

User Manual

CANoe Test Hardware VH1150

Version 1.3
English

Imprint

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1 Introduction

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1.1 Product Overview

Applications

The **CANoe** test hardware **VH1150** is a USB-hardware for automating ECU conformance tests for CAN and LIN. It is typically used by **CANoe**-based test implementations to automatically hardware reset the ECU before each test case. Further applications include the programmed adjustment of the ECU's supply voltage and the automated detection of sleep and wake modes by measuring the ECU's current consumption.

Additionally the **VH1150** supports stress features to produce a ground offset or to limit the recessive level of the LIN line. It is also possible to short circuit or interrupt CAN and LIN lines.

The **VH1150** provides IO lines which allow to interface with external devices.

Currently this hardware is used by the Vector **CANoe** test package VAG for CAN high-speed and by the LIN conformance tests implementation provided with **CANoe.LIN**.

Requirements

- > **CANoe** version 8.0 SP4 or higher for **Windows 8**
- > **CANoe** version 7.2 SP3 or higher for **Windows 7**
- > **CANoe** version 7.1 or higher

Scope of delivery

- > USB hardware **VH1150** (external power supply not included)
- > **VH1150** installation manual
- > Installation CD
- > USB cable (2 m)
- > Y cable
- > 2 CANterms 120 Ohm

1.2 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 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 and/or BroadRReach.

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 workshops 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.

1.2.2 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.

1.2.3 Disclaimer



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

1.3 About this User Manual

To find information quickly








This user manual provides you with the following access help:






- > At the beginning of each chapter you will find a summary of the contents
- > The header shows in which chapter of the manual you are
- > The footer shows the version of the manual
- > At the end of the user manual an index will help you to find information quickly

Conventions

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

Style	Utilization
bold	Fields/blocks, user/surface interface elements, window- and dialog names of the software, special emphasis of terms. [OK] Push buttons in square brackets File Save Notation for menus and menu entries
Windows	Legally protected proper names and marginal notes.
Source Code	File and directory names, source code, class and object names, object attributes and values
Hyperlink	Hyperlinks and references.
<Ctrl>+<S>	Notation for shortcuts.

Symbol	Utilization
	This icon indicates notes and tips that facilitate your work.
	This icon warns of dangers that could lead to damage.
	This icon indicates more detailed information.
	This icon indicates examples.
	This icon indicates step-by-step instructions.
	This icon indicates text areas where changes of the currently described file are allowed or necessary.
	This icon indicates files you must not change.

Symbol	Utilization
	This icon indicates multimedia files like e.g. video clips.
	This icon indicates an introduction into a specific topic.
	This icon indicates text areas containing basic knowledge.
	This icon indicates text areas containing expert knowledge.
	This icon indicates that something has changed.

1.3.1 Certification

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

1.3.2 Warranty

Restriction of 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.

1.3.3 Support

You need support? You can get through to our hotline at the phone number

- > Phone: +49 711 80670-200
- > Email: support@de.vector.com
- > [Online formula](#)

