VECTOR

VN5000 Ethernet Interface Family Manual

Version 2.8 | English

Imprint

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Contents

1 Introduction

In this chapter you find the following information:

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.
	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 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.

1.2.2 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 Licenses

1.2.3.1 Google Protocol Buffer

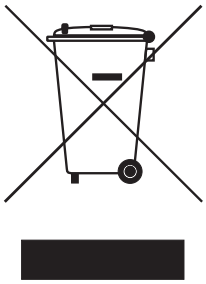
Reference
This device uses the Google Protocol Buffer. The license information can be found in the separate text file on the Vector Driver Disk in `\Documentation\Licenses`.

1.2.3.2 Petteri Aimonen Nano Protocol Buffer

Reference
This device uses the Petteri Aimonen Nano Protocol Buffer. The license information can be found in the separate text file on the Vector Driver Disk in `\Documentation\Licenses`.

1.2.4 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 General Information

In this chapter you find the following information:

2.1 Manual Validity

Note
This manual is valid for the VN5000 interface family with effect from device driver version 11.2.

Note
Driver version 11.2 introduces the **network-based** Ethernet configuration but still supports the previous **channel-based** configuration (legacy mode).

This manual focuses on the new **network-based** Ethernet configuration. Therefor, the mode of the VN5610 (A) or VN5640 interface has to be changed with the **Vector Hardware Config** tool (see section Ethernet Device Configuration on page 142).

Note
The **network-based** Ethernet configuration requires at least CANoe V12.0 SP4 or CANape V18!

Reference
For previous driver versions and the **channel-based** configuration, please refer to the separate VN5610A or the VN5640 manual.

2.2 Examples of Usage

2.2.1 Transparent Ethernet Monitoring

Monitoring

The VN5000 network interface can be used for Ethernet monitoring between an ECU and a connected sensor without influencing the Ethernet bus (Test Access Point). In this particular setup the VN5000 network interface receives and forwards incoming data packages transparently from one port to the other. The VN5000 network interface offers up to six TAP (Test Access Point) paths which can be used in parallel.

Setup

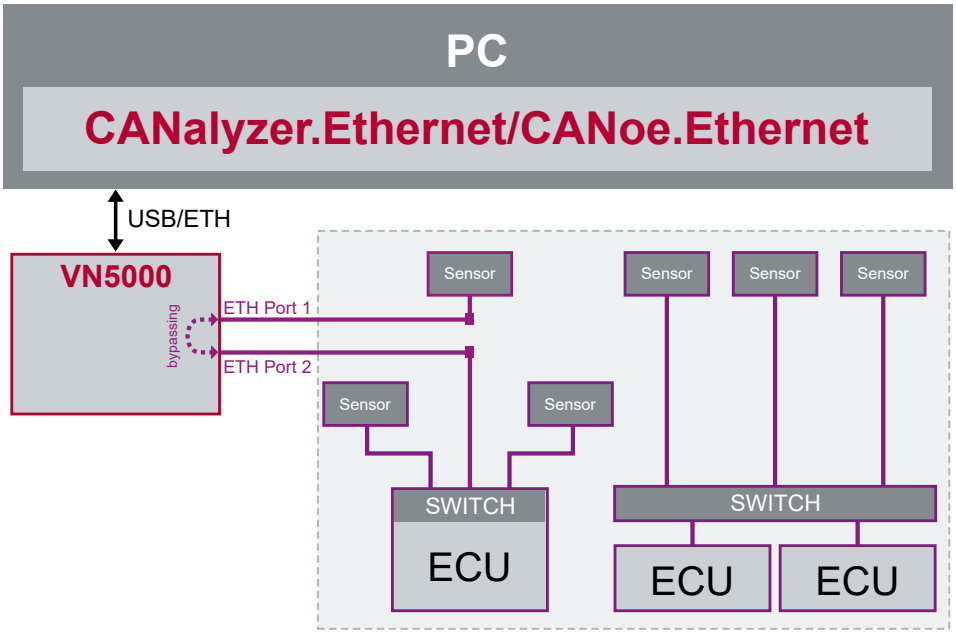


Figure 1: TAP Ethernet data

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

VN5610A

Physical Layer	Bypassing Latency Δt
100BASE-T1 ⟷ 100BASE-T1	8.1 µs
1000BASE-T ⟷ 1000BASE-T	1.6 µs

VN5611

Physical Layer	Bypassing Latency Δt
100BASE-T1⟷ 100BASE-T1	10.9 µs
1000BASE-T1⟷ 1000BASE-T1	6.4 µs

VN5620 / VN5430

Physical Layer	Bypassing Latency Δt
100BASE-T1⟷ 100BASE-T1	8.3 µs
1000BASE-T1⟷ 1000BASE-T1	5.7 µs

VN5640

Physical Layer	Bypassing Latency Δt
100BASE-T1 ⟷ 100BASE-T1	7.7 µs
1000BASE-T1⟷ 1000BASE-T1	6.6 µs
1000BASE-T ⟷ 1000BASE-T	2.3 µs

VN5650/VN5240

Physical Layer	Bypassing Latency Δt
100BASE-T1⟷ 100BASE-T1	12.2 µs
1000BASE-T1⟷ 1000BASE-T1	7.7 µs

Note
The latency values depend on PHY characteristics, used MII interface and VN5000 specific TAP handling.

Note
For a network tap, you have to connect the VN5000 interface between the ECUs. In the event of a fault or when the VN5000 is switched off, the network connection between the ECUs will be interrupted. This can lead to malpractice of the vehicle. The feature **Physical Bypass Relay** of VN5650/VN5240 (see according sections) solves this potential problem.

Time stamp clock for Ethernet and CAN

The VN5000 network interface 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.

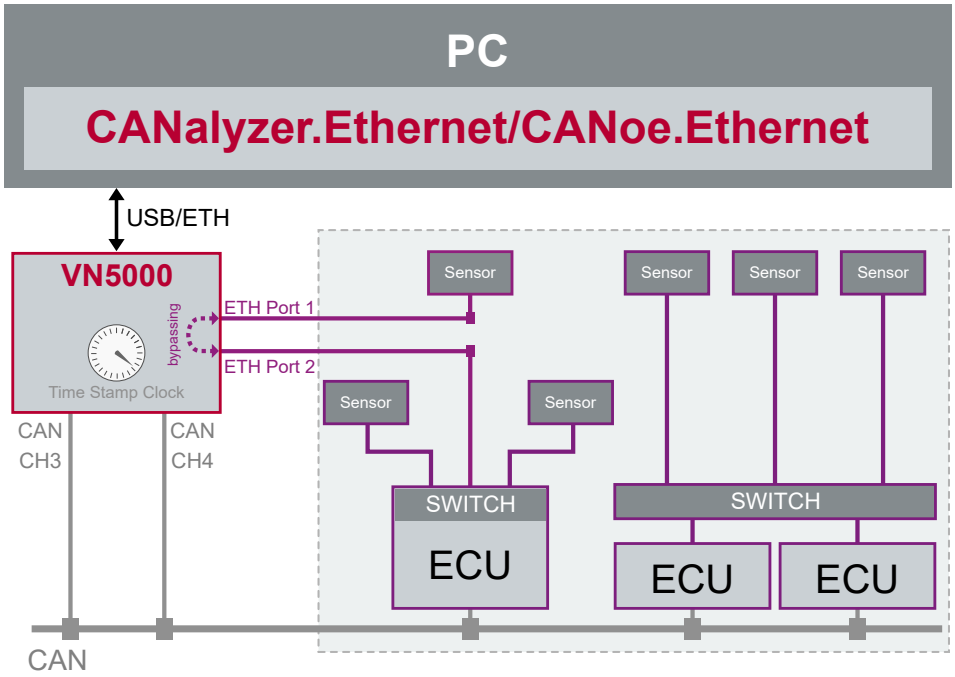


Figure 2: Extended measuring setup

Note
Additional Vector network interfaces can be synchronized by software, hardware or IEEE 1588 (see section Time Synchronization on page 161).

2.2.2 Remaining Bus Simulation

Developing networks

The VN5000 network interface is able to send and receive data packages on separate Ethernet ports as well as events on two separate CAN channels. With this, the VN5000 network interface is a perfect choice for the remaining bus simulation during the development of complex networks.

Setup

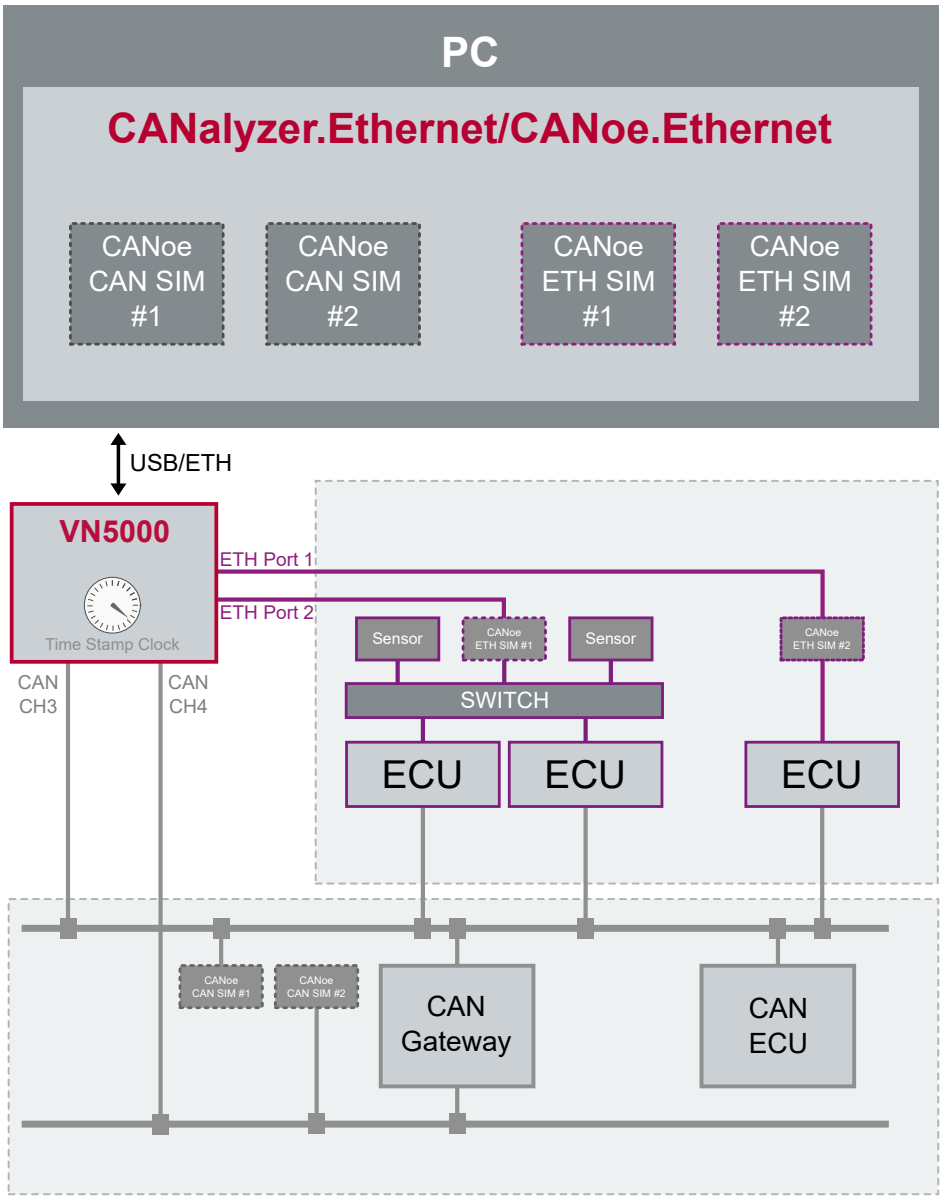


Figure 3: Simulated nodes

Note
For the remaining bus simulation CANoe.Ethernet is required.

2.2.3 Standalone Media Converter

Physical layer conversion

The Ethernet ports of the VN5000 network interface can be configured independently. That way the VN5000 network interface can be used as a media converter between an ECU using the 100BASE-T1/1000BASE-T1 Ethernet standard and any standard Ethernet equipment (e. g. loggers) using 100BASE-TX/1000BASE-T. The VN5000 network interfaces offer up to four media converters which can be used independently.

Setup

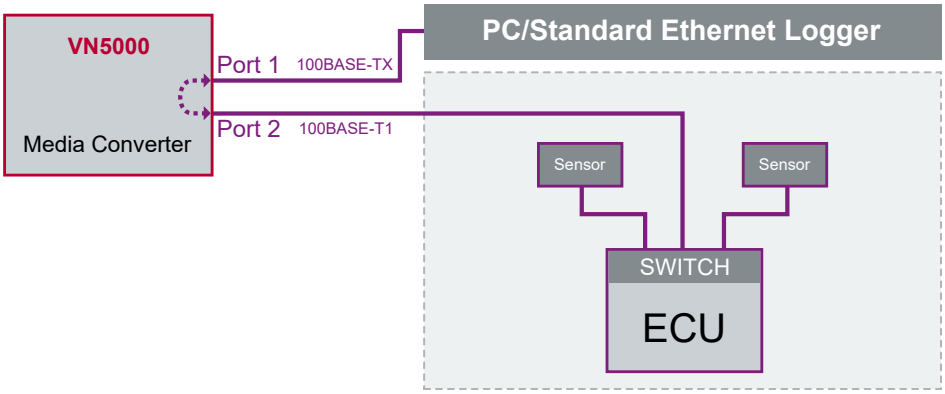


Figure 4: Media converter

Media converter

Device	Count
VN5610(A)	1
VN5620	2
VN5430	1
VN5640	4
VN5240	3
VN5650	4

2.2.4 Diagnostics over IP

DoIP activation line

For diagnostics over IP, the VN5000 network interface supports, beside the necessary 100BASE-TX port, an digital IO channel which has a DoIP activation line according to the ISO specification (ISO DIS 13400-3). The activation level can be set by the VN5000 network interface to switch the ECU to diagnostic mode.

Setup

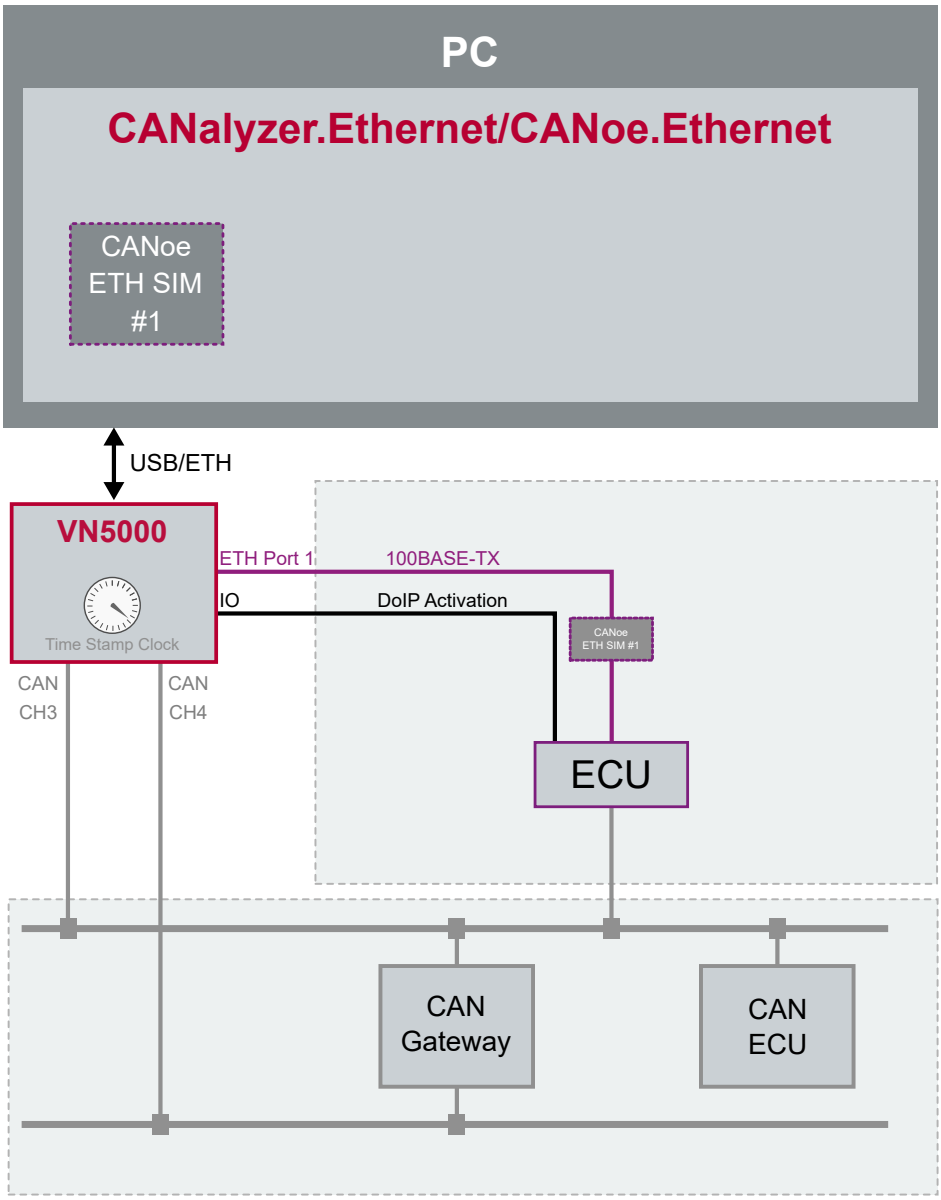


Figure 5: Simulated nodes

2.2.5 Port Mirroring

Note
This feature is only supported on VN5240, VN5430, VN5640 and VN5650.

Description

The VN5000 network interface supports mirroring of incoming packets of selected source port to a specific target port. For example, this mirroring feature can be used to attach an Ethernet logger to the target port. Additionally, the outgoing logging traffic can be reduced by setting protocol filters.

Setup

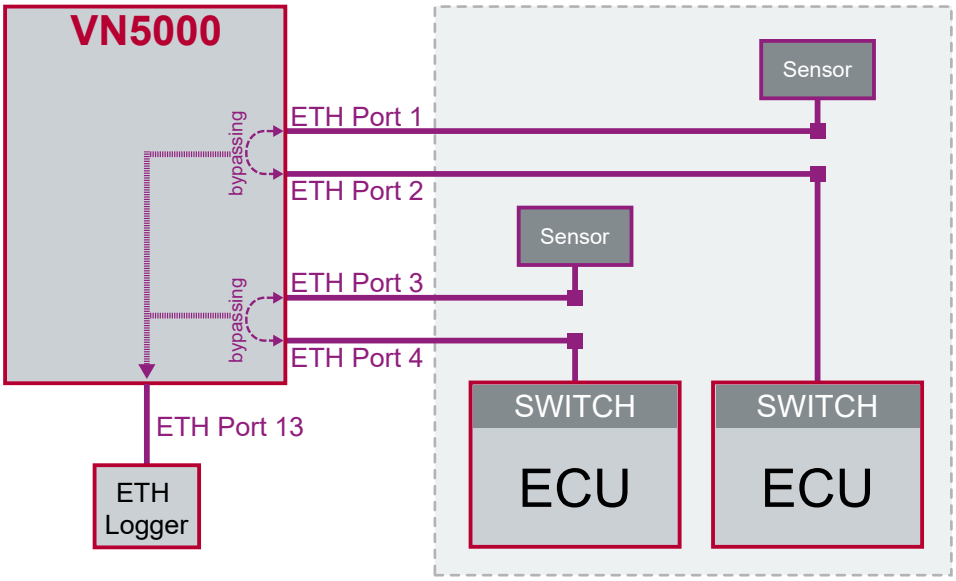


Figure 6: Ethernet port 13 configured as target, port 1...4 as source

Note
The configuration is done in **Vector Hardware Config**.

3 VN5610A

In this chapter you find the following information:

3.1 Scope of Delivery

Contents

The delivery includes:

- VN5610(A) Ethernet/CAN interface
- Vector Power Supply 12 V / 1.25 A (part number 05024)
- USB 2.0 cable (part number 05011)

3.2 Introduction

About the VN5610(A)

The VN5610(A) 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.

Figure 7: VN5610 Ethernet/CAN Interface

Figure 8: VN5610A Ethernet/CAN Interface

The VN5610(A) 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 VN5610(A) 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

Common features of VN5610 and VN5610A:

- Support of two independent Ethernet ports, available as 2x RJ45 or 1x D-SUB9
- Support of standard Ethernet (10BASE-T/100BASE-TX/1000BASE-T)
- Support of two independent CAN/CAN FD channels, available as 1x D-SUB9
- High resolution time stamps for Ethernet frames
- High resolution time stamps for CAN/CAN FD frames

- Software, hardware and IEEE 1588 time synchronization of multiple Vector network interfaces
- Internal three-way-routing in/monitor/out
- Robustness, power supply and temperature ranges suitable for automotive and industrial applications

Differences

Differences between VN5610 and VN5610A:

VN5610

- Support of BroadR-Reach physical layer

VN5610A

- Support of 100BASE-T1 (OPEN Alliance BroadR-Reach)
- Support of one digital input/output (e. g. for DoIP Activation Line)

3.3 Connectors Ethernet Side

Device connectors

Figure 9: Ethernet CH1, D-SUB9 (100BASE-T1), Ethernet CH2

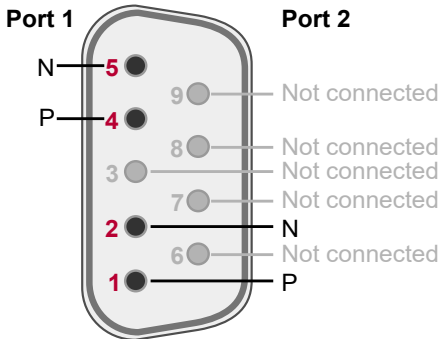
- **Ethernet CH1/CH2 (RJ45)**
  Standard Ethernet connector for 10BASE-T, 100BASE-TX and 1000BASE-T.

LED ACT
- Illuminates if there is an Ethernet link.
- Blinks if there is Ethernet activity.

LED SPEED
- Off: 10 Mbit
- Orange: 100 Mbit
- Green: 1000 Mbit

- **Ethernet CH1/CH2 (D-SUB9)**
  D-SUB9 connector for 100BASE-T1. Use the BRcable 2Y to access both ports on separate D-SUB9 connectors (see accessories manual, part number 05103).

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	CH1 P
5	CH1 N
6	Not connected
7	Not connected
8	Not connected
9	Not connected



Reference
The Ethernet configuration must be done in **Vector Hardware Config**.

3.3.1 Connectors USB Side

Device connectors

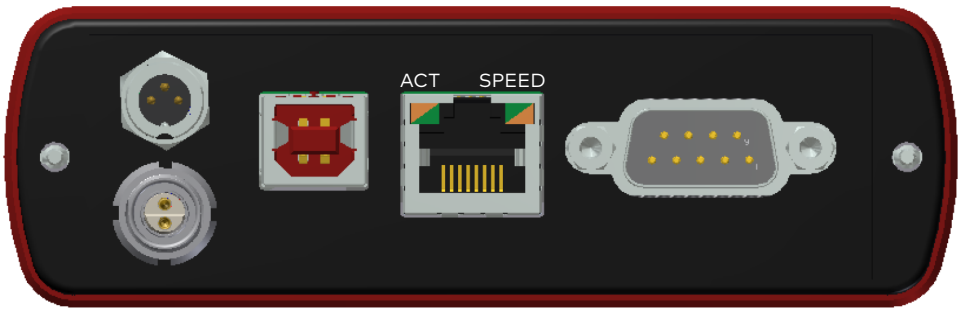


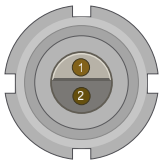
Figure 10: Connectors on the USB side

- **Power/sync (Binder connector)**
  The VN5610A has one power/sync connector (Binder type 711) which can be used for time synchronization of different Vector devices (see section Time Synchronization on page 161) or for power.

Pin	Assignment
1	Power supply (6 V … 50 V DC, typ. 12 V)
2	Synchronization line
3	Ground

- **IO CH5 (Lemo connector)**
  The VN5610A has a Lemo connector (type 302) for dedicated digital input/output tasks (e. g. as DoIP Activation Line). Use the VX1362B adapter cable to access the pins (see accessories manual, part number 22258). The pin assignment is as follows:

Pin	Assignment
1	Digital input/output (see technical data)
2	Ground



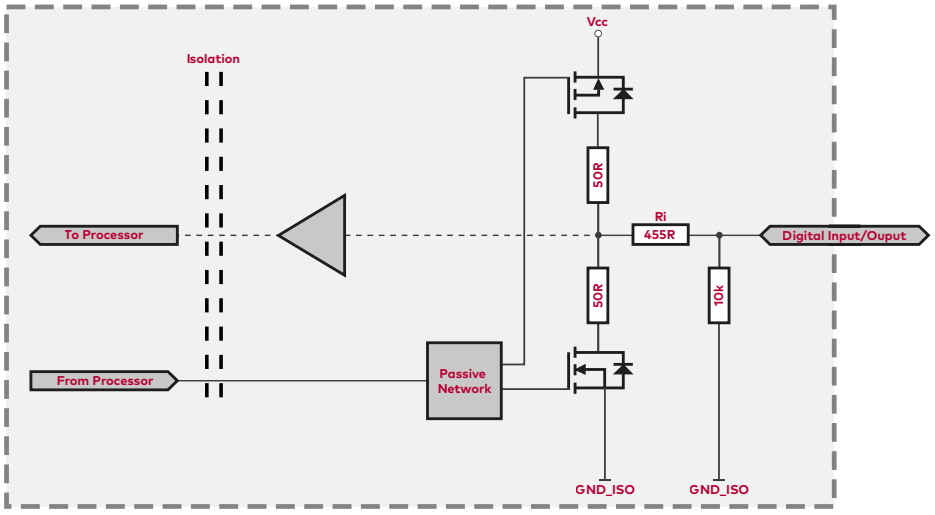


Figure 11: Digital input /output

Note
The VN5610A requires at least 8 V to power up. Afterwards the power supply can be reduced to 6 V for operation (typ. 12 V DC). The need of an external power supply depends on the Ethernet configuration (see table).

Ethernet Configuration	Port 1			
Port 2	Disabled	100BASE-T1	100BASE-TX	1000BASE-T
Disabled	O	O	O	O
100BASE-T1	O	O	X	X
100BASE-TX	O	X	X	X
1000BASE-T	O	X	X	X

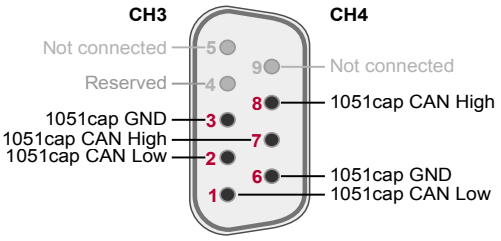
O: bus-powered (also when both CAN channels in use), X: external power supply recommended.
Note: CAN itself requires no external power supply.

- **USB**
  Connect your computer and the VN5610A over USB to install and to use the device with measurement applications (CANoe, CANalyzer). Use the USB 2.0 compliant cable found in the delivery (USB extension cables may generate faults between the computer and the device). Connect the device directly to a USB port at your computer or use a USB hub with its own power supply (self-powered). The device can also be powered via this connector.

- **Host (Ethernet)**
  Alternative host connection over Ethernet (1000BASE-T). For configuration, see section Getting Started on page 179.

- **CAN CH3/4 (D-SUB9)**
  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).

Pin	Assignment
1	CH4 CAN Low
2	CH3 CAN Low
3	CH3 GND
4	Reserved. Please do not use.
5	Not connected
6	CH4 GND
7	CH3 CAN High
8	CH4 CAN High
9	Not connected



3.3.2 LEDs

LEDs on top side

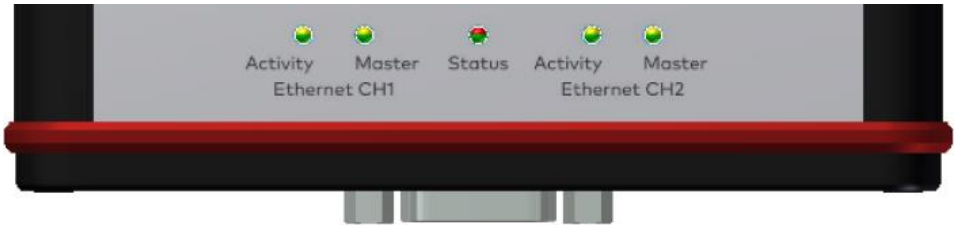


Figure 12: LEDs on VN5610(A)

- **Activity (Ethernet CH1/CH2)**
  Same as LED ACT at RJ45 connectors. LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at CH1/CH2.

Color	Description
Green	Link to RJ45.
Yellow	Link to D-SUB9.

- **Master (Ethernet CH1/CH2)**
  Illuminates if CH1/CH2 is configured as Master.

Color	Description
Green	PHY is configured as master on RJ45.
Yellow	PHY is configured as master on D-SUB9.

- **Status**
  Multicolored LED indicating the device status.

Color	Description
Green	Blinks 4x at power up and illuminates afterwards. Blinks quicker during an update progress. Please wait for the automatic reboot of the device (approx. 30 s) after the update has been finished.
Red	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.

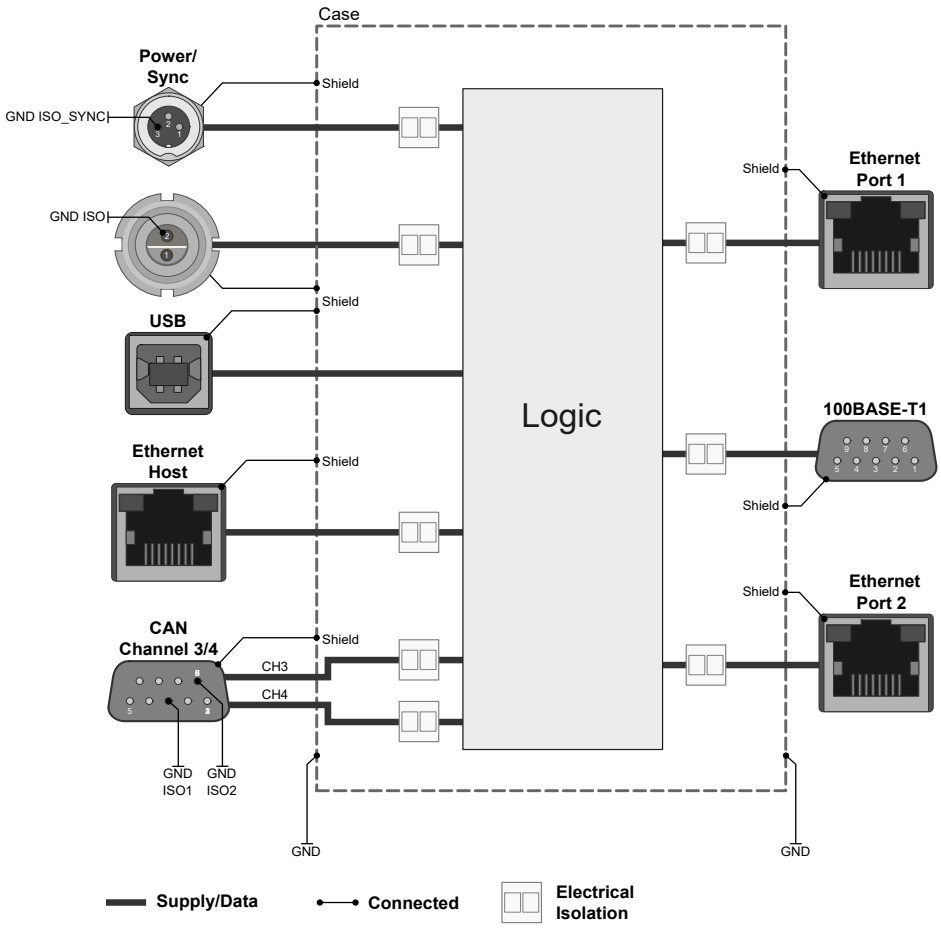
3.3.3 Technical Data

3.3.3.1 Overview

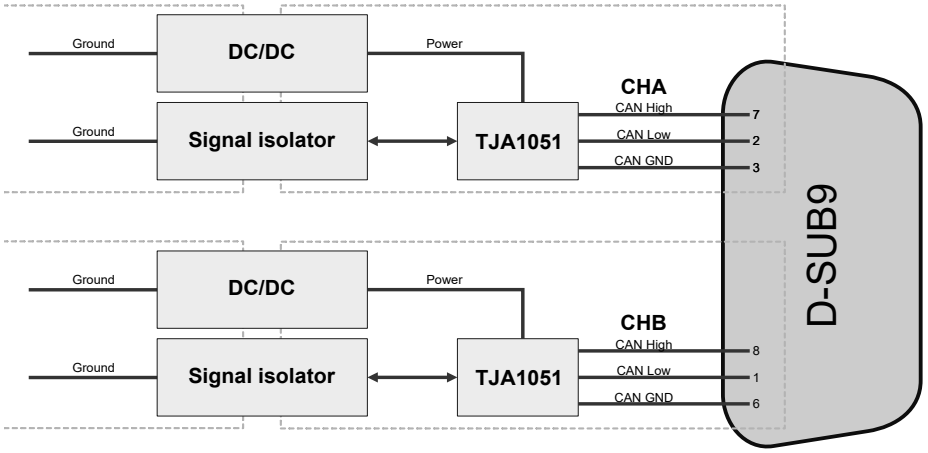
Ethernet ports	Max. 2, selectable from: 2x RJ45 10BASE-T, 100BASE-TX, 1000BASE-T (on-board BCM54810 PHY) 1x D-SUB9 for 100BASE-T1 (OPEN Alliance BroadR-Reach; dual port) (on-board BCM89811 PHY)
CAN/CAN FD channels	Max. 2 (on-board TJA1051 transceivers) 1x D-SUB9 (dual channel) CAN2.0: 2 MBit/s CAN FD: up to 8 MBit/s
Digital input/output	1x Lemo 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 346Ω): 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: 503 Ω
Computer interface	USB 2.0 or Ethernet (1000BASE-T)
Power supply	Without external power supply: bus-powered at 100 Mbit operation mode With external power supply: 6…50 V DC, typ. 12 V DC, power-up: 8 V DC
Power consumption	Approx. 2.5 W
Time stamps	Resolution: 8 ns Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs Accuracy PTP sync (IEEE1588): typ. 1 µs
Temperature range	Operation: -40 °C ... +65 °C Storage: -40 °C ... +85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	Approx. 125 mm x 106 mm x 32 mm
Operating system requirements	Windows 10 (64 bit)

3.3.3.2 Electrical Isolation

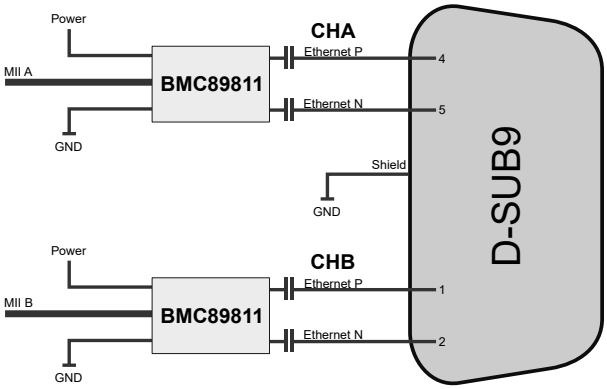
Electrical isolation of the connectors



Electrical isolation of CAN in detail



Electrical isolation of Ethernet in detail



3.3.3.3 Network Features

Ports/channels	**Total number of Ethernet Ports**	4
	100BASE-T1 / 1000BASE-T1	2 / -
	1000BASE-T1 Legacy Mode	-
	10/100/1000BASE-T(X)	2
	1, 2.5, 5, 10G BASE-T	-
	CAN FD	2
	DoIP Activation / Wake-up Line	X
	Multiple digital / analog IO	-
Power supply	**External**	X
	USB buspowered	X
Infrastructure	**Hardware synchronization**	X
	Software synchronization	X
	IEEE1588 (PTP)	X
	Computer uplink	USB2.0
	Computer uplink Ethernet	1000BASE-T
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	2
	Media conversion	1
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	-
	Physical bypass relays	-
Measure	**Mirroring port**	-
	Uplink Frame filter	16 rules
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	-
	Virtual switch ports for Vector-Tools or XL-API based tools	16
Test	**On-board packet generator**	X
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	-
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

3.4 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors

- BRcable 2Y
- VNcable D-SUB9 HSD Z
- CANcable1
- CANcableA
- CANcable TnT
- CANcable Y
- CANcable 2Y
- CANterm 120
- CANcable Set Pro
- Vector SYNCcableXL
- Vector SYNCcable50
- Multi SYNCbox external
- Multi SYNCbox internal
- Multi SYNCbox active
- Cable Binder 3pol Connector with Pigtail
- Cable Lemo/Banana Plugs
- USB Cable 2.0

Power supply

- Vector Power Supply 12V/1.5A
- Cable Banana Plug <> Binder 3-pin
- Car Power Supply Cable 12V with Binder

Miscellaneous

- Fix Kit 32mm Device

4 VN5611

In this chapter you find the following information:

4.1 Scope of Delivery

Contents

The delivery includes:

- 1x VN5611 Ethernet Interface

4.2 Introduction

About the VN5611

The VN5611 is a very compact and convenient network interface for Automotive Ethernet IEEE 100BASE-T1/1000BASE-T1. It is used for the analysis of Ethernet networks as well as for simulation and test tasks in the Ethernet environment. USB 3.0 is used as an interface to the computer. Thanks to the small and compact format, the devices are ideally suited for portable use.

