:

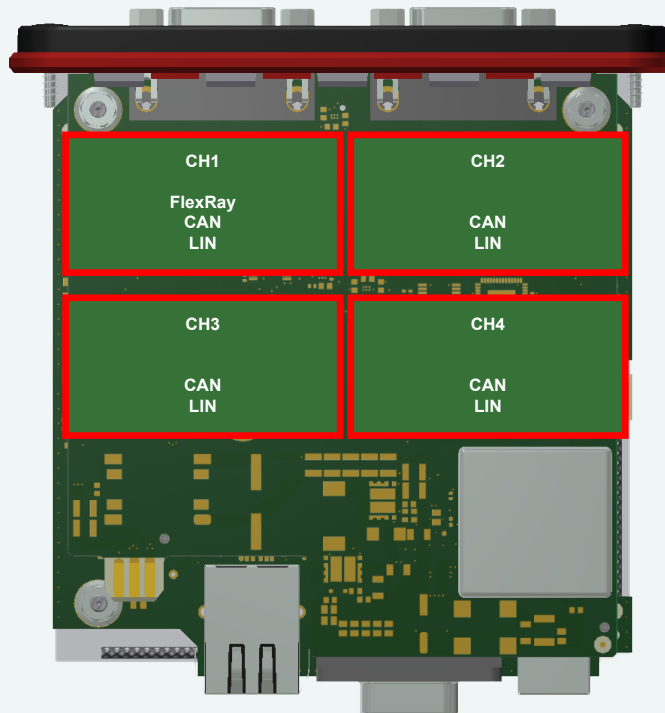


Figure 14: Piggyback plug-in locations



3. Each Piggyback is fastened by a screw and retainer. Please loosen the appropriate screw including the retainer and carefully remove the Piggyback from the plug-in location.

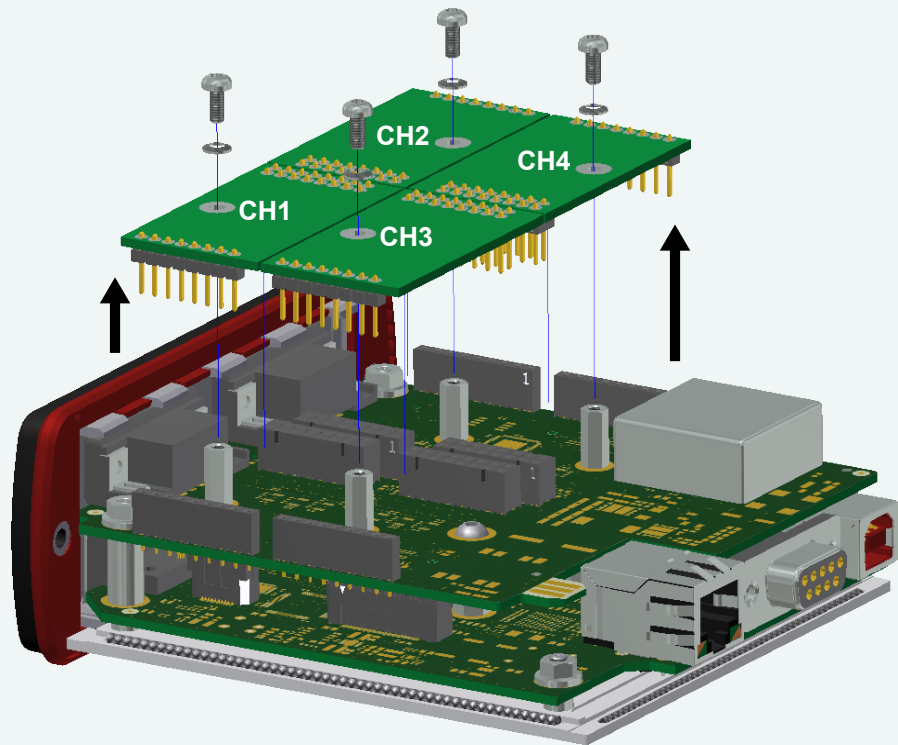


Figure 15: Unmount/mount Piggybacks

4. Insert the replacement Piggyback. When doing this please make sure that the single and dual-row connectors are not laterally offset.
5. Secure the new Piggyback with the appropriate screw and retainer.

- Place the VN7640 main board back in the housing. This operation involves placing the housing with its back side (side with the bar code) facing upward. Then the main board with the Piggybacks facing upward is inserted into the first guide rails.

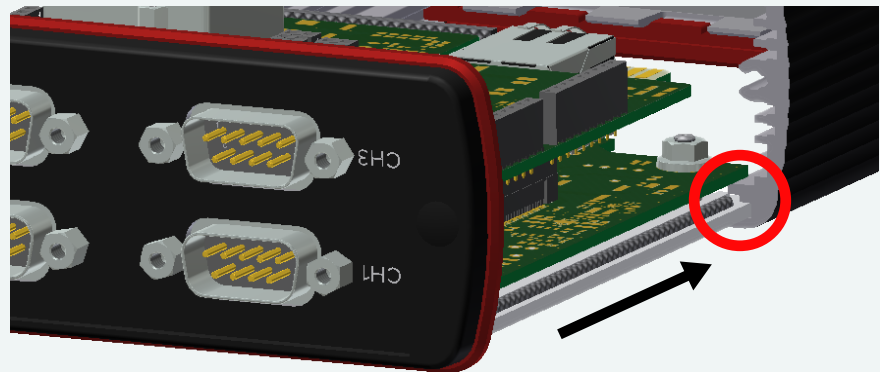


Figure 16: First guide rails

- It should be possible to slide the main board in the housing up to a few millimeters from the end without forcing it in. Close the housing by applying light pressure and then secure it with the appropriate screw fasteners. The screws should be secure but not excessively tight.
- Please also attach the two black decorative caps.
- Connect the VN7640 and the PC via the USB cable and check the bus configuration in **Vector Hardware Config**.

