VECTOR

VN7640 Manual

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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
bold	Blocks, surface elements, window and dialog names of the software. Accentuation of warnings and advices. **[OK]** Push buttons in brackets **File|Save** 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

WARNING!
We provide our important notes and safety instructions in several languages, including Englisch (EN) and German (DE). For more details, see the relevant section:

- EN: Important Notes - Details
- DE: Wichtige Hinweise

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 20)
- 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

- 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 20. A list of compatible piggybacks can be found in the accessories manual or on our website.

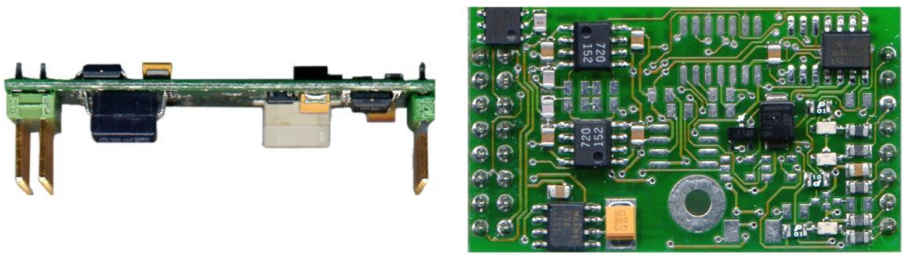


Figure 2: Piggyback

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.

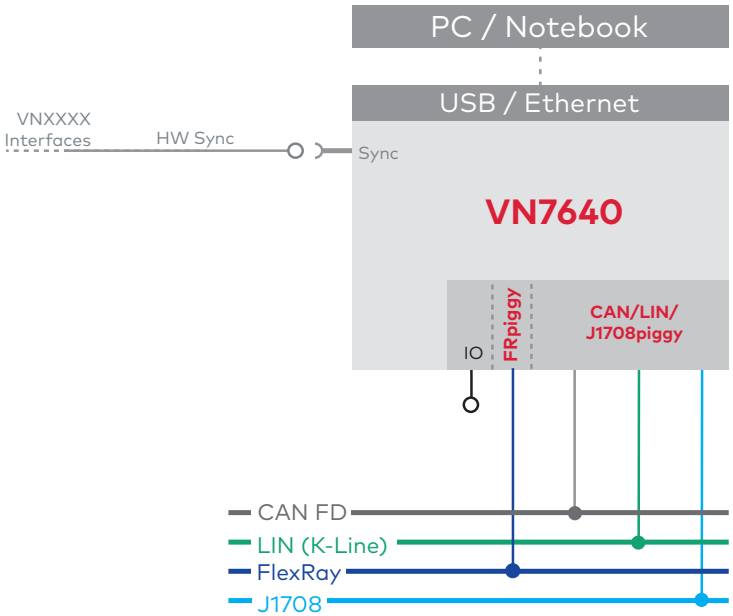


Figure 3: Connection options

2.5 Connectors Bus Side

Front side

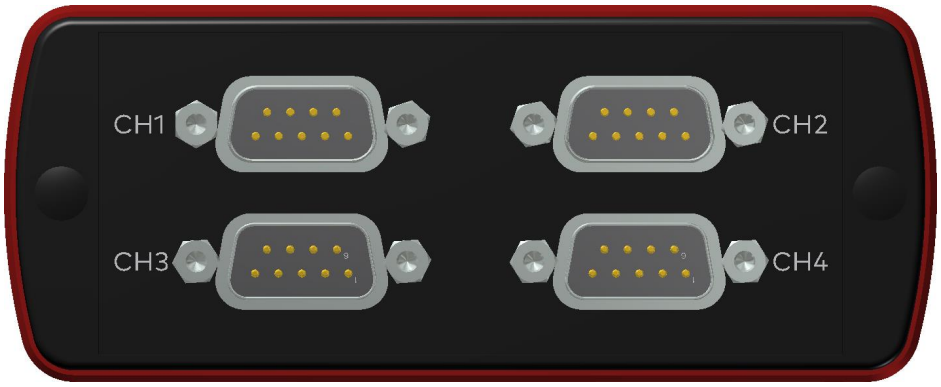


Figure 4: VN7640 with D-SUB9 connectors

- **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

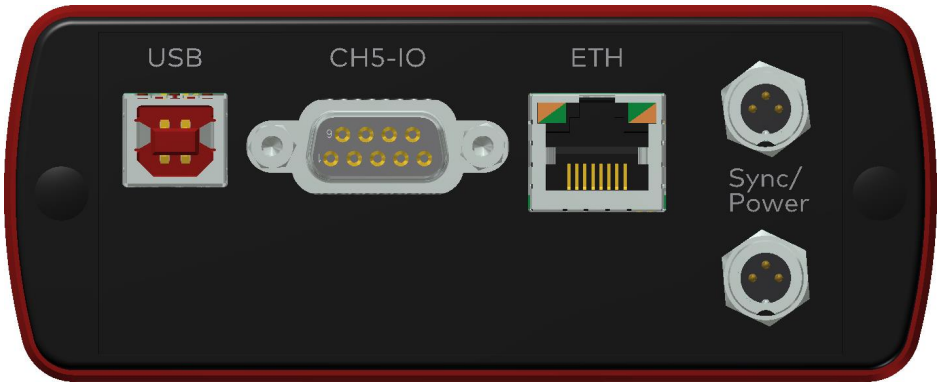


Figure 5: Connectors on the USB side

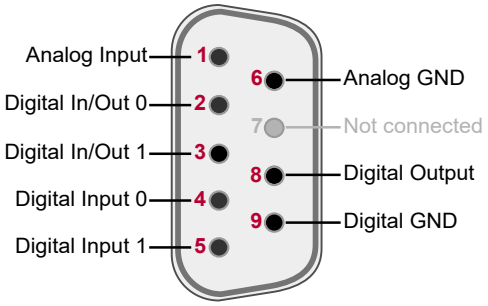
Device connectors

- **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/ouput pins can be found on the next page.

Details on CH5

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

Internal interconnection of digital in/out 0/1

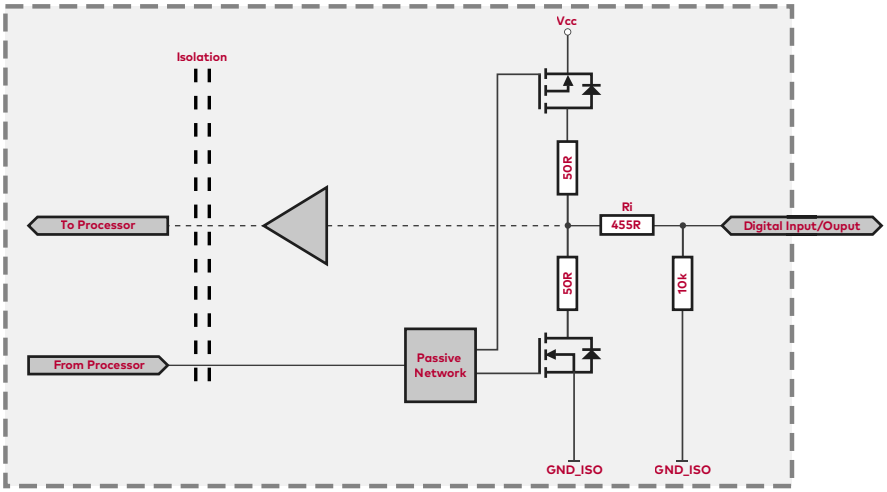


Figure 6: Digital input /output

Internal interconnection of digital input 0/1

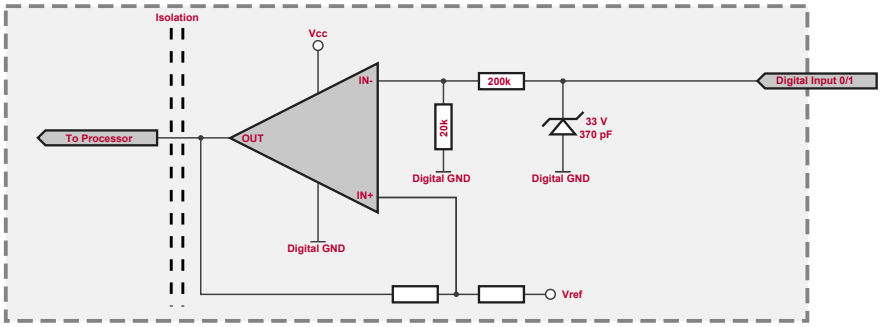


Figure 7: Digital input 0/1

Internal interconnection of digital output

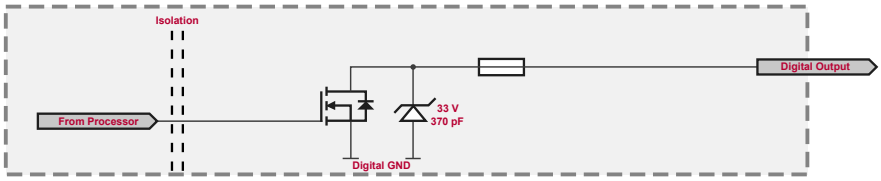


Figure 8: Digital output

Internal interconnection of analog input

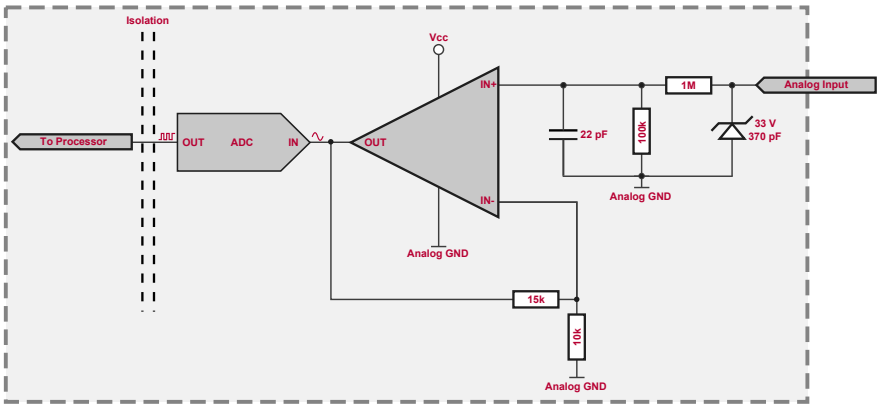


Figure 9: Analog input

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:

$$R_{ext}\,[kOhm] = [(U_{input} * 0.61111) - 11] * 100$$
$$with\ 18\,V < U_{input} \leq 50\,V$$

