



# **VH5110A CCS Listener**

User Manual

Version 1.1  
English

## Imprint

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# 1 Introduction

In this chapter you find the following information:

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## 1.1 Product Overview

With the VH5110A the communication, based on CCS protocols, between a charging station (EVSE) and an electric vehicle (EV) can be analyzed. The VH5110A listens to the data communicated on the Control Pilot (CP) line via PLC and converts it into Ethernet frames, which will be interpreted in CANoe. In addition, also the PWM parameters of the basic communication will be measured and displayed in CANoe as system variables.

The VH5110A offers the following features:

- ▶ portable and easy to use
- ▶ capable of listening to all data transmitted between EVSE and EV
- ▶ full support (SLAC and V2G) of DIN70121 and ISO15118 protocol
- ▶ measurement of voltage, frequency and duty cycle of the PWM communication according to IEC61851
- ▶ direct connection to the Control Pilot signal, no Man-in-the-middle is necessary
- ▶ indirect connection through inductive coupling possible
- ▶ passive behavior, no influence on charging communication
- ▶ fully compliant with the HPGP specification

### Requirements

CANoe version 12.0 SP3 or later with

- ▶ option .Ethernet and
- ▶ option .SmartCharging

### Scope of Delivery

- ▶ VH5110A CCS Listener
- ▶ Power supply cable for VH5110A (part number 05204)
- ▶ Quick Start Guide

## 1.2 Important Notes

### 1.2.1 Safety Instructions and Hazard Warnings

**Warning!**

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

### 1.2.2 Proper Use and Intended Purpose

**Warning!**

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

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

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

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

### 1.2.3 Hazards

**Warning!**

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

Comply with all safety standards and public regulations which are relevant for the operation of

the system. Before you operate the system in public areas, it should be tested on a site which is not accessible to the public and specifically prepared for performing test drives in order to reduce hazards.

#### 1.2.4 Disclaimer



##### **Warning!**









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

## 1.3 About This User Manual








### 1.3.1 Conventions

In the two tables below you will find the notation and icon conventions used throughout the manual.

| Style       | Utilization   |
|-------------|---|
| <b>bold</b> | Fields/blocks, user/surface interface elements, window- and dialog names of the software, special emphasis of terms<br><b>[OK]</b> Buttons in brackets<br><b>File Save</b> Notation for menus and menu commands |
| Source Code | File and directory names, source code, class and object names, object attributes and values   |
| Hyperlink   | Hyperlinks and references   |
| <CTRL>+<S>  | Notation for key combinations   |

| Symbol  | Utilization  |
|---|--|
|   | Additional information.<br>► Notes and tips that facilitate your work.   |
|  | Possibly damaging situation!<br>► Failure to observe can result in damage to the product or the surroundings!  |
|  | Possibly dangerous situation!<br>► Failure to observe can result in light or minor injuries to persons!<br>► Failure to observe can result in damage to the product or the surroundings! |
|  | Dangerous situation!<br>► Failure to observe can result in death or extremely severe injuries to persons!  |
|  | Immediate hazard!<br>► Failure to observe will result in death or extremely severe injuries to persons!  |
|  | More detailed information.   |
|  | Examples   |
|  | Step-by-step instructions.   |



| Symbol   | Utilization  |
|--|--|
|   | Text areas where changes of the currently described file are allowed or necessary. |
|   | Files you must not change.   |
|   | Multimedia files e.g. video clips.   |
|   | Introduction into a specific topic.  |
|   | Text areas containing basic knowledge.   |
|   | Text areas containing expert knowledge.  |
|  | Something has changed.   |

### 1.3.2 Certification

Vector Informatik GmbH has ISO 9001:2008 certification. The ISO standard is a globally recognized standard.

### 1.3.3 Warranty

We reserve the right to modify the contents of the documentation or the software without notice. Vector disclaims all liabilities for the completeness or correctness of the contents and for damages which may result from the use of this documentation.

### 1.3.4 Support

Use the [Vector Support Website](#) to find supportive answers for your work with Vector products from multiple resources.