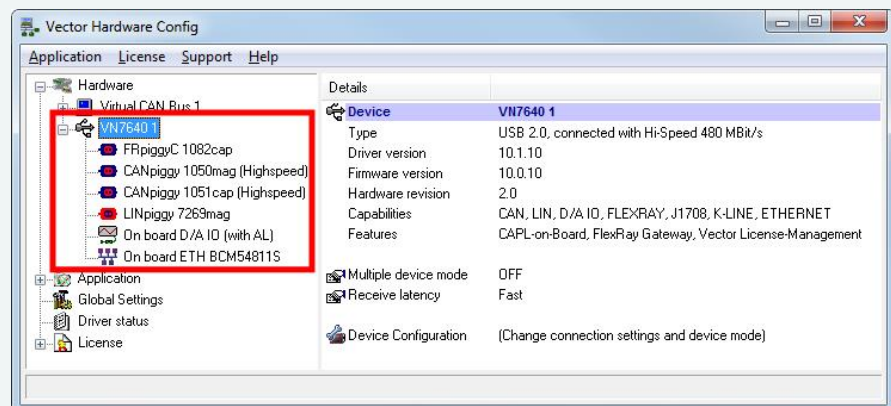


Figure 17: Check inserted Piggybacks

## 2.10 Technical Data

<b>FlexRay communication-controller</b>	<p>Analysis Bosch E-Ray (FPGA)</p> <p>Startup Bosch E-Ray (FPGA)</p>
<b>FlexRay channel</b>	<p>Max. 1 channel A and B at channel 1 (configurable via Piggyback)</p> <p>2 MB memory for data transmission</p>
<b>CAN/CAN FD channels</b>	<p>Max. 4 (configurable via Piggybacks)</p> <p>Bitrates</p> <ul style="list-style-type: none"> <li>- CAN: up to 1 MBit/s (up to 2 MBit/s depending on wiring and transceivers)</li> <li>- CAN FD: up to 5 MBit/s (up to 8 MBit/s depending on wiring and transceivers)</li> </ul>
<b>LIN channels</b>	<p>Max. 4 (configurable via Piggybacks)</p> <p>Bitrates</p> <ul style="list-style-type: none"> <li>- Normal-Mode: up to 20 kBit/s</li> <li>- Flash-Mode: up to 115.2 kBit/s (depending on wiring higher bitrates are possible)</li> </ul>
<b>K-Line channels</b>	<p>Max. 1 at channel 4 (with LINpiggy 7269mag)</p>
<b>Channel configurations</b>	<p>Configurable with Piggybacks</p> <p>1x FlexRay, 3 x CAN 1x FlexRay, 2x CAN, 1x LIN (1x K-Line)</p> <p>4x CAN 3x CAN, 1x LIN (1x K-Line) 2x CAN, 2x LIN (1x K-Line) 1x CAN, 3x LIN (1x K-Line)</p> <p>4x LIN (1x K-Line)</p> <p>Additional: Digital/analog IO channel</p>
<b>Analog input</b>	<p>10 bit Input 0 V...18 V (<math>R_i = 1.1 \text{ M}\Omega</math>) Voltage tolerance up to 30 V Details on the extended measuring range see on page 18.</p>
<b>Digital input</b>	<p>Range 0 V...32 V Schmitt trigger high 2.8 V, low 2.3 V Input frequencies up to 1 kHz</p>

<b>Digital output</b>	Open Drain External supply up to 32 V Output frequency up to 1 kHz Current max. 500 mA Short circuit / over voltage protected
<b>Digital input/output</b>	Push/Pull mode (e.g. DoIP Activation Line) or Push-Mode only (e.g. Wake-up Triggers) Output high (no load): 13 V Output high (load 346 Ω): 5.5 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
<b>Time stamps</b>	Accuracy (in device): 1 μs Accuracy software sync: typ. 50 μs Accuracy hardware sync: typ. 1 μs
<b>PC interface</b>	USB 2.0 or Ethernet (100BASE-TX, 1000BASE-T)
<b>External power supply</b>	Power-up: min. 6 V Continuous operation: 5 V ... 36 V
<b>Power consumption</b>	Typical 6...7 W
<b>Temperature range (ambient temp. of the device)</b>	Operation: -40 °C ... +65 °C Storage: -40 °C ... +85 °C
<b>Relative humidity of ambient air</b>	15 %...95 %, non-condensing
<b>Dimensions (LxWxH)</b>	Approx. 124 mm x 111 mm x 45 mm
<b>Weight</b>	Approx. 500 g
<b>Operating system requirements</b>	Windows 10 (x64, 64 bit) Windows 11 (x64, 64 bit)

# 3 Getting Started

In this chapter you find the following information:

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3.1.2 Installation Instructions .....	30
<b>3.2 Vector Hardware Manager</b> .....	<b>32</b>
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## 3.1 Driver Installation

### 3.1.1 General Information

The **Vector Driver Setup** allows the installation or the removal of Vector devices.