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

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

Examples

	24 V	32 V	36 V	48 V
R_{ext}	367 kΩ	856 kΩ	1100 kΩ	1833 kΩ
R_{ext} (E96)	374 kΩ (24.12 V)	866 kΩ (32.17 V)	1100 kΩ (36.00 V)	1870 kΩ (48.60 V)
f_c (-3 dB)	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 18.

- **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 40) 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.

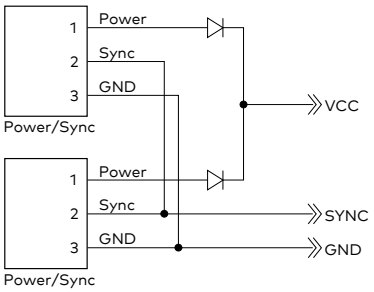


Figure 10: Internal wiring of the power/sync connector

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.

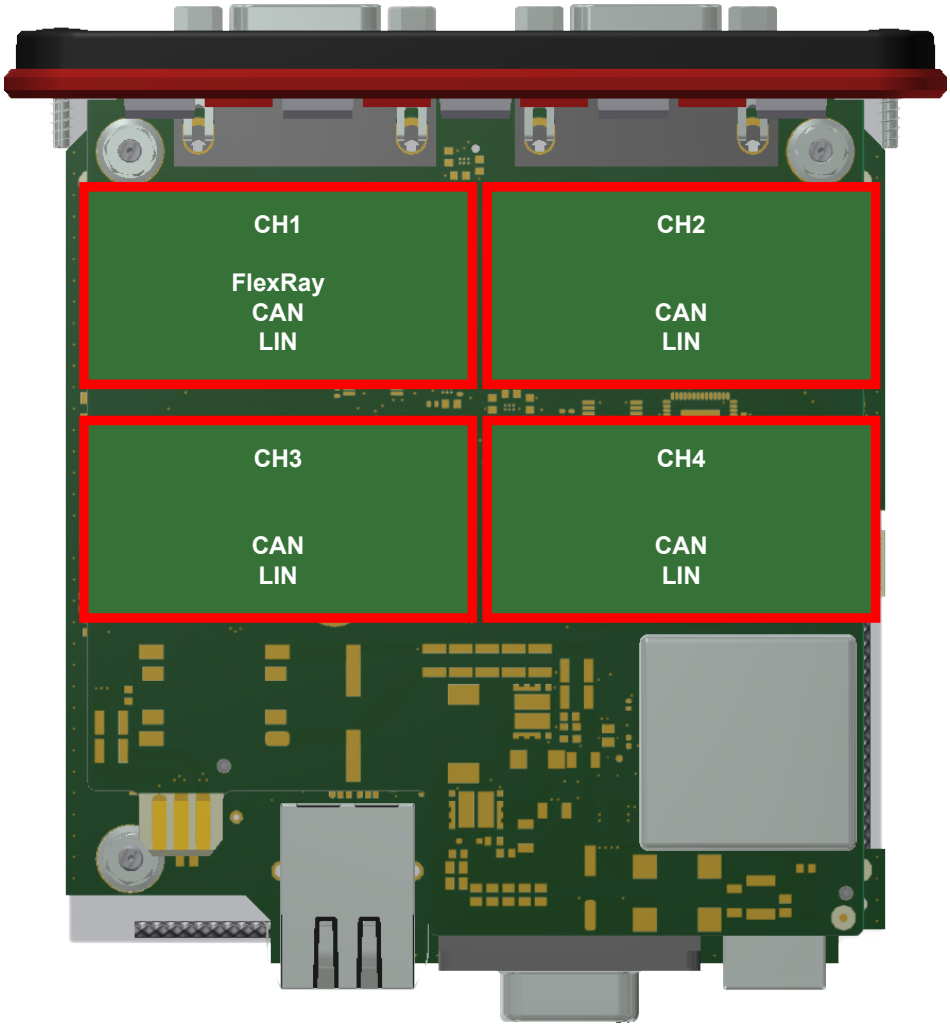


Figure 12: Piggyback plug-in locations for CH1…CH4

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

	CH1	CH2	CH3	CH4
Piggyback	FlexRay or CAN1 or LIN4	CAN2 or LIN3	CAN3 or LIN2	CAN4 or LIN1/K-Line

Examples

The following tables show examples of possible configurations:

	CH1	CH2	CH3	CH4
4x CAN	CANpiggy 1	CANpiggy 2	CANpiggy 3	CANpiggy 4
1x FR 3x CAN	FRpiggyC	CANpiggy 1	CANpiggy 2	CANpiggy 3
1x FR 2x CAN 1x LIN	FRpiggyC	CANpiggy 1	CANpiggy 2	LINpiggy 1
3x CAN 1x LIN	CANpiggy 1	CANpiggy 2	CANpiggy 3	LINpiggy 1
1x CAN 1x LIN	CANpiggy 1	-	-	LINpiggy 1
1x CAN 2x LIN	CANpiggy 1	-	LINpiggy 2	LINpiggy 1

2.9 Replacing Piggybacks

WARNING!
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.

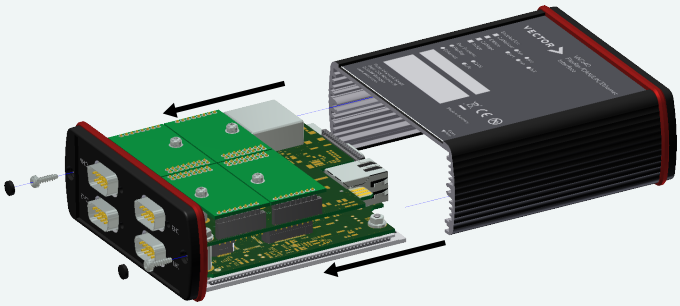


Figure 13: Opening the housing

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

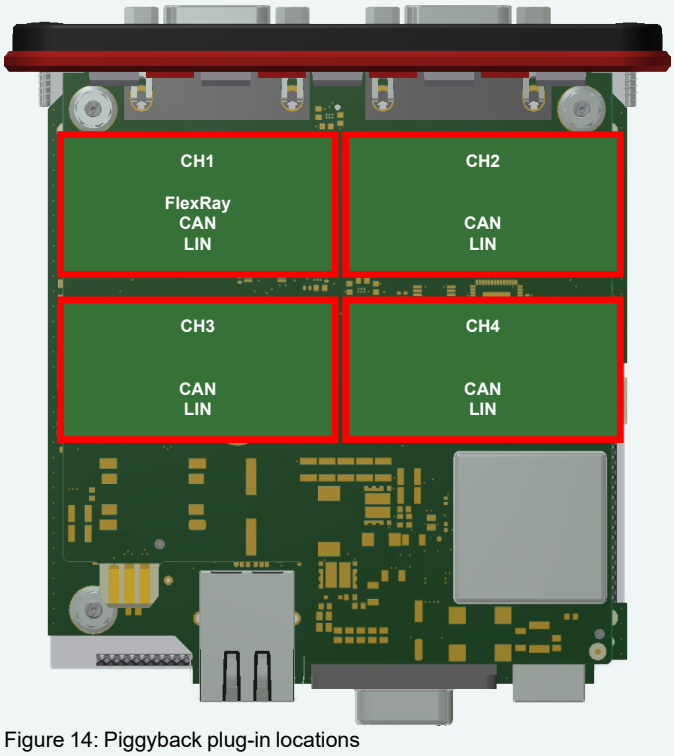


Figure 14: Piggyback plug-in locations

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.