1.3.4 Trademarks

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

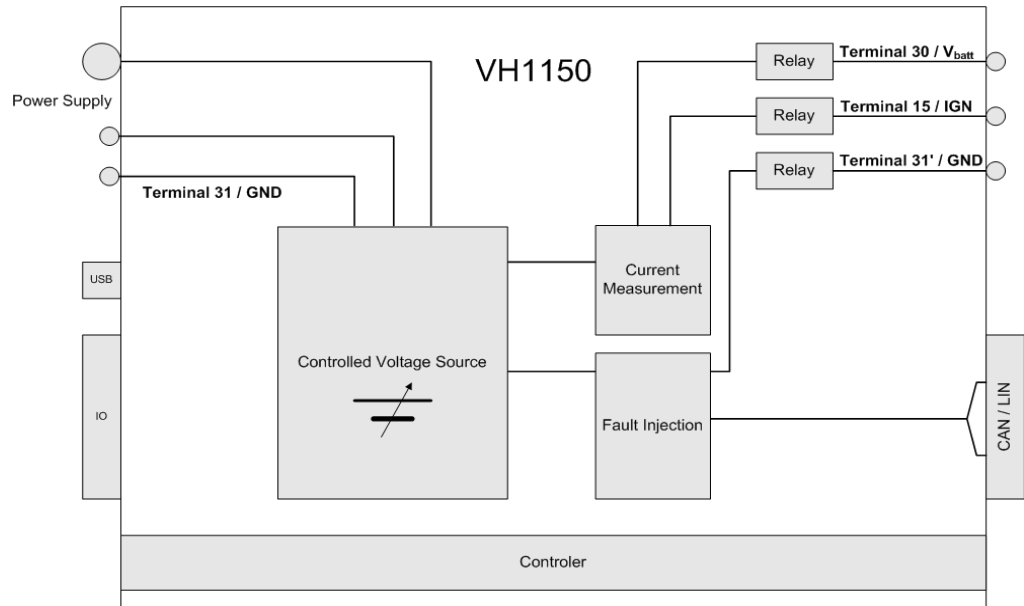
2 Installation

In this chapter you will find the following information:

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2.1 VH1150 Overview

Block diagram



- > Controller: Control unit of the **VH1150**.
- > Current Measurement: Measures the ECU current consumption (e.g. detection of sleep/wake-up of an ECU).
- > Fault Injection: controls ground offset, recessive level limitation of LIN line and bus line disturbances.
- > Relays: Switching the terminals 30, 15, 31'.
- > CAN/LIN: Connector to attach the bus lines.
- > Voltage Supply: Programmable voltage supply.

Terminals and CAN/LIN connector



Power supply, USB
and IO connectors



- > Power Supply: Four pin connector for recommended power supply. 4 mm connectors for laboratory power supply.
- > USB connector: Connection to the PC. An FTDI driver is required. The device is referenced as a COM port in the PC's hardware configuration.
Note: The device is referenced as a **USB serial port** in the **Windows** Device Manager (section **COM and LPT connections**)
- > IO: Digital and analog input and output ports.

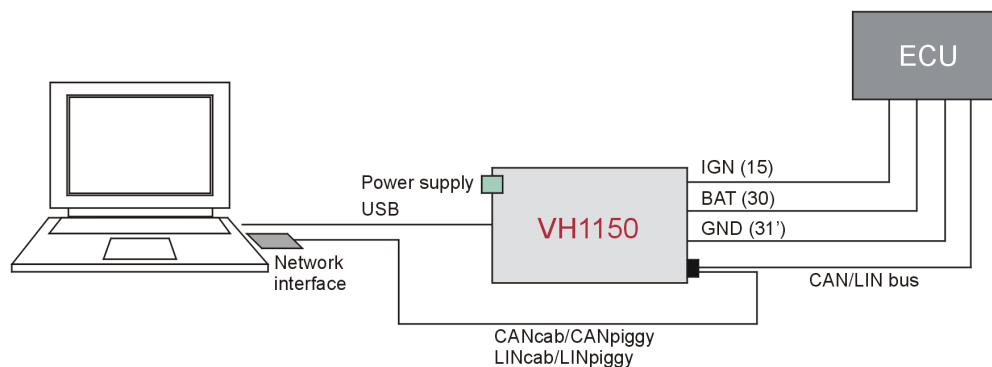


Caution: Neither power supply nor terminal connections must be removed nor connected while the **VH1150** operates!

Never supply the **VH1150** device on both power supply connectors (four pin connector/4 mm connectors)!

2.2 Hardware Setup

Hardware connections



VH1150

- > **VH1150** should be connected to PC or laptop using the USB cable provided.
- > An external power supply (12-28 V) is required for the **VH1150**. Please note that the power supply is not included in the scope of delivery. For a power supply recommendation please refer to chapter 2.2.2 Recommended Power Supply.
- > The external power supply can be connected to the **VH1150** via the 4 mm connectors or the four pin connector.
- > The ECU supply lines should be connected to the ECU's terminals for ignition (15), battery (30) and ground (31').
- > Required bus lines must be connected to the CAN/LIN connector. Please ensure that your CAN bus is properly terminated.