**Note**

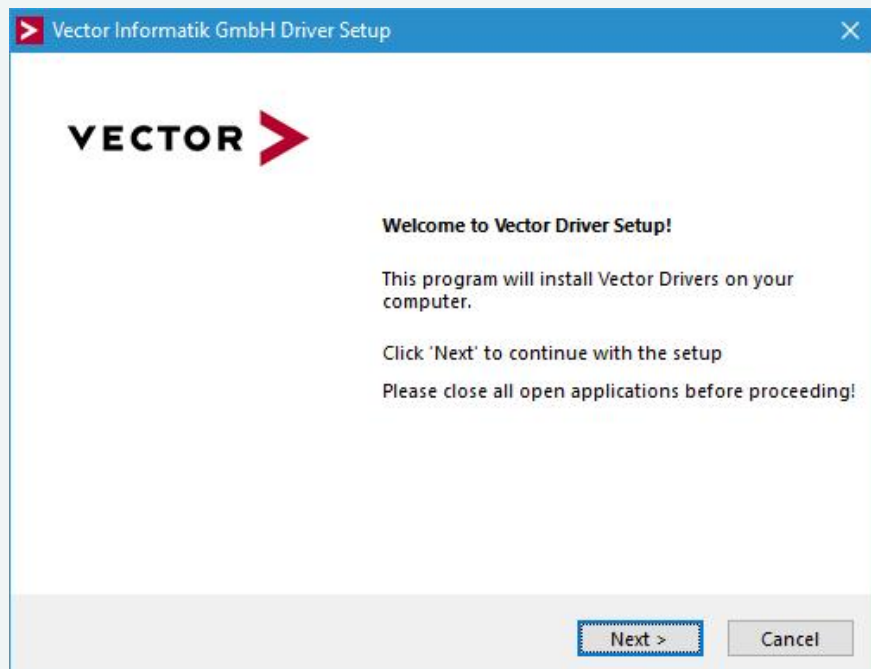
Please note that you will need **Administrator Rights** for the following steps.

### 3.1.2 Installation Instructions

**Step by Step Procedure**

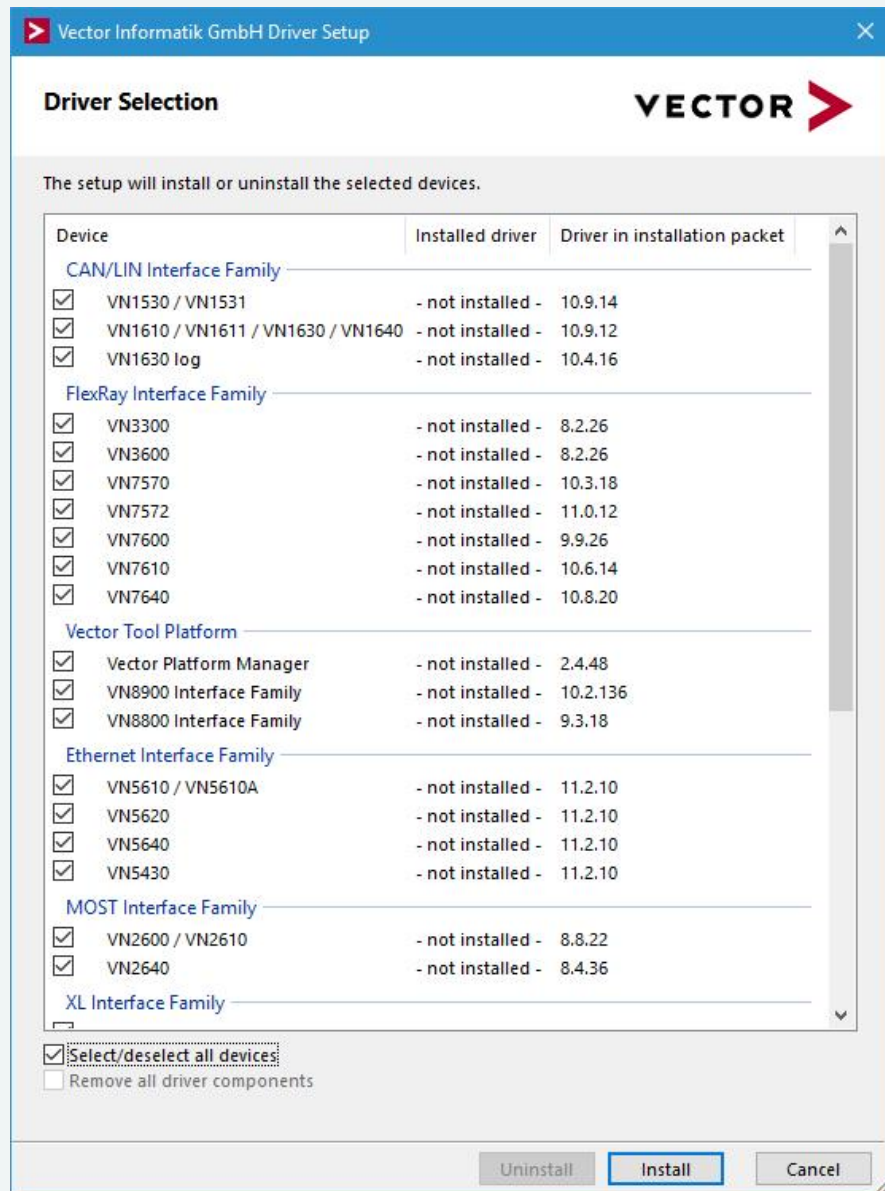
1. Execute the driver setup `\Drivers\Setup.exe` before the device is connected to the PC with the included USB cable.

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.

- In the driver selection dialog, select your devices to be installed (or to be uninstalled).