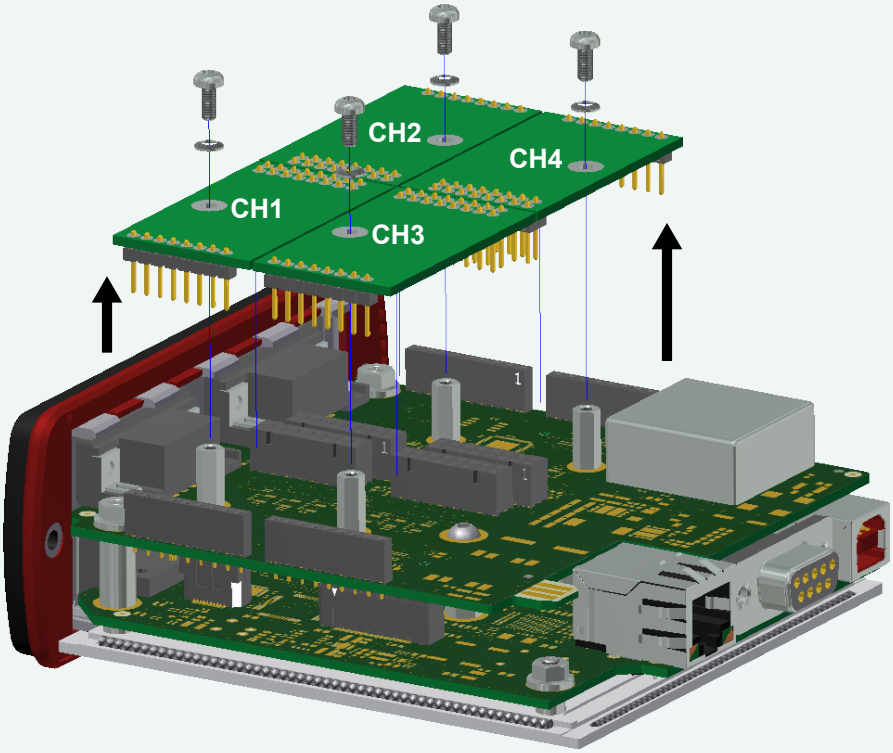


Figure 15: Unmount/mount Piggybacks

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.

6. 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.

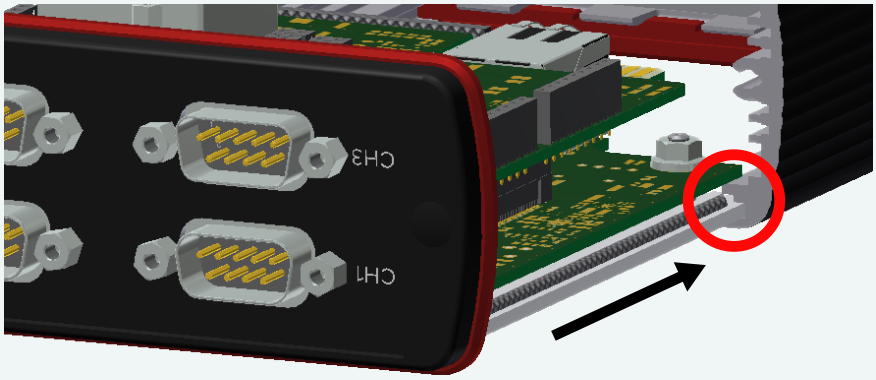


Figure 16: First guide rails

7. 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.
8. Please also attach the two black decorative caps.
9. Connect the VN7640 and the PC via the USB cable and check the bus configuration in the **Vector Hardware Manager**.

2.10 Technical Data

FlexRay communication-controller	Analysis Bosch E-Ray (FPGA) Startup Bosch E-Ray (FPGA)
FlexRay channel	Max. 1 channel A and B at channel 1 (configurable via Piggyback) 2 MB memory for data transmission
CAN/CAN FD channels	Max. 4 (configurable via Piggybacks) - max. 2x CANpiggy 10011opto Bitrates - CAN: up to 1 Mbit/s (up to 2 Mbit/s depending on wiring and transceivers) - CAN FD: up to 5 Mbit/s (up to 8 Mbit/s depending on wiring and transceivers)
LIN channels	Max. 4 (configurable via Piggybacks) Bitrates - Normal-Mode: up to 20 kBit/s - Flash-Mode: up to 115.2 kBit/s (depending on wiring higher bitrates are possible)
K-Line channels	Max. 1 at channel 4 (with LINpiggy 7269mag)
Channel configurations	Configurable with Piggybacks 1x FlexRay, 3 x CAN 1x FlexRay, 2x CAN, 1x LIN (1x K-Line) 4x CAN 3x CAN, 1x LIN (1x K-Line) 2x CAN, 2x LIN (1x K-Line) 1x CAN, 3x LIN (1x K-Line) 4x LIN (1x K-Line) Additional: Digital/analog IO channel
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 17.
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 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
Time stamps	Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs
PC interface	USB 2.0 or Ethernet (100BASE-TX, 1000BASE-T)
External power supply	Power-up: min. 6 V Continuous operation: 5 V … 36 V
Power consumption	Typical 6...7 W
Temperature range (ambient temp. of the device)	Operation: -40 °C ... +65 °C Storage: -40 °C ... +85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	Approx. 124 mm x 111 mm x 45 mm
Weight	Approx. 500 g
Operating system requirements	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 Driver Installation

3.1.1 General Information

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

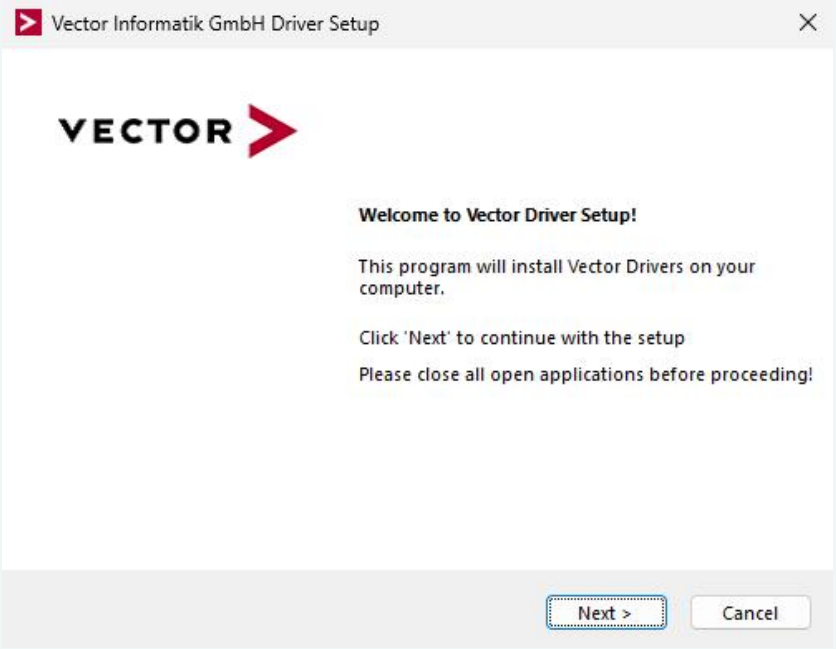
Note
Please note that you will need **Administrator Rights** for the following steps.

3.1.2 Installation Instructions

Step by Step Procedure

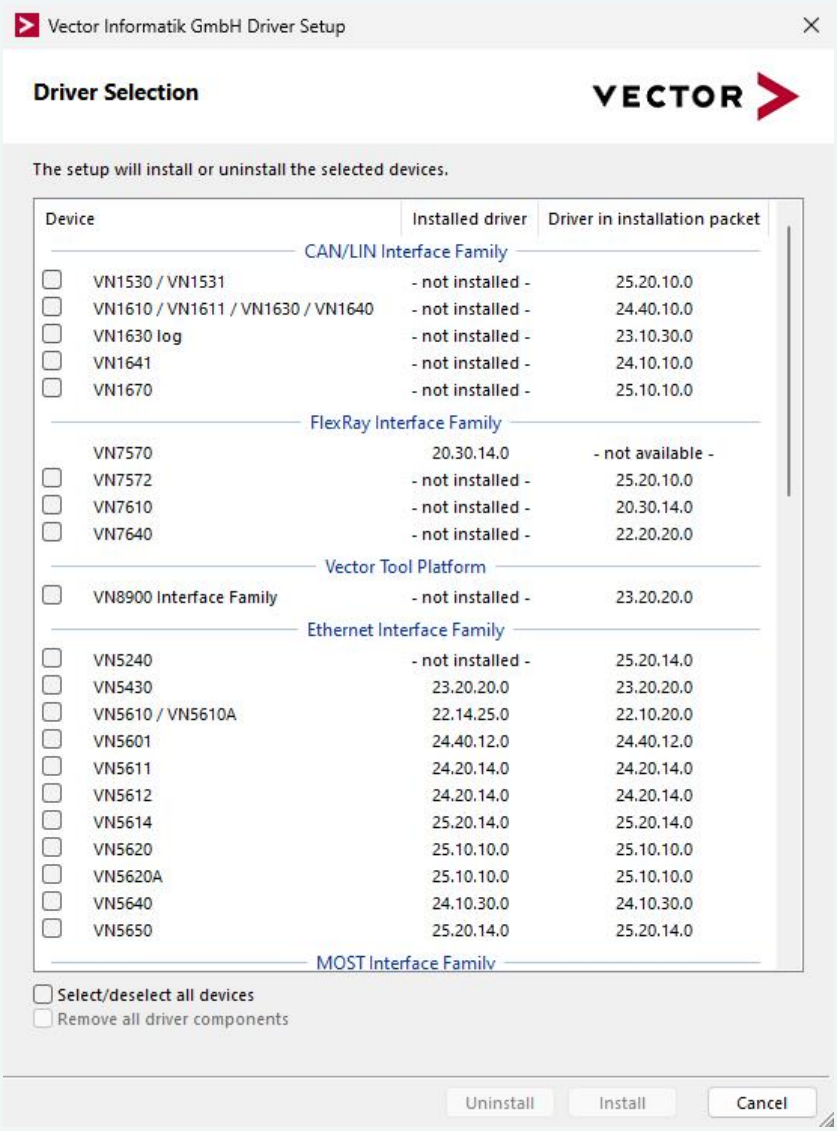
1. Execute the driver setup `\Drivers\Setup.exe` before the device is connected to the computer with the included USB cable.