2.2.1 Required Power Supply

Output Voltage	22 V – 28 V (+- 0.3 V)
Output Voltage (reduced VH1150 output current)	12 V – 22 V (+- 0.3 V)
Output Current	5.0 A

2.2.2 Recommended Power Supply

- > **Manufacturer:** Mean Well
- > **Description:** GS120A24-R7B

The power supply can be purchased from Vector Informatik GmbH.




Caution: The Mean Well power supply connects internally ground to the protective conductor (PE). Therefore, the ground line or any other line of the **VH1150** device must not be connected to a protective conductor.

2.3 Software Requirements

Operating system	<ul style="list-style-type: none">> Windows 7, 8> Windows VISTA> Windows XP with Service Pack 2> Windows 2000 with Service Pack 4
CANoe version	<ul style="list-style-type: none">> CANoe version 8.0 SP4 or higher for Windows 8> CANoe version 7.2 SP3 or higher for Windows 7> CANoe version 7.1 or higher
FTDI driver	Version 2.08.30 or higher (http://www.ftdichip.com/Drivers/VCP.htm)

2.4 Software Installation

Installation	<p>Please ensure that you have administrator access rights for your PC before following the installation steps below:</p>  <ol style="list-style-type: none">1. Install or update CANoe.2. Close CANoe application.3. Update VH1150 CANoe driver (see Installation CD).4. Install or update the FTDI driver (see Installation CD).5. Connect all hardware as described in chapter 2.2 Hardware .6. After successful installation please connect the VH1150 via USB interface to your PC. Power up your VH1150. Windows should automatically recognize the VH1150.
Uninstall	FTDI and CANoe driver can be uninstalled using the standard Windows mechanism.

2.5 Compatibility with VH100

Compatibility	The VH1150 is backward compatible to the VH100. This means, in configuration dialogs of older CANoe versions (e.g. LIN Conformance Test Module, VAG Test Package) the VH100 has to be selected although a VH1150 is used as real device.
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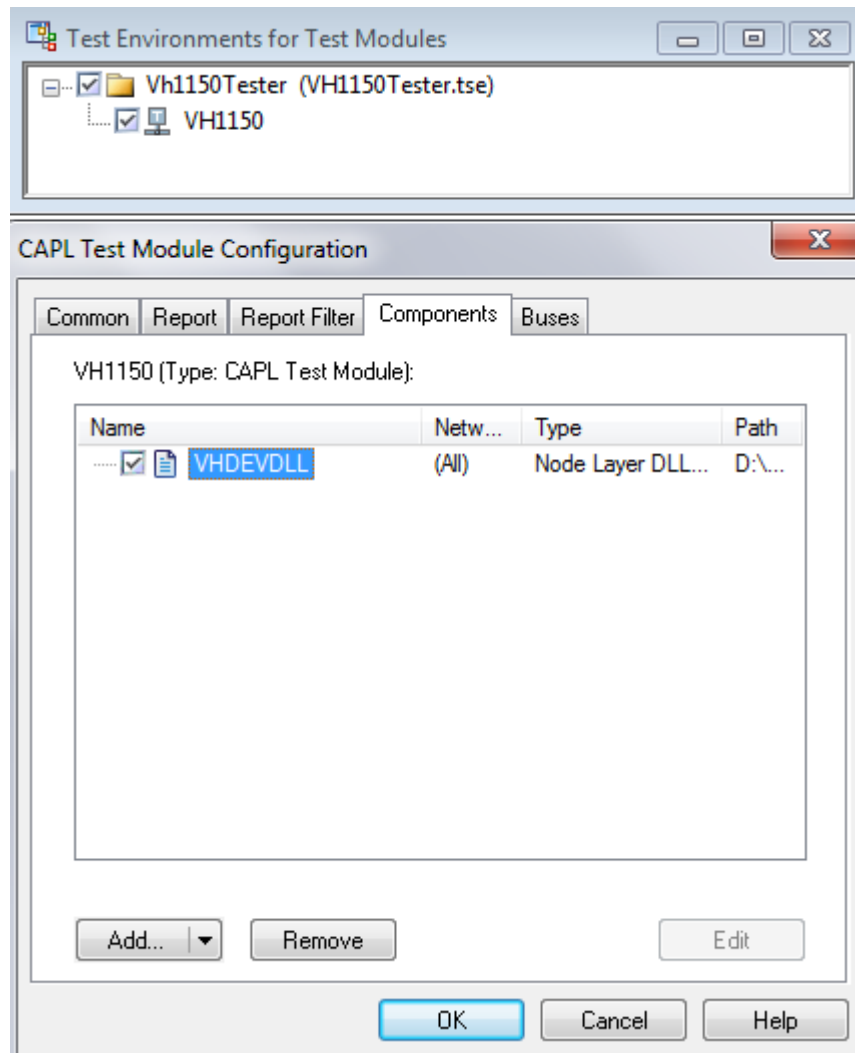
2.6 Configuring VH1150