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



**Reference**

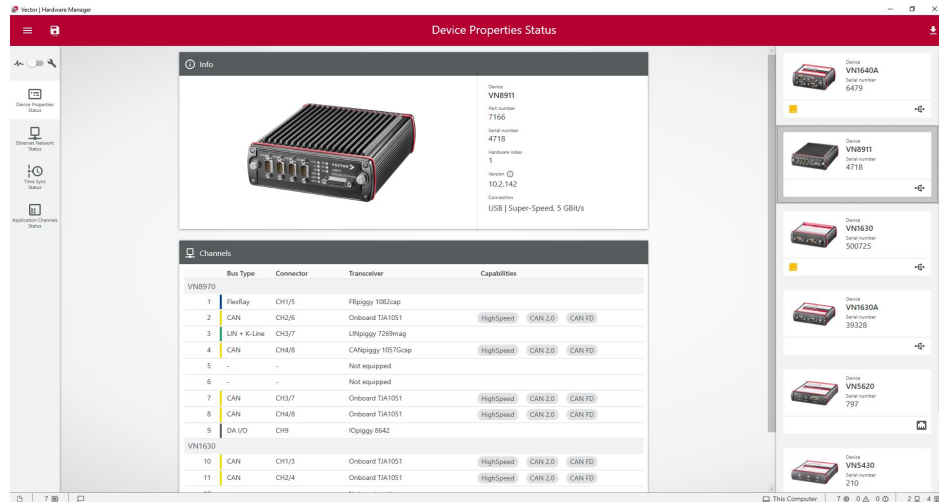
If you want to connect your computer and the device via Ethernet instead of USB, the device must be configured via the Vector Hardware Manager. A detailed description can be found in section **Tips and Tutorials** of the Vector Hardware Manager help.

## 3.2 Vector Hardware Manager

### 3.2.1 Hardware Configuration

**General information**

The **Vector Hardware Manager** is the successor of the Vector Hardware Config tool and a newly developed configuration and diagnostic tool for your installed Vector devices. It is strongly needed to set up your Vector devices for use with your Vector applications (e. g. CANoe, CANalyzer, CANape, XL API applications, ...).



### 3.2.2 Tool Location and Help

After successful driver installation of your Vector device, you will find the Vector Hardware Manager in the Windows Start menu or in the installation folder:  
`C:\Program Files (x86)\Vector Hardware Manager\vHardwareManager.exe`



**Reference**

Details, tips and instructions for the Vector Hardware Manager can be found in the supplied help. You can open the help by pressing **<F1>** in the Vector Hardware Manager or directly via:

`C:\Program Files (x86)\Vector Hardware Manager\Help01\HTML5\VectorHardwareManager.htm`

For a brief introduction, we recommend reading the sections **Basic Concept** and **Quick Start Guide**. Furthermore, we have provided additional information for you in the section **Tips and Tutorials**.



## 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 10 / Windows 11** and independent of the used application.

## 3.3.1 CAN

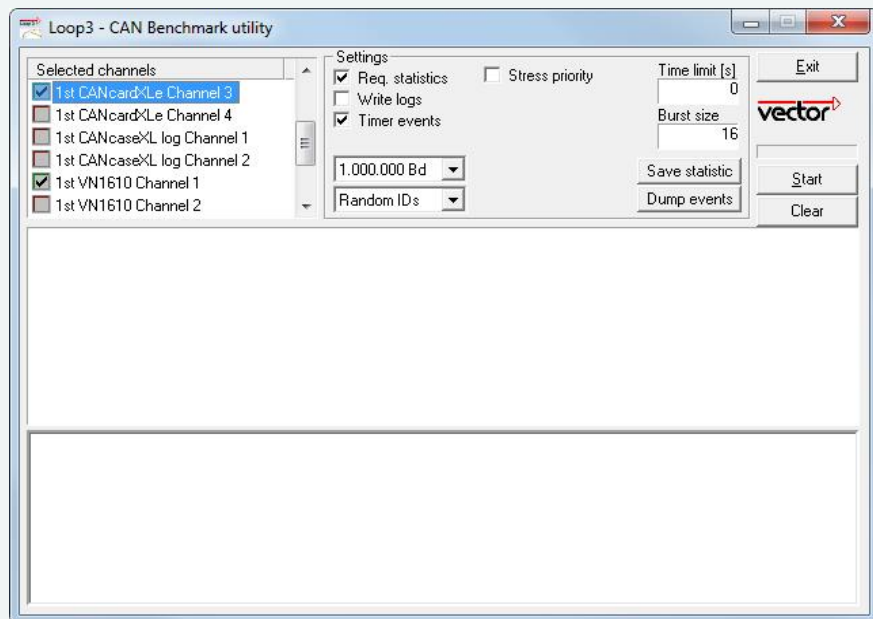
### Device test

The operating test for CAN requires either two high-speed or two low-speed transceivers and can be executed as follows:



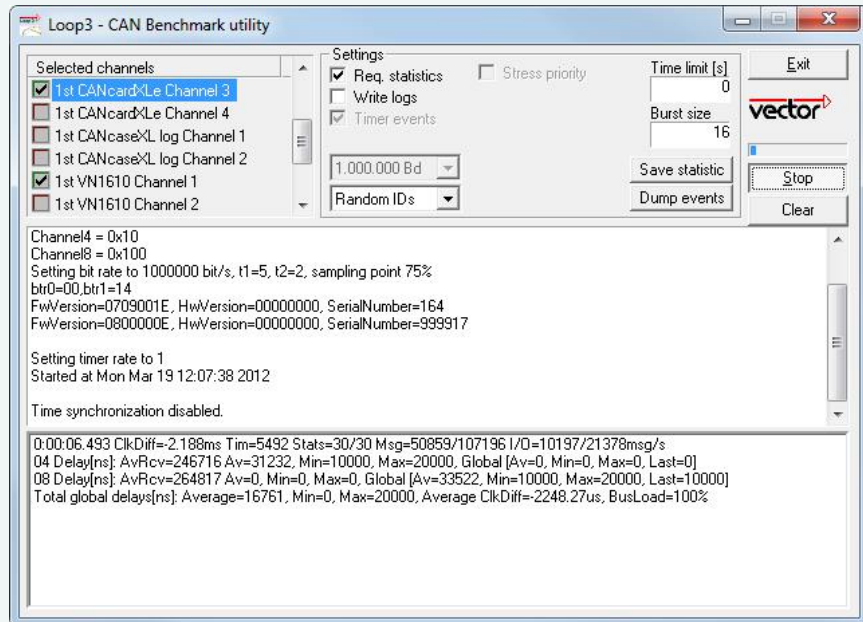
#### Step by Step Procedure

1. Connect two CAN channels with a suitable cable.  
If two high-speed transceivers are being used, we recommend our **CANcable1** (**CANcable0** for low-speed transceivers).
2. Start `\Drivers\Common\Loop3.exe` from the **Vector Driver Setup**.  
This program accesses the Vector devices and transmits CAN messages.