Figure 13: VN5611 Ethernet Interface

Highlights

Features of the VN5611:

- 2x IEEE 100BASE-T1/ 1000BASE-T1 user port
- Host connection USB 3.0
- On-board Ethernet TAPs to link between two Ethernet ports
- On-board Vector Ethernet Switch IP supporting free segmentation
- New hardware configuration concept for flexible configuration
- OPEN Alliance TC10 (Wake/Sleep) support
- Software synchronization to other Vector interfaces (typ. 50 µs accuracy)
- Multi-application support (different tools can share an Ethernet port at the same time)
- High precision time stamped Ethernet frames (< 20 ns precision)
- Device is designed for mobile use
  - small, handy and lightweight housing
  - power-supply via USB

4.3 Connectors

4.3.1 Front Side

Device connectors

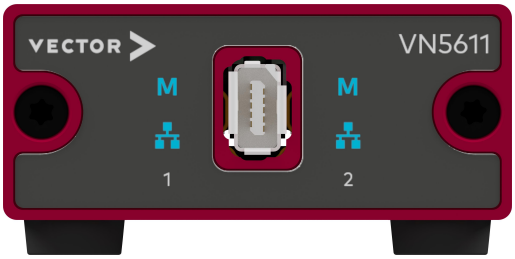
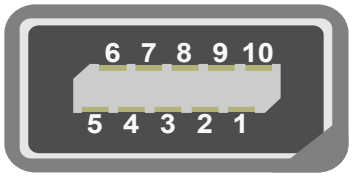


Figure 14: Connectors on the Ethernet side

- **Ethernet (ix Industrial)**
  ix Industrial connectors for 100BASE-T1/1000BASE-T1 (e. g. Harting ix Industrial type 10A-1). Each connector has two Ethernet ports (A and B). Use cables of the Vector AEcable 2Y family to access both ports on separate connectors (different plug systems available)

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	Not connected
5	Not connected
6	CH1 P
7	CH1 N
8	Not connected
9	Not connected
10	Not connected



4.3.2 Back Side

Device connectors

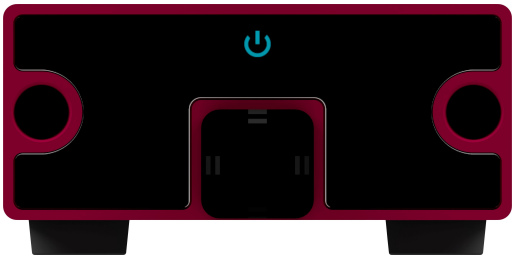


Figure 15: Connectors on the USB side

- **USB**
  Connect your computer and the VN5611 over USB to install and to use the device with measurement applications (CANoe, CANalyzer). Connect the device directly to a USB port at your computer or use a USB hub with its own power supply (self-powered).

4.4 LEDs

- **(Ethernet Port 1/2)**

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

Color	Description
Green	1000 MBit.
Orange	100 MBit.

- **M (Ethernet Port 1/2)**

Illuminates if the according port is configured as master.

State	Description
On	PHY is configured as master.
Off	PHY is configured as slave.

- **Power**

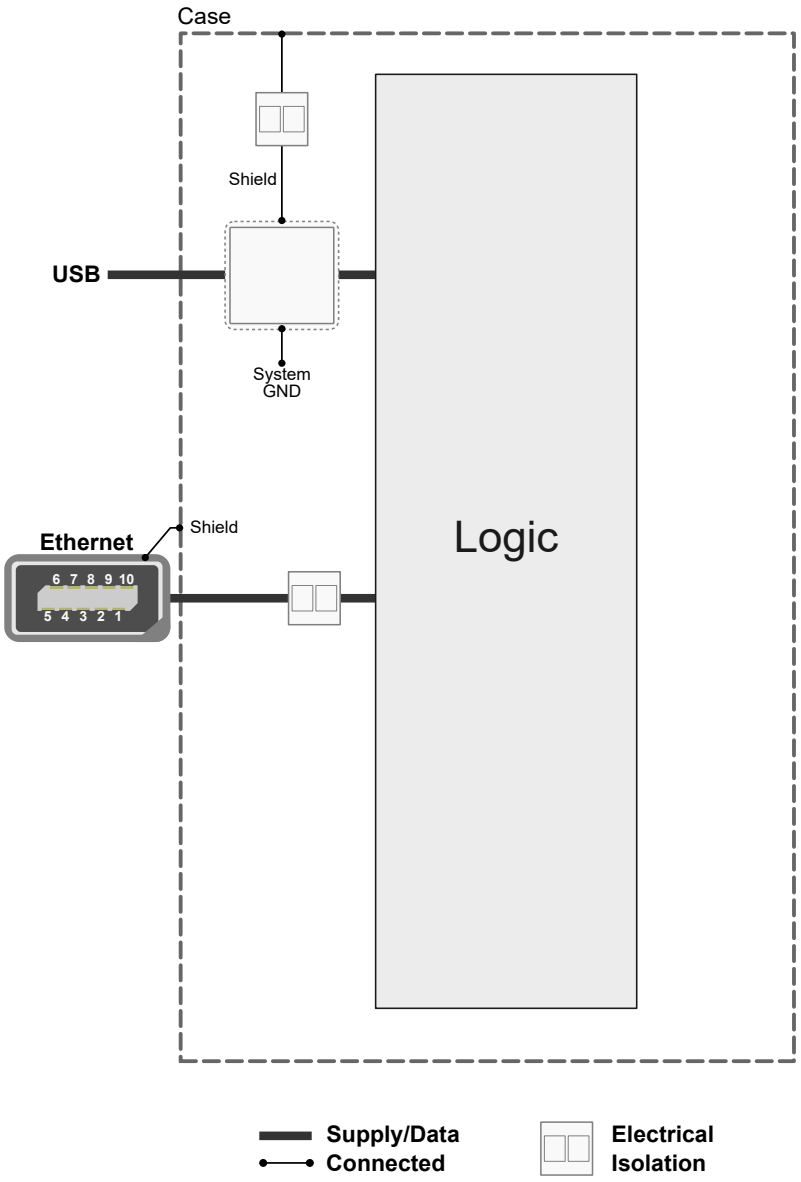
Multicolored LED indicating the device status.

Color	Description
Green	Blinks 4x at power up and illuminates afterwards. Blinks quicker during an update progress. Please wait for the automatic reboot of the device (approx. 30 seconds) after the update has been finished.
Red	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.

4.5 Technical Data

Ethernet ports	2x Broadcom BCM89883 (100BASE-T1/1000BASE-T1)
Computer interface	USB 3.0, bus-powered, fixed cable (length 1 m, min. bend radius 45 mm) with type-A connector
Input voltage	Nom. 5 V (USB bus-powered)
Power consumption	Max. 4.5 W (USB bus-powered)
Temperature range (ambient temp. of the device)	Operation: 0 °C...+45 °C Storage: -40 °C...+85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	Approx. 54 mm x 98 mm x 23 mm
Weight	174 g
Operating system requirements	Windows 10 (64 bit)

Electrical isolation of the connectors



Note

The usage of an AEcable 2Y is recommended because it separates the interface's shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

4.5.1 Network Features

Ports/channels	**Total number of Ethernet Ports**	2
	100BASE-T1 / 1000BASE-T1	2
	1000BASE-T1 Legacy Mode	-
	10/100/1000BASE-T(X)	-
	1, 2.5, 5, 10G BASE-T	-
	CAN FD	-
	DoIP Activation / Wake-up Line	-
	Multiple digital / analog IO	-
Power supply	**External**	-
	USB buspowered	X
Infrastructure	**Hardware synchronization**	-
	Software synchronization	X
	IEEE1588 (PTP)	-
	Computer uplink	USB3.0
	Computer uplink Ethernet	-
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	2
	Media conversion	-
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	X
	Physical bypass relays	-
Measure	**Mirroring port**	-
	Uplink Frame filter	-
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	-
	Virtual switch ports for Vector-Tools or XL-API based tools	16
Test	**On-board packet generator**	-
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	X
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

4.6 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors

- AEcable 2Y

5 VN5612

In this chapter you find the following information:

5.1 Scope of Delivery

Contents

The delivery includes:

- 1x VN5612 Ethernet Interface

5.2 Introduction

About the VN5612

The VN5612 is a very compact and convenient network interface for Standard Ethernet IEEE 100BASE-TX/1000BASE-T. It is used for the analysis of Ethernet networks as well as for simulation and test tasks in the Ethernet environment. USB 3.0 is used as an interface to the computer. Thanks to the small and compact format, the devices are ideally suited for portable use.

Figure 16: VN5612 Ethernet Interface

Highlights

Features of the VN5612:

- 2x IEEE 100BASE-TX / 1000BASE-T user port
- Host connection USB 3.0
- On-board Ethernet TAPs to link between two Ethernet ports
- On-board Vector Ethernet Switch IP supporting free segmentation
- New hardware configuration concept for flexible configuration
- Software synchronization to other Vector interfaces (typ. 50 µs accuracy)
- Multi-application support (different tools can share an Ethernet port at the same time)
- High precision time stamped Ethernet frames (< 20 ns precision)
- Device is designed for mobile use
  - small, handy and lightweight housing
  - power-supply via USB

5.3 Connectors

5.3.1 Front Side

Device connectors

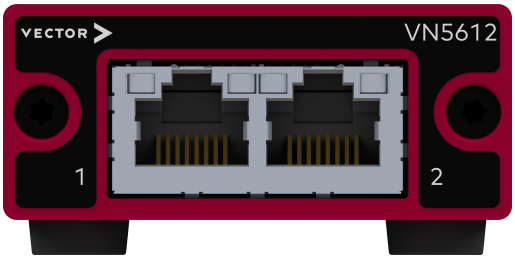


Figure 17: Connectors on the Ethernet side

- **Ethernet (RJ45 connectors)**
  Standard Ethernet connectors for 10BASE-T, 100BASE-TX and 1000BASE-T.

5.3.2 Back Side

Device connectors

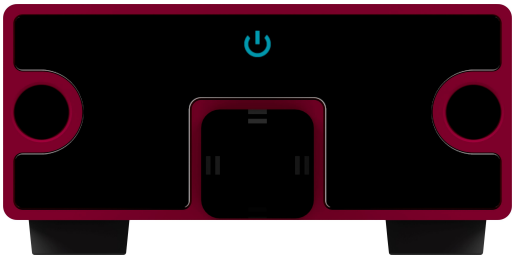


Figure 18: Connectors on the USB side

- **USB**
  Connect your computer and the VN5612 over USB to install and to use the device with measurement applications (CANoe, CANalyzer). Connect the device directly to a USB port at your computer or use a USB hub with its own power supply (self-powered).

5.4 LEDs

- **RJ45**

LEDs illuminate if there is an Ethernet link or blink if there is Ethernet activity.

Color (Left)	Description
Green	Activity

Color (Right)	Description
Off	10 MBit/s
Orange	100 MBit/s
Green	1000 MBit

- **Power**

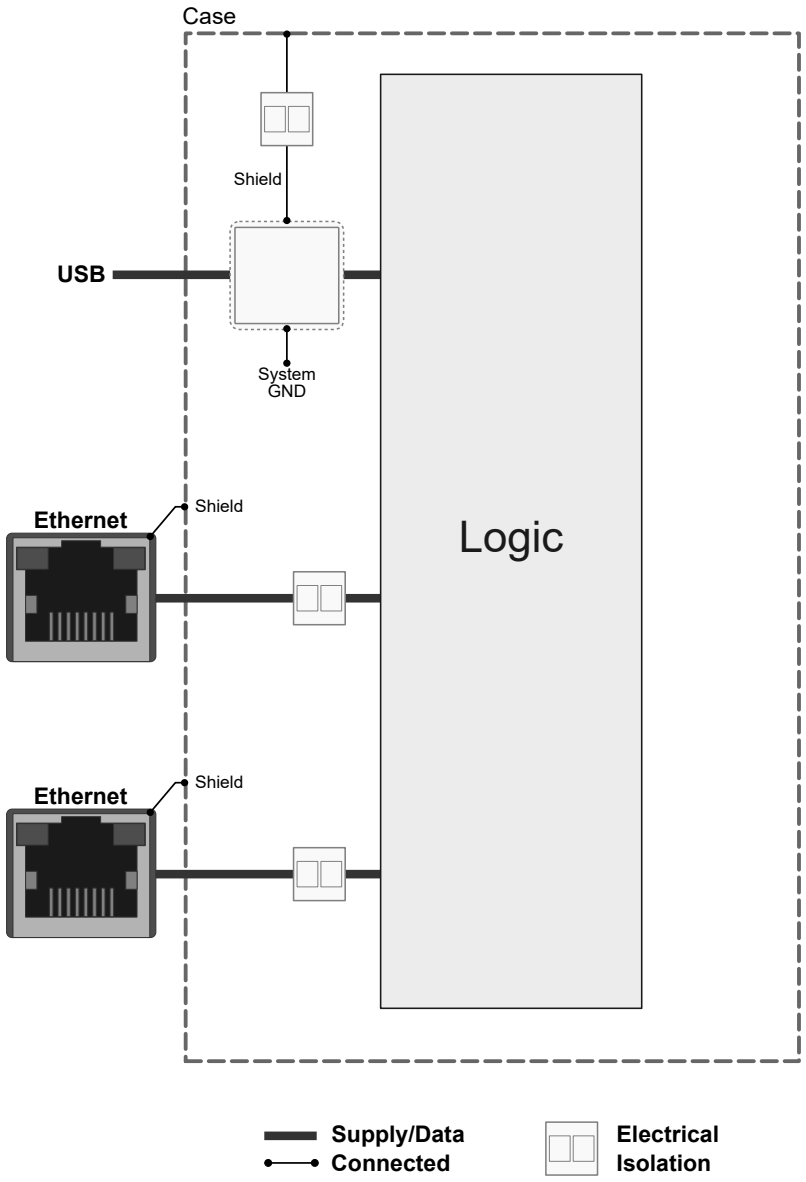
Multicolored LED indicating the device status.

Color	Description
Green	Blinks 4x at power up and illuminates afterwards. Blinks quicker during an update progress. Please wait for the automatic reboot of the device (approx. 30 seconds) after the update has been finished.
Red	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.

5.5 Technical Data

Ethernet ports	2x Broadcom BCM54210 (10BASE-T/100BASE-TX /1000BASE-T)
Computer interface	USB 3.0, bus-powered, fixed cable (length 1 m, min. bend radius 45 mm) with type-A connector
Input voltage	Nom. 5 V (USB bus-powered)
Power consumption	Max. 4.5 W (USB bus-powered)
Temperature range (ambient temp. of the device)	Operation: 0 °C...+45 °C Storage: -40 °C...+85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	Approx. 54 mm x 98 mm x 23 mm
Weight	183 g
Operating system requirements	Windows 10 (64 bit)

Electrical isolation of the connectors



5.5.1 Network Features

Ports/channels	**Total number of Ethernet Ports**	2
	100BASE-T1 / 1000BASE-T1	-
	1000BASE-T1 Legacy Mode	-
	10/100/1000BASE-T(X)	2
	1, 2.5, 5, 10G BASE-T	-
	CAN FD	-
	DoIP Activation / Wake-up Line	-
	Multiple digital / analog IO	-
Power supply	**External**	-
	USB buspowered	X
Infrastructure	**Hardware synchronization**	-
	Software synchronization	X
	IEEE1588 (PTP)	-
	Computer uplink	USB3.0
	Computer uplink Ethernet	-
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	2
	Media conversion	-
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	-
	Physical bypass relays	-
Measure	**Mirroring port**	-
	Uplink Frame filter	-
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	-
	Virtual switch ports for Vector-Tools or XL-API based tools	16
Test	**On-board packet generator**	-
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	-
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

5.6 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors

- Ethernet cables

6 VN5620

In this chapter you find the following information:

6.1 Scope of Delivery

Contents

The delivery includes:

- 1x VN5620 Ethernet/CAN Interface
- 1x USB cable 3.0 (A-C, 1. 8m, with screws)
- 1x USB cable 3.0 (C-C, 1. 8m, with screws)
- 1x Vector power supply 12 V / 1.25 A (part number 05024)

6.2 Introduction

About the VN5620

The VN5620 is a compact and powerful interface for the analysis, simulation, test and validation of Ethernet networks. The VN5620 interface supports a wide range of possible applications. It is suitable for synchronous Ethernet monitoring with other bus systems, network participation (e. g. in simulations and generation of frames, loads and errors in tests). The user can use Ethernet (1000BASE-T) or USB 3.0 as interface to the computer.

Figure 19: VN5620 Ethernet/CAN Interface

Highlights

Features of the VN5620:

- 4x IEEE 100BASE-T1 / 1000BASE-T1 user port
- 2x CAN FD channel
- 1x digital IO (e. g. for DoIP ActivationLine)
- 2x infrastructure port, standard Ethernet (100BASE-TX / 1000BASE-T), usable as:
  - uplink to host computer
  - an alternative user port (e. g. to analyze traffic of a 100BASE-TX/1000BASE-T link)
- Host connection via USB 3.0 or Ethernet
- On-board Ethernet TAPs to link between two Ethernet ports
- On-board Vector Ethernet Switch IP
- New hardware configuration concept
- Usable without host-connection to interconnect ECUs
  - Self-configuration after power-up
- Hardware filtering of Ethernet packets on protocol base
- Device synchronization to other Vector interfaces or 3rd party via
  - software synchronization (typ. 50 µs accuracy)
  - hardware synchronization (1 µs accuracy)
- Multi-application support (different tools can share an Ethernet port at the same time)
- Support of 3rd party tools with free XL Driver Library

- High precision time stamped Ethernet/CAN frames (< 20 ns precision)

6.3 Connectors

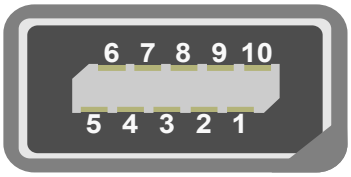
6.3.1 Front Side

Device connectors

Figure 20: Connectors on the Ethernet side

- **Ethernet 1/2 and 3/4 (ix Industrial)**
  ix Industrial connectors for 100BASE-T1/1000BASE-T1 (e. g. Harting ix Industrial type 10A-1). Each connector has two Ethernet ports (A and B). Use cables of the Vector AEcable 2Y family to access both ports on separate connectors (different plug systems available)

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	Not connected
5	Not connected
6	CH1 P
7	CH1 N
8	Not connected
9	Not connected
10	Not connected

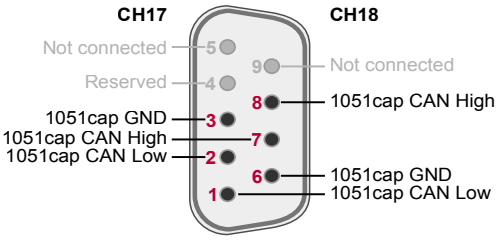


Note
We recommend the usage of an AEcable 2Y (see section Accessories on page 65), because it separates the VN5620 shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

CAN 5/6 (D-SUB9)

D-SUB9 connector for CAN. The connector has two channels. Use the CANcable 2Y to access both channels on separate D-SUB9 connectors (see accessories manual, part number 05075)

Pin	Assignment
1	CH18 CAN Low
2	CH17 CAN Low
3	CH17 GND
4	Reserved. Do not use.
5	Not connected
6	CH18 GND
7	CH17 CAN High
8	CH18 CAN High
9	Not connected



6.3.2 Back Side

Device connectors

Figure 21: Connectors on the USB side

- **Power (Binder)**
  Use this connector to power the VN5620 as alternative to USB-C (see USB connector details).

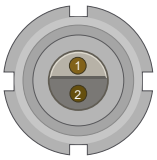
Pin	Assignment
1	Power supply 10 V...32 V (typ. 12 V DC)
2	Not connected
3	Ground

- **Sync (Binder)**
  The VN5620 has one sync connector (Binder type 711) which can be used for time synchronization of different Vector devices (see section Time Synchronization on page 161).

Pin	Assignment
1	Not connected
2	Synchronization line
3	Ground

- **Reset**
  If the device configuration is corrupted, start it with pushed reset button.
- **I/O (Lemo connector)**
  Lemo connector (type 302) for bidirectional digital input/output.

Pin	Assignment
1	Digital IO
2	Ground



- **USB (Type-C)**
  Connect your computer and the VN5620 via USB to install and to use the device with measurement applications (e. g. CANoe, CANalyzer). If the host computer provides a current of 3 A, the device can also be powered via this connector.

- **Host (RJ45 connector)**
  Connect your computer and the VN5620 via RJ45 to use the device with measurement applications (e. g. CANoe, CANalyzer) in a network setup.
- **Casc (RJ45 connector)**
  Infrastructure port with different possible configurations:
  - alternative analysis port
- **Functional Earth (FE)**
  Optional connection of housing ground to system ground.
- **Kensington Lock**
  Mounting of Nano Kensington (NanoSaver).

6.4 LEDs

LEDs

Figure 22: Top LEDs on VN5620

- **Ethernet Port 1...4**

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

Color	Description
Green	1000 MBit.
Orange	100 MBit.

- **M Ethernet Port 1...4**

Illuminates if the according port is configured as master.

State	Description
On	PHY is configured as master.
Off	PHY is configured as slave.

- **CAN (CH5/CH6)**

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

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.

- **Sync**

LED illuminates if the device is synchronized.

Color	Sync State	Description
Off	Not configured.	No master or slave protocols are active for this device or no configuration has been loaded yet.
Orange	Configured, waiting for master.	A slave protocol is active, but no master could be found / assigned yet. The state is assumed when the PTP protocol **Slave** or **Best-Master** is activated in the firmware, i. e. when starting the PTP stack in the firmware or if one of the slave protocols was activated in the driver, i. e. when or after the configuration was applied by the Vector Timesync Service (vTSS).
Green (flashing)	Pending.	A slave protocol is active and a master was found or could be assigned. The SYNC condition / the steady

Color	Sync State	Description
		state was not yet reached or was left again. ► **PTP** Transition to the Slave-With-Master state, but the SYNC condition has not yet been reached. ► **HW-SYNC** Pulse and master time present, but the SYNC accuracy has not yet been reached. ► **SW-SYNC** SYNC accuracy not yet reached.
Green	In-sync.	SYNC condition reached and is met or only master protocols active on the interface.
Red	Failure.	► **PTP** Master lost, SYNC accuracy not maintained. ► **HW-SYNC** Missing pulse, missing time information of the master, SYNC accuracy not maintained. ► **SW-SYNC** SYNC accuracy not maintained. If the SYNC accuracy is not maintained but the master is present, this state is only maintained for three seconds, then the state changes to **Pending**.

► **Power**

Multicolored LED indicating the device status.

Color	Description
Green	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.
Red	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.

- **RJ45**

LEDs illuminate if there is an Ethernet link or blink if there is Ethernet activity.

Color (Left)	Description
Green	Activity

Color (Right)	Description
Off	10 MBit/s
Orange	100 MBit/s
Green	1000 MBit

6.5 Technical Data

6.5.1 Overview

Ethernet ports	4x Marvell 88Q2112-A2 (IEEE 100BASE-T1/ 1000BASE-T1) 2x Broadcom BCM54210 (IEEE 1000BASE-T)
CAN/CAN FD channels	2x NXP TJA1057
Digital input/output	Output high (no load): 13 V Output high (load 346 Ohm): 5.3 V Output low: 0 V Input range: 0...16 V Input Schmitt trigger high: 3.4 V Input Schmitt trigger low: 2.5 V Rout: 503 Ohm
Computer interface	USB 3.0 / IEEE 1000BASE-T
Input voltage	External powered 10...32 V (typ. 12 V DC) or USB-C powered (must support USB-C, 3 ampere)
Power consumption	Max. 15 W Typ. 10 W
Time stamps	Resolution: 15.625 ns Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs
Temperature range (ambient temp. of the device)	Operation: -25 °C ... +60 °C Storage: -40 °C ... +85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	143 mm x 153 mm x 37 mm
Weight	570 g
Operating system requirements	Windows 10 (64 bit)

6.5.2 Temperature Shutdown

Temperature limits

The units are temperature monitored to prevent damage to the unit. The devices switch off automatically when the upper limit temperature is exceeded. This limit value represents the theoretical maximum of the hardware. However, it is possible to leave this range slightly without damaging the hardware.

For this purpose the temperature shutdown can be switched off actively.
If the maximum temperature is exceeded, it is indicated by a red status LED on the device. Vector applications also display this (e. g. in the **Write** window of CANoe).

You can find the settings in the **Vector Hardware Config** tool.

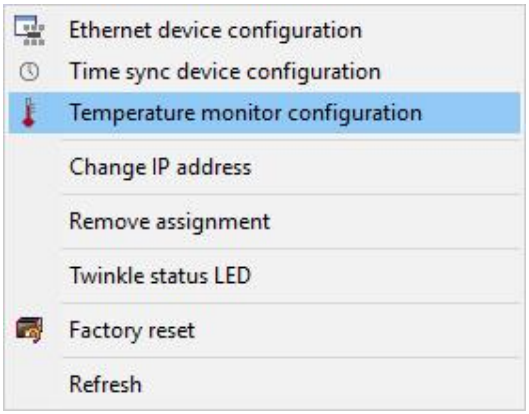


Figure 23: Open configuration

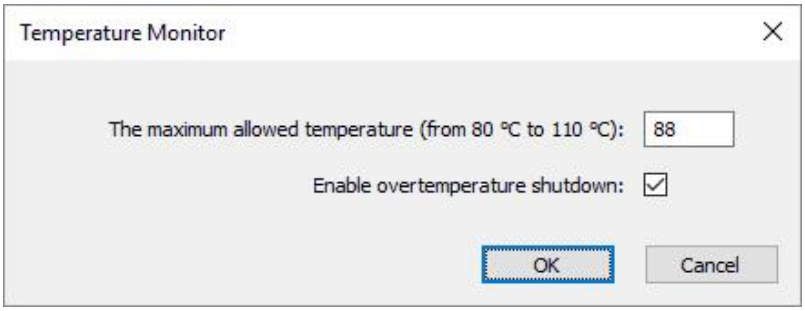
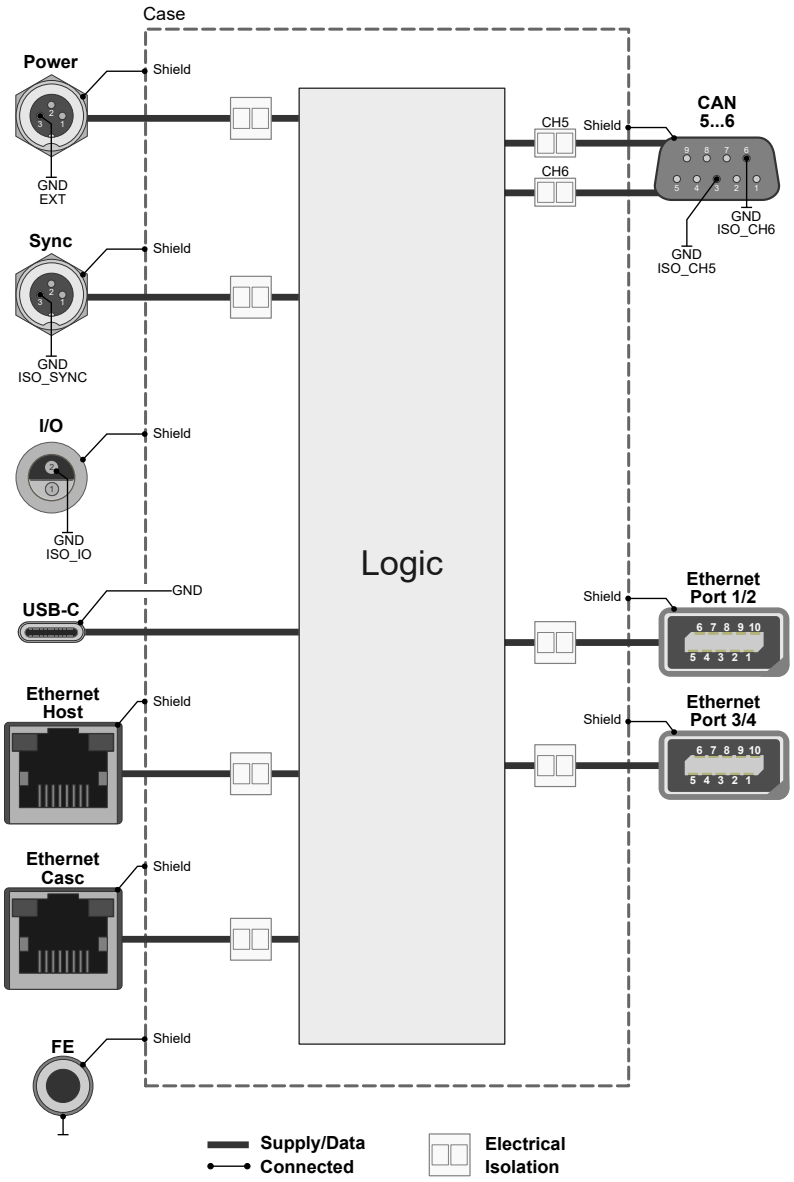


Figure 24: Setting limit for shutdown

6.5.3 Electrical Isolation

Electrical isolation of the connectors



Note

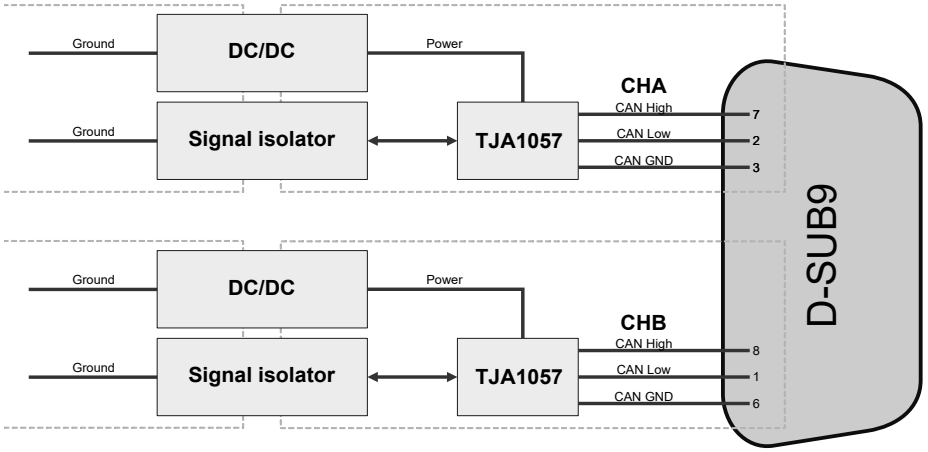
Please note that the shield of the USB-C connector is the same potential as the logic GND and that it is isolated from the case shield. This is intended to avoid ground loops when using a 12 V notebook power supply without electrical isolation.

The FE plug must be connected to the chassis ground if the network interface is used in a vehicle with shieled cables.