VHDevDLL.dll	The API (see chapter 4 API) to control the VH1150 is implemented in the VHDevDLL.dll. The DLL can be found in the EXEC32 directory of the CANoe installation. To use the API the VHDevDLL.dll has to be attached to a test module (see figure below).
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Note: The VHDevDLL.dll must not be attached to a network node. The VHDevDLL.dll always requires the context of a test module.

Configuration of
VHDevDLL.dll



3 Technical Data

In this chapter you find the following information:

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	Connector CAN/LIN	

3.1 Output Voltage Terminal 15/30

Parameter	Value Range
Voltage Range	2 – 28 V
Output Current @ input voltage $\geq 22V$	Max. 2.5 A
Output	Short-circuit proof
Accuracy Output Voltage	+/- 60 mV
Typical Settling Time	≤ 5 ms

3.2 Measurement of Output Current

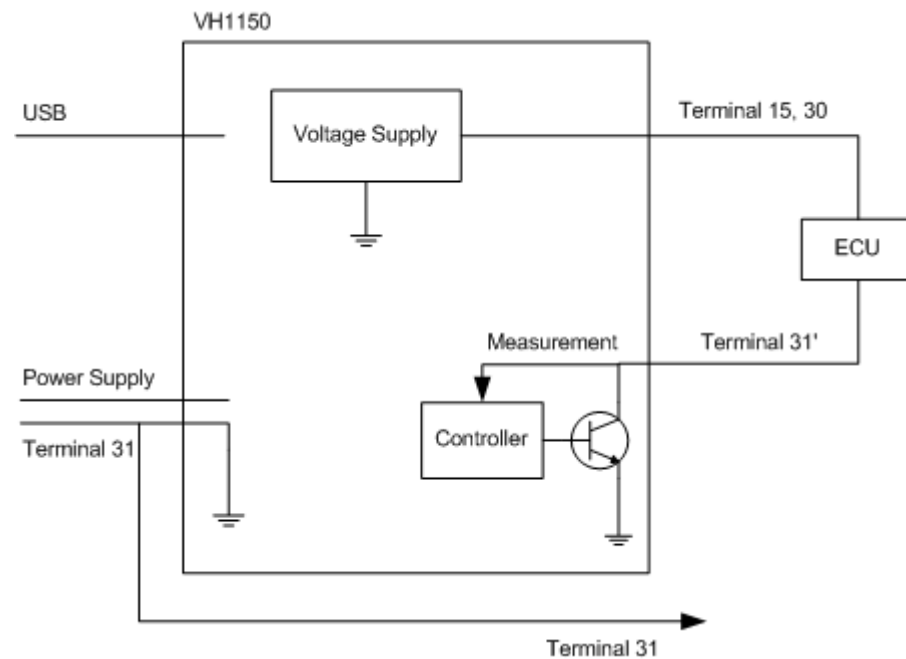
Parameter	Value
Measurement location	Supply line to the ECU
Accuracy	+/- 2 % or 0.5 mA

3.3 Relay for Terminals

Parameter	Value Range
Relay	Terminal 30 Terminal 15 Terminal 31'
Typical switching time	7 ms