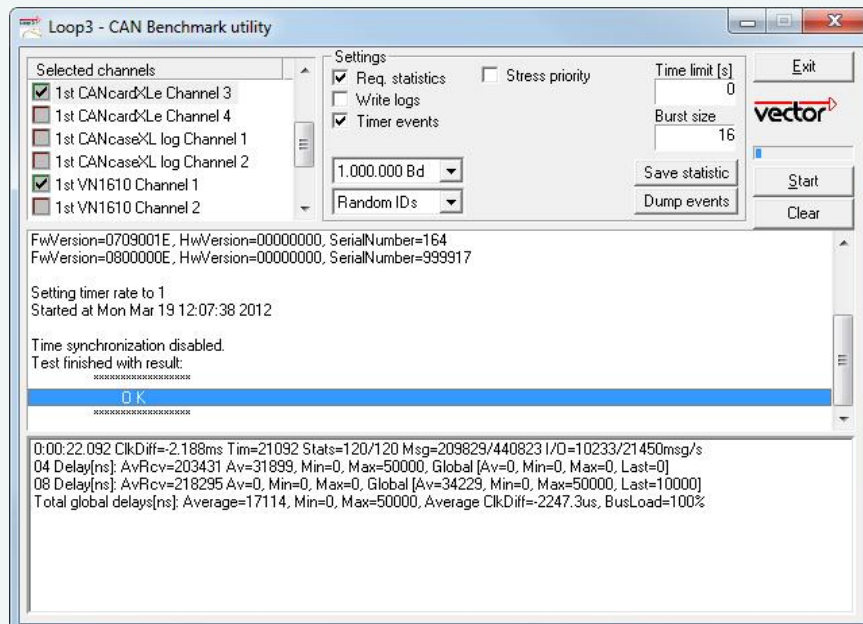


3. Select the connected CAN channels of the device(s) to be tested.

4. Set the appropriate baudrate depending on the transceiver being used (high-speed max. 1,000,000 Bd, low-speed max. 125,000 Bd).
5. Click **[Start]**.
6. You will see statistical data in the lower part of the window if the system has been configured properly.



7. The test procedure can be terminated with the **[Stop]** button. An **OK** should appear in the upper part of the window.



## 3.3.2 FlexRay

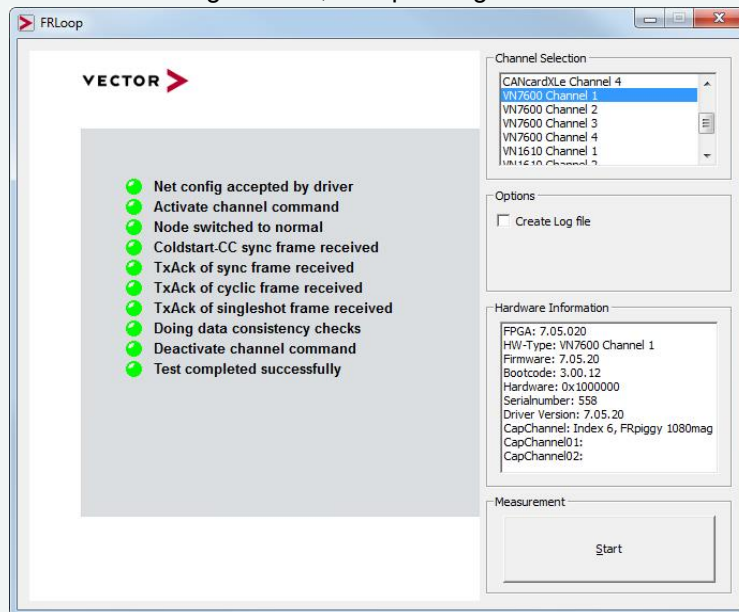
### Device test

The operating test for FlexRay requires an inserted FRpiggy (except for VN7610) and can be executed as follows:



#### Step by Step Procedure

1. Remove the FlexRay cable if it is connected.
2. Start `\Drivers\Common\FRLoop.exe` from the **Vector Driver Setup**.
3. Execute the test.
4. If no error messages occur, the operating test was successful.



# 4 Time Synchronization

In this chapter you find the following information:

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# 4.1 General Information

## Time stamps and events

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

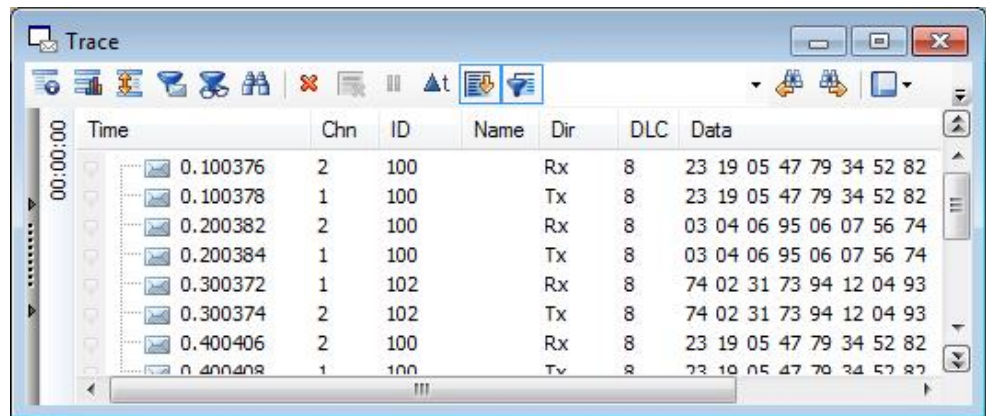


Figure 18: Time stamps of two CAN channels in CANalyzer

## 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.

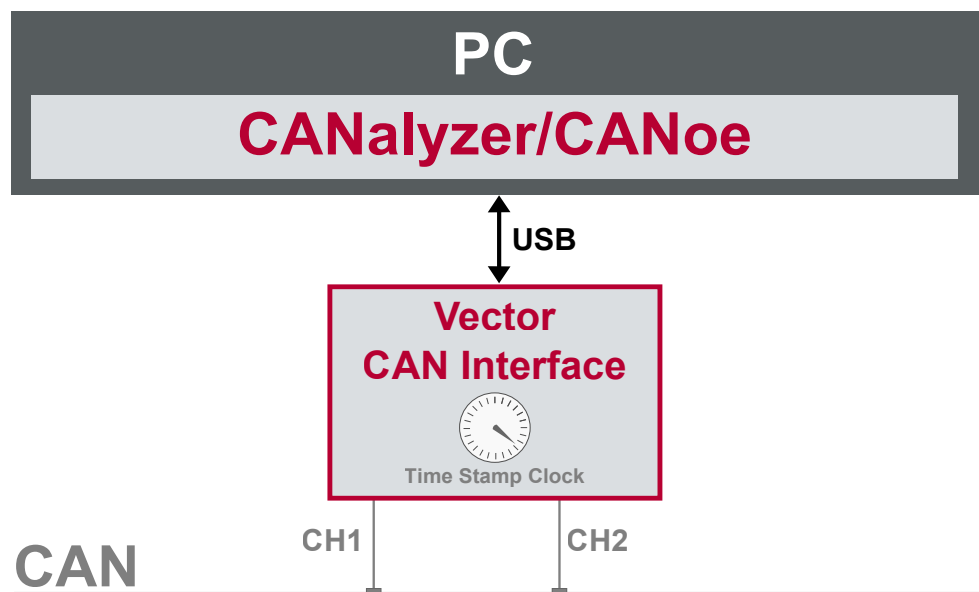


Figure 19: Common time stamp clock for each channel

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.

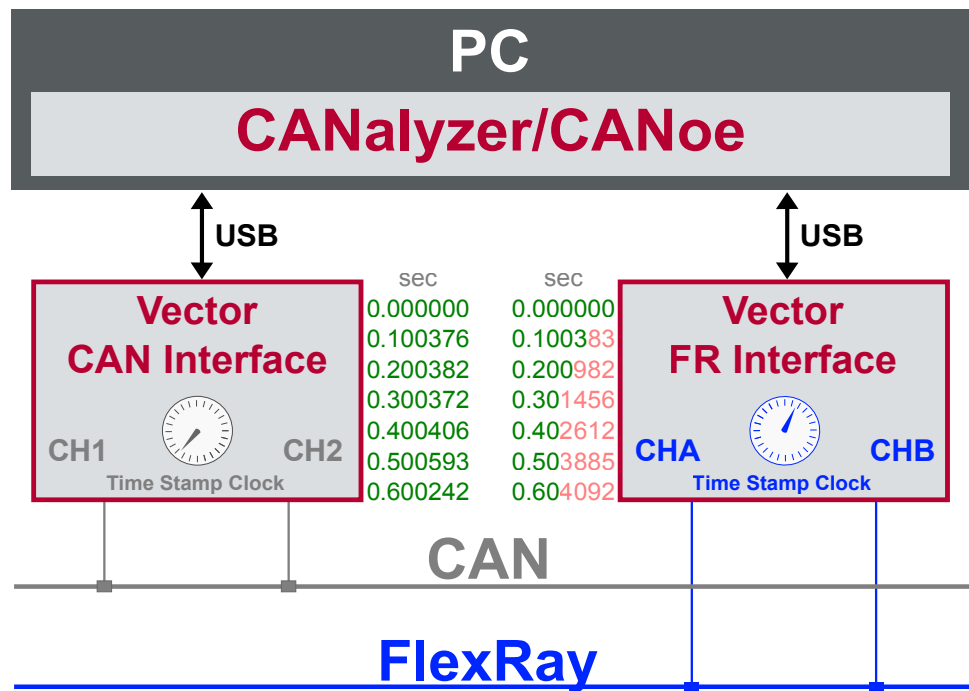


Figure 20: Example of unsynchronized network interfaces. Independent time stamps drift apart

To compensate for these time stamp deviations between the Vector network interfaces, the time stamps can be either synchronized by software, hardware, PTP or GNSS (capability depends on the Vector device).

**i** **Note**  
 The accuracy of the software, hardware, PTP or GNSS sync depends on the interface. Further information on specific values can be found in the technical data of the respective devices.

## 4.2 Software Sync

### 4.2.1 General Information

**Synchronization by software**

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.