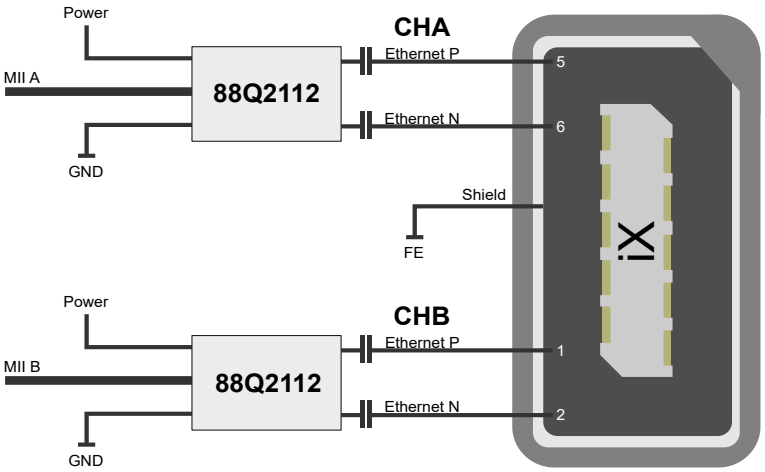
Note

The usage of an AEcable 2Y is recommended because it separates the interface's shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

Electrical isolation of CAN in detail



Electrical isolation of Ethernet in detail



6.5.4 Network Features

Ports/channels	**Total number of Ethernet Ports**	6
	100BASE-T1 / 1000BASE-T1	4
	1000BASE-T1 Legacy Mode	X
	10/100/1000BASE-T(X)	2
	1, 2.5, 5, 10G BASE-T	-
	CAN FD	2
	DoIP Activation / Wake-up Line	X
	Multiple digital / analog IO	-
Power supply	**External**	X
	USB buspowered	X[2)]
Infrastructure	**Hardware synchronization**	X
	Software synchronization	X
	IEEE1588 (PTP)	X[1)]
	Computer uplink	USB3.0
	Computer uplink Ethernet	1000BASE-T
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	4
	Media conversion	2
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	-
	Physical bypass relays	-
Measure	**Mirroring port**	-
	Uplink Frame filter	16 rules
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	X
	Virtual switch ports for Vector-Tools or XL-API based tools	32
Test	**On-board packet generator**	X
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	-
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

6.6 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors
- AEcable 2Y
- CANcable1
- CANcableA
- CANcable TnT
- CANcable Y
- CANcable 2Y
- CANterm 120
- CANcable Set Pro
- Vector SYNCcableXL
- Vector SYNCcable50
- Multi SYNCbox external
- Multi SYNCbox internal
- Multi SYNCbox active
- Cable Binder 3pol Connector with Pigtail
- Cable Lemo/Banana Plugs
- USB Cable 3.1 Type A-C (Dual Screw Lock)
- USB Cable 3.1 Type C-C (Dual Screw Lock)
- Ethernet cables

Power supply
- Vector Power Supply 12V/1.5A
- Cable Banana Plug <> Binder 3-pin

Miscellaneous
- Fix Kit 32mm Device

7 VN5430

In this chapter you find the following information:

7.1 Scope of Delivery

Contents

The delivery includes:

- 1x VN5430 Ethernet Interface
- 1x Ethernet cable CAT6A (2 m)
- 1x Vector power supply 12 V / 1.25 A (part number 05024)

7.2 Introduction

About the VN5430

The VN5430 is a compact interface for simulation and test tasks for Ethernet. The user benefits from the VN5430‘s versatile configuration options. A wide range of simulation and test scenarios can be implemented and the network topology can be maintained at the same time. The device can also be used as a stand-alone switch. Ethernet (1000BASE-T) is used as the interface to the computer.

Figure 25: VN5430 Ethernet Interface

Highlights

Features of the VN5430:

- 6x IEEE 100BASE-T1 / 1000BASE-T1 user port
- 2x infrastructure port, standard Ethernet (100BASE-TX / 1000BASE-T), usable as:
  - uplink to host computer
  - an alternative user port
    (e. g. to analyze traffic of a 100BASE-TX / 10000BASE-T link)
- Host connection via Ethernet
- On-board Ethernet TAPs to link between two Ethernet ports
- On-board Vector Ethernet Switch IP
- New hardware configuration concept
- Usable without host-connection to interconnect ECUs
  - Self-configuration after power-up
- Hardware filtering of Ethernet packets on protocol base
- Device synchronization to other Vector interfaces or 3rd party via
  - software synchronization (typ. 50 µs accuracy)
  - hardware synchronization (1 µs accuracy)
- Multi-application support (different tools can share an Ethernet port at the same time)
- Support of 3rd party tools with free XL Driver Library
- High precision time stamped Ethernet frames (< 20 ns precision)

7.3 Connectors

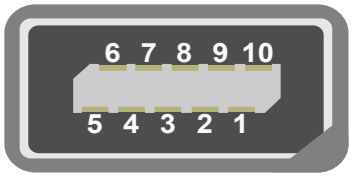
7.3.1 Front Side

Device connectors

Figure 26: Connectors on the Ethernet side

- **Ethernet 1...6 (ix Industrial)**
  ix Industrial connectors for 100BASE-T1/ 1000BASE-T1 (e. g. Harting ix Industrial type 10A-1). Each connector has two Ethernet ports (A and B). Use cables of the Vector AEcable 2Y family to access both ports on separate connectors (different plug systems available).

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	Not connected
5	Not connected
6	CH1 P
7	CH1 N
8	Not connected
9	Not connected
10	Not connected



Note
We recommend the usage of an AEcable 2Y (see section Accessories on page 77) because it separates the VN5430 shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

Note
In order to change the device configuration (link type, connection speed), you must use the configuration tool **Vector Hardware Config**.

7.3.2 Back Side

Device connectors

Figure 27: Connectors on the USB side

- **Functional Earth (FE)**
  Optional connection of housing ground to system ground.
- **Power (Binder)**
  Use this connector to power the VN5430.

Pin	Assignment
1	Power supply 10 V...18 V (typ. 12 V DC)
2	Not connected
3	Ground

- **Sync (Binder)**
  The VN5430 has one sync connector (Binder type 711) which can be used for time synchronization of different Vector devices (see section Time Synchronization on page 161).

Pin	Assignment
1	Not connected
2	Synchronization line
3	Ground

- **Reset**
  If the device configuration is corrupted, start it with pushed reset button.
- **Host (RJ45 connector)**
  Connect your computer and the VN5430 via RJ45 (100BASE-TX/1000BASE-T) to use the device with measurement applications (e. g. CANoe, CANalyzer) in a network setup.
- **Casc (RJ45 connector)**
  Infrastructure port with different possible configurations:
  - mirroring port
  - alternative analysis port
- **Kensington Lock**
  Mounting of Nano Kensington (NanoSaver).

7.4 LEDs

LEDs

Figure 28: Top LEDs on VN5430

- **Ethernet Port 1...6**

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

Color	Description
Green	1000 MBit.
Orange	100 MBit.

- **M Ethernet Port 1...6**

  Illuminates if the according port is configured as master.

State	Description
On	PHY is configured as master.
Off	PHY is configured as slave.

- **Sync**

  LED illuminates if the device is synchronized.

Color	Sync State	Description
Off	Not configured.	No master or slave protocols are active for this device or no configuration has been loaded yet.
Orange	Configured, waiting for master.	A slave protocol is active, but no master could be found / assigned yet. The state is assumed when the PTP protocol **Slave** or **Best-Master** is activated in the firmware, i. e. when starting the PTP stack in the firmware or if one of the slave protocols was activated in the driver, i. e. when or after the configuration was applied by the Vector Timesync Service (vTSS).
Green (flashing)	Pending.	A slave protocol is active and a master was found or could be assigned. The SYNC condition / the steady state was not yet reached or was left again. - **PTP** Transition to the Slave-With-Master state, but the SYNC condition has not yet been reached.

Color	Sync State	Description
		▶ **HW-SYNC** Pulse and master time present, but the SYNC accuracy has not yet been reached. ▶ **SW-SYNC** SYNC accuracy not yet reached.
Green	In-sync.	SYNC condition reached and is met or only master protocols active on the interface.
Red	Failure.	▶ **PTP** Master lost, SYNC accuracy not maintained. ▶ **HW-SYNC** Missing pulse, missing time information of the master, SYNC accuracy not maintained. ▶ **SW-SYNC** SYNC accuracy not maintained. If the SYNC accuracy is not maintained but the master is present, this state is only maintained for three seconds, then the state changes to **Pending**.

▶ **Power**

Multicolored LED indicating the device status.

Color	Description
Green	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.
Red	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.

- **RJ45**

LEDs illuminate if there is an Ethernet link or blink if there is Ethernet activity.

Color (Left)	Description
Green	Activity

Color (Right)	Description
Off	10 MBit/s
Orange	100 MBit/s
Green	1000 MBit

7.5 Technical Data

7.5.1 Overview

Ethernet ports	6x Marvell 88Q2112-A2 (IEEE 100BASE-T1/ 1000BASE-T1) 2x Broadcom BCM54210 (IEEE 1000BASE-T)
Computer interface	IEEE 1000BASE-T
Input voltage	External powered: 10 ...18 V (typ. 12 V DC)
Power consumption	Max. 15 W Typ. 11 W
Time stamps	Resolution: 15.625 ns Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs
Temperature range (ambient temp. of the device)	Operation: -25 °C ... +60 °C Storage: -40 °C ... +85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	143 mm x 149 mm x 37 mm
Weight	554 g
Operating system requirements	Windows 10 (64 bit)

7.5.2 Temperature Shutdown

Temperature limits

The units are temperature monitored to prevent damage to the unit. The devices switch off automatically when the upper limit temperature is exceeded. This limit value represents the theoretical maximum of the hardware. However, it is possible to leave this range slightly without damaging the hardware.

For this purpose the temperature shutdown can be switched off actively.
If the maximum temperature is exceeded, it is indicated by a red status LED on the device. Vector applications also display this (e. g. in the **Write** window of CANoe).

You can find the settings in the **Vector Hardware Config** tool.

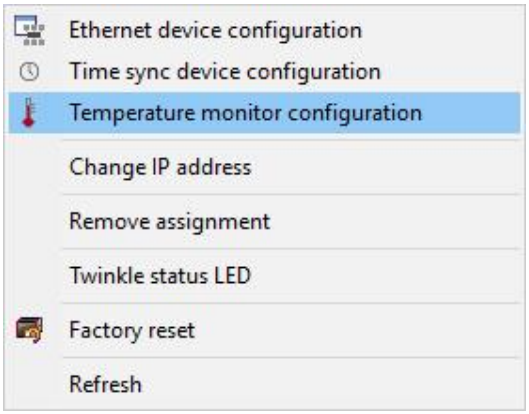


Figure 29: Open configuration

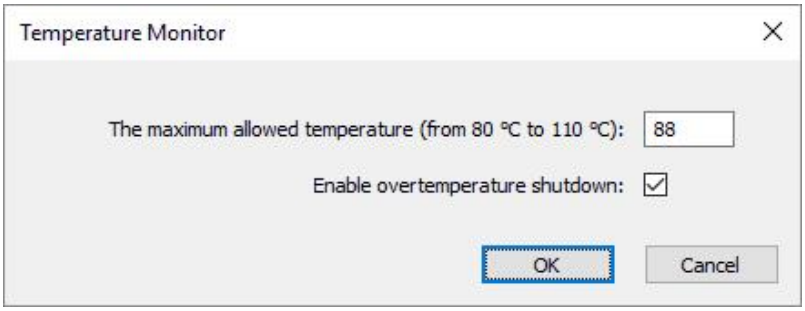
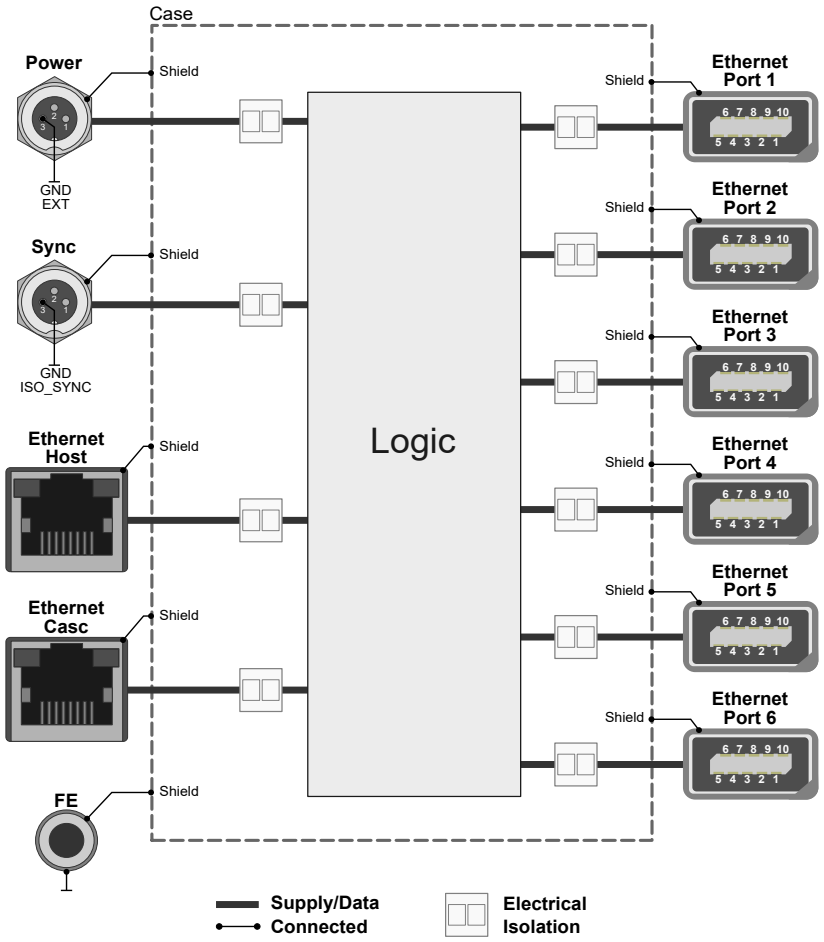


Figure 30: Setting limit for shutdown

7.5.3 Electrical Isolation

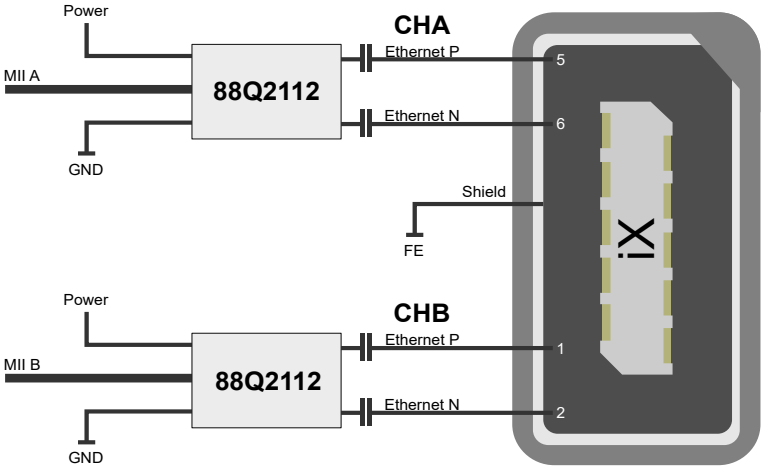
Electrical isolation of the connectors



Note
The FE plug must be connected to the chassis ground if the network interface is used in a vehicle with shieled cables.

Note
The usage of an AEcable 2Y is recommended because it separates the interface's shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

Electrical isolation of Ethernet in detail



7.5.4 Network Features

Ports/channels	**Total number of Ethernet Ports**	8
	100BASE-T1 / 1000BASE-T1	6
	1000BASE-T1 Legacy Mode	X
	10/100/1000BASE-T(X)	2
	1, 2.5, 5, 10G BASE-T	-
	CAN FD	-
	DoIP Activation / Wake-up Line	-
	Multiple digital / analog IO	-
Power supply	**External**	X
	USB buspowered	-
Infrastructure	**Hardware synchronization**	X
	Software synchronization	X[1)]
	IEEE1588 (PTP)	X[1)]
	Computer uplink	-
	Computer uplink Ethernet	1000BASE-T
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	6
	Media conversion	1
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	-
	Physical bypass relays	-
Measure	**Mirroring port**	X
	Uplink Frame filter	16 rules
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	X
	Virtual switch ports for Vector-Tools or XL-API based tools	32
Test	**On-board packet generator**	X
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	-
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

7.6 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors	▶ AEcable 2Y ▶ Vector SYNCcableXL ▶ Vector SYNCcable50 ▶ Multi SYNCbox external ▶ Multi SYNCbox internal ▶ Multi SYNCbox active ▶ Cable Binder 3pol Connector with Pigtail ▶ Ethernet cables
Power supply	▶ Vector Power Supply 12V/1.5A ▶ Cable Banana Plug <> Binder 3-pin
Miscellaneous	▶ Fix Kit 32mm Device

8 VN5640

In this chapter you find the following information:

8.1 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)

8.2 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.

Figure 31: VN5640 Ethernet/CAN Interface

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 12 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 or Ethernet (1000BASE-T)
- High resolution time stamps for Ethernet frames
- High resolution time stamps for CAN/CAN FD frames
- Software, hardware and IEEE 1588 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 ports
- 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)

8.3 Main Connectors

Device connectors

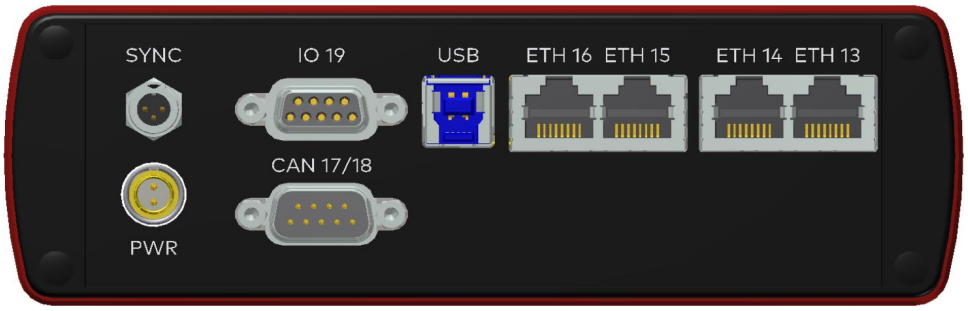


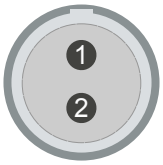
Figure 32: Connectors on the USB side

- **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 161).

Pin	Assignment
1	Not connected
2	Synchronization line
3	Ground

- **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).

Pin	Assignment
1	Power supply (8 V ... 50 V)
2	Ground

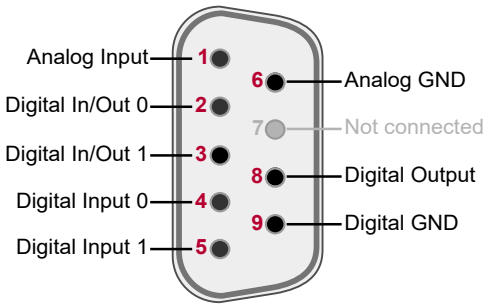


Note
The VN5640 requires at least 5 V to power up. For continuous operation, use 8 V or higher (typ. 12 V DC, max. 50 V). Temporary voltage drops (< 1 min) down to 5 V are allowed.

IO 19 (D-SUB)

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

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



Internal interconnection of digital in/out 0/1

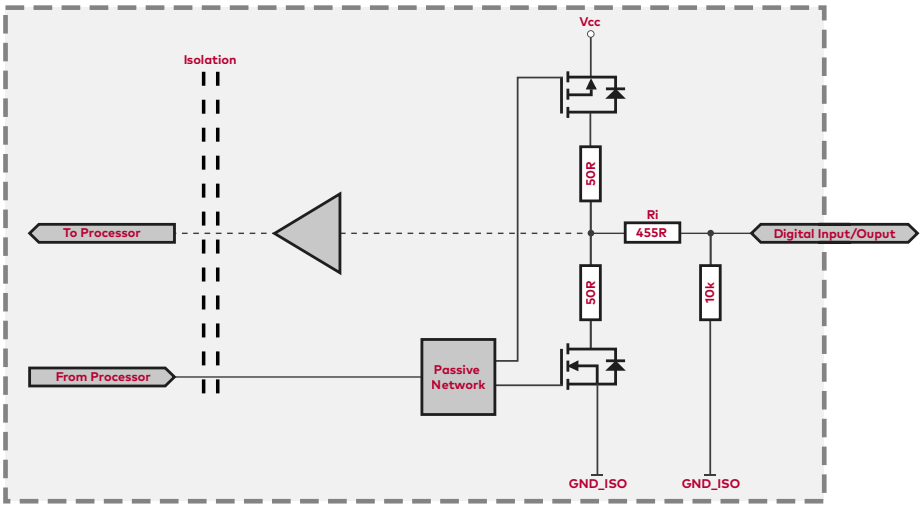


Figure 33: Digital input /output

Internal interconnection of digital input 0/1

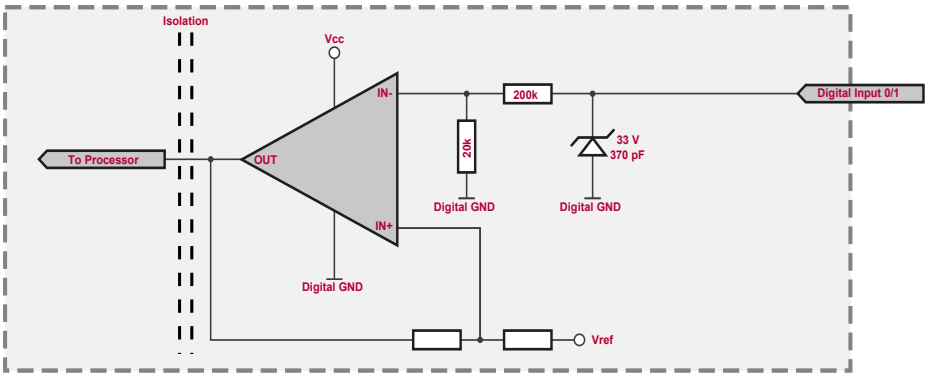


Figure 34: Digital input 0/1

Internal interconnection of digital output

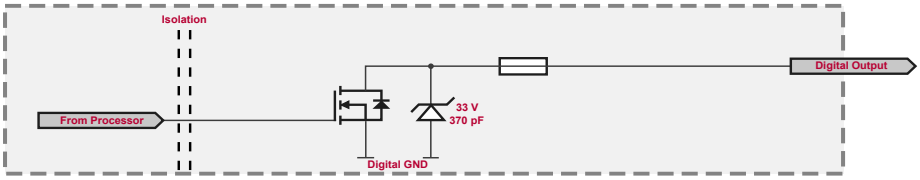


Figure 35: Digital output

Internal interconnection of analog input

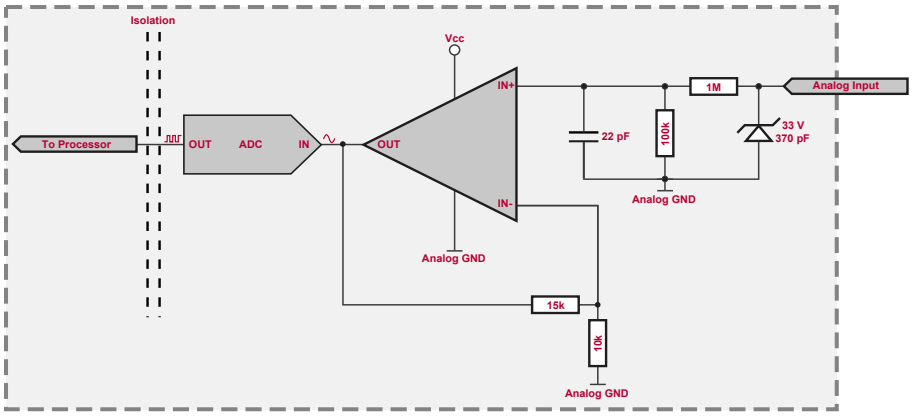


Figure 36: Analog input

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:

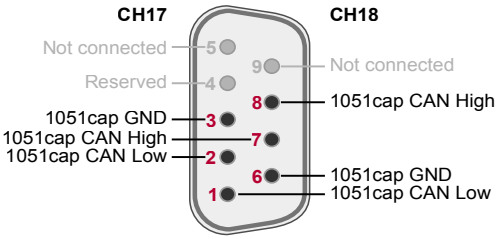
$$f_c\left[Hz\right] = \frac{1}{2.33 * 10^{-6} * R_{ext}\,[kOhm]}$$

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

- **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).

Pin	Assignment
1	CH18 CAN Low
2	CH17 CAN Low
3	CH17 GND
4	Reserved. Please do not use.
5	Not connected
6	CH18 GND
7	CH17 CAN High
8	CH18 CAN High
9	Not connected



- **USB**
  Connect your computer 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 computer and the device). Connect the device directly to a USB port at your computer 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.

8.4 LEDs

Top LEDs

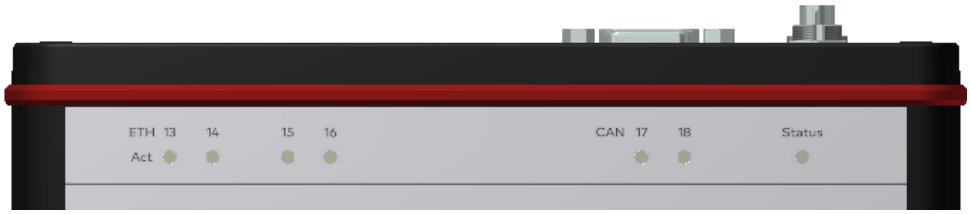


Figure 37: Top LEDs on VN5640

- **Act (Ethernet Port 13...16)**
  LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at the according port.

Color	Description
Green	1000 MBit.
Orange	100 MBit.

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

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.

- **Status**
  Multicolored LED indicating the status.

Color	Description
Green	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.
Red	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.

Bottom LEDs

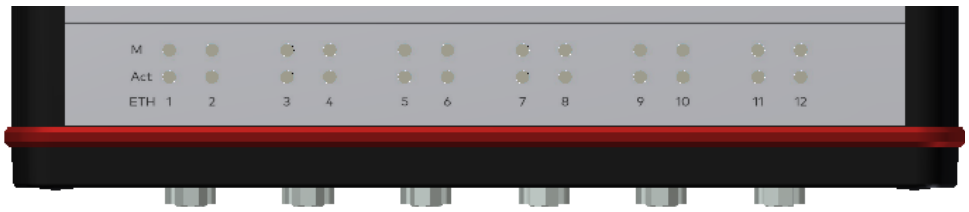


Figure 38: Bottom LEDs on VN5640

- **M (Ethernet Port 1...12)**
  Illuminates if the according port is configured as master.

Color	Description
Green	PHY is configured as master.
Off	PHY is configured as slave.

- **Act (Ethernet Port 1...12)**
  LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at the according port.

Color	Description
Green	1000 MBit.
Orange	100 MBit.

Note
During a firmware update process, the LEDs of port 1...12 turns into a progress bar.

8.5 Interface Option 100BASE-T1

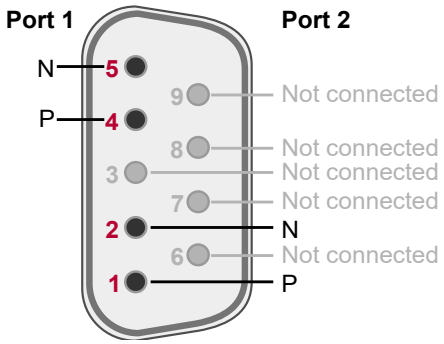
8.5.1 Connectors

Device connectors

Figure 39: Ethernet CH1...CH12

- **Ethernet Port 1...12 (D-SUB9)**
  D-SUB9 connector for 100BASE-T1. Use the BRcable 2Y to access both ports on separate D-SUB9 connectors (see accessories manual, part number 05103).

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	CH1 P
5	CH1 N
6	Not connected
7	Not connected
8	Not connected
9	Not connected



Reference
The Ethernet configuration can be done in **Vector Hardware Config** (see section Ethernet Device Configuration on page 142).

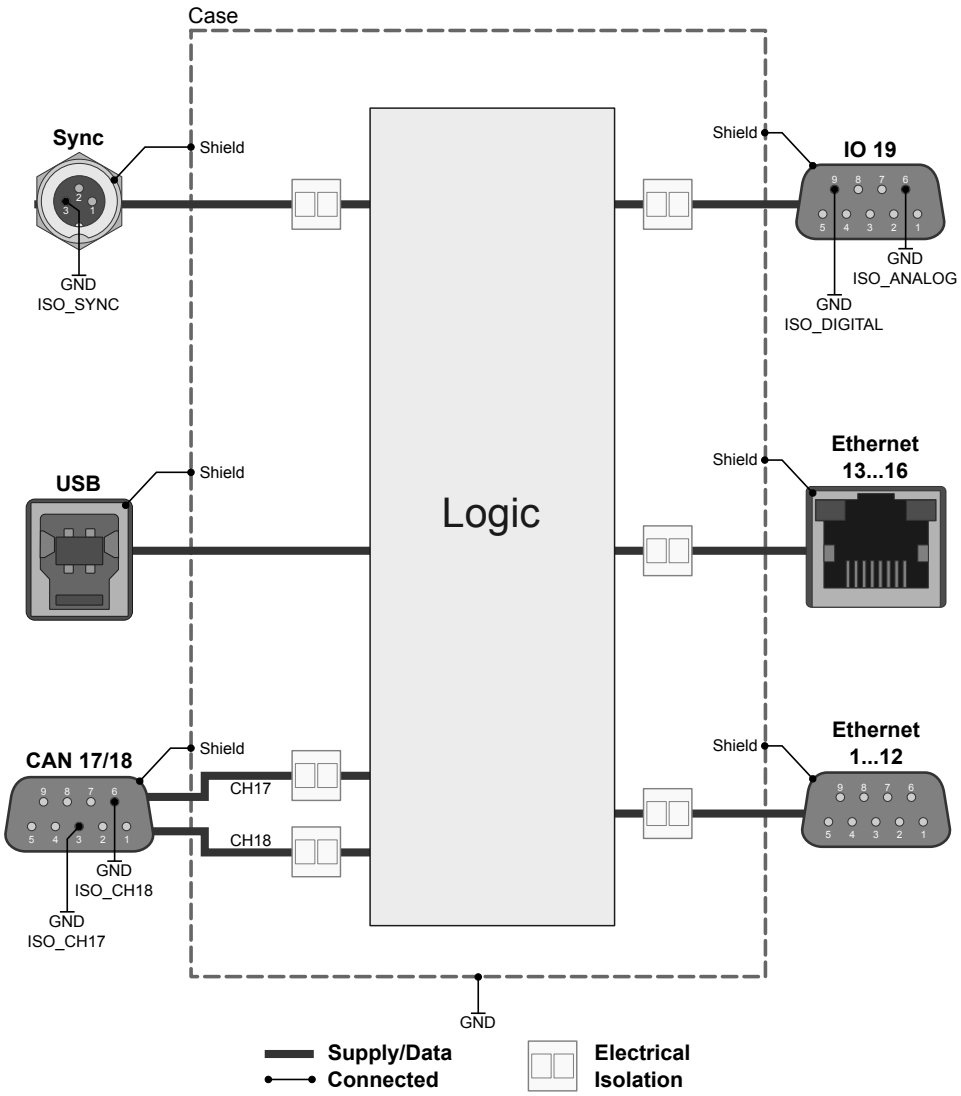
8.5.2 Technical Data

8.5.2.1 Overview

Ethernet ports	12x NXP TJA1101 (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 83.
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: 15.625 ns Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs
Computer interface	USB 3.0 or Ethernet (1000BASE-T)
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	Max. 15 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)	186 mm x 172 mm x 55 mm
Weight	1300 g
Operating system requirements	Windows 10 (64 bit)

8.5.2.2 Electrical Isolation

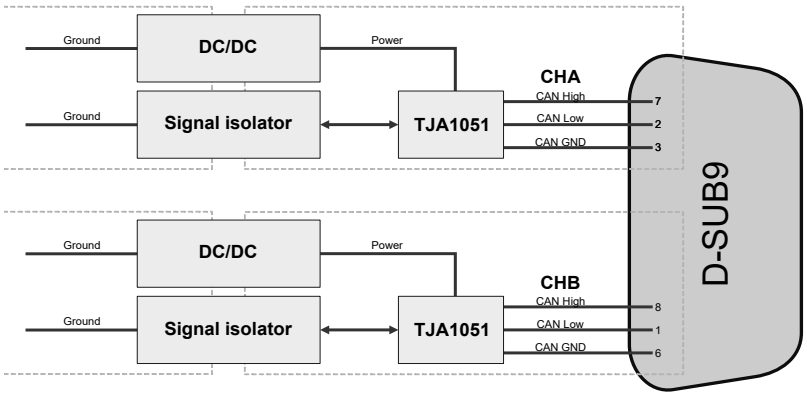
Electrical isolation of the connectors



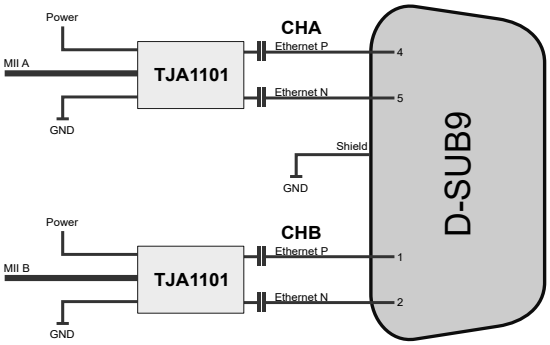
Note

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.

Electrical isolation of CAN in detail



Electrical isolation of Ethernet in detail



8.5.3 Network Features

Ports/channels	**Total number of Ethernet Ports**	16
	100BASE-T1 / 1000BASE-T1	12 / -
	1000BASE-T1 Legacy Mode	-
	10/100/1000BASE-T(X)	4
	1, 2.5, 5, 10G BASE-T	-
	CAN FD	2
	DoIP Activation / Wake-up Line	X
	Multiple digital / analog IO	X
Power supply	**External**	X
	USB buspowered	X
Infrastructure	**Hardware synchronization**	X
	Software synchronization	X
	IEEE1588 (PTP)	X
	Computer uplink	USB3.0
	Computer uplink Ethernet	1000BASE-T
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	12
	Media conversion	4
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	X
	Physical bypass relays	-
Measure	**Mirroring port**	X
	Uplink Frame filter	16 rules
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	X
	Virtual switch ports for Vector-Tools or XL-API based tools	32
Test	**On-board packet generator**	X
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	X
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

8.6 Interface Option 1000BASE-T1

8.6.1 Connectors

Device connectors

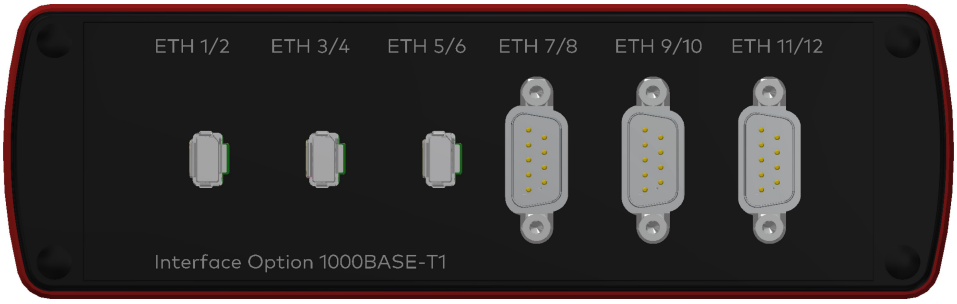
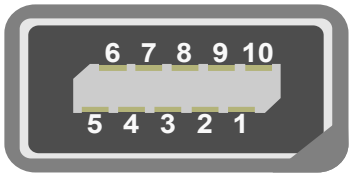


Figure 40: Ethernet CH1...CH12

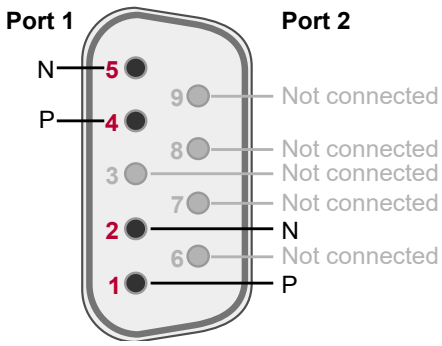
- **Ethernet Port 1...6 (ix Industrial®)**
  ix Industrial® connectors for 100BASE-T1/1000BASE-T1 (e. g. Harting ix Industrial® type 10A-1). Each connector has two Ethernet ports (A and B). Use cables of the Vector AEcable 2Y family to access both ports on separate connectors (different plug systems available).