3.4 Ground Offset for DUT Supply

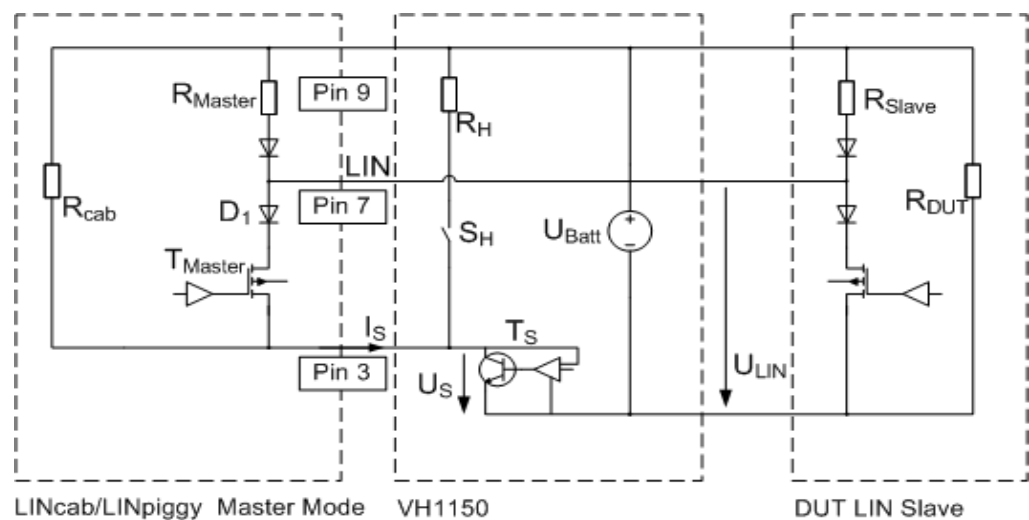
Block diagram
ground offset



Parameter	Value Range
Offset Voltage Terminal 31'	0 – 10 V
Terminal 31	Supply Ground
Accuracy	+/- 50 mV

3.5 Ground Offset LIN Line

Principle ground
offset LIN line



Parameter	Value Range
Offset Range VS	2.5 – 17.5 V
Operation Range V_{batt}	6.0 – 28.0 V
Accuracy	+/- 50 mV
Settling Time	100 ms or faster

3.6 LIN Recessive Level Limit

The **VH1150** fault injection unit allows to limit the LIN recessive level.

Parameter	Value Range
V_LIN_Rec_min	3.0 V
V_LIN_Rec_max	28.0 V
V_LIN_Rec Accuracy	+/-70 mV in the range 3 V to (V_Batt-3V)
Settling Time	100 ms
General	$V_{Batt} > V_{LIN_Rec}$

3.7 Device IOs

3.7.1 Analog Input Port

Parameter	Value Range
Measurement Range	0 – 30 V
Accuracy	+/- 1 % of full scale
Input Resistance	> 500 kOhm
Max Voltage	+/- 40 V

3.7.2 Analog Output Port

Parameter	Value Range
Voltage Range	0 – 15 V
Accuracy	+/- 0.5 %
Output Current	+/- 5 mA Short circuit proof

3.7.3 Digital Output Port

Parameter	Value Range
Output Type	Open drain with 3.3 kOhm pull-up to V_{batt} .
Current I_{low} max	100 mA @ $V = 0.2$ V Caution: The current must not exceed 100mA! Do not attach a power supply to the port!
Max Voltage	30 V

3.7.4 Digital Input Port

Parameter	Value Range
Switching Threshold	1.5 – 2.5 V
Input Resistance	> 10 kOhm
Max Voltage	Max. 40 V

3.7.5 I/O Connector Pin Assignment

Pin D-Sub 9 connector (female)	Description
1	Digital input
2	Not available
3	Terminal 31'
4	Not used
5	Analog input
6	Digital output
7	Terminal 30
8	Terminal 15
9	Analog output