   If you have already connected the device to the computer, 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 computer 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 Command Line

Command line installation is an important feature for administration purposes when new drivers need to be installed or updated in the background without user interaction.

This section describes how to use the command line for

- Vector drivers

3.3 Vector Driver

3.3.1 Prerequisites

Prerequisites

Administrative rights are required to use the `setup.exe` command line tool. If the device is not connected to the computer during installation, a pre-installation to the Windows Driver Store is performed. If the device is connected to the computer for the first time, the device driver installation must be completed. The requirements and actual behavior of this process varies between Windows operating systems (see section Remarks on page 34).

3.3.2 Options and Actions

The `setup.exe` can be found on the Vector Driver Disk and provides a command line interface as follows:

```
setup.exe [option] [action]
```

3.3.2.1 Options

Option	Command	Description
Silent mode	`/s`	Executes the driver setup in silent mode. No user interaction is required. This command cannot be used with uncertified Vector drivers. Use with the `/installCert` option under Windows 7/8 and above.
No virtual driver	`/nv`	Does not install any virtual driver (Virtual CAN Bus).
Update only	`/uo`	The setup is forced to install only a newer version of a driver located in the folder `\Drivers`.
Vector DLLs only	`/dongleDLLsOnly`	Use this option to install only the Vector Keyman API DLLs. The WIBU service of the dongle manufacturer will not be installed. Attention: This option is only valid if you actually install the Vector Keyman driver. This means using action: `/i keyman`.
Install certificate	`/installCert`	This option installs the Vector driver certificate in the local certificate store under trusted publishers. Use this option in conjunction with the `/s` option to silently install the Vector drivers under Windows 7/8 and above.
No CodeMeter runtime service	`/ncmr`	Does not install the WIBU service.

3.3.2.2 Actions

Action	Command	Description
Install	`/i <driver name>`	Installs the specified driver from the driver source path.The driver name is the name of the device (e. g. `vn1630`). Lower case and

Action	Command	Description
		upper case will be ignored.
Install all	`/i all`	Installs all available interface drivers from the driver source path. Note: The following drivers are **not automatically** installed with the `all` option: Vector Keyman VN8900 Ethernet driver (vnIpClient). They must be installed explicitely.
Install all and Vector Keyman	`/i all keyman`	Installs all available interface drivers from the driver source path and the Vector Keyman.
Install all and Vector Keyman	`/i all keyman`	Installs all available interface drivers from the driver source path and the Vector Keyman.
Uninstall	`/u <driver name>`	Removes (uninstalls) the specified driver from the system. The driver name is the name of the device (e. g. `vn1630`). Lower case and upper case will be ignored.
Uninstall all	`/u all`	Removes (uninstalls) all interface drivers and driver components from the system. This action removes everything except for the Vector Keyman and the VN8900 Ethernet driver (vnIpClient).
Uninstall all and Vector Keyman	`/u all keyman`	Removes (uninstalls) all available interface drivers from the system including the Vector Keyman.
Info	`/info <file name>`	Creates a new file containing information about the drivers, which are available in this installation package (e. g. the version number).
Install Vector Keyman	`/i keyman`	Installs only the Vector Keyman.
Install virtual driver and driver components only	`/i virtual`	Installs the virtual driver and the driver components only.
Uninstall Vector Keyman	`/u keyman`	Uninstalls the Vector Keyman.
Uninstall the virtual driver and driver components	`/u virtual`	Uninstalls the virtual driver and the driver components only.
No automatic update	`/noAutoUpdate <driver name>`	Disables automatic updating of software running on the device when a driver is installed on the host system. The driver name is the name of the device (e. g. vx1161.41). Lower case and upper case will be ignored. If the specified driver does not support this feature, the action is silently ignored.
No automatic update all	`/noAutoUpdate all`	Disables automatic updating of software running on the device when a driver is installed on the host system for all drivers that support this feature.

3.3.2.3 Return Values

When executing `setup.exe` in command line mode, the following values may be returned:

Return Value	Description
0	The operation was successful.
1	The installation was not successful.
2	The uninstallation was not successful.
3	Restart of the system is required.
4	Command `/info` could not be executed.
5	User attempted to install/uninstall an unknown driver or component.

3.3.2.4 Examples

Action	Command
`setup.exe /s /installCert /i all`	Installs all interface drivers silently. Except for the Vector USB dongle, the Vector Keyman and the VN8900/VN8810 Ethernet drivers.
`setup.exe /s /installCert /i all vnipclient vnipcl8800`	Installs all interface drivers silently including the VN8900/VN8810 Ethernet drivers.
`setup.exe /s /installCert /i all keyman`	Installs all interface drivers silently including the Vector Keyman.
`setup.exe /s /installCert /i vn1630`	Installs the driver for VN1630(A) silently.
`setup.exe /s /i keyman`	Installs the driver for the Vector Keyman silently.
`setup.exe /s /dongleDLLsOnly /i keyman`	Installs only the Vector Keyman API-DLLs silently. The CodeMeter runtime is not installed.
`setup.exe /s /dongleDLLsOnly /u keyman`	Uninstalls only the Vector Keyman API-DLLs silently. The CodeMeter runtime is not uninstalled.
`setup.exe /s /u vn1630`	Uninstalls the VN1630 driver from the system silently.

`setup.exe /info "Drivers.txt"`	Example output of `Drivers.txt`
	
	`[Common]`
	`version=0x703001e`
	`root=C:\Drivers\`
	`file1=setup.exe`
	`file2=DIFxAPI.dll`
	`file3=.\CommonFiles`
	`[CANboardXL]`
	`version=0x7030012`
	`path=.\CANboardXL`

3.4 Remarks

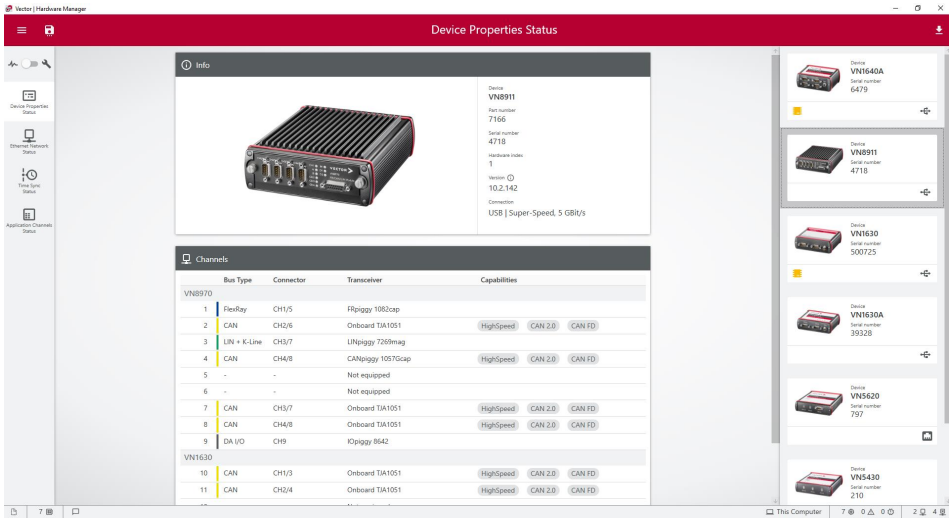
- **Windows 10 (64 bit) / Windows 11 (64 bit)**
  - Recommended installation command:
    `setup.exe /installCert /s /i all`
  - Recommended uninstallation command:
    `setup.exe /s /u all`
  - It is not possible to install the drivers from a network drive.
  - It is possible to pre-install the drivers, if the hardware is currently not connected. In this case, the installation of the driver automatically completes after connecting the device.
  - In order to use the silent mode (`/s`), the Vector certificate must be added to the trusted publishers. The Vector certificate can be added silently during the first installation by specifying the `/installCert` option. Any future installation of a Vector certified driver can be installed silently then.
  - The Vector certificate can also be added to the trusted publishers during the first installation by hitting the checkbox **Always trust content from this publisher**. This installs the Vector certificate locally. Any future installation of a Vector certified driver can be installed silently then.

3.5 Vector Hardware Manager

3.5.1 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, ...).



3.5.2 Tool Location and Help

After successful driver installation (see page 28) 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`
- The most recent version of the help is also available online:
  https://help.vector.com/VectorHardwareManager/index.php

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**.

3.6 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.