If you don't find what you are looking for, you can open a support case to get individual help.

- ▶ [Vector Support Website \(support.vector.com\)](#)
- ▶ [Vector KnowledgeBase \(support.vector.com/kb\)](#)
- ▶ Support E-Mail: [support@vector.com](mailto:support@vector.com)

### **1.3.5 Trademarks**

All brand names in this documentation are either registered or non registered trademarks of their respective owners.

## 2 Interfaces and Accessories

In this chapter you find the following information:

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## 2.1 Interfaces of the Front Site

### 2.1.1 RJ45 Ethernet Connector



Figure 1: VH5110A with RJ45 Ethernet connector

With the RJ45 Ethernet connector the VH5110A will be connected to the computer where CANoe is running. For this purpose a separate Ethernet adapter is necessary. Also the built-in Ethernet adapter of the computer can be used.

The VH5110A can also be used for logging of the charging communication. In this case the VH5110A will be directly connected to the Ethernet port of a suitable data logger. CANoe is then only used for later offline analysis.

The LEDs on the RJ45 socket indicate the following status:

| Color  | Activity | Description                  |
|--------|----------|------------------------------|
| Green  | Turn on  | 100Base-TX                   |
|        | Turn off | 10Base-T                     |
|        | Blinking | Transmitting/Receiving       |
| Yellow | Turn on  | Ethernet Link established    |
|        | Turn off | No Ethernet link established |

## Status LEDs

The LEDs indicate the status of the VH5110A and communication activities. The dedicated meaning is listed on the table below:

| LED | Color | Activity | Description             |
|-----|-------|----------|-------------------------|
| 1   | White | Static   | Power supply            |
| 2   | Green | Static   | Application is ready    |
| 3   | Green | Flashing | Traffic frames received |
| 4   | Green | Flashing | Beacon frames received  |

## 2.2 Connectors of the Back Site



Figure 2: VH5110A with MQS and BNC connector

### 2.2.1 MQS Connector

With the MQS connector the VH5110A will be supplied with 9-36 V. The power supply cable is included in the scope of delivery. The control pilot (CP) and protective earth (PE) can be connected via the MQS connector instead of using the standard BNC interface (see chapter 2.2.2 BNC Connector). The signal cable is not included in the scope of delivery. The power supply cable can be used for adjustments and extensions to connect CP and PE via the MQS connector.

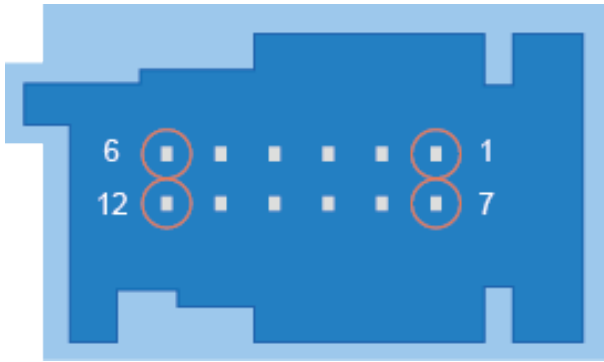


Figure 3: MQS Connector

| Pin | Assignment | Pin | Assignment |
|-----|------------|-----|------------|
| 1   | PE         | 7   | CP         |
| 2   | GND        | 8   | GND        |
| 3   | Not used   | 9   | Not used   |
| 4   | Not used   | 10  | Not used   |
| 5   | Not used   | 11  | Not used   |
| 6   | GND        | 12  | DC 9-36 V  |

**Caution!**

The applied supply voltage has been within the range of 9 V to 36 V. Supply voltages beyond this range lead to a damage of the device.

## 2.2.2 BNC Connector

With the BNC connector the VH5110A can be connected to the Control Pilot (CP) signal and Protective Earth (PE) to listen to the communication.