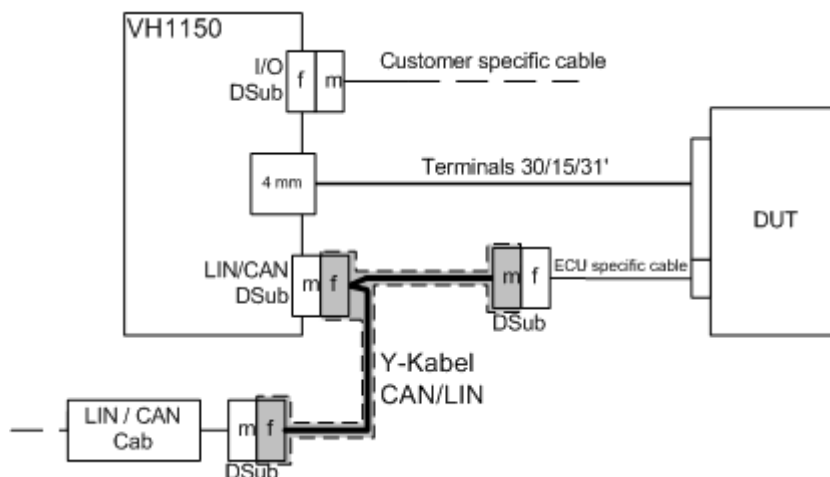
Caution: Do not draw over 0.5 A at any pin. Especially, this applies for the terminals 30, 15 and 31'.

3.8 Short Circuit and Interruption of CAN, LIN

Connection CAN/LIN line for short circuit and interruption

The CAN/LIN lines are routed over the **VH1150** to the DUT.

The CAN/LIN lines can be interrupted or short-circuited.



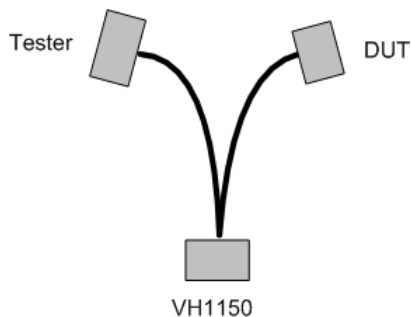
Possible short circuits

- > CAN_H/LIN – ground
- > CAN_L – ground
- > CAN_H/LIN – V_{batt}
- > CAN_L – V_{batt}
- > CAN_H – CAN_L
- > CAN_H/LIN interrupted
- > CAN_L interrupted