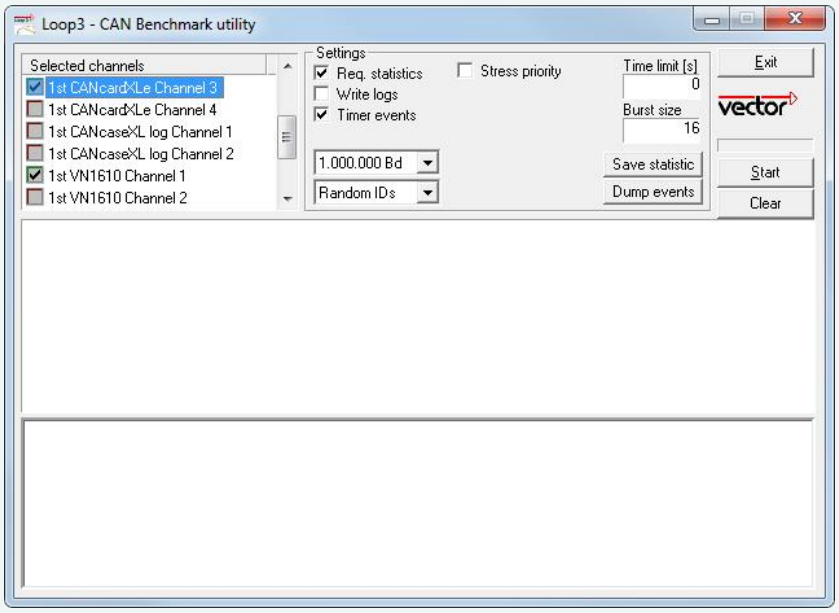
3.6.1 CAN

Device test

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

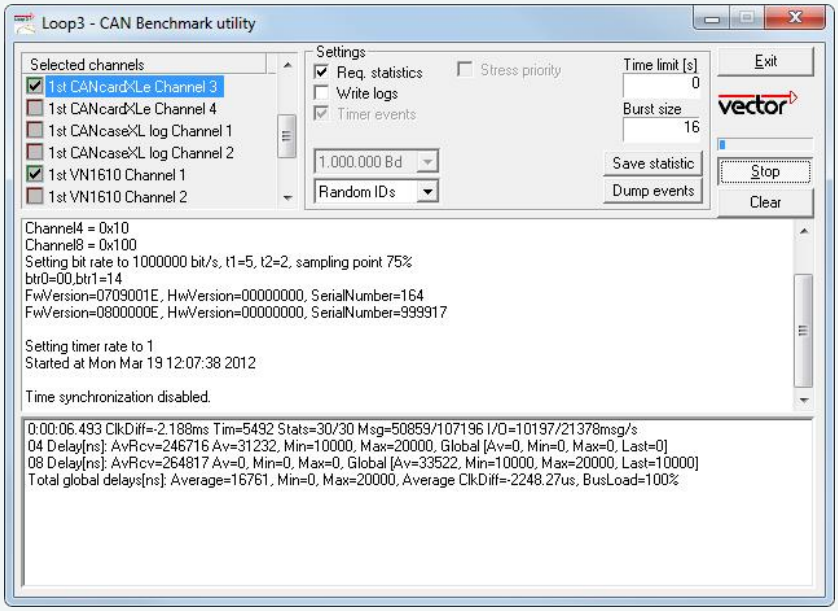
Step by Step Procedure

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.

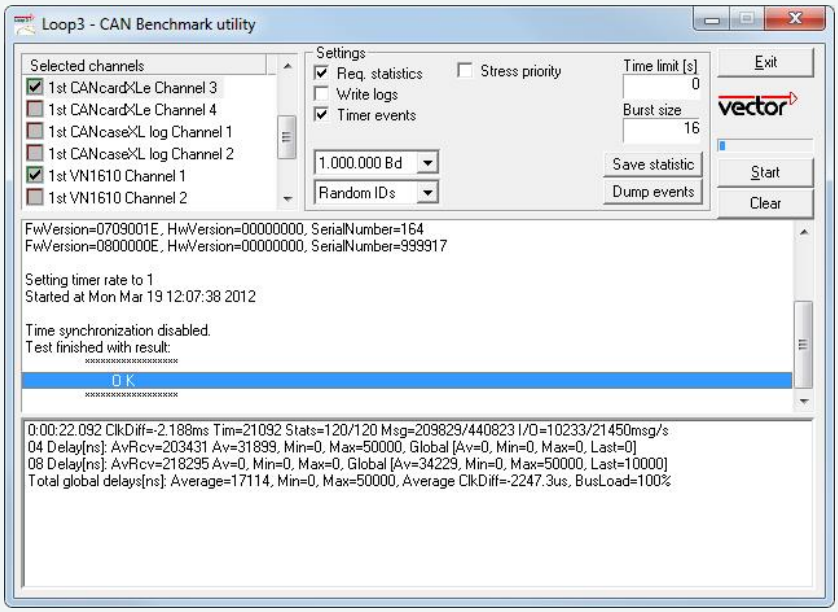


3. Select the connected CAN channels of the device(s) to be tested.

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.



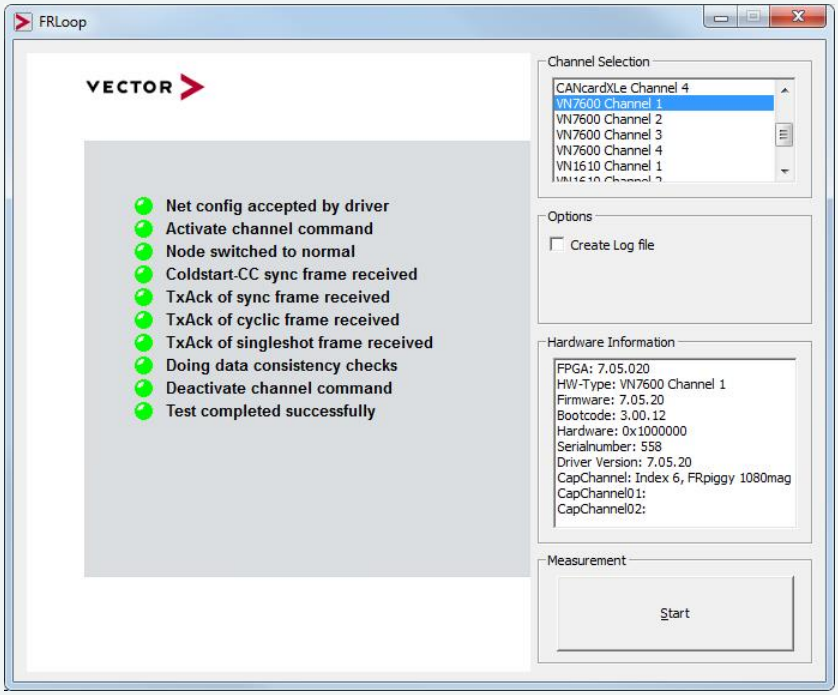
3.6.2 FlexRay

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:

4.1 General Information **41**

4.2 Software Sync **43**
4.2.1 General Information 43
4.2.2 Configuration 43

4.3 Hardware Sync **44**
4.3.1 General Information 44
4.3.2 Configuration 45

4.4 Precision Time Protocol Sync **46**
4.4.1 General Information 46
4.4.2 Supported Features 46
4.4.3 Network Topology 47
4.4.4 Configuration 47

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.

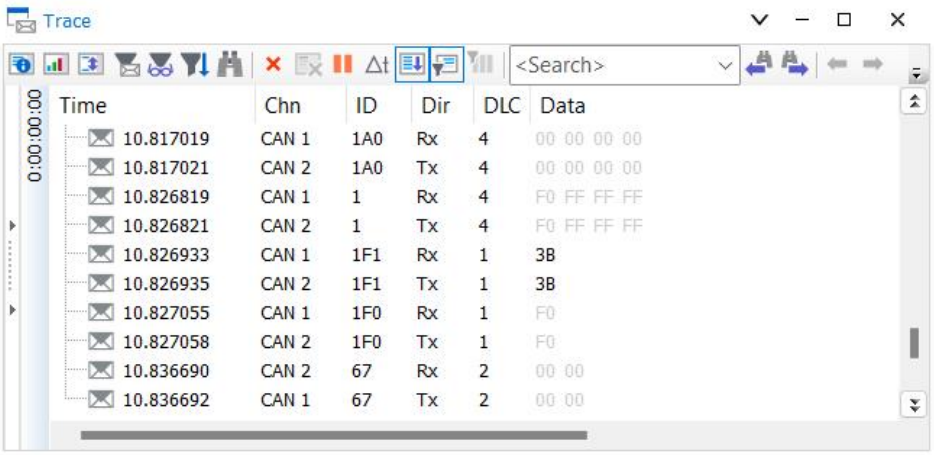


Figure 17: Time stamps of two CAN channels in CANoe

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.