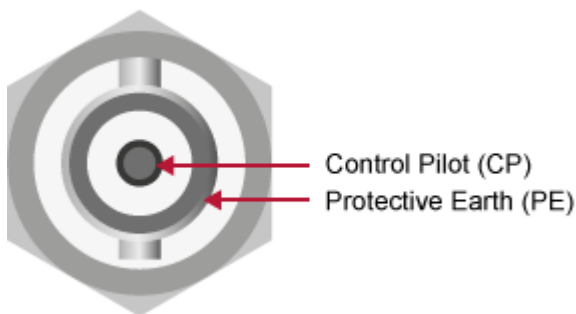


Figure 4: BNC connector

The impedance of the BNC cable shall be 50 Ohms. This cable is not in the scope of delivery but can be ordered separately. Please find more information in the chapter 2.3 Accessories.

If there is no direct access to the CP and PE available e.g. at field analysis, an indirect connection is also possible by using an inductive coupler around the charging cable.

**Note**

In case of missing communication frame (see 3.1 Listening V2G High Level Communication), we recommend a conductive coupling instead of inductive coupling.

## 2.3 Accessories

### 2.3.1 Inductive Coupler

For indirect access a special inductive coupler is necessary which is mounted around the charging cable.



Figure 5: Premo MICU 300A-S/LF

A suitable coupler with an integrated BNC connector is for example the Premo MICU 300A-S/LF.

This coupler is not contained in the scope of delivery but can be ordered separately under the part number 05212.

Technical data (for more details see Premo website/datasheet):

| Parameter           | Value          |
|---------------------|----------------|
| Dimensions (HxWxL)  | 106x140x118 mm |
| Max. cable diameter | < 50 mm        |
| Weight              | < 2.5 kg       |

**Note**

Only high-level communication based on PLC can be captured with the inductive coupler. Measurement of low level signaling (PWM and CP voltage) isn't possible due to physical constraints. This concerns the AC charging use case based on IEC 61851, which don't use high level communication. High level communication of AC and DC charging based on DIN 70121 or ISO 15118 can be captured with the inductive coupler.

### 2.3.2 BNC Cable

For connecting the Control Pilot (CP) signal and Protective Earth (PE) to the VH5110A a BNC cable with the following specifications is available:

| Parameter                          | Value                |
|------------------------------------|----------------------|
| Cable                              |                      |
| ▶ Length                           | Approx. 70 cm        |
| ▶ Impedance                        | 50 Ohms              |
| VH5110A Connector                  |                      |
| ▶ Type                             | BNC male             |
| DUT Connector                      |                      |
| ▶ Type                             | 4mm Banana plug (2x) |
| ▶ Plug color Control Pilot (CP)    | Blue                 |
| ▶ Plug color Protective Earth (PE) | Yellow               |

This BNC cable is not contained in the scope of delivery but can be ordered separately under the part number 05210.



## 3 Technical Information

In this chapter you find the following information:

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### 3.1 Listening V2G High Level Communication

The V2G high level communication between an EV and EVSE according the DIN70121 and ISO15118 protocol is based on the HPGP specification. The communication on the physical layer is based on orthogonal frequency division multiplexing (OFDM) within the broadband from 1.8 to 30 MHz. The VH5110A is passive listening on this broadband communication. On the one hand this has advantage that no timings are disturbed. On the other hand, the passive listening has the constraints, that the VH5110A can not trigger any retransmission in case of missing communication frames. Missing frames occurs rarely. The following issues influence missing frames:

- ▶ Low power spectral density (PSD) by the EV or/and EVSE controllers
- ▶ High interference which associated low signal to noise ratio (SNR)

Missed communication frames during the V2G communication are indicated in the Trace Window in CANoe as **[TCP-004] TCP sequence error**. If during the Signal Level Attenuation Characterization (SLAC) the **SLAC\_Match.Cnf** could not captured by the VH5110A, the VH5110A don't know the Network Membership Key (NMK) and could not listen the further communication. The following measures can help to improve the reliability of V2G communication listening:

- ▶ Connect the VH5110A as short as possible to communication lines (CP/PE)
- ▶ Use conductive instead of inductive coupling (inductive coupling is an additional attenuation)