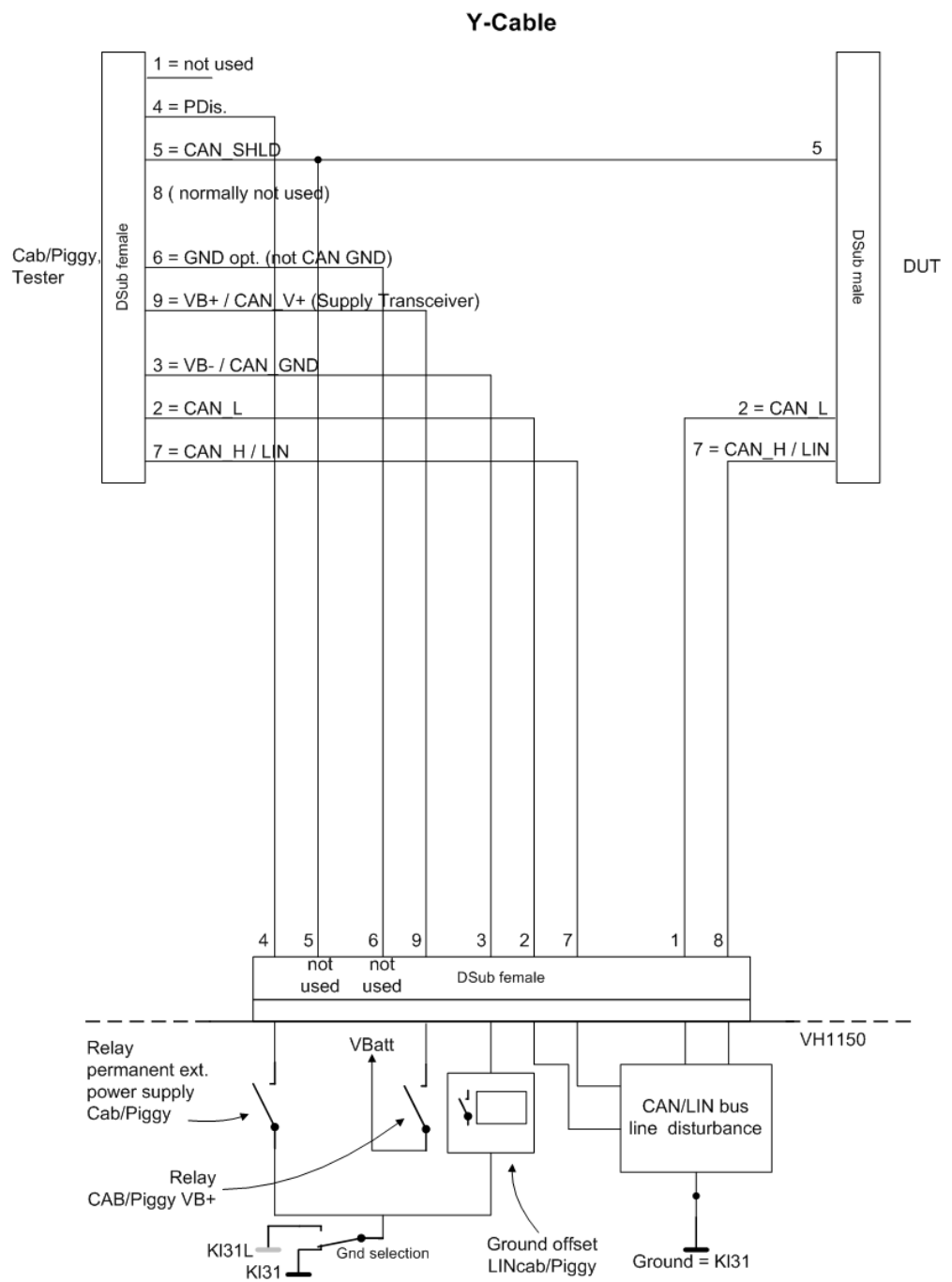
3.8.1 Y Cable

Connector	Type
Connector Tester	D-Sub 9 connector (female)
Connector DUT	D-Sub 9 connector (male)
Connector VH1150	D-Sub 9 connector (female)

Y cable



Y cable wiring



3.8.2 Connector CAN/LIN

Pin D-Sub 9 connector (male)	Name	Description
1	CAN_L DUT	CAN low connection of the device (DUT)
2	CAN_L Tester	CAN low connection of the CANcab/CANpiggy
3	CAN GND Cab	Connected to terminal 31
4	Pdis	LINcab/LINpiggy forced to external supply
5	–	Not used
6	–	Not used
7	CAN H / LIN Tester	CAN/LIN connection Tester
8	CAN H / LIN DUT	CAN/LIN connection ECU (DUT)
9	CAN VB+	Can be switched with relay to V_{batt}



Note: For CAN and LIN tests it is required that the DUT is also connected to the supply terminals 30 (VBat) or 15 (IGN) and 31' (GND).

4 API

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	VHDevOpen	
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	VHDevMeasureCANDiffVoltage	
4.7	Error Codes	page 42

4.1 General Functions

4.1.1 VHDevSearchOpen

Syntax	<code>long VHDevSearchOpen (long handle[1], char deviceType[], char deviceName[], int buffSize)</code>	
Function	<p>At first, the function tries to open a VH1100 device if National Instruments driver is installed. The function builds a list of compatible devices as known by the National Instruments driver. If this list contains more than one entry, no device will be opened and the function returns the error code <code>ERR_OPEN_NO_REPLACEMENT_FOUND</code>. If the list contains exactly one entry, the function opens this device.</p> <p>If no VH1100 device is found the function tries to open a VH1150 device.</p> <p>The function opens the first compatible device. If no compatible device is found, the function returns the error code <code>ERR_OPEN_NO_REPLACEMENT_FOUND</code>.</p>	
Parameters	handle	This function returns a handle. The handle is valid if the function returns zero, otherwise the handle must not be used.
	deviceType	Returns the type of the current device. Either VH1100 or VH1150 .
	deviceName	Returns the name of the actual used device.
	buffSize	Size of the buffers deviceType and deviceName .
Returns	0 on success, handle is valid. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.1.2 VHDevOpen