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	Not connected
5	Not connected
6	CH1 P
7	CH1 N
8	Not connected
9	Not connected
10	Not connected



- **Ethernet Port 7...12 (D-SUB9)**
  D-SUB9 connector for 100BASE-T1. Use the BRcable 2Y to access both ports on separate D-SUB9 connectors (see accessories manual, part number 05103).

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	CH1 P
5	CH1 N
6	Not connected
7	Not connected
8	Not connected
9	Not connected



Reference
The Ethernet configuration can be done in **Vector Hardware Config** (see section Ethernet Device Configuration on page 142).

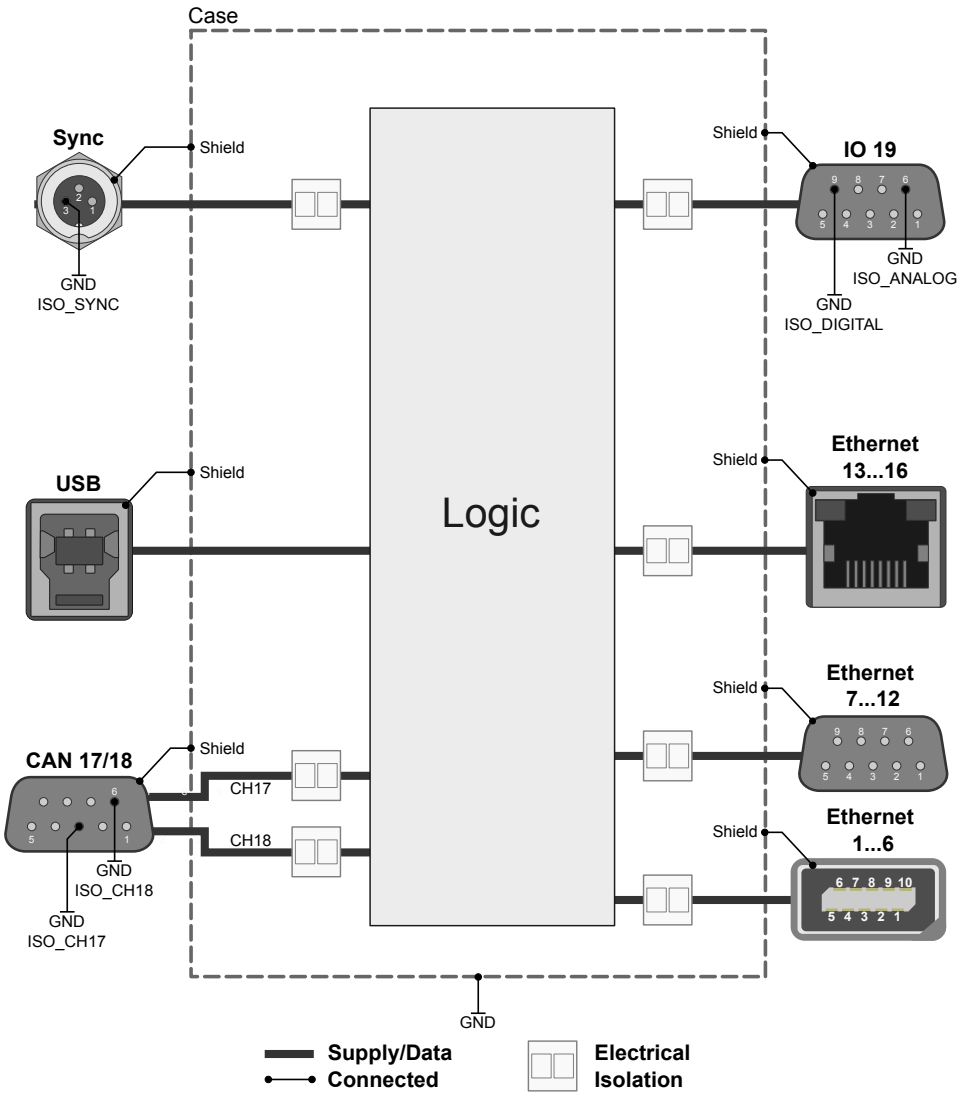
8.6.2 Technical Data

8.6.2.1 Overview

Ethernet ports	6x Marvell 88Q2112 Rev.A2 (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 83.
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: 15.625 ns Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs Accuracy PTP sync (IEEE1588): typ. 1µs
Computer interface	USB 3.0 or Ethernet (1000BASE-T)
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	Max. 15 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)	186 mm x 172 mm x 55 mm
Weight	1300 g
Operating system requirements	Windows 10 (64 bit)

8.6.2.2 Electrical Isolation

Electrical isolation of the connectors



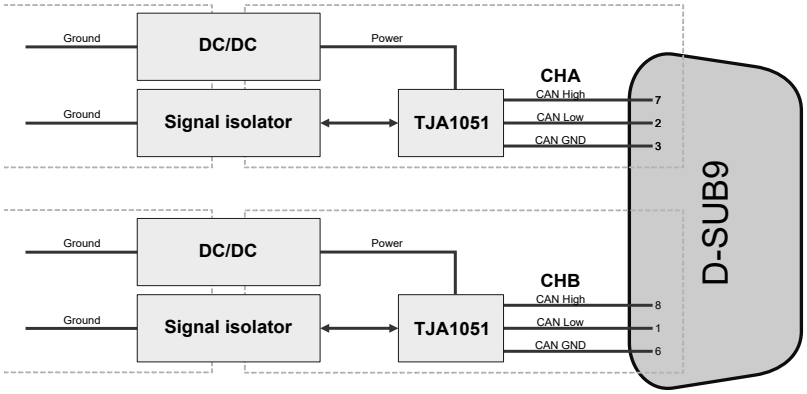
Note

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.

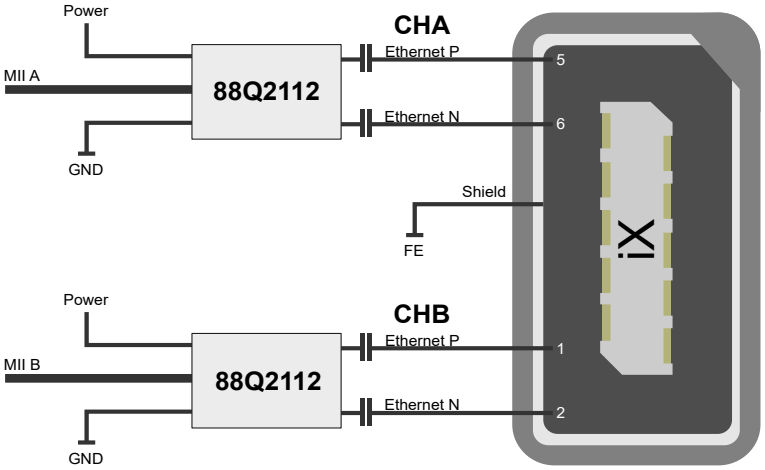
Note

The usage of an AEcable 2Y is recommended because it separates the interface's shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

Electrical isolation of CAN in detail



Electrical isolation of Ethernet in detail



8.6.2.3 Network Features

Ports/channels	**Total number of Ethernet Ports**	16
	100BASE-T1 / 1000BASE-T1	12 / 6
	1000BASE-T1 Legacy Mode	X
	10/100/1000BASE-T(X)	4
	1, 2.5, 5, 10G BASE-T	-
	CAN FD	2
	DoIP Activation / Wake-up Line	X
	Multiple digital / analog IO	X
Power supply	**External**	X
	USB buspowered	X
Infrastructure	**Hardware synchronization**	X
	Software synchronization	X
	IEEE1588 (PTP)	X
	Computer uplink	USB3.0
	Computer uplink Ethernet	1000BASE-T
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	12
	Media conversion	4
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	-
	Physical bypass relays	-
Measure	**Mirroring port**	X
	Uplink Frame filter	16 rules
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	X
	Virtual switch ports for Vector-Tools or XL-API based tools	32
Test	**On-board packet generator**	X
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	-
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

8.7 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors

- AEcable 2Y
- BRcable 2Y
- VNcable D-SUB9 HSD Z
- CANcable1
- CANcableA
- CANcable TnT
- CANcable Y
- CANcable 2Y
- CANterm 120
- CANcable Set Pro
- Vector SYNCcableXL
- Vector SYNCcable50
- Multi SYNCbox external
- Multi SYNCbox internal
- Multi SYNCbox active
- Cable Binder 3pol Connector with Pigtail
- USB Cable 3.0
- Ethernet cables

Power supply

- Vector Power Supply ODU Mini-Snap
- Cable Vehicle Input <> ODU Mini-Snap
- Cable Banana Plug <> ODU Mini-Snap

Miscellaneous

- Fix Kit Large Device

9 VN5240

In this chapter you find the following information:

9.1 Scope of Delivery

Contents

The delivery includes:

- 1x VN5240 Ethernet Measurement Interface
- 1x Cable Banana Plug <> ODU Mini-Snap (part number 05069)
- 1x Ethernet cable CAT6A (2 m)

9.2 Introduction

About the VN5240

The VN5240 is an interface that has been specially designed for monitoring and analysis of Ethernet networks. For recording Ethernet data in the vehicle, the VN5240 is ideal in combination with the VP6400 smart logging platform. The interface is connected to the computer via Ethernet (10GBASE-T). The tapped data-streams can also be accessed very flexible via up to three mirroring ports.

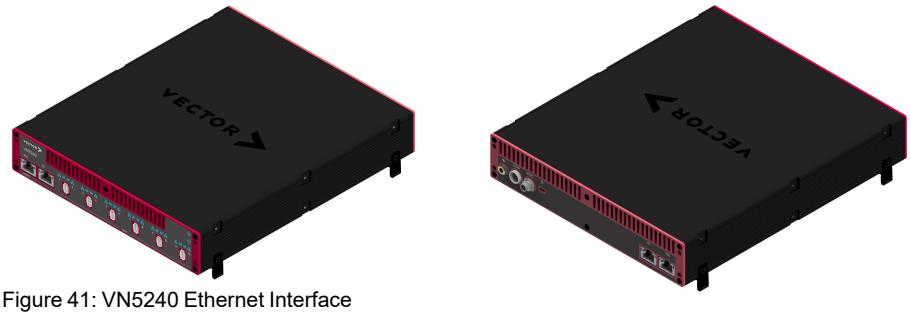


Figure 41: VN5240 Ethernet Interface

Highlights

Features of the VN5240:

- 12x 100BASE-T1/ 1000BASE-T1 user port
- 2x 10/100/1000BASE-T(X) infrastructure port
- 2x 1G/2.5G/5G/10GBASE-T infrastructure port
  usable:
  - as uplink to host computer
  - as an alternative user port (e. g. to analyze traffic of a 100BASE-TX/10000BASE-T link)
- Host connection Ethernet (10GBASE-T)
- On-board Ethernet TAPs to link between two Ethernet ports
- New hardware configuration concept for flexible configuration
- Usable without host-connection to interconnect ECUs
  - Self-configuration after power-up
- Hardware filtering of Ethernet packets on protocol base
- Hardware synchronization to other Vector interfaces via
  - IEEE 1588 (PTP)
  - software synchronization (typ. 50 µs accuracy)
  - hardware synchronization (1 µs accuracy)
- Multi-application support (different tools can share an Ethernet port at the same time)
- Support of 3rd party tools with free XL Driver Library
- Provides high precision time stamped Ethernet frames (< 20 ns precision)
- Device is designed for in-vehicle applications:
  - Robust housing with various mounting possibilities
  - Form-factor fits perfect two times in a standard 19-inch rack system

- Extended power supply range (8 V…32 V)
- Extended temperature-range (-40 °C...+65 °C)
- Low-power soft off mode (only 2 mA power consumption)
- On-board/configurable high frequency Ethernet bypass relays ensure a closed TAP connection between two ECUs while the VN5240 is not powered

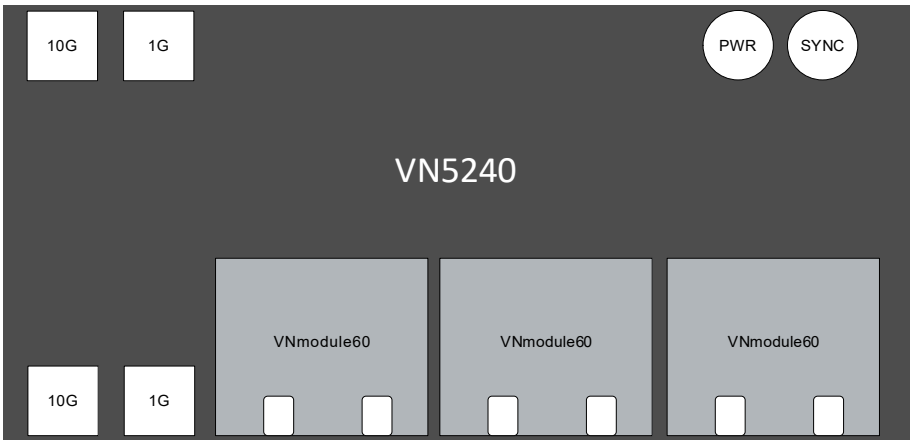


Figure 42: Ports overview

9.3 VNmodule60

General information

The VNmodule60 provides the connection to the physical layer with up to four ports. The VN5240 has three VNmodule60 slots, i. e. up to 12 ports can be used at the same time.

Possible configurations:

- 3x VNmodule60 4AE1G BCM89883
- 3x VNmodule60 4AE1G 88Q2112

Supported Feature	VNmodule60 4AE1G BCM89883	VNmodule60 4AE1G 88Q2112
100BASE-T1	X	X
1000BASE-T1	X	X
1000BASE-T1 Legacy Mode	-	X
OPEN Alliance TC10 (100BASE-T1 WAKE/SLEEP)	X	-

9.4 Connectors

9.4.1 Front Side

Device connectors

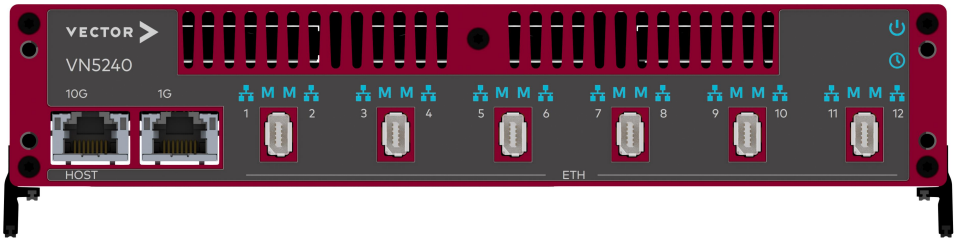


Figure 43: Connectors on the Ethernet side

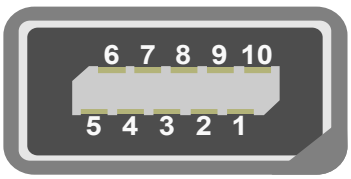
- **Host 10G (RJ45)**
  Connect your computer and the VN5240 via RJ45 to use the device with measurement applications (e. g. CANoe, CANalyzer) in a network setup. Alternatively, you also can configure 1G.

Note
10 Gbps Ethernet connections show an increased sensitivity to EMI. Data integrity is guaranteed by use of protocols which may reduce data throughput.

- **1G (RJ45)**
  Infrastructure port with different possible configurations:
  - mirroring port
  - alternative analysis port

- **Ethernet 1...12 (ix Industrial)**
  ix Industrial connectors for 100BASE-T1/1000BASE-T1 (e. g. Harting ix Industrial type 10A-1). Each connector has two Ethernet ports (A and B). Use cables of the Vector AEcable 2Y family to access both ports on separate connectors (different plug systems available)

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	Not connected
5	Not connected
6	CH1 P
7	CH1 N
8	Not connected
9	Not connected
10	Not connected



9.4.2 Back Side

Device connectors

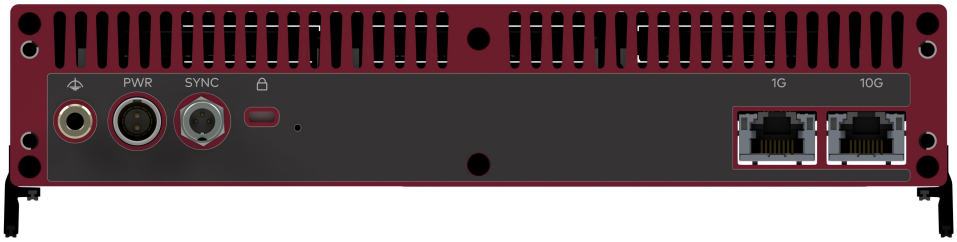


Figure 44: Connectors on the USB side

- **Functional Earth (FE)**
  Optional connection of housing ground to system ground.

- **Power (ODU)**
  For power supply, the VN5420 has a two-pin ODU connector (MINI-SNAP size 1, type GF1L0C-P02RP00-0000). Attach the enclosed power cable to power up the unit (matching ODU connector type S11L0C-P02NPL0-6200).

Pin	Assignment
1	Power supply (8 V ... 32 V)
2	Ground

- **Sync (Binder)**
  The VN5240 has a sync connector (Binder type 711) which can be used for time synchronization of different Vector devices (see section Time Synchronization on page 161).

Pin	Assignment
1	Terminal 15
2	Synchronization line
3	Ground Sync

- **Kensington Lock**
  Mounting of Nano Kensington (NanoSaver).

- **Reset**
  If the device configuration is corrupted, start it with pushed reset button.

- **1G/10G (RJ45 connectors)**
  Infrastructure port with different possible configurations:
  - mirroring port
  - alternative analysis port

9.5 LEDs

LEDs

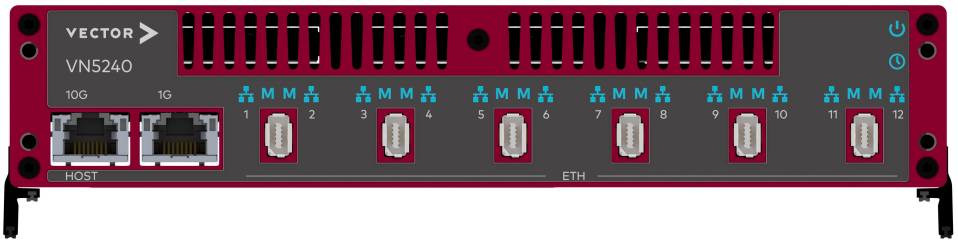


Figure 45: LEDs on VN5240

- **Power**
  LED illuminates if the device is supplied with power.

- **Sync**
  LED illuminates if the device is synchronized.

Color	Sync State	Description
Off	Not configured.	No master or slave protocols are active for this device or no configuration has been loaded yet.
Orange	Configured, waiting for master.	A slave protocol is active, but no master could be found / assigned yet. The state is assumed when the PTP protocol **Slave** or **Best-Master** is activated in the firmware, i. e. when starting the PTP stack in the firmware or if one of the slave protocols was activated in the driver, i. e. when or after the configuration was applied by the Vector Timesync Service (vTSS).
Green (flashing)	Pending.	A slave protocol is active and a master was found or could be assigned. The SYNC condition / the steady state was not yet reached or was left again. ▶ **PTP** Transition to the Slave-With-Master state, but the SYNC condition has not yet been reached. ▶ **HW-SYNC** Pulse and master time present, but the SYNC accuracy has not yet been reached. ▶ **SW-SYNC** SYNC accuracy not yet reached.
Green	In-sync.	SYNC condition reached and is met or only master protocols active on the interface.
Red	Failure.	▶ **PTP** Master lost, SYNC accuracy not maintained.

Color	Sync State	Description
		▶ **HW-SYNC** Missing pulse, missing time information of the master, SYNC accuracy not maintained. ▶ **SW-SYNC** SYNC accuracy not maintained. If the SYNC accuracy is not maintained but the master is present, this state is only maintained for three seconds, then the state changes to **Pending**.

▶ **10G Port (RJ45)**
LEDs illuminate if there is an Ethernet link or blink if there is Ethernet activity.

Color (Left)	Color (Right)	Description
Orange	-	100M
Green	-	1G
-	Orange	2.5G
-	Green	5G
Orange	Orange	10G

▶ **1G Port (RJ45)**
LEDs illuminate if there is an Ethernet link or blink if there is Ethernet activity.

Color (Left)	Description
Green	Activity

Color (Right)	Description
Off	10 MBit/s
Orange	100 MBit/s
Green	1000 MBit

▶ **(Ethernet Port 1...12)**
LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at the according port.

Color	Description
Green	1000 MBit.
Orange	100 MBit.

▶ **M (Ethernet Port 1...12)**
Illuminates if the according port is configured as master.

State	Description
On	PHY is configured as master.
Off	PHY is configured as slave.

9.6 Technical Data

9.6.1 Overview

Ethernet ports	Up to 12 ports via three plug-in modules. Port characteristics depend on the plugged module: - VNmodule60 4AE1G BCM89883 (12x Broadcom BCM89883 - IEEE 100BASE-T1/1000BASE-T1) - VNmodule60 4AE1G 88Q2112 (12x Marvell 88Q2112-A2 - IEEE 100BASE-T1/1000BASE-T1) 2x Broadcom BCM54210 (IEEE 1000BASE-T/100BASE-TX) 2x Broadcom BCM84891 (IEEE 1/2.5/5/10GBASE-T)
Time stamps	Resolution: 15.625 ns Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs Accuracy PTP sync (IEEE1588): typ. 1µs
Computer interface	Ethernet (1/2.5/5/10GBASE-T)
Power supply	External: 8 V...32 V (typ. 12 V DC)
Power consumption	Typ. 1.8 A @ 12 V Max. 3.1A @ 12 V (65 °C) Standby: 2 mA @ 12 V For more information, see section Power Consumption on page 107.
Temperature range	Operation: -40 °C ... +65 °C Storage: -40 °C ... +85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	250 mm x 219 mm x 54 mm (with case feet)
Weight	Approx. 2.5 kg
Operating system requirements	Windows 10 (64 bit)

9.6.2 Power Consumption

The power consumption depends primarily on the used device configuration and the ambient conditions under which the device is operated. The following example shows the power consumption in typical applications.

Example

Device configuration:

- 6x port 100BASE-T1
- 6x port 1000BASE-T1
- Uplink to computer: 10Gbit Ethernet

Ambient temperature	25 °C	40 °C	65 °C
Voltage supply	12 V	12 V	12 V
Current consumption	1.7 A	1.8 A	2.0 A
Power consumption	20.4 W	21.6 W	24.0 W

When using 12 ports 1000BASE-T1 as an alternative configuration, an additional consumption of 1.4 W occurs.

Note

The hardware is designed for a maximum power consumption of 3.1 A @ 12 V at maximum device temperature (+65 °C). Future device features may change the power consumption of the device.

9.6.3 Temperature Shutdown

Temperature limits

The units are temperature monitored to prevent damage to the unit. The devices switch off automatically when the upper limit temperature is exceeded. This limit value represents the theoretical maximum of the hardware. However, it is possible to leave this range slightly without damaging the hardware.

For this purpose the temperature shutdown can be switched off actively.
If the maximum temperature is exceeded, it is indicated by a red status LED on the device. Vector applications also display this (e. g. in the **Write** window of CANoe).

You can find the settings in the **Vector Hardware Config** tool.

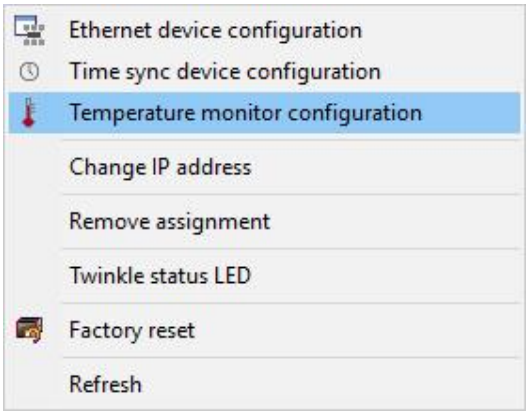


Figure 46: Open configuration

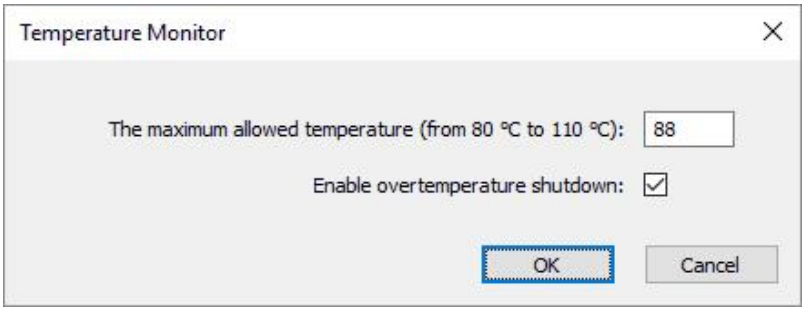
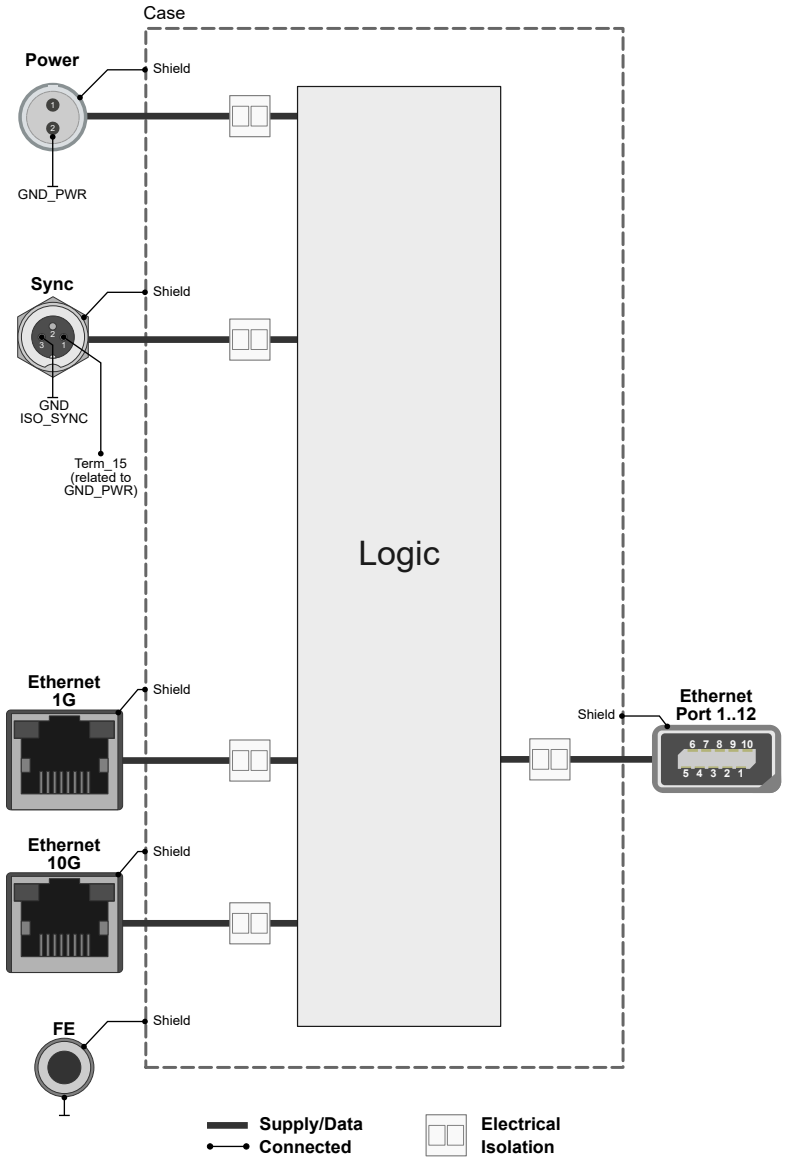


Figure 47: Setting limit for shutdown

9.6.4 Electrical Isolation

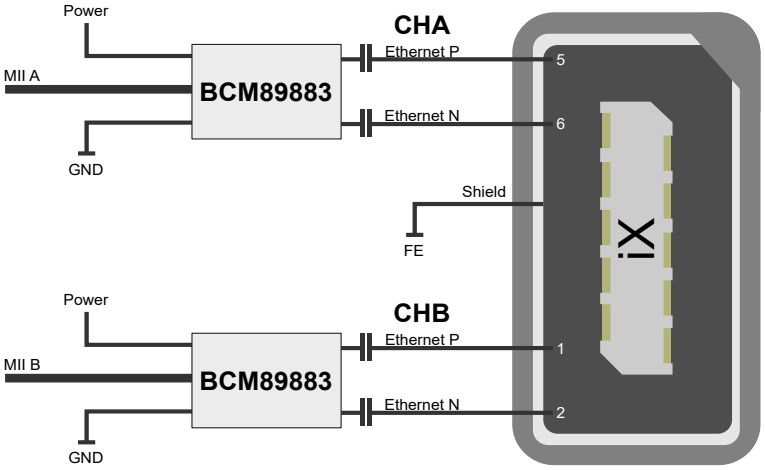
Electrical isolation of the connectors



Note
The FE plug must be connected to the chassis ground if the network interface is used in a vehicle with shieled cables.

Note
The usage of an AEcable 2Y is recommended because it separates the interface's shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

Electrical isolation of Ethernet in detail



9.6.5 Network Features

Ports/channels	**Total number of Ethernet Ports**	16
	100BASE-T1 / 1000BASE-T1	12
	1000BASE-T1 Legacy Mode	X[3)]
	10/100/1000BASE-T(X)	2
	1, 2.5, 5, 10G BASE-T	2
	CAN FD	-
	DoIP Activation / Wake-up Line	-
	Multiple digital / analog IO	-
Power supply	**External**	X
	USB buspowered	-
Infrastructure	**Hardware synchronization**	X
	Software synchronization	X
	IEEE1588 (PTP)	X
	Computer uplink	-
	Computer uplink Ethernet	10GBASE-T
Port interconnection	**Layer 2 Switch**	-
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	12
	Media conversion	3
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	X[4)]
	Physical bypass relays	X
Measure	**Mirroring port**	X
	Uplink Frame filter	16 rules
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	-
	Virtual switch ports for Vector-Tools or XL-API based tools	-
Test	**On-board packet generator**	-
	Error Frame generation	-
	OPEN Alliance TC10 (Wake/Sleep)	-
Application area	**Measurement / analysis**	X
	Simulation	-
	Test	-

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

9.6.5.1 Physical Bypass Relay

General information

If a Vector Ethernet Network Interface is connected as TAP between two 100/1000BASE-T1 nodes, the communication of the two terminals is permanently interrupted when the interface is switched off or fails. By activating the physical bypass on the Vector Ethernet Network Interface, this communication can still be enabled. This physical bypass can be activated and deactivated via software, resulting in the following options or operation modes:

Operation Mode	After Booting	Before Shutdown
2-channel mode	bypass inactive	bypass inactive
physical bypass mode	bypass inactive	bypass active
passive mode	bypass active	bypass active

The terms **bypass active** or **bypass inactive** are explained in the following figures:

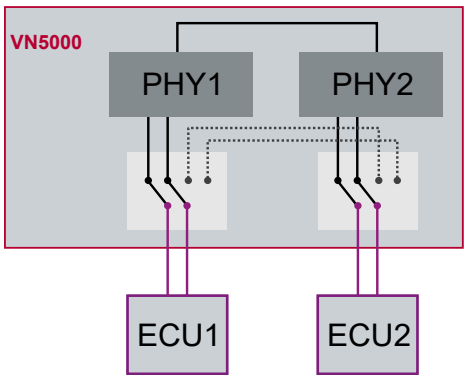


Figure 48: Bypass inactive, interface actively switches data between both ports

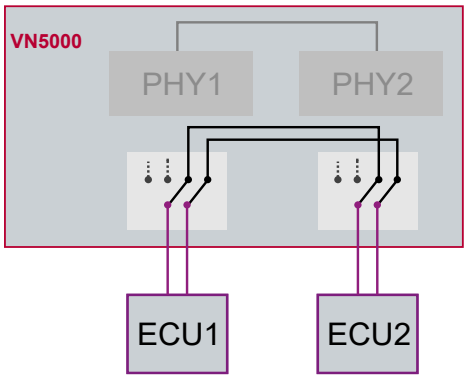


Figure 49: Bypass active, interface is switched off

Note
If the physical bypass is active, the interface cannot read the data.

Note
When switching the relay, the link is briefly interrupted for 200 ms.

9.7 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors

- AEcable 2Y
- Vector SYNCcableXL
- Vector SYNCcable50
- Multi SYNCbox external
- Multi SYNCbox internal
- Multi SYNCbox active
- Cable Binder 3pol Connector with Pigtail
- Ethernet cables

Power supply

- Vector Power Supply ODU Mini-Snap
- Cable Banana Plug <> ODU Mini-Snap

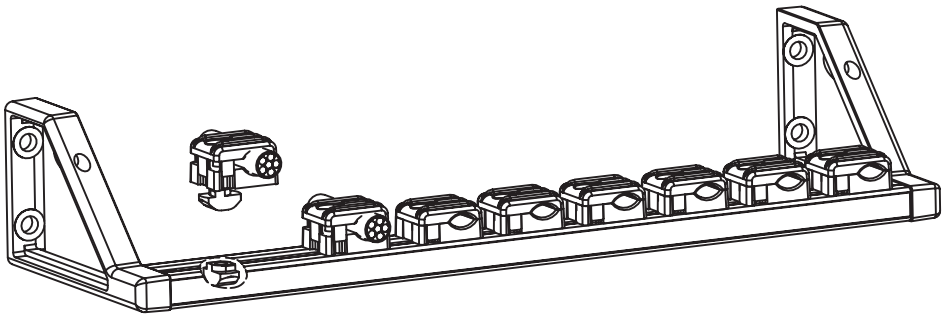
Miscellaneous

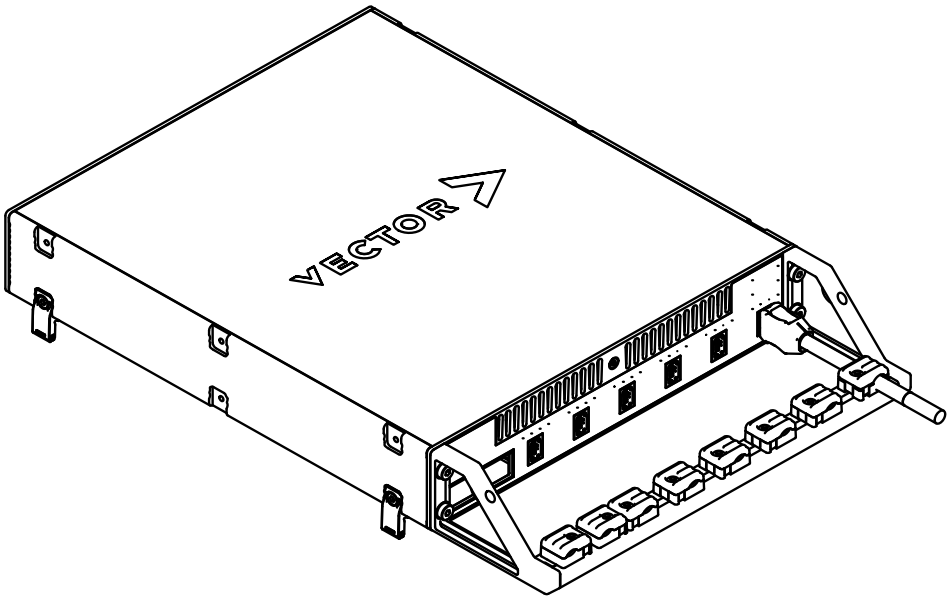
- VSH Cable Guard 216
- VSH Cable Guard 216 Clip
- VSH Connecting Kit 19"
- VSH Connecting Kit Horizontal
- VSH Connecting Kit Vertical
- VSH Equipment Foot Kit
- VSH Mounting Flange

9.7.1 VSH Cable Guard 216

Technical data

Description	Cable support system including eight clips for clamping single cables. For cable diameters (clamping range) from Ø 3.8 mm to Ø 6.8 mm.
Part number	05149



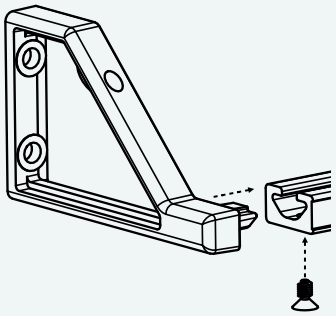


Note
The VSH Cable Guard 216 and the clips are not designed for use with VNcable 3Y.