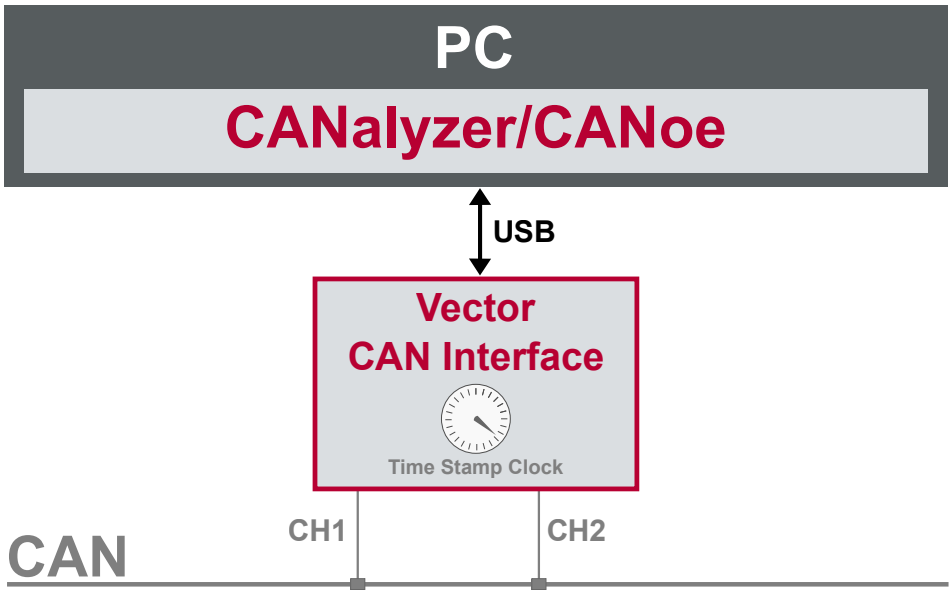


Figure 18: Common time stamp clock for each channel

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.

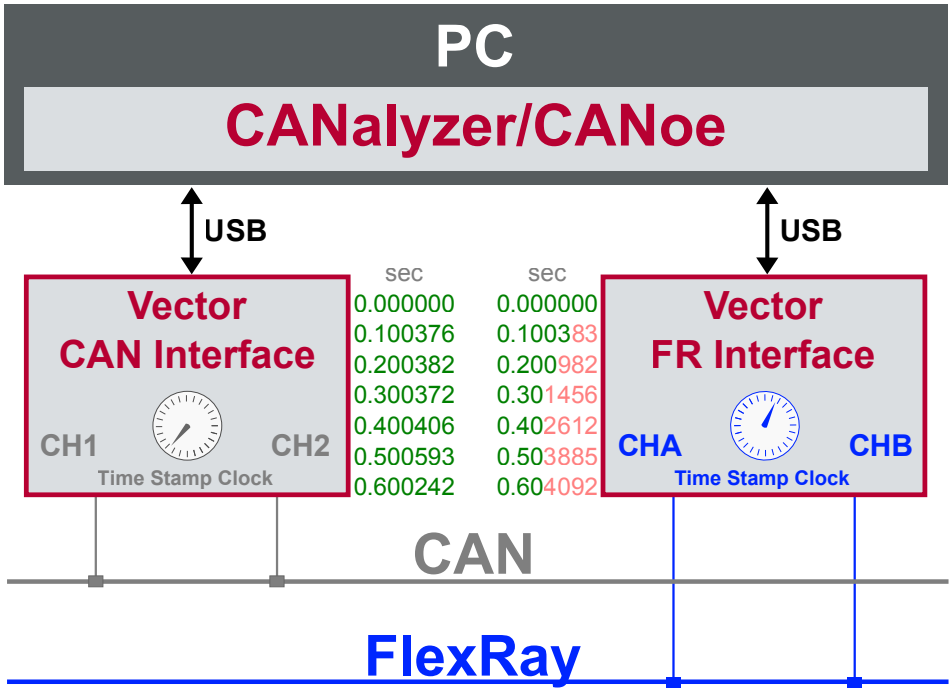


Figure 19: Example of unsynchronized network interfaces. Independent time stamps drift apart

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).

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.

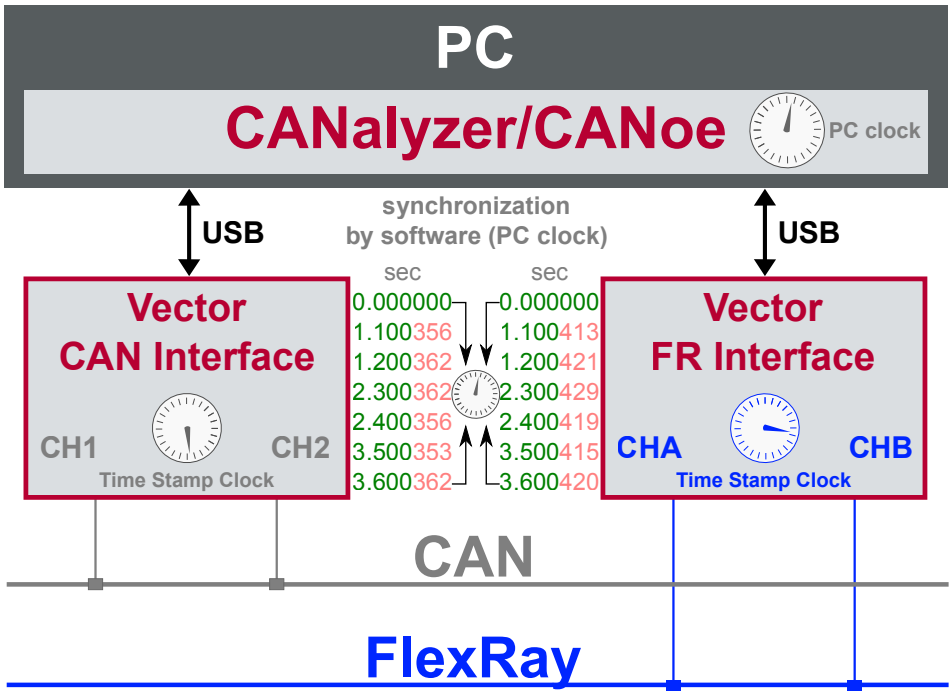


Figure 20: Time stamps of devices are synchronized to the PC clock

Note
Software time synchronization may lead to an increased latency for all connected Vector network interfaces. If a use 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).

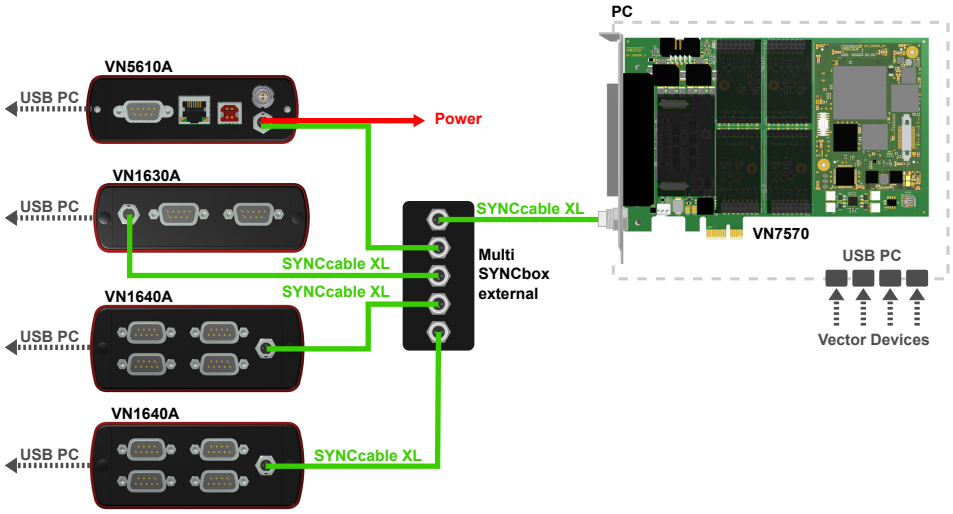


Figure 21: Example of a time synchronization with multiple devices

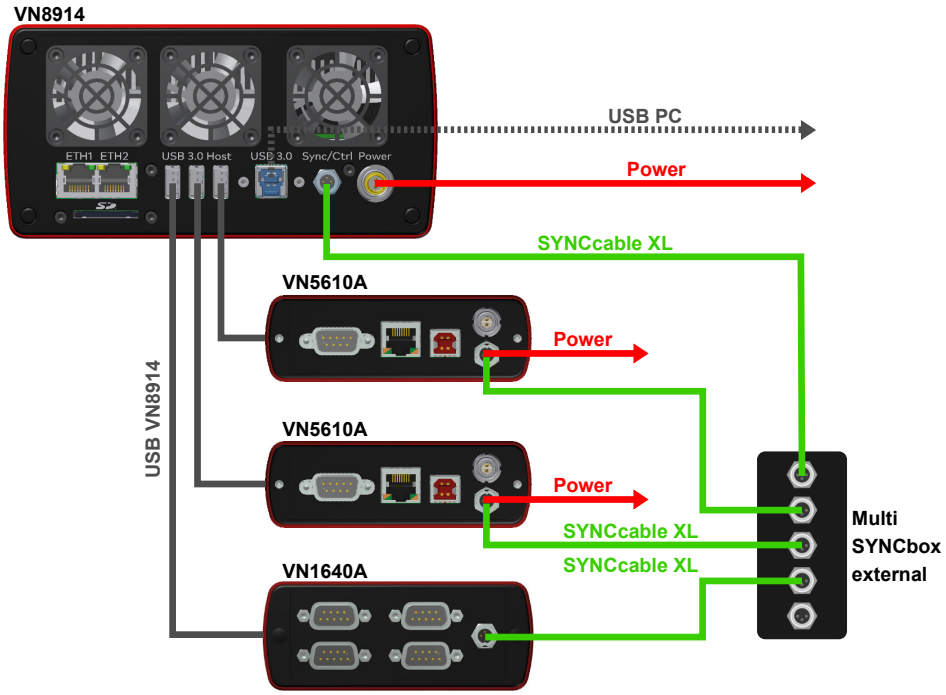


Figure 22: Example of a time synchronization with VN8914 and additional devices

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.