### 3.2 CP Signal Measurement

The low level and safety communication between an EV and EVSE according the IEC61851 specification is based on basic signal which uses different voltage level and pulse width modulation (PWM). The VH5110A is able to measure the CP signal of the voltage level, duty cycle and frequency of the PWM. The following table lists the specification of the CP signal measurement:

| Parameter                | Value                |
|--------------------------|----------------------|
| Analog digital converter |                      |
| ▶ Resolution             | 10 Bit               |
| Voltage                  |                      |
| ▶ Accuracy               | $\pm 0.25 \text{ V}$ |
| Duty Cycle               |                      |
| ▶ Accuracy               | $\pm 1 \%$           |
| Frequency                |                      |
| ▶ Accuracy               | $\pm 5 \text{ Hz}$   |

### 3.3 Technical Data

| Parameter   | Value Range                     |
|---|---------------------------------|
| Power supply                                      |                                 |
| ▶ Connector type                                  | MQS                             |
| ▶ Voltage   | 9-36 V DC                       |
| Power consumption                                 |                                 |
| ▶ Average   | 1200 mW typ.                    |
| ▶ Peak  | 1600 mW                         |
| Host interface                                    |                                 |
| ▶ Interface type                                  | Ethernet                        |
| ▶ Connector Type                                  | RJ45                            |
| ▶ Data rate                                       | 10/100 Mbit/s                   |
| Measurement connection                            |                                 |
| ▶ Connector type                                  | BNC female                      |
| ▶ Connector impedance                             | 50 Ohms                         |
| ▶ Max. voltage limit                              | 80 Volt                         |
| Start-up time (power-on to push first packet out) |                                 |
| ▶ With fixed Ethernet speed                       | < 7 s                           |
| ▶ With auto-negotiation                           | < 8 s                           |
| Supported standards                               | HomePlug Green PHY v1.1         |
| Temperature range (ambient temperature)           |                                 |
| ▶ Operation temperature                           | -40 °C ... +85 °C               |
| Dimensions (LxWxH, incl. BNC connector)           | Approx. 115 mm x 110 mm x 35 mm |
| Weight  | Approx. 230 g                   |

## 4 Getting Started

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## 4.1 Driver Installation

The VH5110A is connected to CANoe by an Ethernet interface. For this reason an installation of a dedicated driver in CANoe is not necessary.

## 4.2 Device Configuration

The configuration and the firmware update of the VH5110A can be done with the Vector GreenPHY Configurator. This tool will be delivered with CANoe and can be opened via **CANoe|Vector Tool Launch** in the CANoe help. . It is also possible to download the tool from the Vector website: [www.vector.com/GreenPHY-Configurator/](http://www.vector.com/GreenPHY-Configurator/)

The following configuration can be done with the Vector GreenPHY Configurator:

- ▶ Enable/disable PWM detection
- ▶ Set report mode (push or poll)
- ▶ Set thresholds and measurement period for push mode
- ▶ Update firmware

## 4.3 PWM Measurement

Besides listening to the high-level communication protocols the VH5110A will also measure the PWM parameters to analyze the low-level communication specified in IEC61851-1. For this purpose, a direct connection of the VH5110A to the Control Pilot line is necessary.



### Note

For measurement of the PWM parameters the VH5110A must be connected directly to the Control Pilot signal. With a connection via an inductive coupler around the charging cable the PWM parameter can not be measured.

The PWM parameters voltage, frequency and duty cycle are measured continuously by the VH5110A. The measurement results you can get with two different methods.

### 4.3.1 Poll Mode

The measurement result will be polled on demand or cyclic via some CAPL code. The returned values are written into system variables which are provided with the **Monitor.dll** in the CANoe option SmartCharging. They are also displayed in the Trace Window.



### Cross Reference

More information how to poll the PWM parameters can be found in the CANoe help.

### 4.3.2 Push Mode

The measurement result can actively be pushed by the VH5110A if a configured threshold of voltage, frequency or duty cycle is exceeded. The pushed values are written into System Variables which are provided with the **Monitor.dll** in the CANoe option SmartCharging. They are also displayed in the Trace Window.



#### Cross Reference

The thresholds for the push mode can be set with the Vector GreenPHY Configurator.

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