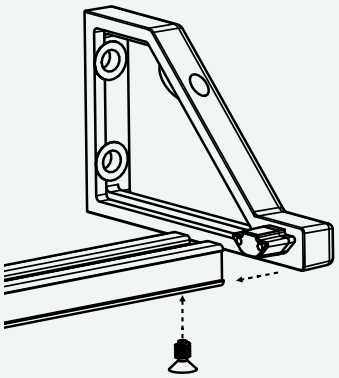
Step by Step Procedure

The following steps describe the mounting of the VSH Cable Guard 216:

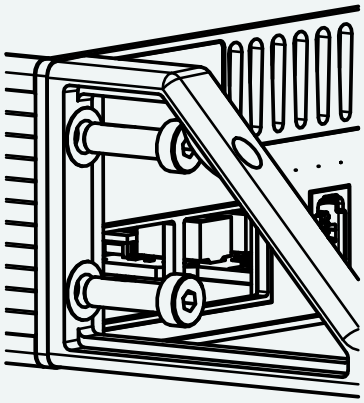
1. Insert the left frame into the cable rail and tighten the screw (Torx 8) with a torque of 1.4 Nm.



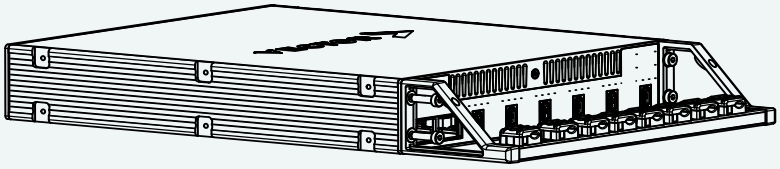
2. Repeat the steps above with the right frame.



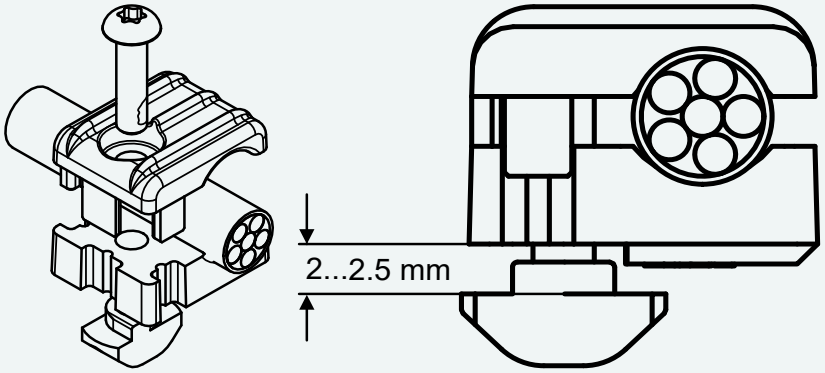
3. Attach the complete Cable Guard to the VN device and tighten it with the enclosed hexagonal screws (3 mm) and with a torque of 1.7 Nm.



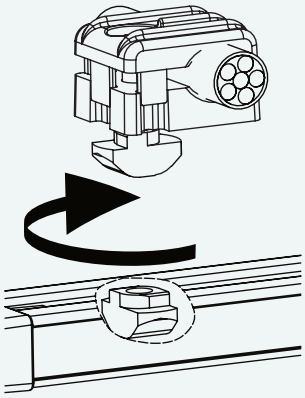
4. Repeat the steps on the other side.



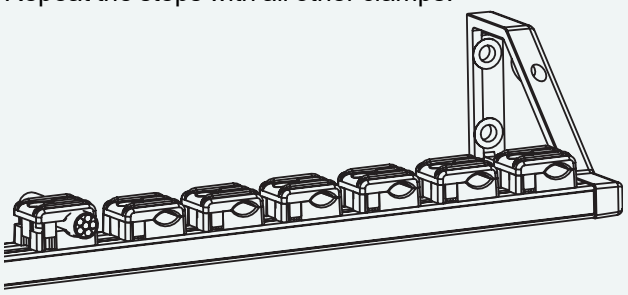
5. Lead the individual cables through the clamps and tighten the individual clamps depending on the cable (Torx 10). Tighten the screw only enough to leave a gap of 2 to 2.5 mm between the slot nut and the cable clamp.



6. Now insert the individual clamps into the Cable Guard and tighten the screw completely. The slot nut will rotate 90° inside the rail and thus fix the entire clamp.



7. Repeat the steps with all other clamps.



10 VN5650

In this chapter you find the following information:

10.1 Scope of Delivery

Contents

The delivery includes:

- 1x VN5650 Ethernet/CAN Interface
- 1x Cable Banana Plug <> ODU Mini-Snap (part number 05069)
- 1x Ethernet cable CAT6A (2 m)
- 1x USB Cable 3.1 Type A-C (Dual Screw Lock)

10.2 Introduction

About the VN5650

The VN5650 is a powerful Ethernet interface supporting 100/1000BASE-BASE-T1 on 12 ports. It is suitable for synchronous monitoring of Ethernet networks with other bus systems. In addition, the VN5650 can provide optimal network access for residual bus simulations and can be used for frame, load and fault generation during tests. Thanks to its robust housing and the various mounting and stacking capabilities, the device is ideally suited for use in vehicles. Ethernet (10GBASE-T) or USB 3.0 is used as the interface to the computer.

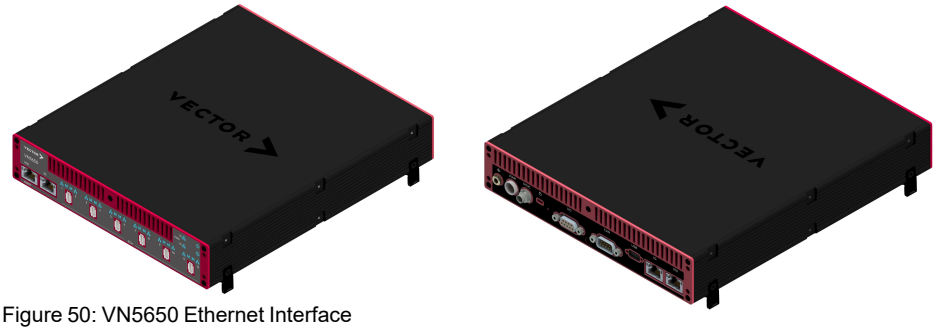


Figure 50: VN5650 Ethernet Interface

Highlights

Features of the VN5650:

- 12x 100BASE-T1/ 1000BASE-T1 user port
- 2x 10/100/1000BASE-T(X) infrastructure port
- 2x 1G/2.5G/5G/10GBASE-T infrastructure port
  usable:
  - as uplink to host computer
  - as an alternative user port (e. g. to analyze traffic of a 100BASE-TX/10000BASE-T link)
  - mirroring port
- 2x CAN FD channel supporting up to 8 Mbit/s
- 1x Analog input
- 2x Digital input
- 1x Digital output (open collector)
- 2x Digital input/output, e. g. for DoIP Activation Line (ISO/DIS 13400-3)
- Host connection USB 3.1 Gen 1 or Ethernet (10GBASE-T)
- On-board Ethernet TAPs to link between two Ethernet ports
- On-board Vector Ethernet Switch IP supporting free segmentation
- New hardware configuration concept for flexible configuration
- Usable without host-connection to interconnect ECUs
  - Self-configuration after power-up
- Hardware filtering of Ethernet packets on protocol base

- Hardware synchronization to other Vector interfaces via
  - IEEE 1588 (PTP)
  - software synchronization (typ. 50 µs accuracy)
  - hardware synchronization (1 µs accuracy)
- Multi-application support (different tools can share an Ethernet port at the same time)
- Support of 3rd party tools with free XL Driver Library
- Provides high precision time stamped Ethernet/CAN frames (< 20 ns precision)
- Device is designed for in-vehicle applications:
  - Robust housing with various mounting possibilities
  - Form-factor fits perfect two times in a standard 19-inch rack system
  - Extended power supply range (8 V…32 V)
  - Extended temperature-range (-40 °C...+65 °C)
  - Low-power stand-by mode (only 2 mA power consumption)
  - On-board/configurable high frequency Ethernet bypass relays ensure a closed TAP connection between two ECUs while the VN5650 is not powered

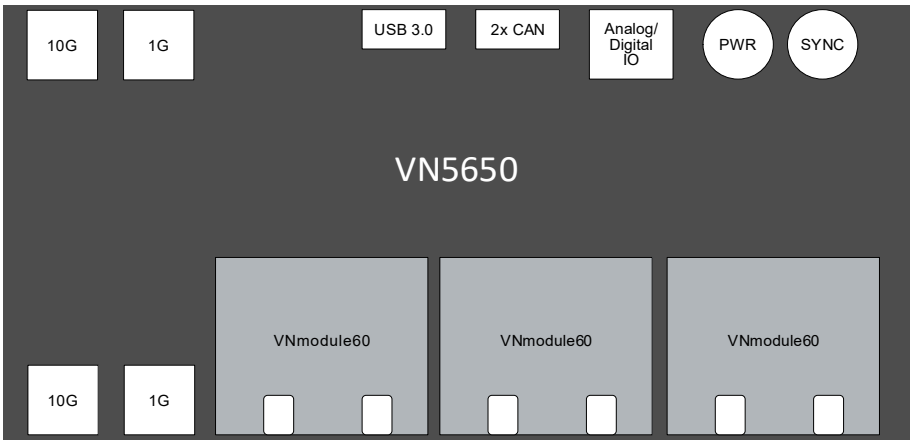


Figure 51: Ports overview

10.3 VNmodule60

General information

The VNmodule60 provides the connection to the physical layer with up to four ports. The VN5650 has three VNmodule60 slots, i. e. up to 12 ports can be used at the same time.

Possible configurations:

- 3x VNmodule60 4AE1G BCM89883
- 3x VNmodule60 4AE1G 88Q2112

Supported Feature	VNmodule60 4AE1G BCM89883	VNmodule60 4AE1G 88Q2112
100BASE-T1	X	X
1000BASE-T1	X	X
1000BASE-T1 Legacy Mode	-	X
OPEN Alliance TC10 (100BASE-T1 WAKE/SLEEP)	X	-

10.4 Connectors

10.4.1 Front Side

Device connectors

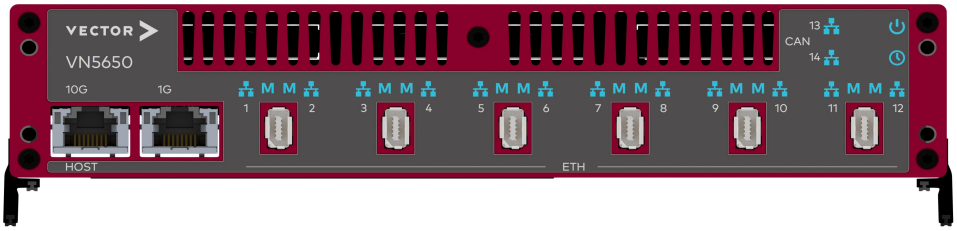


Figure 52: Connectors on the Ethernet side

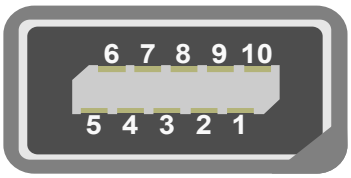
- **Host 10G (RJ45)**
  Connect your computer and the VN5650 via RJ45 to use the device with measurement applications (e. g. CANoe, CANalyzer) in a network setup.

Note
10 Gbps Ethernet connections show an increased sensitivity to EMI.
Data integrity is guaranteed by use of protocols which may reduce data throughput.

- **1G (RJ45)**
  Infrastructure port with different possible configurations:
  - mirroring port
  - alternative analysis port

- **Ethernet 1...12 (ix Industrial)**
  ix Industrial connectors for 100BASE-T1/1000BASE-T1 (e. g. Harting ix Industrial type 10A-1). Each connector has two Ethernet ports (A and B). Use cables of the Vector AEcable 2Y family to access both ports on separate connectors (different plug systems available)

Pin	Assignment
1	CH2 P
2	CH2 N
3	Not connected
4	Not connected
5	Not connected
6	CH1 P
7	CH1 N
8	Not connected
9	Not connected
10	Not connected



10.4.2 Back Side

Device connectors

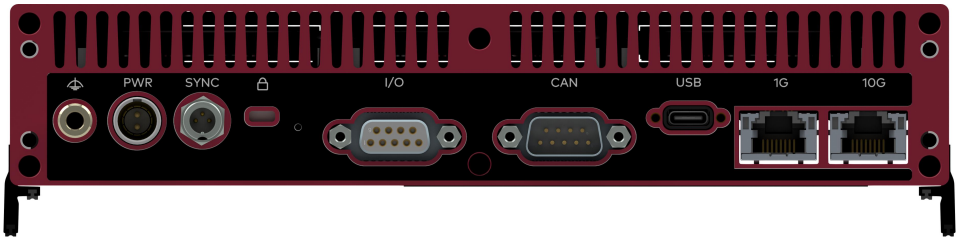


Figure 53: Connectors on the USB side

- **Functional Earth (FE)**
  Optional connection of housing ground to system ground.

- **Power (ODU)**
  For power supply, the VN5650 has a two-pin ODU connector (MINI-SNAP size 1, type GF1L0C-P02RP00-0000). Attach the enclosed power cable to power up the unit (matching ODU connector type S11L0C-P02NPL0-6200).

Pin	Assignment
1	Power supply (8 V ... 32 V)
2	Ground

- **Sync (Binder)**
  The VN5650 has a sync connector (Binder type 711) which can be used for time synchronization of different Vector devices (see section Time Synchronization on page 161).

Pin	Assignment
1	Terminal 15
2	Synchronization line
3	Ground Sync

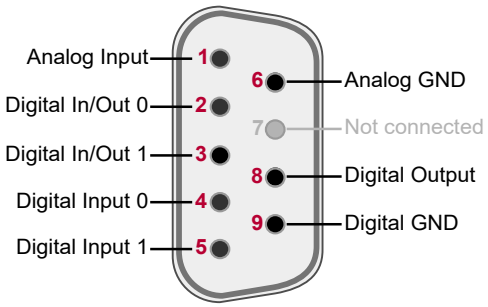
- **Kensington Lock**
  Mounting of Nano Kensington (NanoSaver).

- **Reset**
  If the device configuration is corrupted, start it with pushed reset button.

IO (D-SUB)

The VN5650 has a D-SUB9 connector for dedicated digital input/output tasks. The pin assignment 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



Internal interconnection of digital in/out 0/1

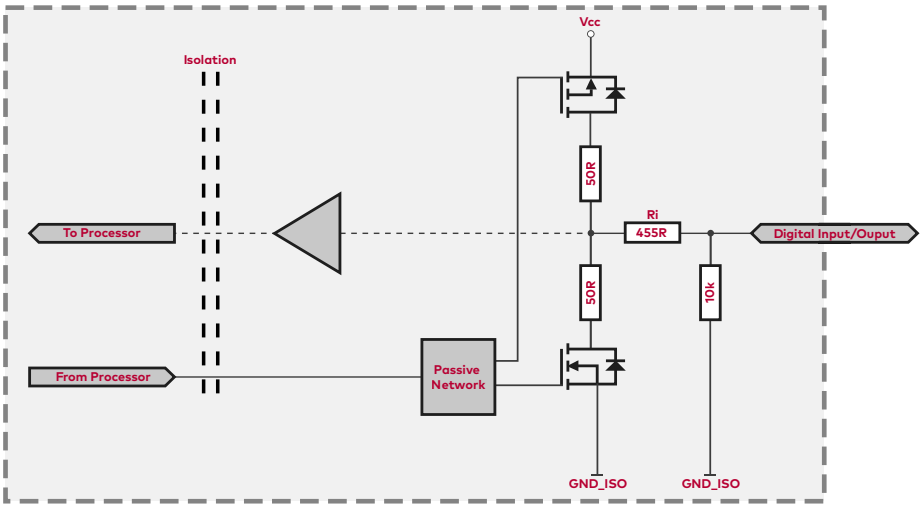


Figure 54: Digital input /output

Internal interconnection of digital input 0/1

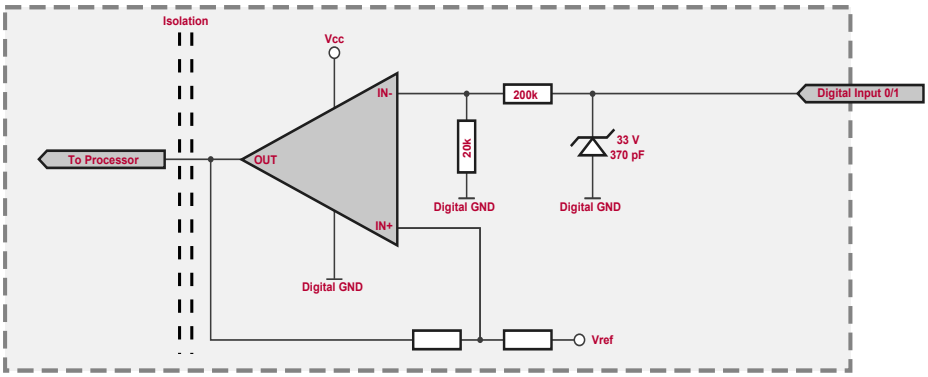


Figure 55: Digital input 0/1

Internal interconnection of digital output

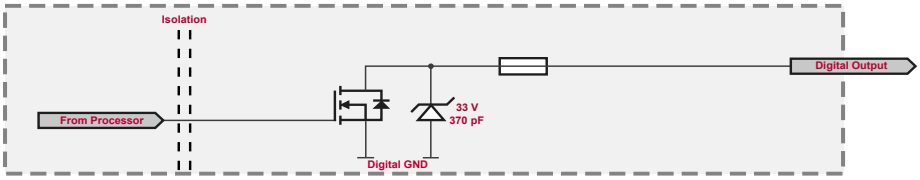


Figure 56: Digital output

Internal interconnection of analog input

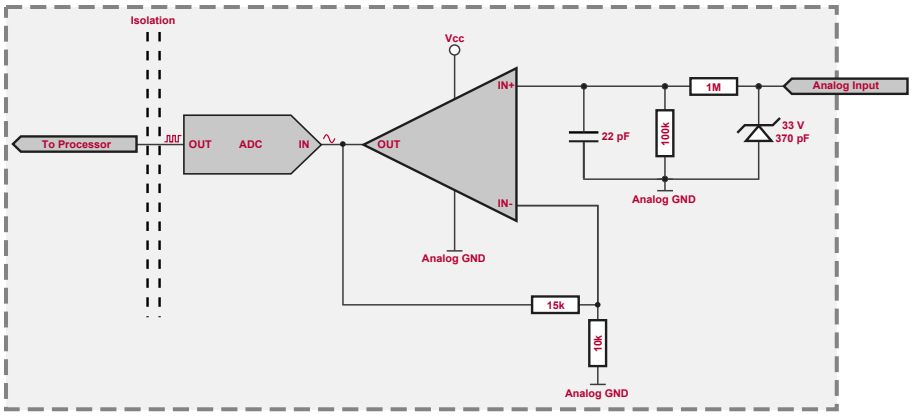


Figure 57: Analog input

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:

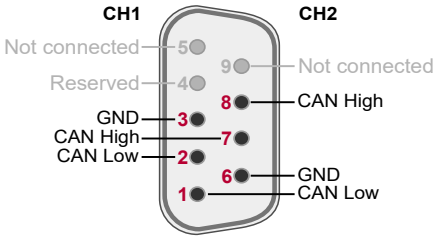
$$f_c\left[Hz\right] = \frac{1}{2.33 * 10^{-6} * R_{ext}\,[kOhm]}$$

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

- **CAN (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).

Pin	Assignment
1	CH2 CAN Low
2	CH1 CAN Low
3	CH1 GND
4	Reserved. Please do not use.
5	Not connected
6	CH2 GND
7	CH1 CAN High
8	CH2 CAN High
9	Not connected



- **USB (Type-C)**
  Connect your computer and the VN5650 via USB to install and to use the device with measurement applications (e. g. CANoe, CANalyzer).

- **1G/10G (RJ45 connectors)**
  Infrastructure port with different possible configurations:
  - mirroring port
  - alternative analysis port

10.5 LEDs

LEDs

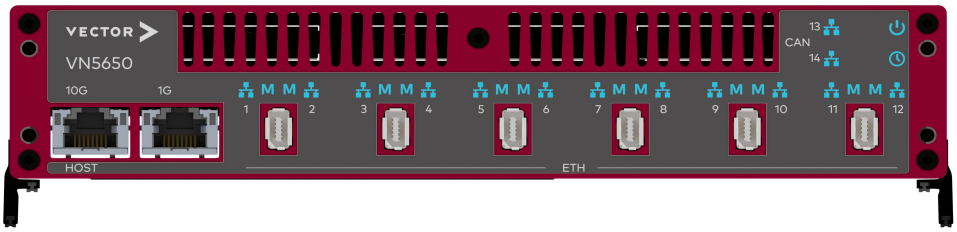


Figure 58: LEDs on VN5650

- **Power**
  LED illuminates if the device is supplied with power.

- **Sync**
  LED illuminates if the device is synchronized.

Color	Sync State	Description
Off	Not configured.	No master or slave protocols are active for this device or no configuration has been loaded yet.
Orange	Configured, waiting for master.	A slave protocol is active, but no master could be found / assigned yet. The state is assumed when the PTP protocol **Slave** or **Best-Master** is activated in the firmware, i. e. when starting the PTP stack in the firmware or if one of the slave protocols was activated in the driver, i. e. when or after the configuration was applied by the Vector Timesync Service (vTSS).
Green (flashing)	Pending.	A slave protocol is active and a master was found or could be assigned. The SYNC condition / the steady state was not yet reached or was left again. - **PTP** Transition to the Slave-With-Master state, but the SYNC condition has not yet been reached. - **HW-SYNC** Pulse and master time present, but the SYNC accuracy has not yet been reached. - **SW-SYNC** SYNC accuracy not yet reached.
Green	In-sync.	SYNC condition reached and is met or only master protocols active on the interface.
Red	Failure.	- **PTP** Master lost, SYNC accuracy not maintained.

Color	Sync State	Description
		▶ **HW-SYNC** Missing pulse, missing time information of the master, SYNC accuracy not maintained. ▶ **SW-SYNC** SYNC accuracy not maintained. If the SYNC accuracy is not maintained but the master is present, this state is only maintained for three seconds, then the state changes to **Pending**.

▶ **10G Port (RJ45)**
LEDs illuminate if there is an Ethernet link or blink if there is Ethernet activity.

Color (Left)	Color (Right)	Description
Orange	-	100M
Green	-	1G
-	Orange	2.5G
-	Green	5G
Orange	Orange	10G

▶ **1G Port (RJ45)**
LEDs illuminate if there is an Ethernet link or blink if there is Ethernet activity.

Color (Left)	Description
Green	Activity

Color (Right)	Description
Off	10 MBit/s
Orange	100 MBit/s
Green	1000 MBit

▶ **Ethernet Port 1...12**
LED illuminates if there is an Ethernet link or blinks if there is Ethernet activity at the according port.

Color	Description
Green	1000 MBit.
Orange	100 MBit.

▶ **M Ethernet Port 1...12**
Illuminates if the according port is configured as master.

State	Description
On	PHY is configured as master.
Off	PHY is configured as slave.

- **(CAN 13/14)**

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

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.

10.6 Technical Data

10.6.1 Overview

Ethernet ports	Up to 12 ports via three plug-in modules. Port characteristics depend on the plugged module: - VNmodule60 4AE1G BCM89883 (12x Broadcom BCM89883 - IEEE 100BASE-T1/1000BASE-T1) - VNmodule60 4AE1G 88Q2112 (12x Marvell 88Q2112-A2 - IEEE 100BASE-T1/1000BASE-T1) 2x Broadcom BCM54210 (IEEE 1000BASE-T/100BASE-TX) 2x Broadcom BCM84891 (IEEE 1/2.5/5/10GBASE-T)
CAN/CAN FD channels	2x NXP TJA1057
Analog input	10 bit Input 0 V...18 V Voltage tolerance up to 50 V (with series resistor) Sampling rate up to 1 kS/s
Digital input	Range 0 V...32 V Schmitt trigger high 2.7 V, low 2.2 V Hysteresis 0.5 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	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: 503 Ω
Time stamps	Resolution: 15.625 ns Accuracy (in device): 1 µs Accuracy software sync: typ. 50 µs Accuracy hardware sync: typ. 1 µs Accuracy PTP sync (IEEE1588): typ. 1µs
Computer interface	USB 3.1 Gen1 or Ethernet (1/2.5/5/10GBASE-T)
Power supply	External: 8 V...32 V (typ. 12 V DC)
Power consumption	Typ. 1.9 A @ 12 V Max. 3.7 A @ 12 V (65 °C)

	Standby: 2 mA @ 12 V For more information, see section Power Consumption on page 129.
Temperature range	Operation: -40 °C ... +65 °C Storage: -40 °C ... +85 °C
Relative humidity of ambient air	15 %...95 %, non-condensing
Dimensions (LxWxH)	250 mm x 219 mm x 54 mm (with case feet)
Weight	2.6 kg
Operating system requirements	Windows 10 (64 bit)

10.6.2 Power Consumption

The power consumption depends primarily on the used device configuration/use case and the ambient conditions under which the device is operated. The following examples show the power consumption in typical applications.

Example

Device configuration:

- 6x port 100BASE-T1
- 6x port 1000BASE-T1
- Uplink USB3.0

Ambient temperature	25 °C	40 °C	65 °C
Voltage supply	12 V	12 V	12 V
Current consumption	1.7 A	1.8 A	2.0 A
Power consumption	20.4 W	21.6 W	24.0 W

Example

Device configuration:

- 6x port 100BASE-T1
- 6x port 1000BASE-T1
- Uplink USB3.0
- Additional 10G uplink-port/ mirroring port

Ambient temperature	25 °C	40 °C	65 °C
Voltage supply	12 V	12 V	12 V
Current consumption	1.9 A	2.0 A	2.2 A
Power consumption	22.8 W	24.0 W	26.4 W

When using 12 ports 1000BASE-T1 as an alternative configuration, an additional consumption of 1.4 W occurs.

Note

The hardware is designed for a maximum power consumption of 3.7 A @ 12 V at maximum device temperature (+65 °C). Future device features may change the power consumption of the device.

10.6.3 Temperature Shutdown

Temperature limits

The units are temperature monitored to prevent damage to the unit. The devices switch off automatically when the upper limit temperature is exceeded. This limit value represents the theoretical maximum of the hardware. However, it is possible to leave this range slightly without damaging the hardware.

For this purpose the temperature shutdown can be switched off actively.
If the maximum temperature is exceeded, it is indicated by a red status LED on the device. Vector applications also display this (e. g. in the **Write** window of CANoe).

You can find the settings in the **Vector Hardware Config** tool.

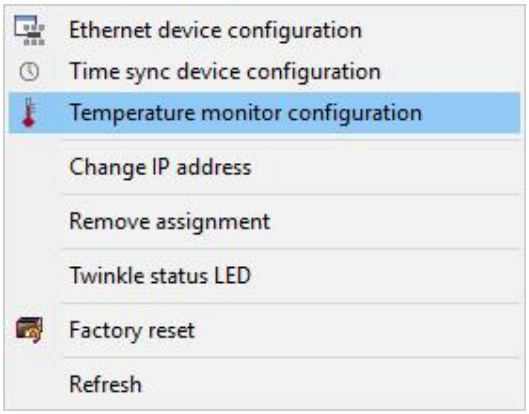


Figure 59: Open configuration

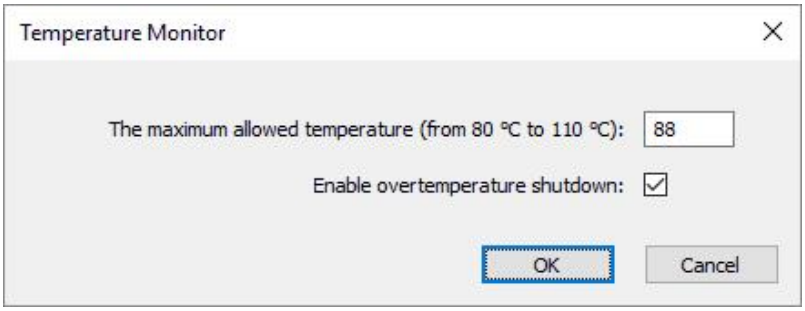
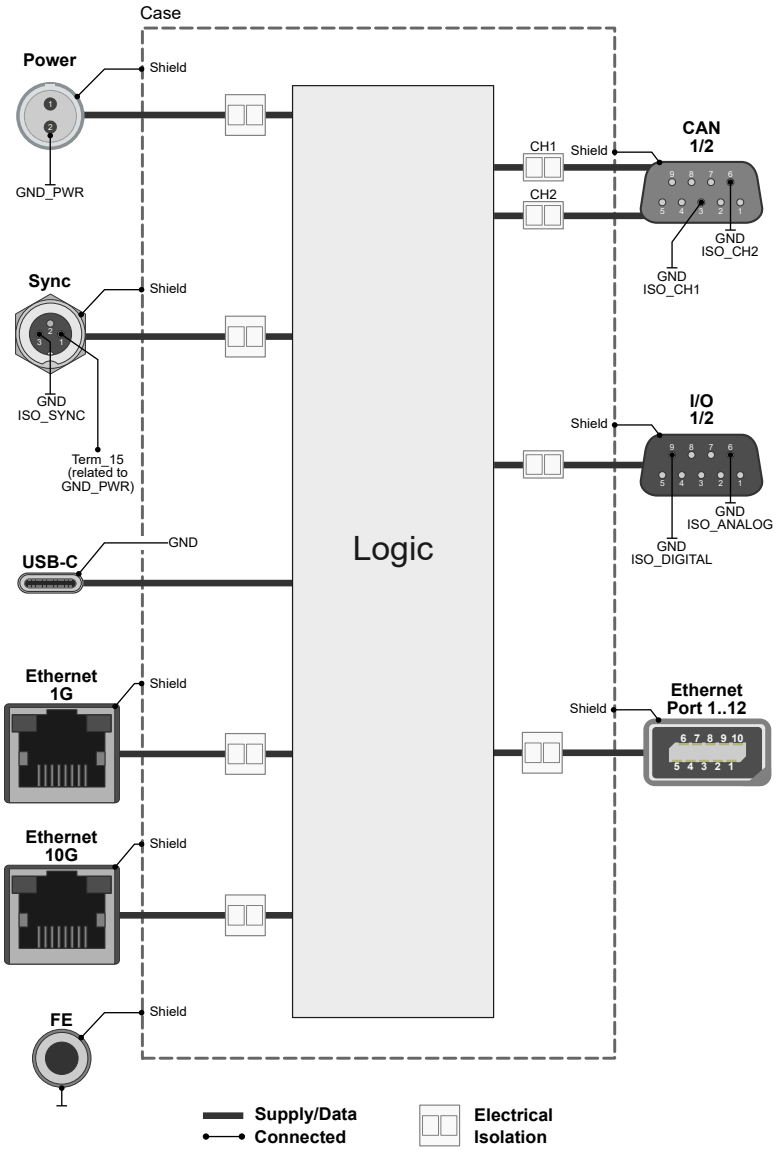


Figure 60: Setting limit for shutdown

10.6.4 Electrical Isolation

Electrical isolation of the connectors



Note

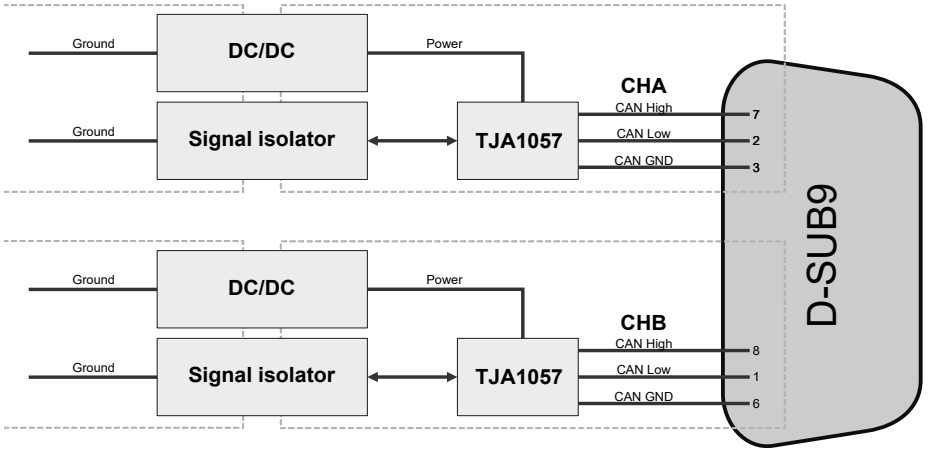
Please note that the shield of the USB-C connector is the same potential as the logic GND and that it is isolated from the case shield. This is intended to avoid ground loops when using a 12 V notebook power supply without electrical isolation.

The FE plug must be connected to the chassis ground if the network interface is used in a vehicle with shielded cables.

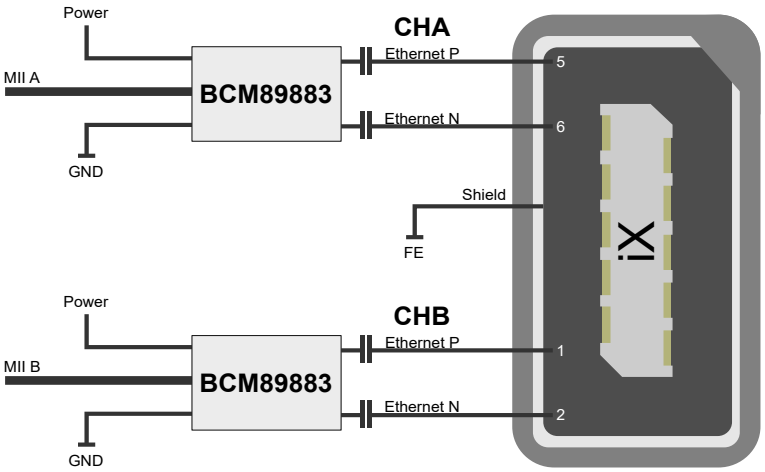
Note

The usage of an AEcable 2Y is recommended because it separates the interface's shield potential from the ECU shield potential. This ensures that all compensating currents over the shields are avoided. A capacitive coupling of the shields is implemented in the AEcable 2Y.