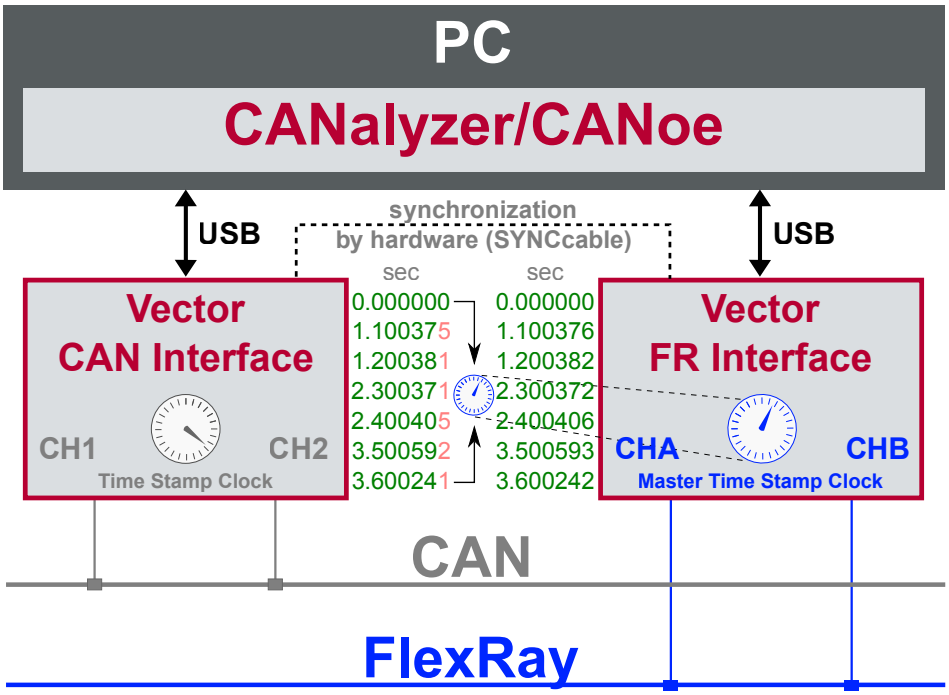


Figure 23: Time stamps are synchronized to the master clock

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.

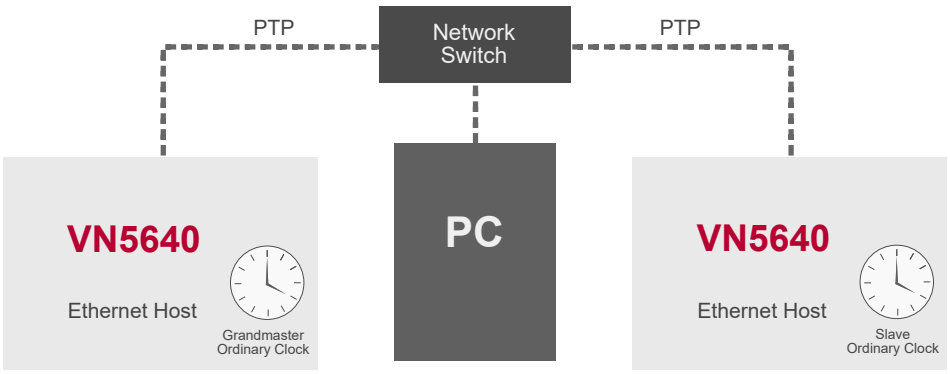


Figure 24: Setup example

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
Best TimeTransmitter Clock Algorithm (BTCA)	X
Transport	
PTP over UDP with IPv4	X
PTP over UDP with IPv6	-
Multicast Master/Slave	X
Unicast Master/Slave	-
Synchronization accuracy	
1 µs	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**.

5 Vehicle Electrics and Ground/Earth

In this chapter you find the following information:

5.1 General Information **49**

5.2 Vehicle Battery Only (Closed System) **50**

5.3 External Power Supplies (Test Bench) **51**

5.1 General Information

WARNING!
When using Vector devices, ensure that the power supply and earthing are correct. Failure to do so may result in damage to the vehicle electronics or the Vector devices due to overvoltage. Two typical scenarios are described below.

5.2 Vehicle Battery Only (Closed System)

In this scenario, the individual Vector devices are powered directly from the vehicle battery. A third device is powered via USB (e. g. from a notebook in battery mode or from the vehicle battery) or via PCIe (card mounted in a computer and powered from the vehicle battery). The system is therefore closed.

The common reference ground is the chassis, which is connected to the negative terminal of the vehicle battery. Vector devices that have a functional earth connection (FE) must also be connected to the reference ground.

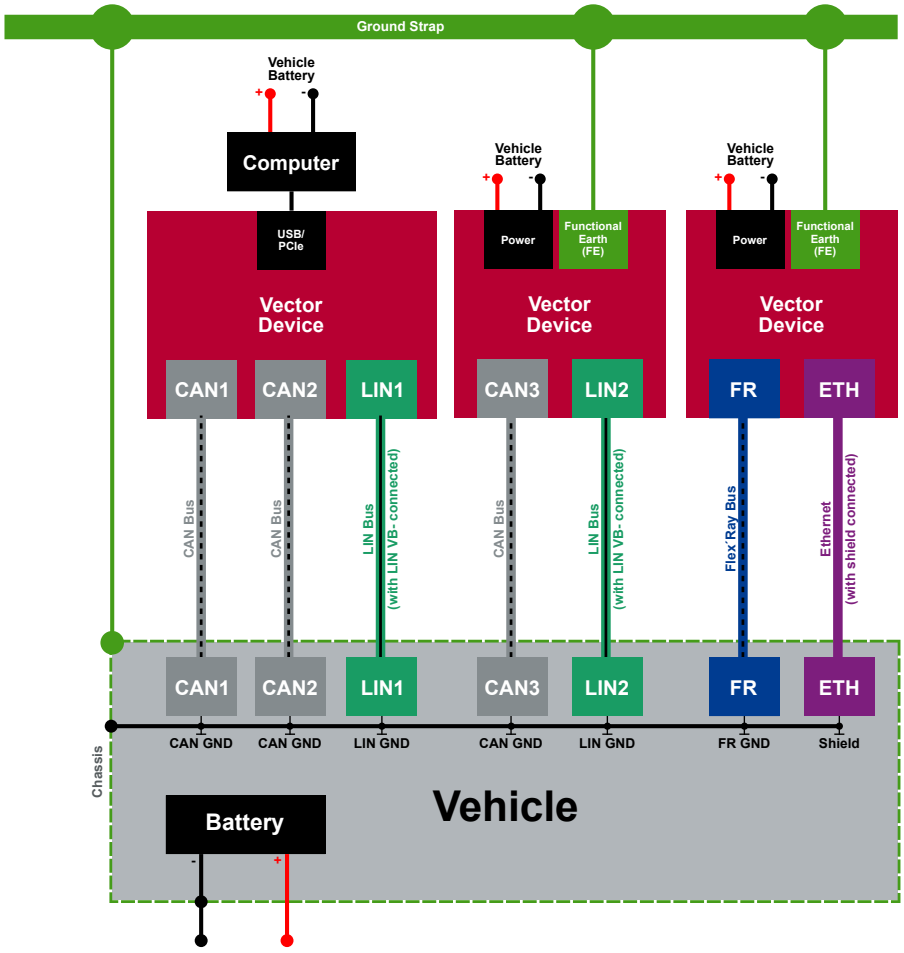


Figure 25: Vector devices powered by vehicle battery

The individual GNDs of the ECUs (in this example CAN, LIN, FlexRay) are connected to the chassis on the vehicle side. The shielding of the Ethernet connections is also connected to the chassis.

In this scenario, LIN VB- must be connected in the LIN signal path (LIN always requires VB- to be connected). For CAN and FlexRay it is recommended to connect all signal GNDs via their connectors (CAN GND, FlexRay VB-) to have the same reference ground from the vehicle battery.

5.3 External Power Supplies (Test Bench)

In this scenario, the individual Vector devices are powered by individual power supplies. A third device is powered via USB or PCIe. This is a typical test bench scenario.

The common reference ground is earth, which is also connected to the chassis and to the negative terminal of the vehicle battery. Vector devices that have a functional earth connection (FE) must also be connected to the reference ground.