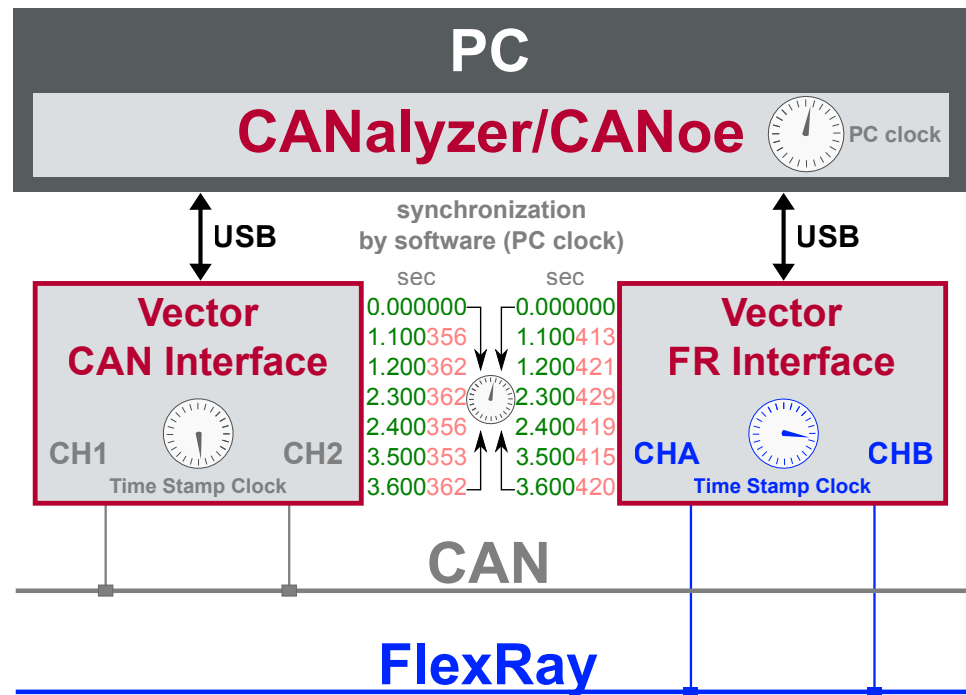


Figure 21: Time stamps of devices are synchronized to the PC clock



**Note**

Software time synchronization may lead to an increased latency for all connected Vector network interfaces. If a case requires low latency, deactivate this option and use another synchronization mechanism.

### 4.2.2 Configuration

**Vector Hardware Manager**

Use the software synchronization if at least one device has no hardware sync connector. Also to synchronize the device clock to the computer time, use the software synchronization (legacy).



**Reference**

Further details and tips on the time sync configuration can be found in the Vector Hardware Manager help in section **User Interface | Navigation Rail | Time Sync**.



## 4.3 Hardware Sync

### 4.3.1 General Information

**Synchronization by hardware**

A more accurate time synchronization of multiple devices is provided by the hardware synchronization. Two Vector network interfaces can therefore be connected with the SYNCcableXL (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).

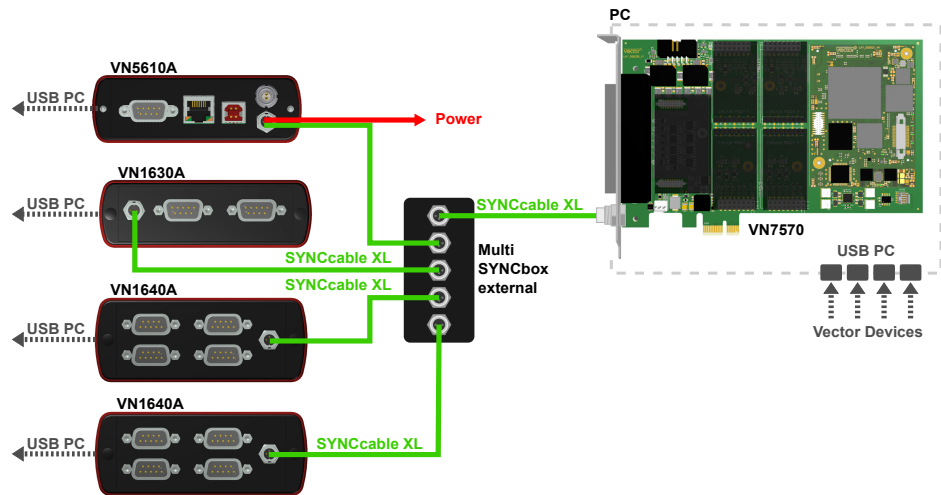


Figure 22: Example of a time synchronization with multiple devices

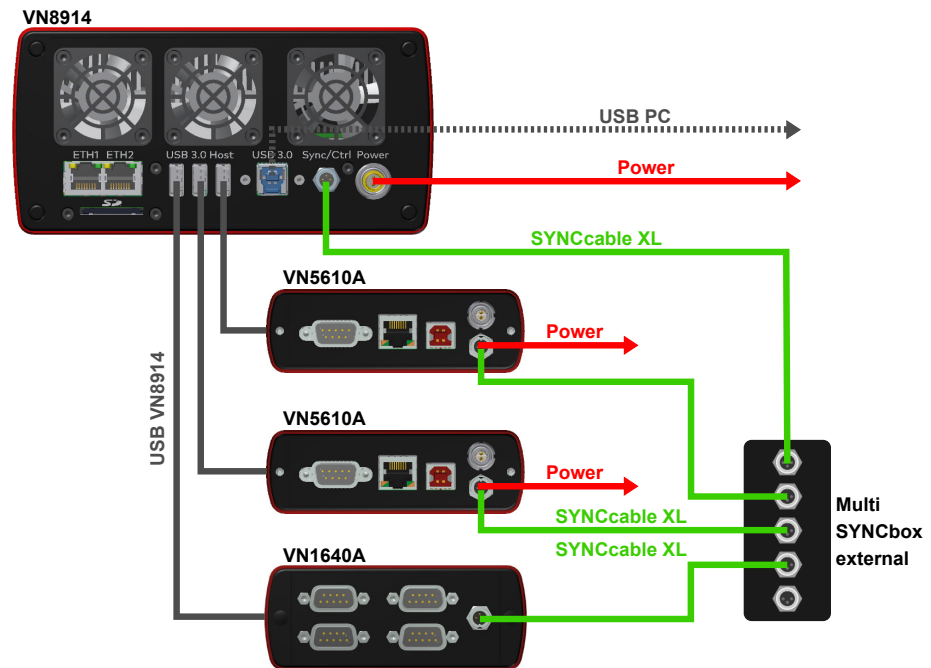


Figure 23: Example of a time synchronization with VN8914 and additional devices

At each falling edge on the sync line which is initiated by the driver, the Vector network interface generates a time stamp that is provided to the driver. This allows the driver to calculate the deviations between the network interfaces and to synchronize

the time stamps to a common time base (master clock) which can be defined by the user.