Electrical isolation of CAN in detail



Electrical isolation of Ethernet in detail



10.6.5 Network Features

Ports/channels	**Total number of Ethernet Ports**	16
	100BASE-T1 / 1000BASE-T1	12
	1000BASE-T1 Legacy Mode	X[3)]
	10/100/1000BASE-T(X)	2
	1, 2.5, 5, 10G BASE-T	2
	CAN FD	2
	DoIP Activation / Wake-up Line	X
	Multiple digital / analog IO	X
Power supply	**External**	X
	USB buspowered	-
Infrastructure	**Hardware synchronization**	X
	Software synchronization	X
	IEEE1588 (PTP)	X
	Computer uplink	USB3.0
	Computer uplink Ethernet	10GBASE-T
Port interconnection	**Layer 2 Switch**	X
	TAP	X
	Simultaneously interconnectable ports via switch/TAP	16
	Media conversion	4
	Link transparency	X
	OPEN Alliance TC10 (Wake/Sleep)	X[4)]
	Physical bypass relays	X
Measure	**Mirroring port**	X
	Uplink Frame filter	16 rules
	Error Frame reporting	X
Simulation	**VLAN tagging / untagging / routing**	X
	Virtual switch ports for Vector-Tools or XL-API based tools	64
Test	**On-board packet generator**	X
	Error Frame generation	X
	OPEN Alliance TC10 (Wake/Sleep)	X[4)]
Application area	**Measurement / analysis**	X
	Simulation	X
	Test	X

1) Available in a later release
2) Host computer must support USB-C with 3 A.
3) Only with VNmodule60 4AE1G 88Q2112
4) Only with VNmodule60 4AE1G BCM89883

10.6.5.1 Physical Bypass Relay

General information

If a Vector Ethernet Network Interface is connected as TAP between two 100/1000BASE-T1 nodes, the communication of the two terminals is permanently interrupted when the interface is switched off or fails. By activating the physical bypass on the Vector Ethernet Network Interface, this communication can still be enabled. This physical bypass can be activated and deactivated via software, resulting in the following options or operation modes:

Operation Mode	After Booting	Before Shutdown
2-channel mode	bypass inactive	bypass inactive
physical bypass mode	bypass inactive	bypass active
passive mode	bypass active	bypass active

The terms **bypass active** or **bypass inactive** are explained in the following figures:

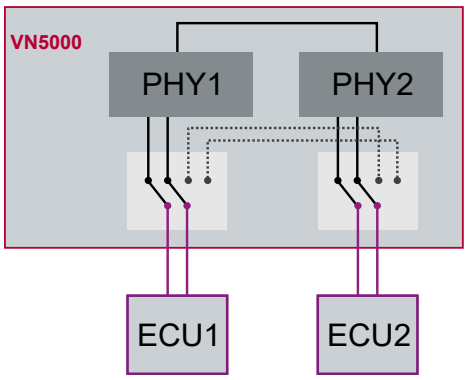


Figure 61: Bypass inactive, interface actively switches data between both ports

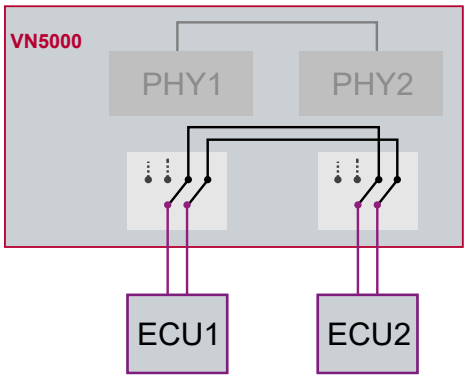


Figure 62: Bypass active, interface is switched off

Note
If the physical bypass is active, the interface cannot read the data.

Note
When switching the relay, the link is briefly interrupted for 200 ms.

10.7 Accessories

Note
Detailed information on the listed accessories can be found in the separate accessories manual on our website.

Cables and connectors

- AEcable 2Y
- CANcable0
- CANcable1
- CANcableA
- CANcable Y
- CANcable 2Y
- CANterm 120
- CANcable Set Pro
- Vector SYNCcableXL
- Vector SYNCcable50
- Multi SYNCbox external
- Multi SYNCbox internal
- Multi SYNCbox active
- Cable Binder 3pol Connector with Pigtail
- USB Cable 3.1 Type A-C (Dual Screw Lock)
- USB Cable 3.1 Type C-C (Dual Screw Lock)
- Ethernet cables

Power supply

- Vector Power Supply ODU Mini-Snap
- Cable Banana Plug <> ODU Mini-Snap

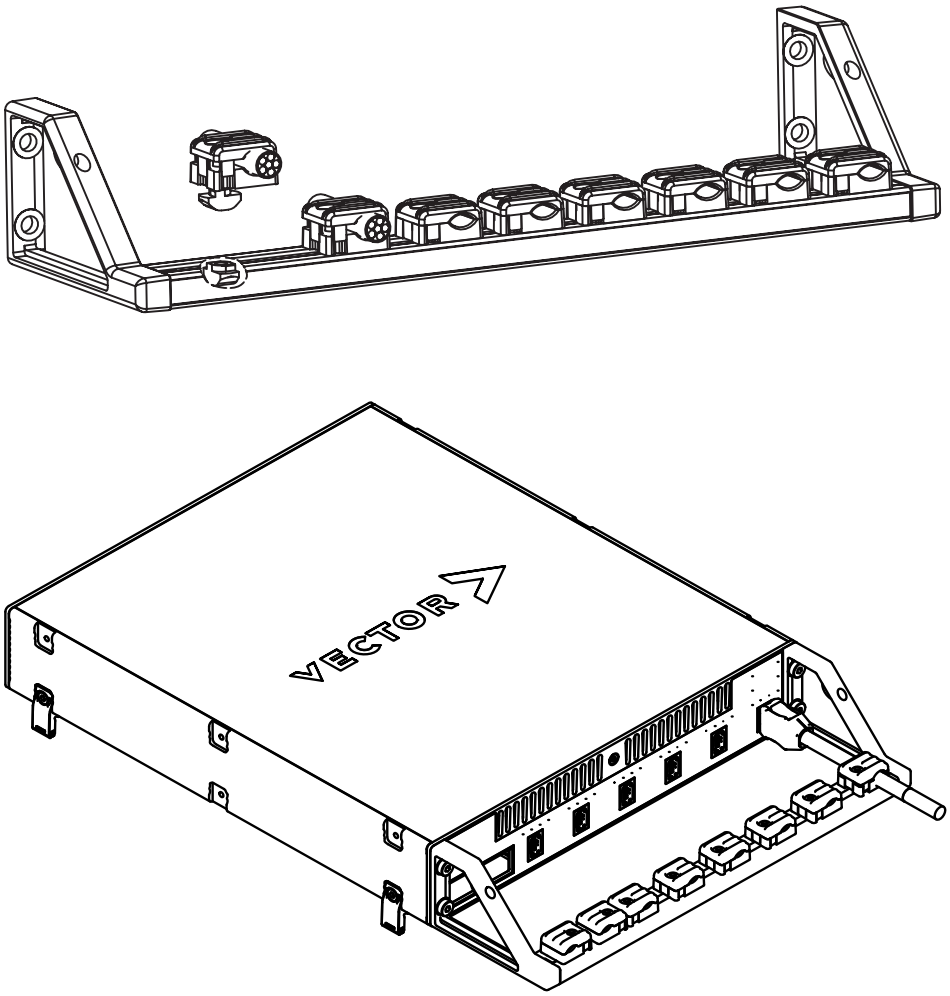
Miscellaneous

- VSH Cable Guard 216
- VSH Cable Guard 216 Clip
- VSH Connecting Kit 19"
- VSH Connecting Kit Horizontal
- VSH Connecting Kit Vertical
- VSH Equipment Foot Kit
- VSH Mounting Flange

10.7.1 VSH Cable Guard 216

Technical data

Description	Cable support system including eight clips for clamping single cables. For cable diameters (clamping range) from Ø 3.8 mm to Ø 6.8 mm.
Part number	05149

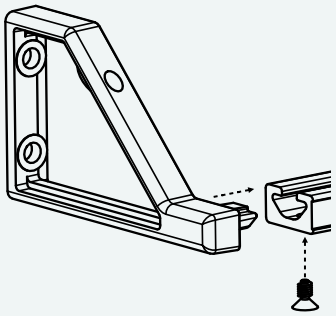


Note
The VSH Cable Guard 216 and the clips are not designed for use with VNcable 3Y.

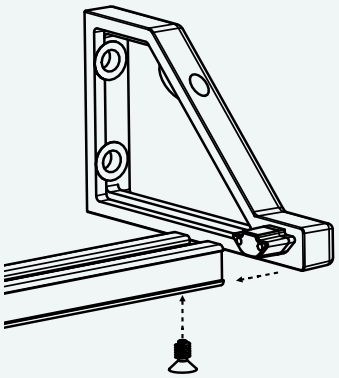
Step by Step Procedure

The following steps describe the mounting of the VSH Cable Guard 216:

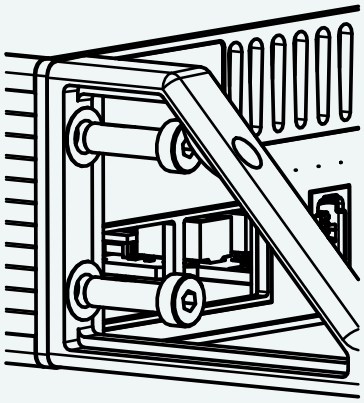
1. Insert the left frame into the cable rail and tighten the screw (Torx 8) with a torque of 1.4 Nm.



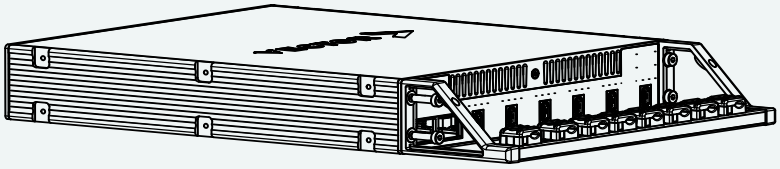
2. Repeat the steps above with the right frame.



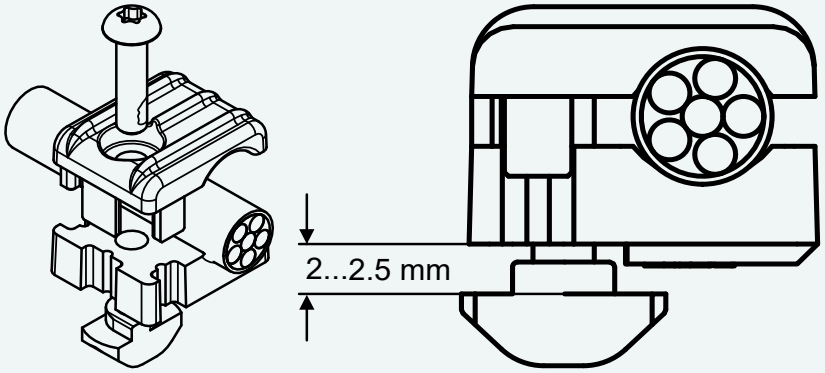
3. Attach the complete Cable Guard to the VN device and tighten it with the enclosed hexagonal screws (3 mm) and with a torque of 1.7 Nm.



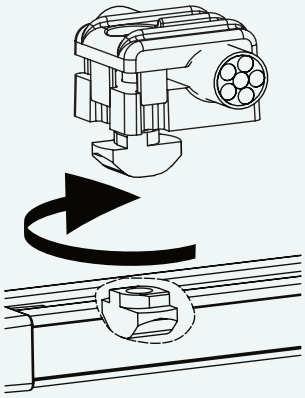
4. Repeat the steps on the other side.



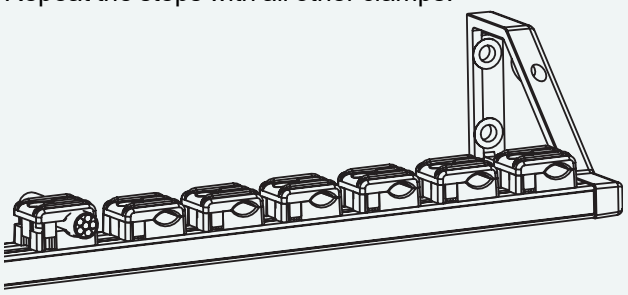
5. Lead the individual cables through the clamps and tighten the individual clamps depending on the cable (Torx 10). Tighten the screw only enough to leave a gap of 2 to 2.5 mm between the slot nut and the cable clamp.



6. Now insert the individual clamps into the Cable Guard and tighten the screw completely. The slot nut will rotate 90° inside the rail and thus fix the entire clamp.



7. Repeat the steps with all other clamps.



11 Getting Started

In this chapter you find the following information:

11.1 Driver Installation

General information

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

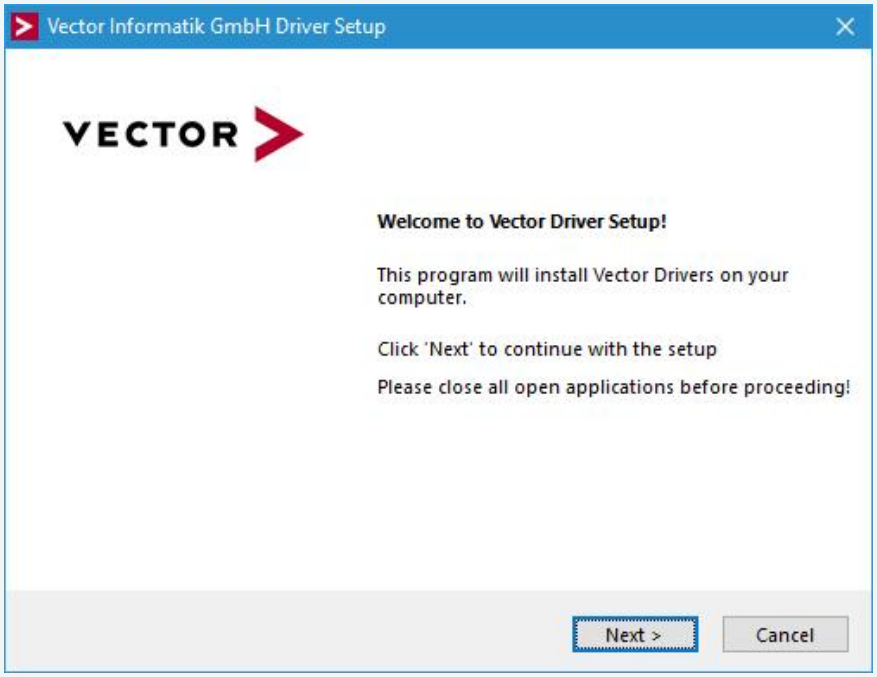
Note

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

Step by Step Procedure

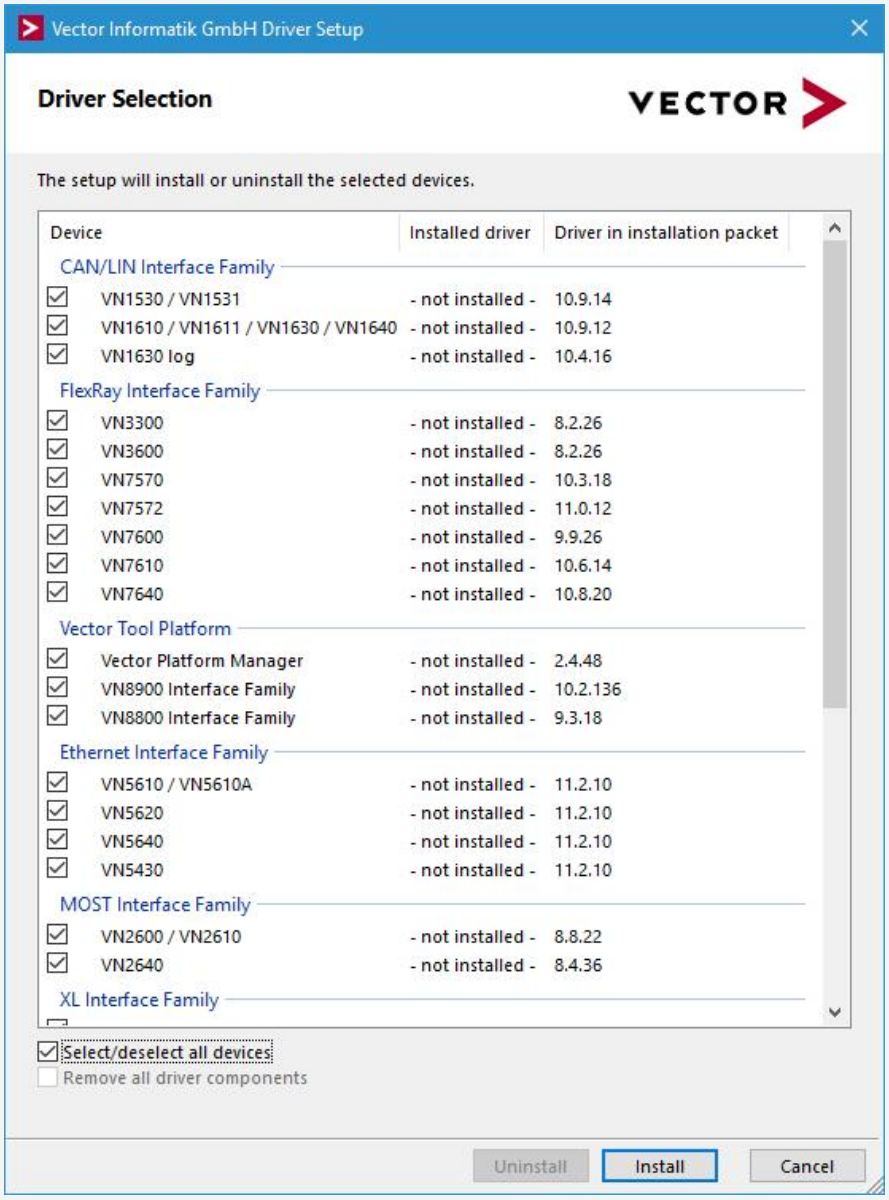
1. Execute the driver setup from `\Drivers\Setup.exe` before the device is connected to the PC with the included USB cable.

   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.

11.2 Ethernet Device Configuration

11.2.1 General Information

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 149) and in the according online help.

Reference
Driver version 11.2 introduces the **network-based** Ethernet configuration but still supports the previous **channel-based** configuration (legacy mode). This section focuses on the **network-based** Ethernet configuration. Therefore, the mode of the VN5000 interface has to be changed (see section Network-based Ethernet Configuration on page 143).

Note
The **network-based** Ethernet configuration requires at least CANoe V12.0 SP4 or CANape V18!

11.2.2 Network-based Ethernet Configuration

Modes

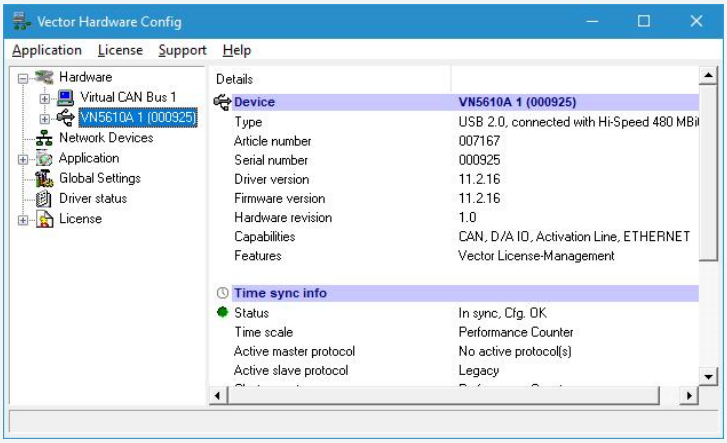
With driver version 11.2, the new **network-based** and the old **channel-based** Ethernet configuration are available. For new projects, the **network-based** Ethernet configuration is recommended. For this, the mode of the VN5000 interface must be switched once. Either via the **Vector Hardware Config** or via CANoe V12 SP4. The following steps show how to switch the mode in **Vector Hardware Config**.

Note

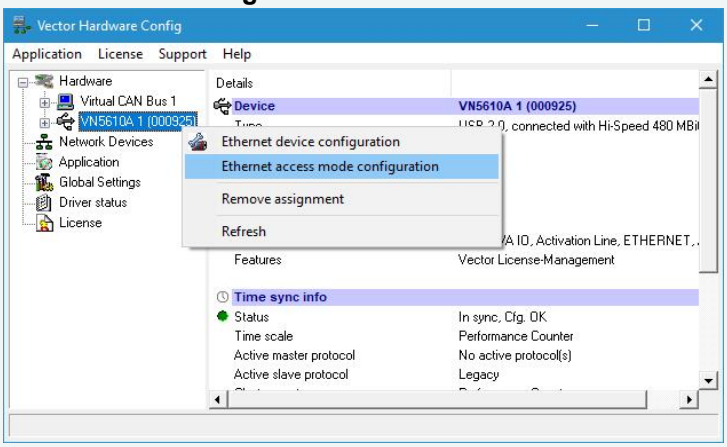
Only the VN5610(A) and VN5640 support both modes. The new interfaces only support network-based Ethernet configuration. Accordingly, this step-by-step guide applies to VN5610A/VN5640 only.

Step by Step Procedure

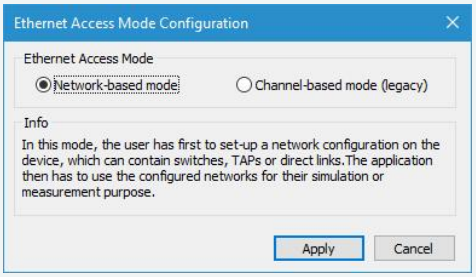
1. Open **Vector Hardware Config**.



2. With a right-click, select an installed VN5000 interface and click **Ethernet access mode configuration** in the context menu.



3. Select **Network-based mode** and click **[Apply]**.



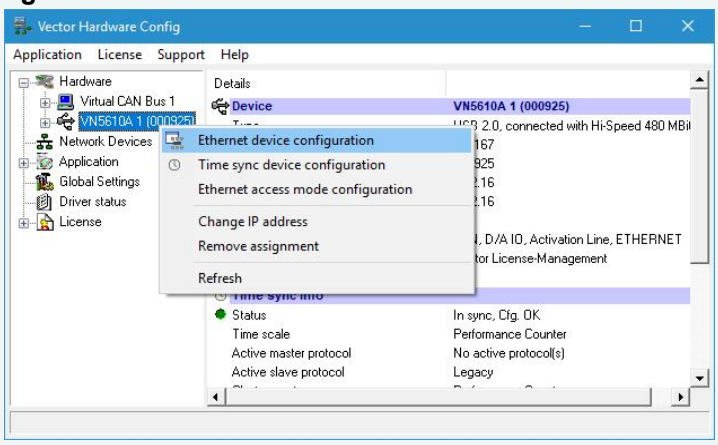
4. Wait until mode programming has finished.

11.2.3 Example: Simple TAP Configuration

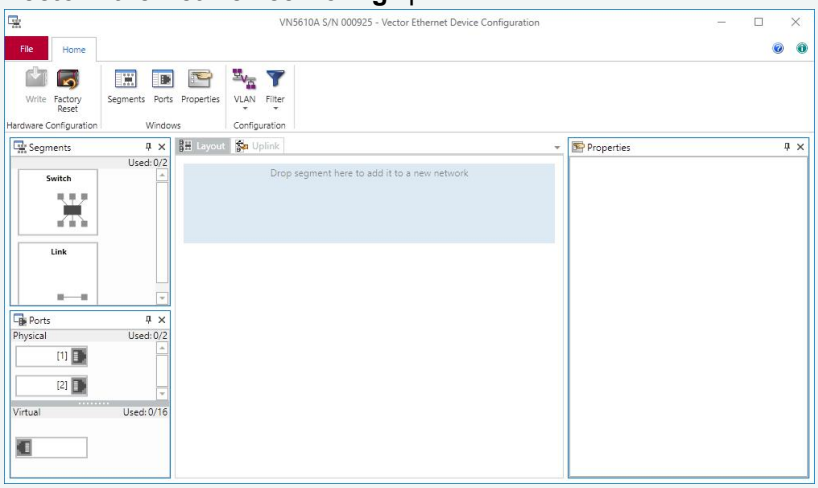
Step by Step Procedure

The following example explains a basic TAP (Test Access Point) configuration with two ports.

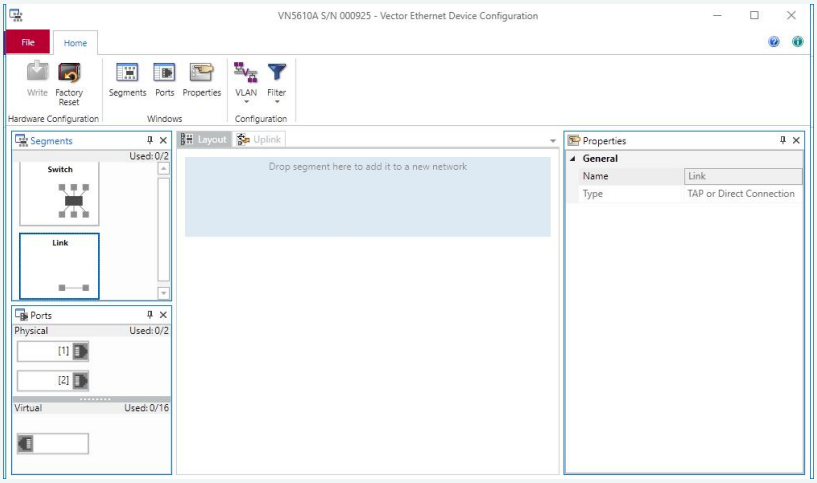
1. Be sure that the VN5000 interface is set to **network-based** Ethernet configuration (see section Network-based Ethernet Configuration on page 143).
2. With a right-click, select the interface again and click **Ethernet device configuration** in the context menu.

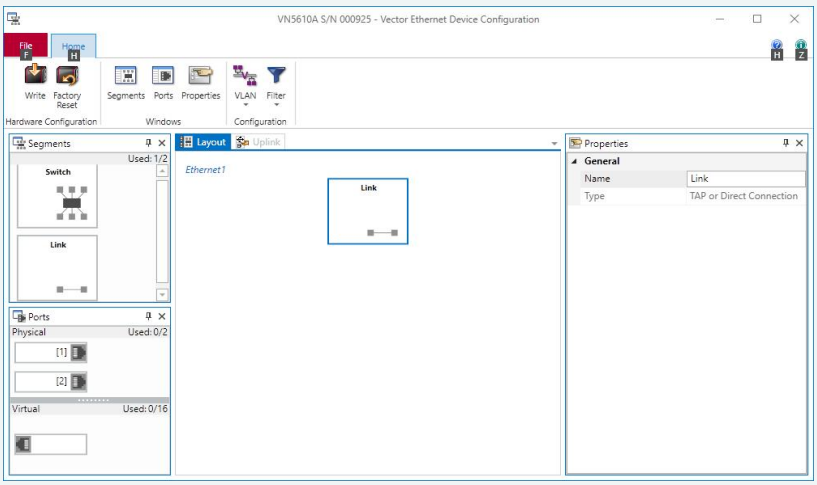


3. **Vector Ethernet Device Config** opens.

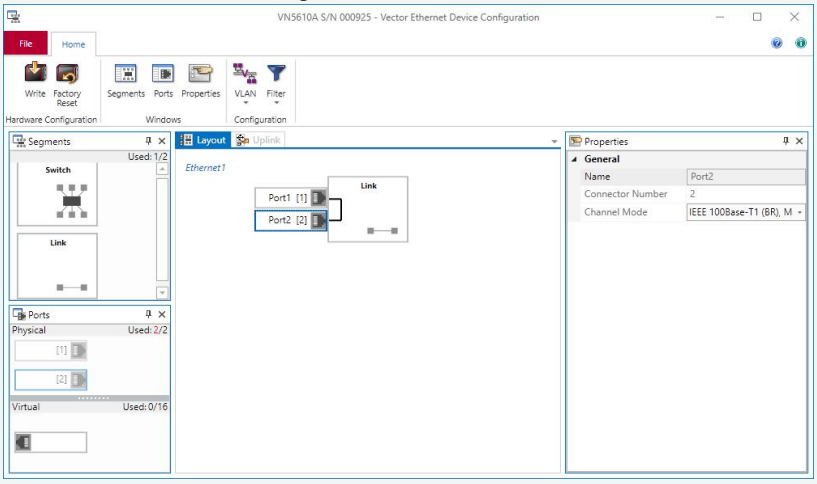


4. From the **Segments** box on the left side, drag **Link** into to blue area.

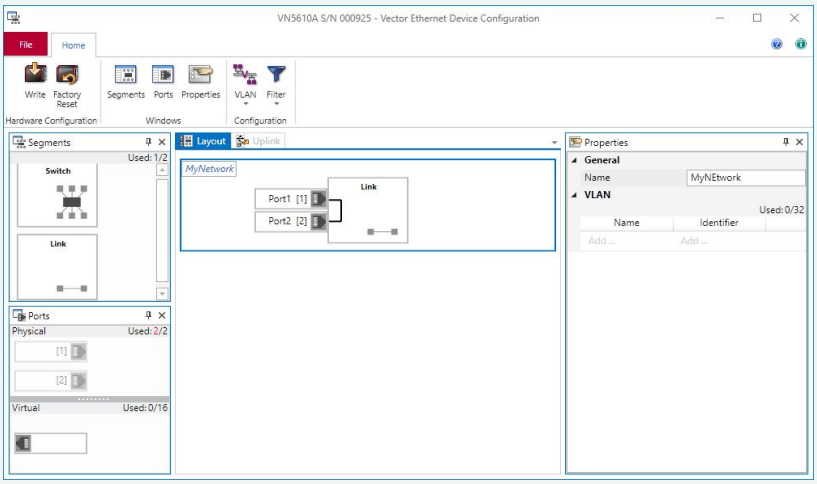




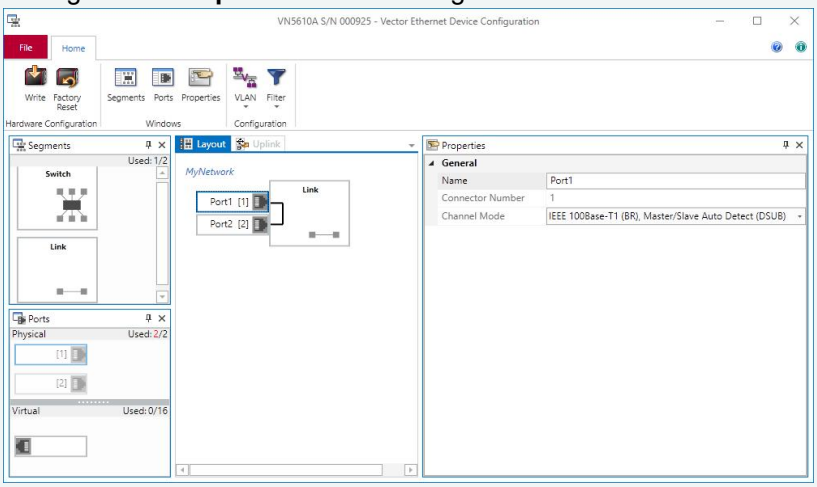
5. From the **Ports** box, drag two **Ports** to the added **Link** segment. Now you have created a TAP configuration.



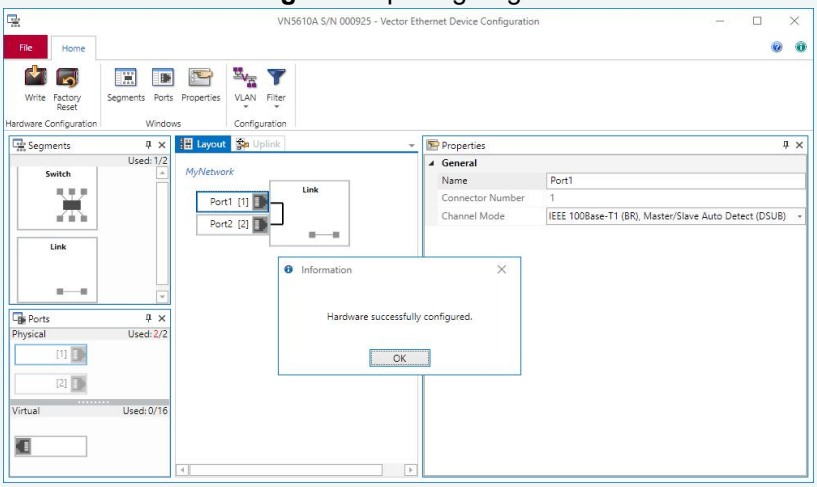
6. Change the name of your network and of your ports (no space allowed). The network name is referenced in the application (e. g. CANoe) to access the network.



7. Change the port settings as required by selecting each port and changing the settings in the **Properties** box on the right side.



8. Click the **Write** icon in the tool bar. The configuration is now persistently written to the VN5000 interface. The configuration will be recovered in **Vector Ethernet Device Config** when opening it again.



9. Close **Vector Ethernet Device Config**.
10. Close **Vector Hardware Config**.
11. Continue your work in CANoe.

Note
Vector Ethernet Device Config offers prepared configuration templates which can be accessed via **File | New**.

Reference
Further details on **Vector Ethernet Device Config** can be found in the according online help.

12 Vector Hardware Configuration

In this chapter you find the following information:

12.1 General Information

Note
With effect from driver version 11.2, the **Vector Hardware Config** tool does only work with CAN settings. For Ethernet, please use the **Vector Ethernet Device Config** tool (see section Vector Ethernet Device Configuration on page 155).

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 63: 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.

12.2 Tool Description

12.2.1 Introduction

Vector Hardware Config

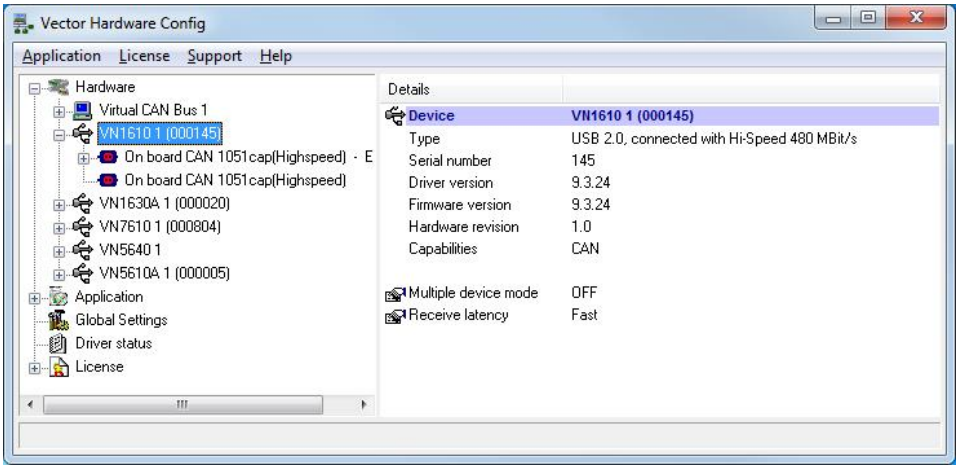


Figure 64: General view of Vector Hardware Config

Logical and physical channels

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.