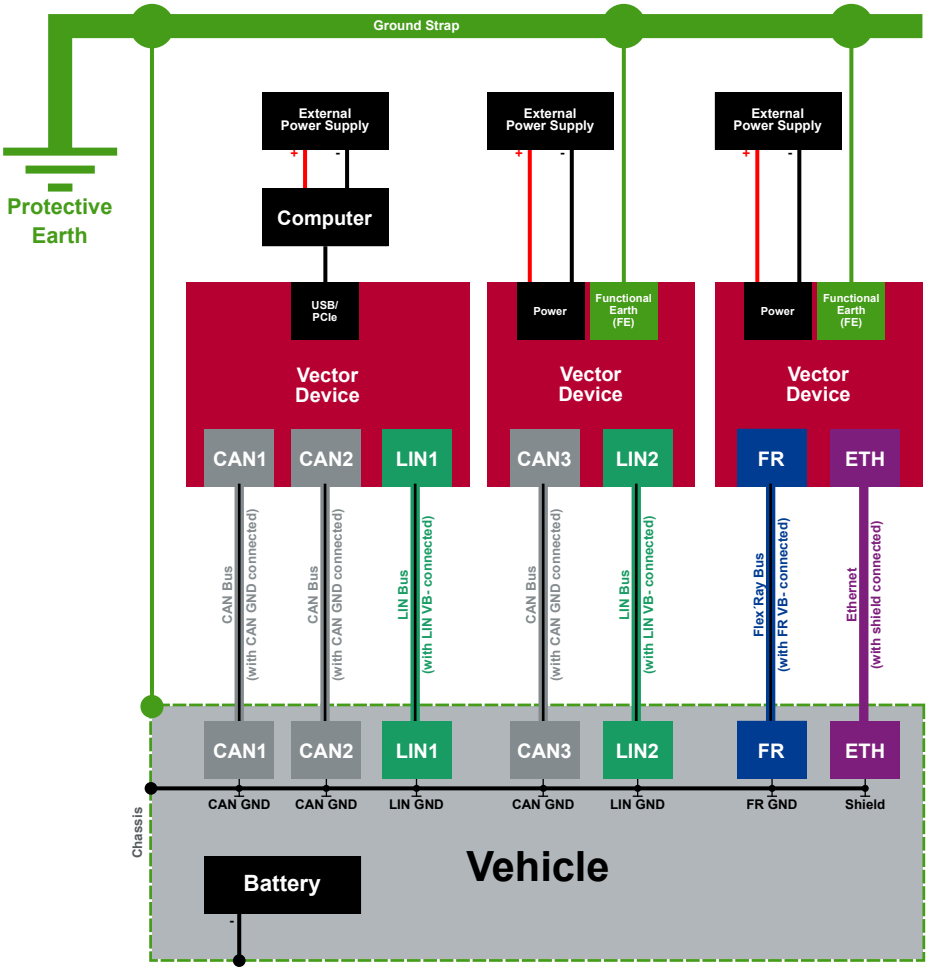


Figure 26: Test bench scenario

The individual GNDs of the ECUs (in this example CAN, LIN, FlexRay) are connected to the chassis on the vehicle side. The shielding of the Ethernet connections is also connected to the chassis.

In this scenario, all signal GNDs must be connected via their connectors (CAN GND, LIN VB-, FlexRay VB-) to have the same reference ground.

6 Important Notes - Details

In this chapter you find the following information:

6.0.1 Safety Instructions and Hazard Warnings 53
6.0.2 Disclaimer 55
6.0.3 Disposal of Vector Hardware 56

6.0.1 Safety Instructions and Hazard Warnings

WARNING!
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.

6.0.1.1 Proper Use and Intended Purpose

WARNING!
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.

6.0.1.2 Hazards

WARNING!
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.

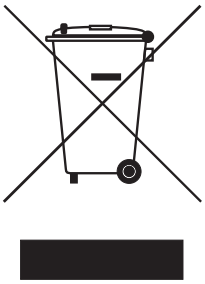
Comply with all safety standards and public regulations which are relevant for the operation of the system. Before you operate the system in public areas, it should be tested on a site which is not accessible to the public and specifically prepared for performing test drives in order to reduce hazards.

6.0.2 Disclaimer

WARNING!
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.

6.0.3 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/

7 Wichtige Hinweise

In diesem Kapitel finden Sie die folgenden Informationen:

7.0.1 Sicherheits- und Gefahrenhinweise 58
7.0.2 Haftungsausschluss 60
7.0.3 Entsorgung von Vector Hardware 61

7.0.1 Sicherheits- und Gefahrenhinweise

WARNUNG!
Um Personen- und Sachschäden zu vermeiden, müssen Sie vor der Installation und dem Einsatz dieses Interfaces die nachfolgenden Sicherheits- und Gefahrenhinweise lesen und verstehen. Bewahren Sie diese Dokumentation (Handbuch) stets in der Nähe dieses Interfaces auf.

7.0.1.1 Sach- und bestimmungsgemäßer Gebrauch

WARNUNG!
Das Interface ist für die Analyse, die Steuerung sowie für die anderweitige Beeinflussung von Regelsystemen und Steuergeräten bestimmt. Das umfasst unter anderem die Bussysteme CAN, LIN, K-Line, MOST, FlexRay, Ethernet, BroadR-Reach oder ARINC 429.

Der Betrieb des Interfaces darf nur im geschlossen Zustand erfolgen. Insbesondere dürfen keine Leiterplatten sichtbar sein. Das Interface ist entsprechend den Anweisungen und Beschreibungen dieses Handbuchs einzusetzen. Dabei darf nur die dafür vorgesehene Stromversorgung, wie z. B. USB-powered, Netzteil, und das Originalzubehör von Vector bzw. das von Vector freigegebene Zubehör verwendet werden.

Das Interface ist ausschließlich für den Einsatz durch geeignetes Personal bestimmt, da der Gebrauch dieses Interfaces zu erheblichen Personen- und Sachschäden führen kann. Deshalb dürfen nur solche Personen dieses Interface einsetzen, welche die möglichen Konsequenzen der Aktionen mit diesem Interface verstanden haben, speziell für den Umgang mit diesem Interface, den Bussystemen und dem zu beeinflussenden System geschult worden sind und ausreichende Erfahrung im sicheren Umgang mit dem Interface erlangt haben.

Die notwendigen Kenntnisse zum Einsatz dieses Interfaces können bei Vector über interne oder externe Seminare und Workshops erworben werden. Darüber hinausgehende und Interface-spezifische Informationen wie z. B. „Known Issues“ sind auf der Vector Webseite unter www.vector.com in der „Vector KnowledgeBase“ verfügbar. Bitte informieren Sie sich dort vor dem Betrieb des Interfaces über aktualisierte Hinweise.

7.0.1.2 Gefahren

WARNUNG!
Das Interface kann das Verhalten von Regelsystemen und Steuergeräten steuern und in anderweitiger Weise beeinflussen. Insbesondere durch Eingriffe in sicherheitsrelevante Bereiche (z. B. durch Deaktivierung oder sonstige Manipulation der Motorsteuerung, des Lenk-, Airbag-, oder Bremssystems) und/oder der Einsatz des Interfaces in öffentlichen Räumen (z. B. Straßenverkehr, Luftraum) können erhebliche Gefahren für Leib, Leben und Eigentum entstehen. Stellen Sie daher in jedem Fall eine gefahrfreie Verwendung sicher. Hierzu gehört unter anderem auch, dass das System, in dem das Interface eingesetzt wird, jederzeit, insbesondere bei Auftreten von Fehlern oder Gefahren, in einen sicheren Zustand geführt werden kann (z. B. durch Not-Abschaltung).

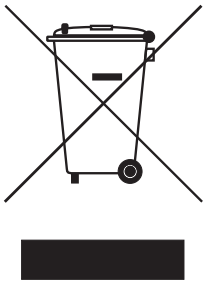
Beachten Sie alle sicherheitstechnischen Richtlinien und öffentlich-rechtlichen Vorschriften, die für den Einsatz des Systems relevant sind. Zur Verminderung von Gefahren sollte das System vor dem Einsatz in öffentlichen Räumen auf einem nicht-öffentlich zugänglichen und für Testfahrten bestimmten Gelände erprobt werden.

7.0.2 Haftungsausschluss

WARNUNG!
Soweit das Interface nicht sach- oder bestimmungsgemäß eingesetzt wird, übernimmt Vector keine Gewährleistung oder Haftung für dadurch verursachte Schäden oder Fehler. Das Gleiche gilt für Schäden oder Fehler, die auf einer mangelnden Schulung oder Erfahrung derjenigen Personen beruhen, die das Interface einsetzen.

7.0.3 Entsorgung von Vector Hardware

Bitte gehen Sie verantwortungsvoll mit Altgeräten um und beachten Sie die in Ihrem Land geltenden Umweltgesetze. Entsorgen Sie die Vector Hardware bitte nur bei den dafür vorgesehenen Stellen und nicht über den Hausmüll.



Innerhalb der Europäischen Gemeinschaft gelten die Richtlinie über Elektro- und Elektronik-Altgeräte (WEEE-Richtlinie) und die Richtlinie zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten (RoHS-Richtlinie).

Für Deutschland und andere EU-Länder bieten wir Ihnen eine kostenlose Rücknahme der alten Vector Hardware an.

Bitte überprüfen Sie die zu entsorgende Vector Hardware vor dem Versand sorgfältig. Bitte entfernen Sie alle Gegenstände, die nicht zum ursprünglichen Lieferumfang gehören, z. B. Speichermedien. Die Vector Hardware muss außerdem frei von Lizenzen sein und darf keine personenbezogenen Daten mehr enthalten. Vector führt keine Kontrollen diesbezüglich durch. Sobald die Hardware versandt wurde, kann sie nicht mehr an Sie zurück geliefert werden. Mit dem Versand der Hardware an uns haben Sie Ihre Rechte an der Hardware abgetreten. Bitte melden Sie vor dem Versand Ihr Altgerät an über:

https://www.vector.com/de/de/support-downloads/return-registration-for-the-disposal-of-vector-hardware/

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