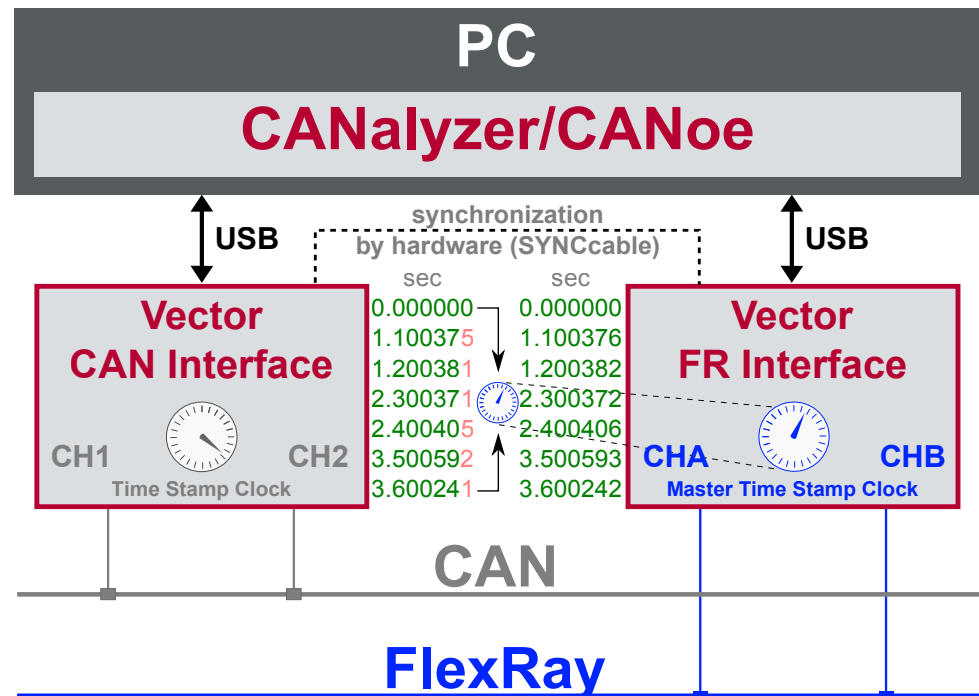


Figure 24: Time stamps are synchronized to the master clock

### 4.3.2 Configuration

Vector  
Hardware Manager

Use hardware synchronization if at least one device is connected with USB or PCIe to the PC and all devices are hardware sync capable. One device should be configured as master and all other devices as slaves. Therefore, all devices must be interconnected with SYNCcableXL and Multi SYNCbox external or SYNCbox active.



**Reference**

Further details and tips on the time sync configuration can be found in the Vector Hardware Manager help in section **User Interface | Navigation Rail | Time Sync**.

## 4.4 Precision Time Protocol Sync

### 4.4.1 General Information

**Overview**

The Precision Time Protocol (PTP) is a protocol used to synchronize clocks through a computer network. On a local area network, it achieves a synchronization accuracy in the sub-microsecond range, making it suitable for measurement and control systems.



**Note**

The PTP feature can only be used on the Ethernet host ports of these devices. Therefore, it can only be used, if the device is connected via Ethernet host port to the PC.

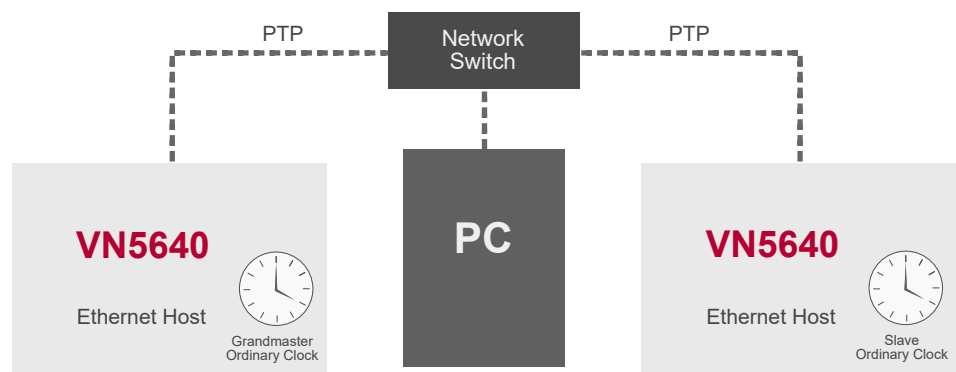


Figure 25: Setup example

### 4.4.2 Supported Features

Vector network interfaces support time synchronization with IEEE1588-2008 standard. The following IEEE1588 features are supported:

IEEE1588 Features	VN Device Support
Clock Types	
Ordinary Clock Master	X
Ordinary Clock Slave	X
Synchronization	
2-step clock	X
E2E	X
BMCA	X
Transport	
PTP over UDP with IPv4	X
PTP over UDP with IPv6	-
Multicast Master/Slave	X
Unicast Master/Slave	-
Synchronization accuracy	
1 $\mu$ s	X

### 4.4.3 Network Topology

**Network switches** To achieve a maximum accuracy, PTP needs transparent clock support in network equipment. Therefore, a PTP transparent clock capable network switch is strongly suggested.

### 4.4.4 Configuration

**Vector Hardware Manager** Use the PTP synchronization if all devices are connected via Ethernet host port to the PC and one device is configured as master and all other devices are configured as slaves.



#### Reference

Further details and tips on the time sync configuration can be found in the [Vector Hardware Manager](#) help in section **User Interface | Navigation Rail | Time Sync**.

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