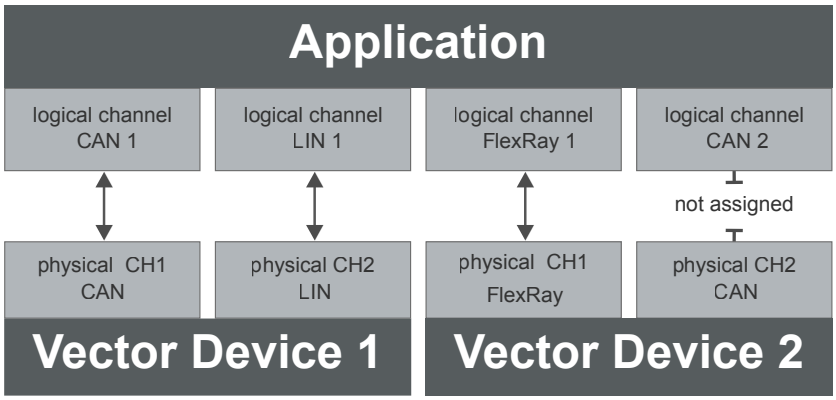


Figure 65: Concept of channel assignments

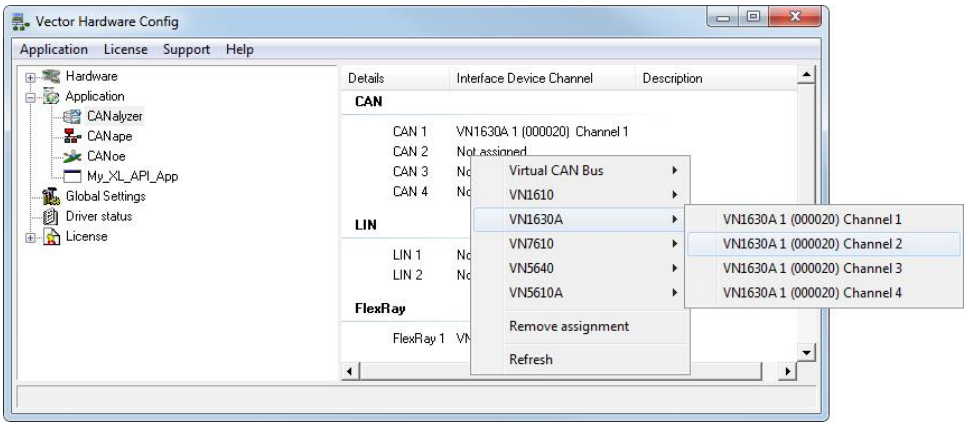


Figure 66: Channel assignment in Vector Hardware Config

12.2.2 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.

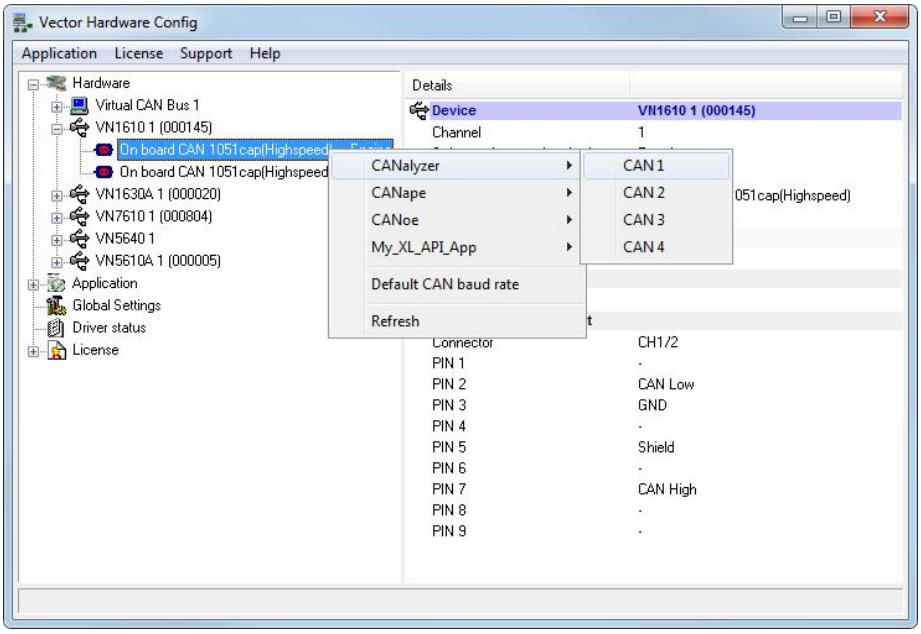


Figure 67: Hardware

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.

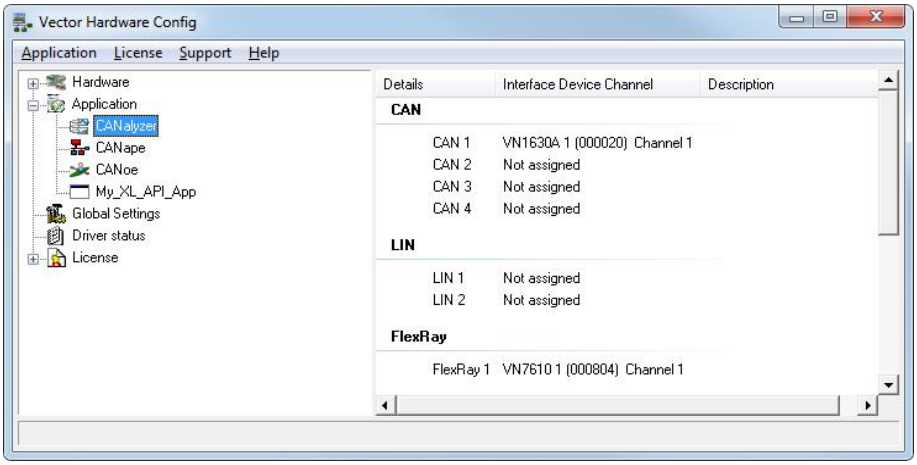


Figure 68: Application

Global settings

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

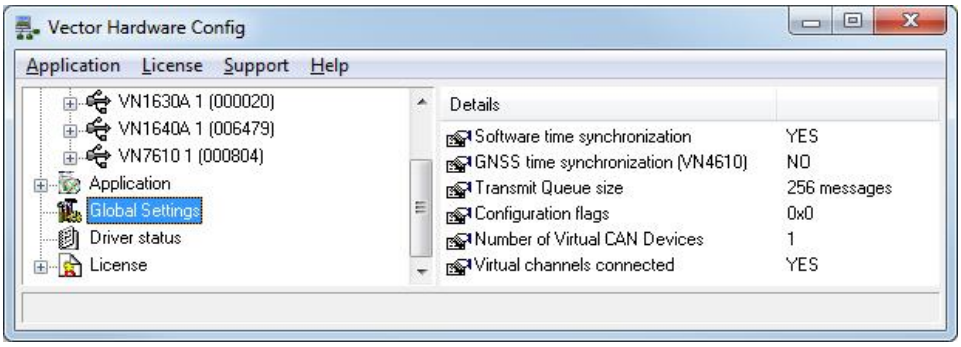


Figure 69: Global settings

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/offline) and whether the time synchronization is activated or not (Time-Sync-On/Time-Sync-Off).

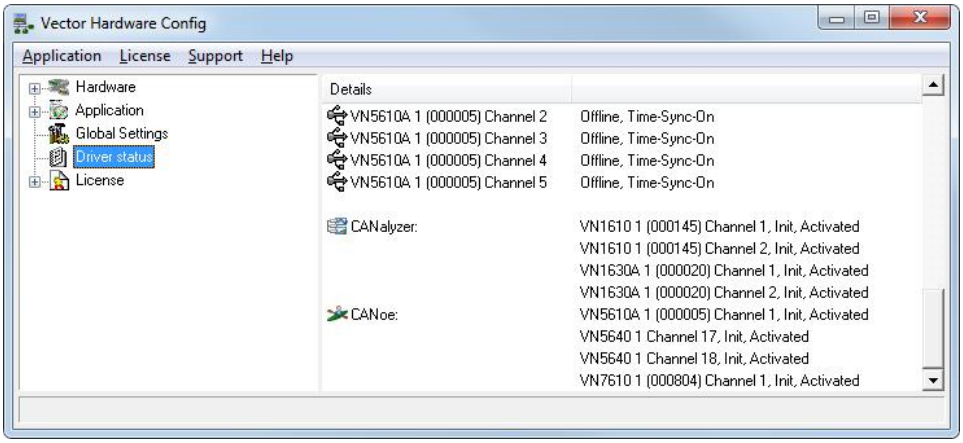


Figure 70: Driver status

License

The **License** section contains information on all current available licenses (Vector bus devices, Vector License USB dongle devices).

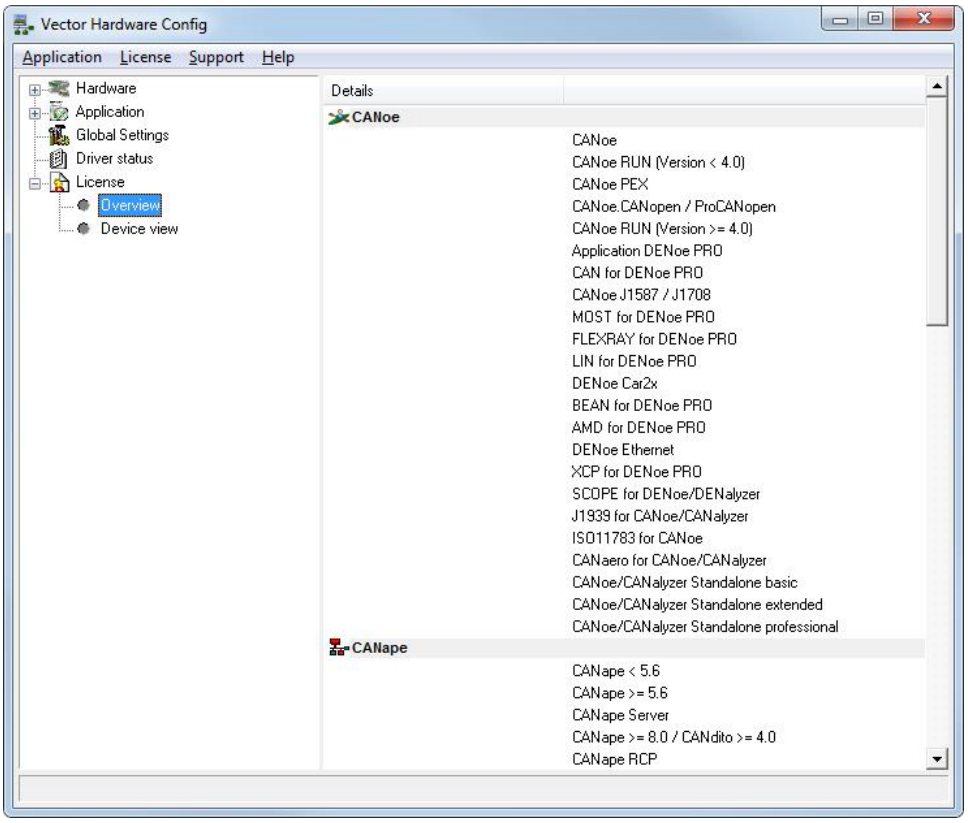


Figure 71: License

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

13 Vector Ethernet Device Configuration

In this chapter you find the following information:

13.1 Basic Concept

With effect from driver version 11.2, Vector introduces a new way of Ethernet configuration for all Vector Ethernet network interfaces.

The device driver before version 11.2 allows a maximum of one switch segment per Ethernet interface. Therefore, two Ethernet interfaces are required. The Ethernet interfaces are connected to CANoe via two application channels (ETH1 and ETH2). This results in two Ethernet networks in the simulation setup of CANoe:

Before V11.2

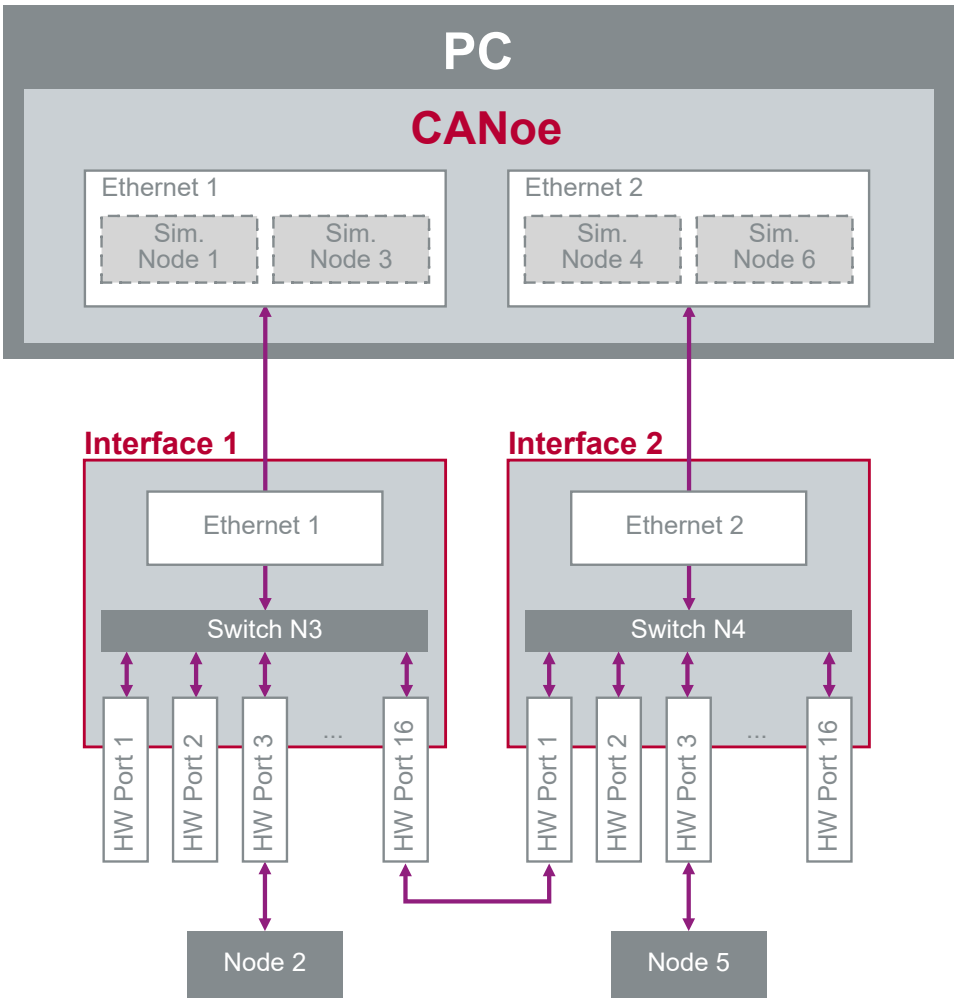


Figure 72: Simulation setup of the device driver before version 11.2

The device driver from version 11.2 allows free segmentation. Therefore, two switch segments with the associated ports can be defined with this version. Both segments are assigned to the same network **Network 1**. In CANoe, in this setup only one Ethernet network is required in the Simulation setup (network name = **Network 1**).

With >= V11.2

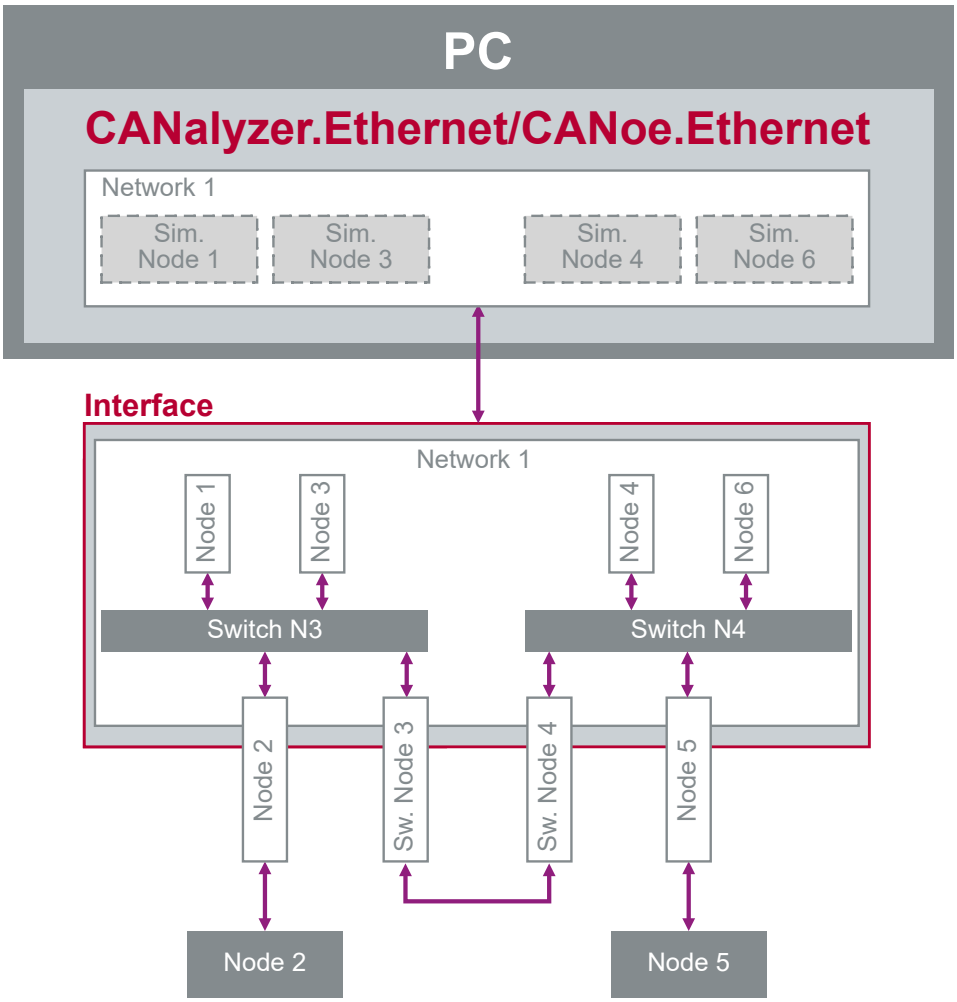


Figure 73: Simulation setup of the device driver from version 11.2

13.2 Example

Reference
A quick example of a network configuration to be written to the VN5000 interface can be found section Ethernet Device Configuration on page 142.

13.3 Definitions

Terms

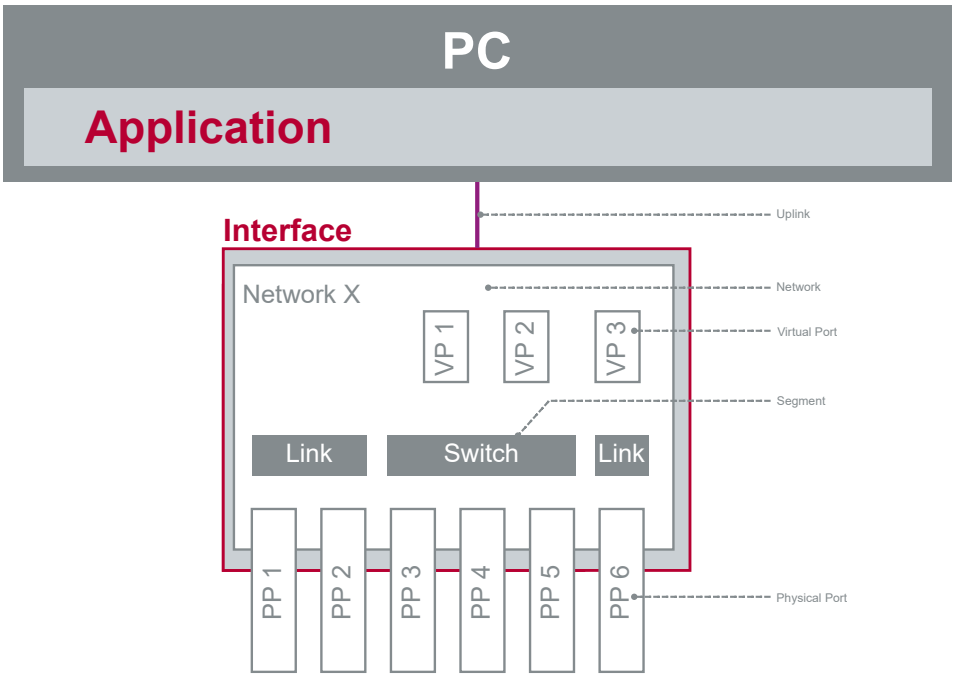


Figure 74: Simulation setup of the device driver from version 11.2

- Port
  A port is an access point for an application like CANoe, CANape or a real device like an ECU. A distinction is made between a physical port and a virtual port. Each port has a unique name and is assigned to exactly one segment.
- Physical Port
  Each Vector Ethernet network interface provides a defined number of physical connections. Exactly one physical port is assigned to each physical connection at one point in time. An application can configure physical layer properties by means of the physical port. An application has only read access to a physical port, apart from stress sending.

Note
Assigning a physical port to a segment enables the usage of a physical connection. Unassigned physical ports will disable the physical connection and no communication can take place.

- Virtual Port
  A virtual port does not represent any physical connection. Therefore, no physical layer properties can be configured. Several applications can have read access to a virtual port. Only one application can have write access to a virtual port.

Note
Simulation nodes (e. g. CAPL program or interactive generator block) are connected to the Ethernet network by means of virtual ports. The number of virtual ports that can be created is limited by the hardware (e. g. a VN5640 supports up to 32 virtual ports). In most cases, the virtual ports are automatically created by the application and no user interaction is necessary.

- Segment
  A segment acts as a coupling element between ports. At least one segment must be created and connected to a physical port. Each segment has a unique name and is assigned to exactly one network. Two types of segments are available: switch and link.

Note
Segments can be set up on the interface via a graphic interface (Ethernet Device Configuration).

- Switch Segment
  A switch segment provides the basic functions of a layer-2 switch. Any number of ports can be assigned to a switch segment.

- Link Segment
  A link segment always connects exactly two ports transparently to each other. The link segment is used to transparently forward Ethernet packets and the states of the physical layer (e. g. link up/down, OPEN Alliance TC10 wake/sleep*).

  * only with VN5640 Interface Option 100BASE-T1 (TJA1101)

Note
A link segment is used when the message traffic between two ports is to be considered.

  - TAP (Test Access Point)
    Connection of two physical ports with very low and constant latency (≤ 8 µs). A TAP is functionally similar to the MAC bypass offered in driver before version 11.2.
  - Direct Connection
    Connection of one physical port to one virtual port.

- Network
  A network groups one or more segments. As a minimum one network must be defined per device. One device can support multiple different networks. A network has a unique name. A network can span over multiple devices.

Note
The network name is also used to connect applications to the devices. For example, in CANoe the network name can be specified in the System View in the Simulation Setup.

- Uplink
  An uplink connects the device to a host. Filters can be configured to reduce the data transfer on an uplink.
  - Host: Vector Application
    From device driver version 11.2, a USB or Ethernet can be used as uplink to the Vector application.
  - Host: Mirroring
    Ethernet packets can be mirrored via a mirror uplink. For example, a data logger can be connected to a mirror port.

14 Time Synchronization

In this chapter you find the following information:

14.1 General Information

Time stamps and events

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

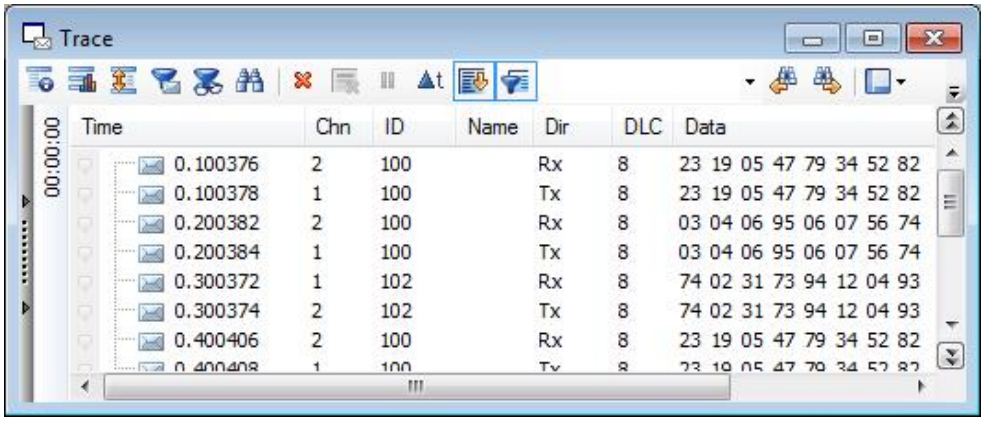


Figure 75: Time stamps of two CAN channels in CANalyzer

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.

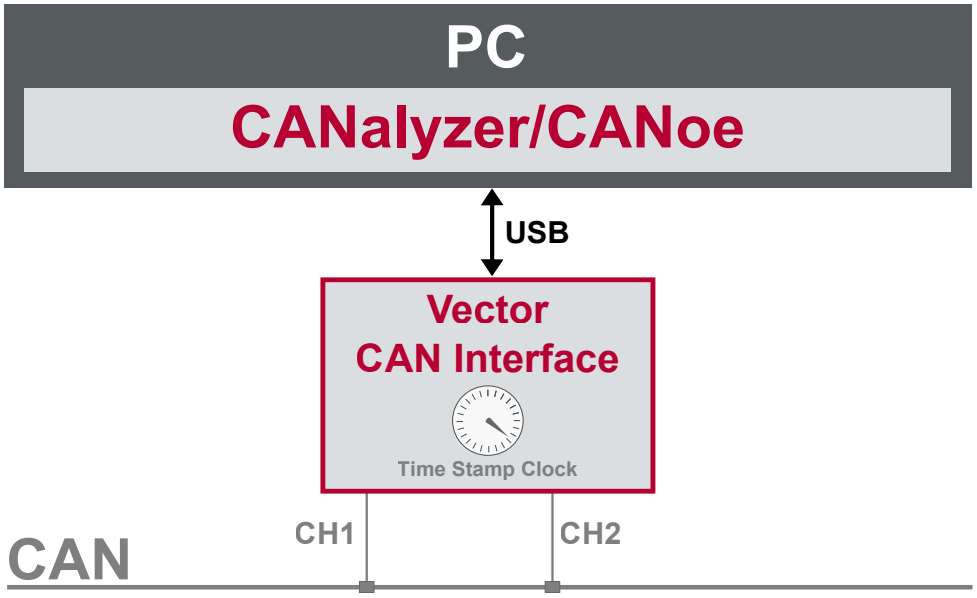


Figure 76: Common time stamp clock for each channel

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.

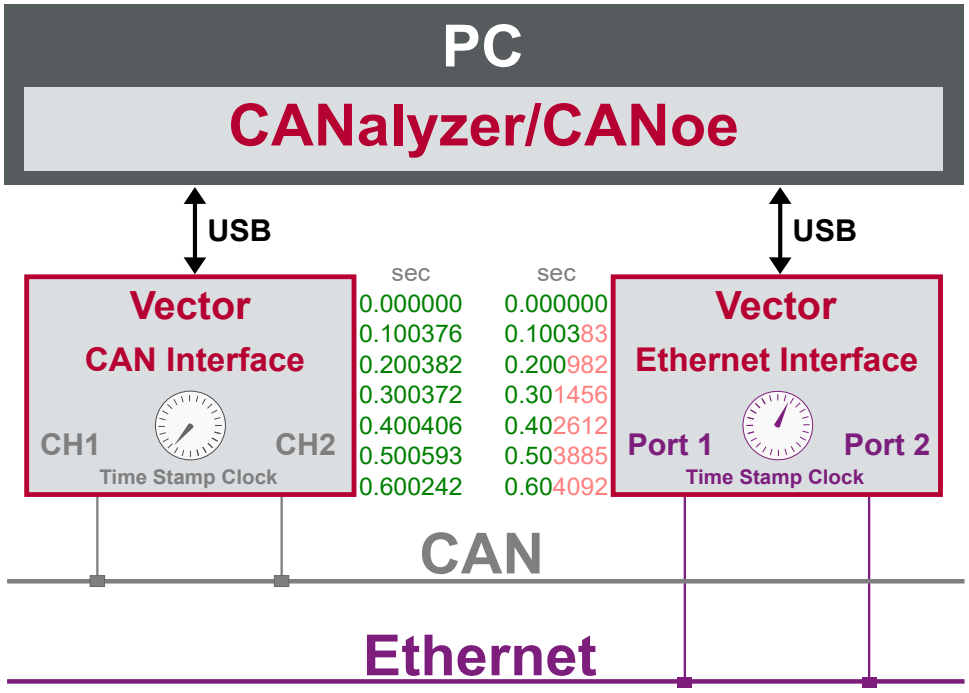


Figure 77: Example of unsynchronized network interfaces. Independent time stamps drift apart

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 (see next section).

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.

14.2 Software Sync

14.2.1 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.

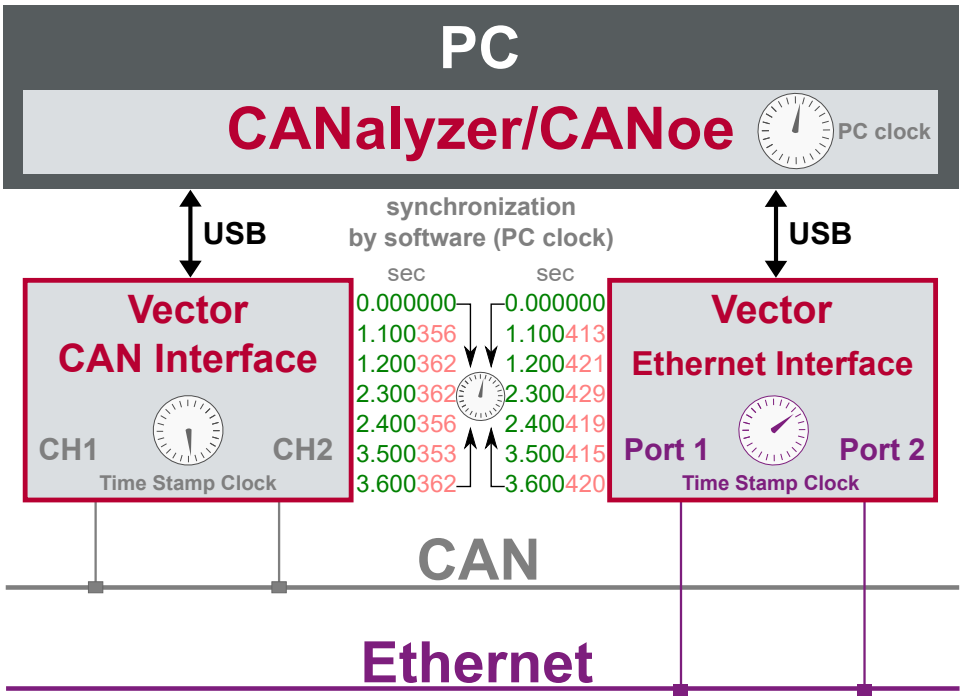


Figure 78: Time stamps of devices are synchronized to the PC clock

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.

14.2.2 Configuration

Vector Hardware Config

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).

The setting of the software time synchronization can be changed in the **Vector Hardware Config** tool via a right-clicking on the device and by selecting **Time sync device configuration**.

Software sync modes

In section **Protocol Mode | Software**, select the required mode:

- **Off**
  Synchronization mechanism is turned off.
- **Legacy**
  Device is synchronized to PC performance counter. This setting is compatible with the previous synchronization mechanism **Software time synchronization**. Can be used in conjunction with device drivers older than 11.2.
- **Master**
  Device operates as software synchronization time master.
- **Slave**
  Device operates as software synchronization time slave.

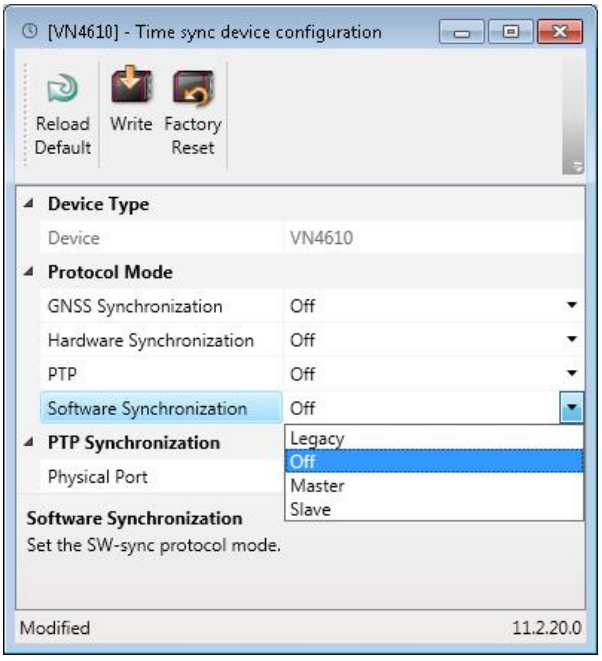


Figure 79: Configuring software synchronization

14.3 Hardware Sync

14.3.1 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).

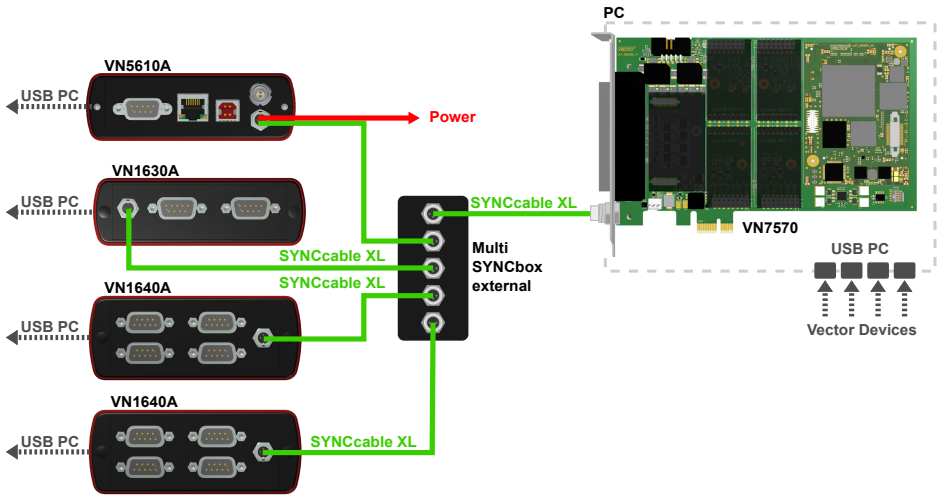


Figure 80: Example of a time synchronization with multiple devices

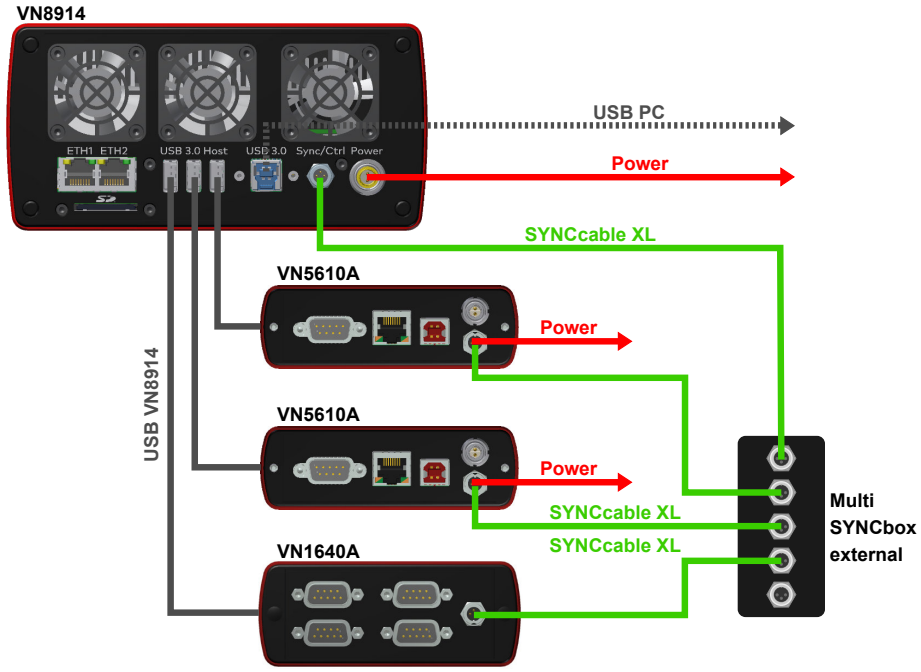


Figure 81: Example of a time synchronization with VN8914 and additional devices

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.

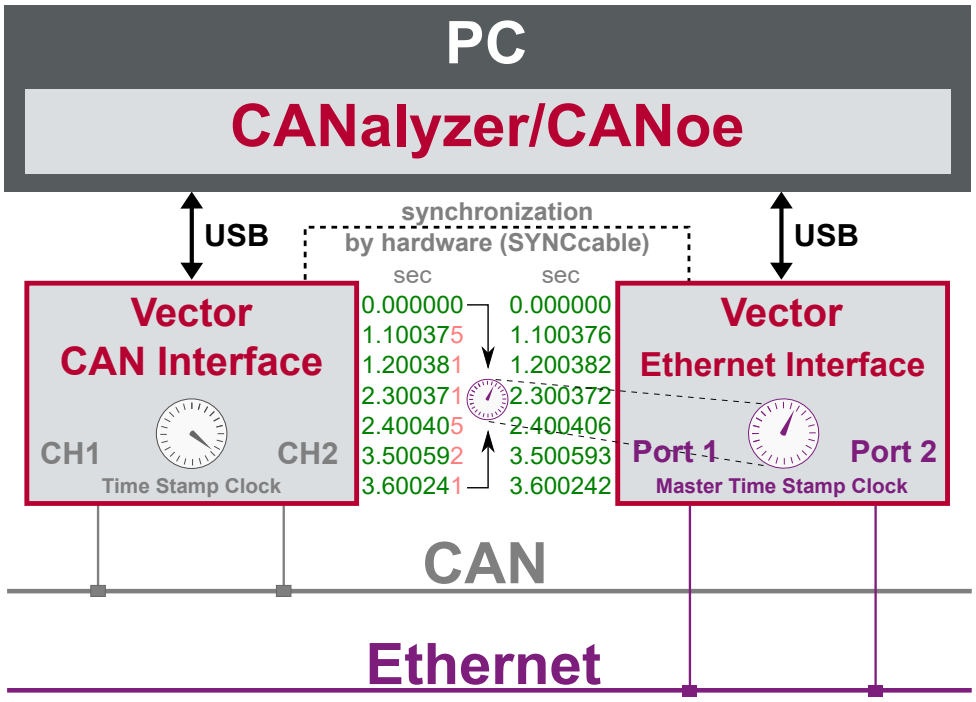


Figure 82: Time stamps are synchronized to the master clock

14.3.2 Configuration

Vector Hardware Config

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.

The setting of the hardware time synchronization can be changed in the **Vector Hardware Config** tool via a right-clicking on the device and by selecting **Time sync device configuration**.

Hardware sync modes

In section **Protocol Mode | Hardware**, select the required mode:

- **Off**
  Synchronization mechanism is turned off.
- **Master**
  Device operates as synchronization master, sending sync pulses on the sync line.
- **Slave**
  Device operates as synchronization slave, awaiting sync pulses on the sync line.

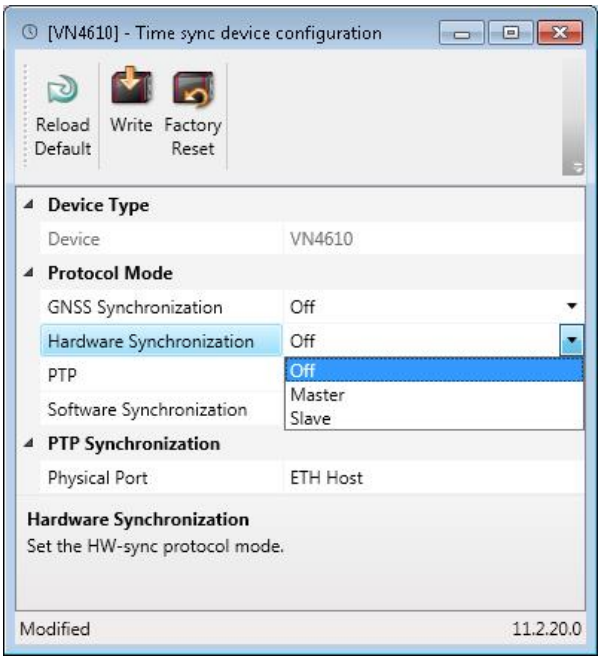


Figure 83: Configuring hardware synchronization

14.4 Precision Time Protocol Sync

14.4.1 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.

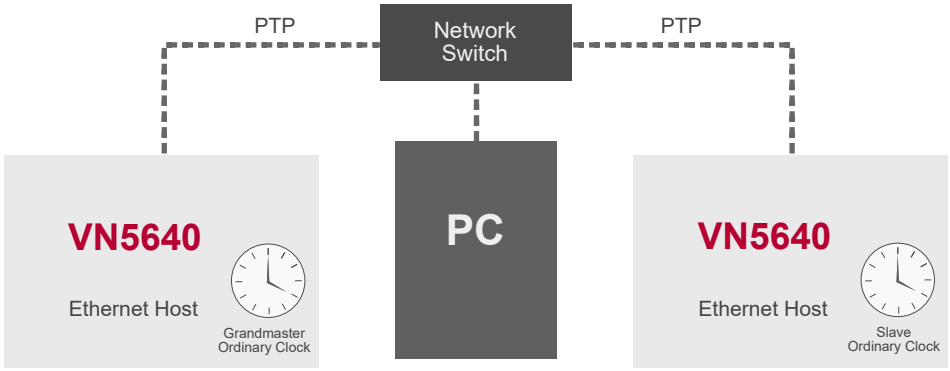


Figure 84: Setup example

14.4.2 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 µs	X

14.4.3 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.

14.4.4 Configuration

Vector Hardware Config

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.

The setting of the PTP synchronization can be changed in the **Vector Hardware Config** tool via a right-clicking on the device and by selecting **Time sync device configuration**.

PTP sync modes

In section **Protocol Mode | PTP**, select the required mode:

- **Off**
  Synchronization mechanism is turned off.
- **Master**
  Device operates as fixed IEEE1588 master.
- **Slave**
  Device operates as fixed IEEE1588 slave.
- **Auto**
  Devices uses the Best Master Clock Algorithm (BMCA) to determine operation mode.

Repeat the steps above to configure each Vector network interface. Keep in mind that only one IEEE1588 Master should be used at the same time and that IEEE1588 Slaves need at least one IEEE1588 Master.

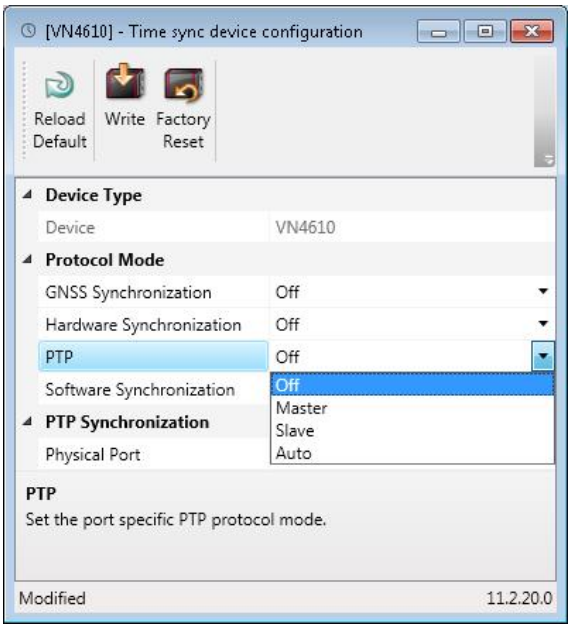


Figure 85: Configuring PTP synchronization

14.5 Protocol Combinations

General information

All described time synchronization protocols can be combined in several ways to support different use cases. The following example illustrates this in a generic way:

Setup

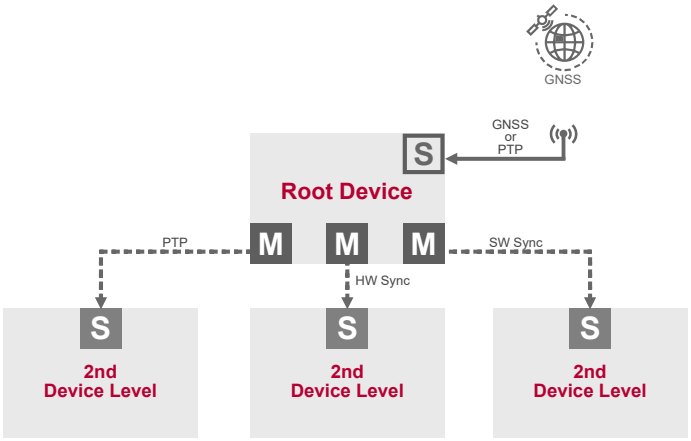


Figure 86: Combination example

Legend

Symbol	Description
S	Active Slave protocol on first device, i. e. protocol which corrects the time on the device.
S	Possible active Slave protocols on second device, i. e. protocol which corrects the time on the device
M	Possible active Master protocol on first device, i. e. protocol which distributes the time to other devices.

Possible combinations

The following table outlines the possible protocol combinations. See legend above. For example, if the first device is synced to GNSS the second device can be synced to the same time using PTP synchronization

	Root Device		2nd Device Level
Sync Role	**Slave**	**Master**	**Slave**
Time Synchronization Protocol	None		Hardware Sync
			Software Sync
			PTP
	GNSS		Hardware Sync
			Software Sync
			PTP
	PTP *		Hardware Sync
	HW Sync		Software Sync
	SW Sync		-

* with external master or Vector device

Note
Only one slave protocol can be active on a device but a device can drive multiple master protocols.

14.6 Use Cases and Configuration Examples

14.6.1 GNSS Synchronization

TAI/UTC time

Synchronizing Vector network interfaces to GNSS (TAI/UTC) time.

Setup

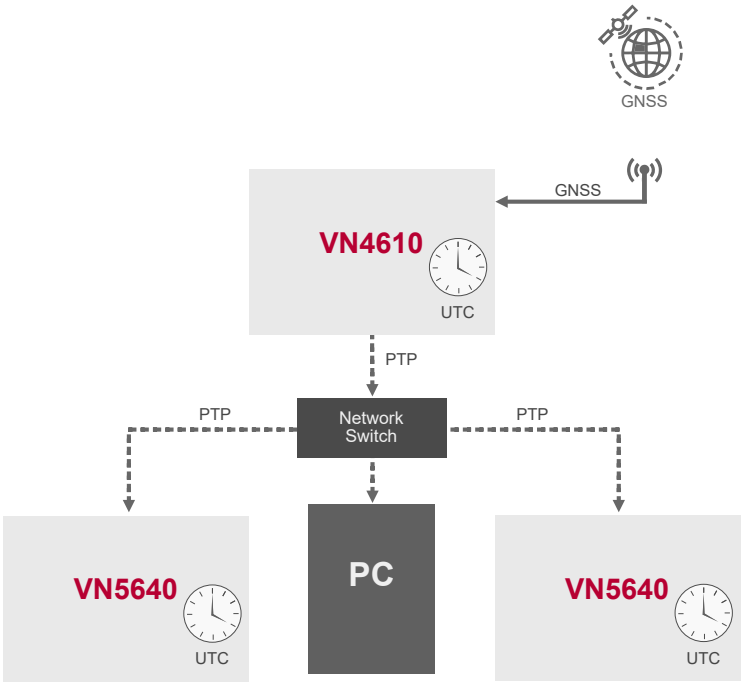


Figure 87: GNSS example

Configuration

In this use-case the devices shall be configured in the following way:

Devices	GNSS	PTP	Software Sync	Hardware Sync
VN4610	Slave	Master	Off	Off
VN5640	Off	Slave	Off	Off

Check the synchronization status of all devices. Configuration shall be ok and all devices shall be In-Sync.

14.6.2 4.2 IEEE1588 Synchronization

PTP master

Synchronizing Vector network interfaces to a PTP master.

Setup

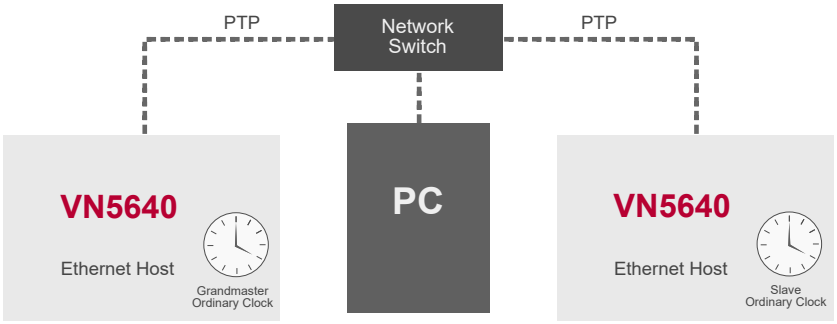


Figure 88: IEEE1588 example

Configuration

In this use-case the devices shall be configured in the following way:

Devices	GNSS	PTP	Software Sync	Hardware Sync
VN5640 (1)	Off	Master	Off	Off
VN5640 (2)	Off	Slave	Off	Off

Check the synchronization status of all devices. Configuration shall be ok and all devices shall be In-Sync.

14.6.3 Hardware Synchronization

Active sync

Synchronizing more than five Vector network interfaces via Multi SYNCbox active.

Setup

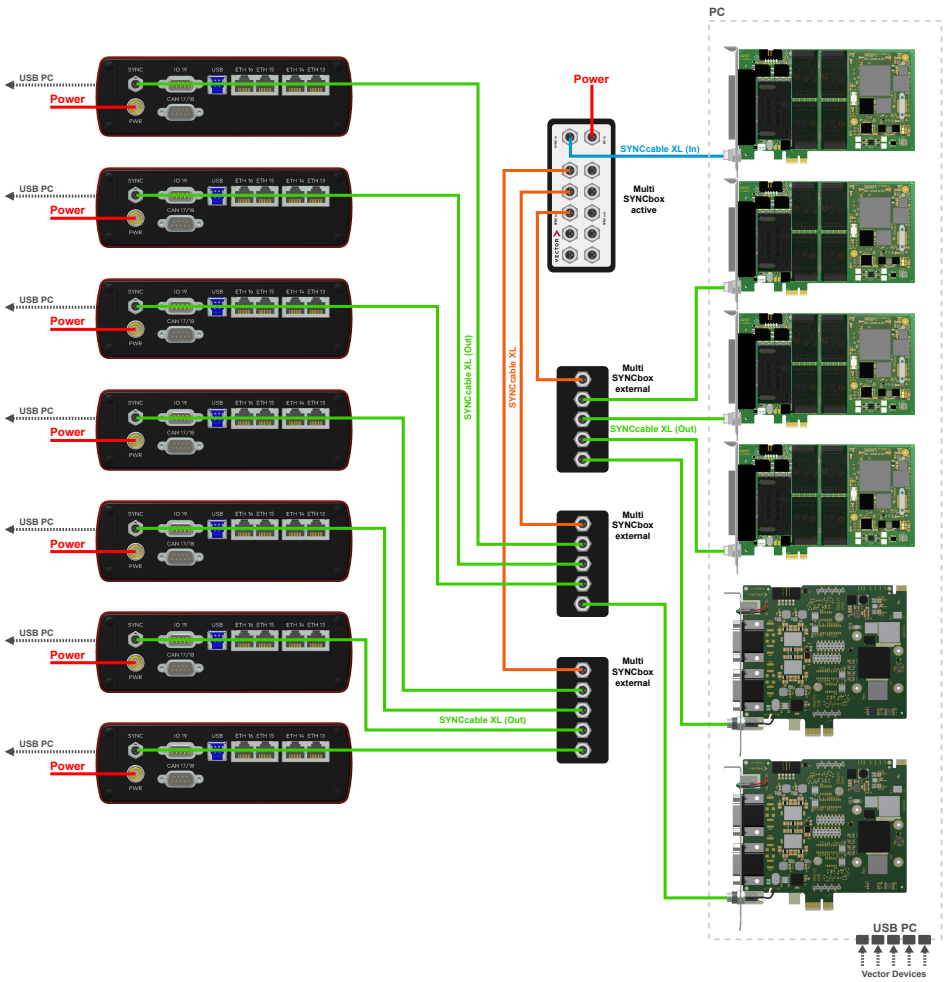


Figure 89: Active sync example

Note

The hardware synchronization topology should be evenly balanced to achieve the best synchronization results. This means all synchronization participants (except the master) shall be interconnected on the same topology level.

Configuration

In this use-case the devices shall be configured in the following way:

Devices	GNSS	PTP	Software Sync	Hardware Sync
VN7572	Off	Off	Off	Master
all others	Off	Off	Off	Slave

Check the synchronization status of all devices. Configuration shall be ok and all devices shall be In-Sync.

14.7 Compatibility

14.7.1 Vector Software

- CANoe 12.0 SP3 or higher
- CANape 18.0 or higher

14.7.2 Device Drivers

- For backwards compatibility, use software synchronization **Legacy** for all devices.
- For devices with driver versions < 11.2, activate **Global Settings | Software time synchronization** in Vector Hardware Config tool.

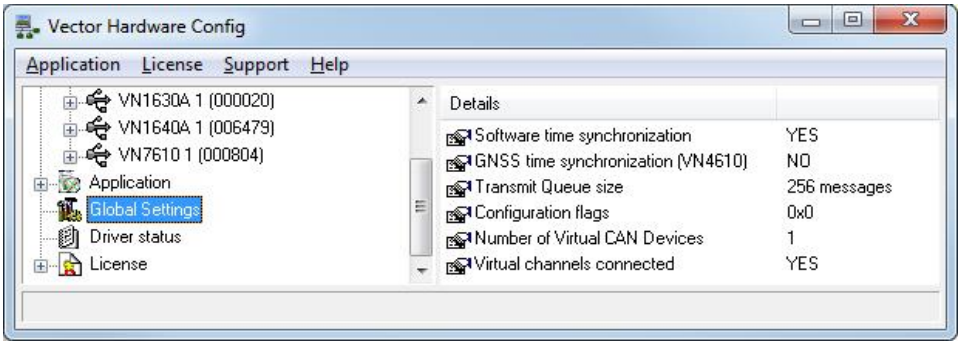


Figure 90: Global settings

Alternatively, disable all synchronization mechanisms and use application hardware synchronization.

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, if application hardware synchronization is used.

14.8 Troubleshooting

Problem	Possible Reason	Solution
Vector Hardware Configuration does not show the context menu to configure timesync on the device.	Old driver.	Update device driver to most recent driver.
Error messages:		
IEEE1588 sync not supported (only with ETH connection)	▶ IEEE1588 Synchronization is only available if the used Host Interface is Ethernet. ▶ A device which uses USB connection for Host Interface cannot be configured for IEEE1588 synchronization (although the Ethernet cable is connected physically in addition to the USB cable).	▶ Disconnect the USB cable from the device. ▶ Connect the Ethernet Host cable to the device. ▶ Power cycle the device. ▶ Use another synchronization protocol if you want to keep the USB Host connection.
Software sync not supported (only with USB connection).	▶ Software synchronization is only available if the host interface used is USB or PCIe. ▶ A device that uses an Ethernet port for the host interface cannot be configured for software synchronization (although the Ethernet cable is physically connected in addition to the USB cable).	▶ Disconnect the Ethernet Host cable from the device. ▶ Connect the USB cable to the device. ▶ Power cycle the device. ▶ Use another synchronization protocol if you want to keep the Ethernet Host connection.
Synchronization cannot be established. Red icon in Vector Hardware Configuration Tool (Status: Out of sync).	▶ Sync cluster not properly configured. ▶ Slave configured but no Master available. ▶ Hw Sync cable not properly connected. ▶ No GNSS satellite signal available(check GNSS LED). ▶ Used Ethernet Switch for IEEE1588 introduces too much jitter. ▶ The used Ethernet switch does not support IEEE1588 transparent clock and therefore generates too much jitter.	

15 Ethernet Host Connections

In this chapter you find the following information:

15.1 General Hints

Network switches

It is best to avoid network switches between your Vector network interface and your PC. Best throughput and performance can be achieved by directly connecting your Vector network interface to your PC.

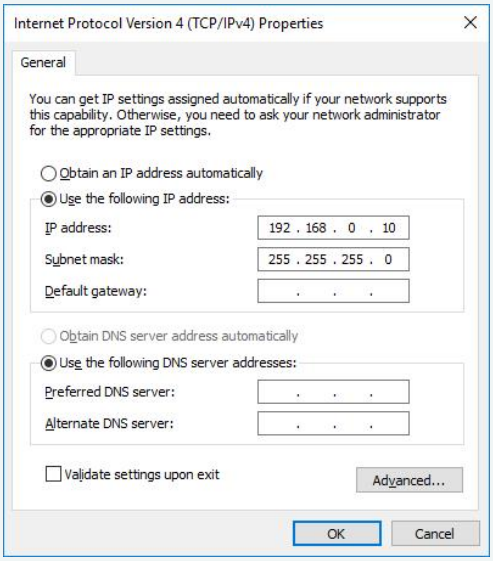
15.2 Getting Started

15.2.1 Connecting the Device

Step by Step Procedure

If you want to connect your device to the PC via Ethernet, the device and the PC have to be configured first.

1. In Windows, first check your TCP/IPv4 settings.



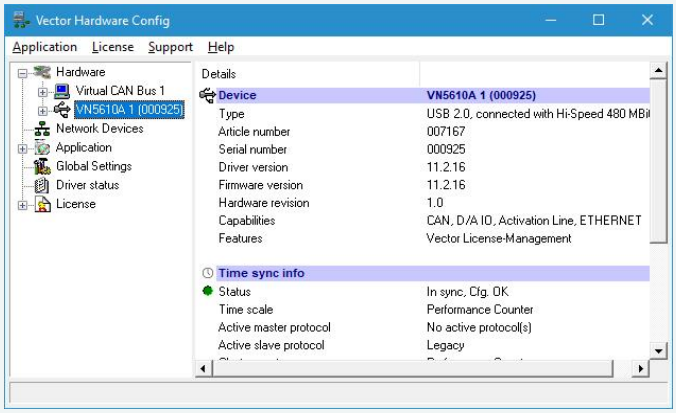
Note

- **Default subnet of device:**
  The devices are initially configured to the subnet 192.168.0.0\24.

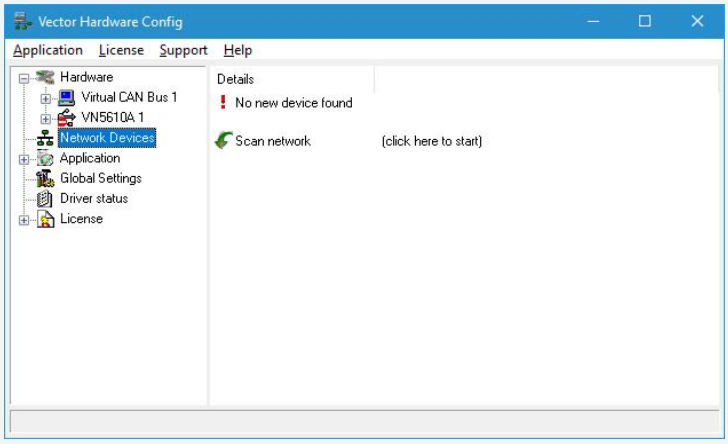
  The default IP address of the devices is 192.168.0.1

- **Firewall settings:**
  The firewall may block the communication. The firewall requires exceptions for the following ports:
  - UDP 42600 (used by Scan network in Vector Hardware Config)
  - TCP 4200, 4201 (necessary for establishing a connection to device)

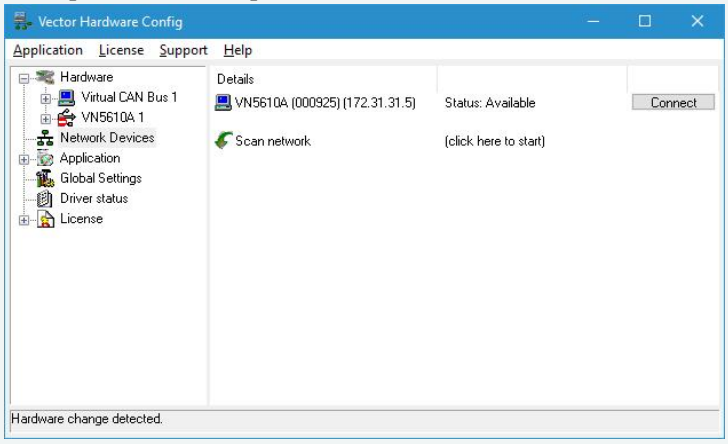
2. Connect the device to your PC via Ethernet. Ensure that no USB cable is connected.
3. Open **Vector Hardware Config**.



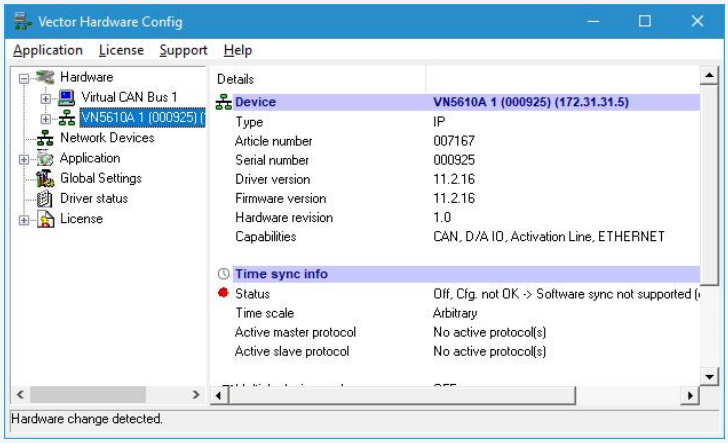
4. Click on **Network Devices**.



5. Click **[Scan network]**. The Ethernet device interface will be listed.



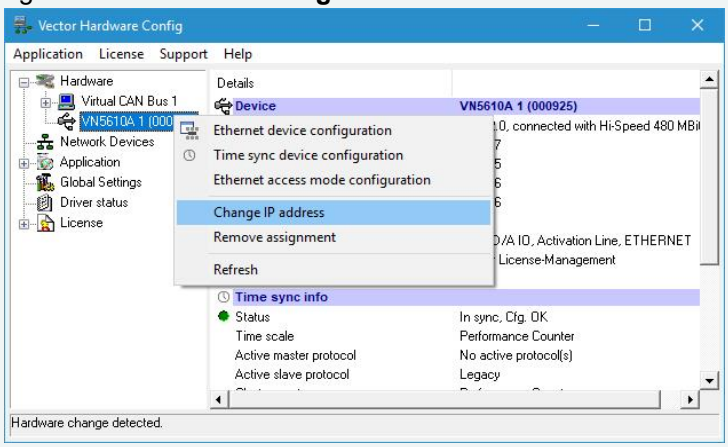
6. Click **[Connect]**. Now, the Ethernet interface is available via your network.



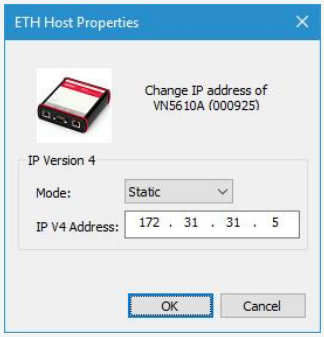
15.2.2 Changing the IP Address

Step by Step Procedure

1. Connect the device to your PC via Ethernet (see section Connecting the Device on page 179) or via USB.
2. In **Vector Hardware Config**, select an installed Ethernet interface with a right-click and select **Change IP address** in the context menu.



3. Enter a suitable IP address according to your network settings and click **[OK]**.



Please follow the extra steps below if your device is connected via USB:

4. Remove the USB cable from your host and the device. Otherwise, the USB connection is always preferred to the Ethernet connection.
5. Connect your host and the device via an Ethernet cable. The device will be listed as not available (red icon).
6. Connect the power supply to your device.

15.3 Windows Network Throttling

15.3.1 Issue

Throttled network traffic

Ethernet network traffic is throttled on Windows PC when running a multimedia application like Windows Media Player or an internet browser. This results in increased latency and less data throughput for Vector network interfaces, connected to the PC via Ethernet.

15.3.2 Solution

Disabling Network Throttling Index

In Windows operating systems, a network throttling mechanism has been existing since 2007 which is activated as soon as the Multimedia Class Scheduler Service is active.

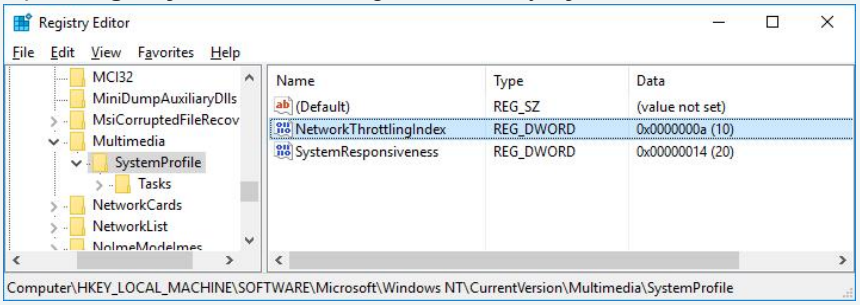
In order to reduce CPU utilization by the network driver, the Network Driver Interface Specification (NDIS) framework passes along a maximum number of packets per milliseconds. This number of packets is defined by the following registry key:

```
HKEY_LOCAL_MACHINE\SOFTWARE\
Microsoft\Windows NT\CurrentVersion\Multimedia\
SystemProfile\NetworkThrottlingIndex
```

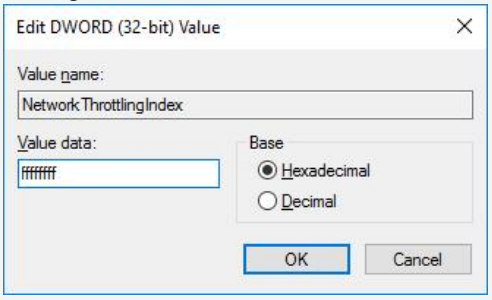
Step by Step Procedure

Follow the steps below to disable the Network Throttling Index:

1. Open **Registry Editor** and navigate to the key **SystemProfile**.



2. Change the `Value NetworkThrottlingIndex` to `0xffffffff`.



3. Reboot your PC.

15.4 Jumbo Frames

15.4.1 Issue

Jumbo Frames not supported

For Vector network interfaces connected to a PC via Ethernet, Jumbo Frames must be supported to achieve maximum data throughput.

15.4.2 Solution

Activating Jumbo Frames

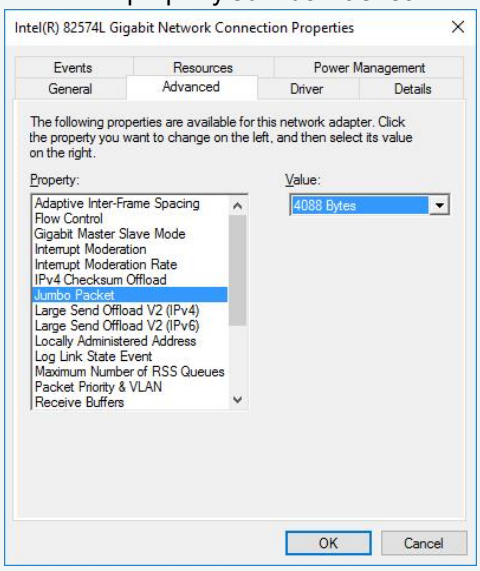
Jumbo Frames allow larger Ethernet frame sizes compared to standard Ethernet frames. Thus more user data can be transferred with a single Jumbo Frame. The data throughput is improved by a smaller proportion of header data relative to the entire packet.

If the data throughput should be maximized, activate Jumbo Frames. This is achieved by directly connecting the Vector network interface to the PC or by using the correct network switches.

Step by Step Procedure

Follow the steps below to enable Jumbo Frames:

1. Open **Device Manager**.
2. In the tree view, open node **Network Adapters**.
3. Select the NIC that is connected to the Vector network interface with a right-lick and select **Properties**.
4. Select tab **Advanced**.
5. Select the property **Jumbo Packet** and choose the highest possible option.



15.5 Interrupt Moderation Rate

15.5.1 Issue

Increased latency

Some network interface cards (NIC) have a property called Interrupt Moderation Rate (IMR). If this property is enabled, the latency is increased while the data throughput is improved.

15.5.2 Solution

Disabling IMR

If latency should be low, disable Interrupt Moderation Rate.

Step by Step Procedure
Follow the steps below to enable Jumbo Frames:

1. Open **Device Manager**.
2. In the tree view, open node **Network Adapters**.
3. Select the NIC that is connected to the Vector network interface with a right-lick and select **Properties**.
4. Select tab **Advanced**.
5. Select the property **Interrupt Moderation Rate** and choose **Disable**.

Note
Depending on the network interface, this option may no be available.

15.6 Known Issues with 3rd Party Hardware

15.6.1 Intel I218 / I219 Network Cards

Issue — Intel I218 and I219 network cards have issues with jumbo frames.

Solution — Disable Jumbo Frames.

VECTOR

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