Syntax	<code>long VHDevOpen (char deviceName[], long handle[1])</code>	
Function	Opens the specified VH device. The format of the parameter deviceName determines whether the function opens a VH1100 or VH1150 device.	
Parameters	deviceName > VH1100 The name of the device as specified in the Measurement and Automation Explorer (MAX). Typical names are dev1 or dev2. > VH1150 COM-PortID encoded as string. The COM-PortID is a one or two digits number and identifies the COM port of the VH1150 . There can be entered any value from 0-99. The function will automatically search for the correct port.	
	handle The function returns a handle. The handle is valid if the function returns zero, otherwise the handle must not be used.	
Returns	0 on success, handle is valid. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.1.3 VHDevClose

Syntax	<code>long VHDevClose (long handle)</code>	
Function	Closes an opened device. Calling this function invalidates the handle.	
Parameters	handle A handle referencing the VH device.	
Returns	0 on success, handle is valid. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.1.4 VHDevSetSafeState

Syntax	<code>long VHDevSetSafeState (long handle)</code>	
Function	Sets the device in a defined and secure state. Note: This function requires Hardware Revision Number ≥ 2 .	
Parameters	handle A handle referencing the VH device.	
Returns	0 on success, handle is valid. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.1.5 VHDevGetHWRevision

Syntax	<code>long VHDevGetHWRevision (long handle, long hwRev[1])</code>	
Function	Retrieves the hardware revision number. This number describes the features of the VH device. API functions may require a certain hardware revision number. For example the function <code>VHDevStartVoltageProfile</code> for a VH1100 device requires a HRN of >1 . If the application uses such a function, the application should first check the HRN and handle the case when the HRN is too low. Note: The HRN cannot be used to distinguish between a VH1100 and VH1150 .	
Parameters	handle A handle referencing the VH device. hwRev The hardware revision number.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.1.6 VHDevResetOverload

Syntax	<code>long VHDevResetOverload (long handle)</code>	
Function	Terminates the Overload state of the device. Calling this function has no effect when the device is not in the Overload mode. If an overload condition (e.g. short circuit on output) is pending, the device may go back into its overload state.	
Parameters	handle A handle referencing the VH device.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.1.7 VHDevGetOverload

Syntax	<code>long VHDevGetOverload (long handle, long overloadState[1])</code>	
Function	Retrieves the overload state of the VH1150 device.	
Parameters	handle A handle referencing the VH device. overloadState Function returns: > 0=normal state > 1=device is in overload state	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.1.8 VHDevSetDebugFlag

Syntax	<code>long VHDevSetDebugFlag (long debugFlag)</code>	
Function	Sets the debug option flag to enable debug output into the CANoe Write Window.	
Parameters	debugflag > 0=disable > 1=enable	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.2 Terminal Control and Measurement

4.2.1 VHDevSetRelay

Syntax	<code>long VHDevSetRelay (long handle, long selector, long state)</code>	
Function	Switches the specified relay. VH1150: The ground line relay (GND, 31) can be controlled only if the ground offset is turned off.	
Parameters	handle A handle referencing the VH device.	
	selector Selects the relay: > 0=V30 > 1=V15 > 2=V31	
	state Relay contacts: > 0=open > 1=closed.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.2.2 VHDevSetRelayEx

Syntax	long VHDevSetRelayEx (long handle, long selector, long state, long relaySettleTime)	
Function	<p>Switches the specified relay.</p> <p>This function should be used for special applications only, in most applications VHDevSetRelay can be used instead.</p> <p>VH1150:</p> <p>The ground line relay (GND, 31) can be controlled only, if the ground offset is turned off.</p>	
Parameters	<p>handle</p> <p>A handle referencing the VH device.</p>	
	<p>selector</p> <p>Selects the relay:</p> <ul style="list-style-type: none"> > 0=V30 > 1=V15 > 2=V31 	
	<p>state</p> <p>Relay contacts 0=open, 1=closed</p>	
	<p>relaySettleTime</p> <p>Relay settle time in ms. The function sends the relay command to the VH device and waits the specified time before it returns to the caller. A settleTime of zero is valid.</p>	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.2.3 VHDevGetVoltage

Syntax	<code>long VHDevGetVoltage (long handle, long selector, double voltage[1])</code>	
Function	Retrieves a voltage value at the specified terminal.	
Parameters	handle A handle referencing the VH device.	
	selector > 0=V30 > 1=V15 VH1150: > 2=V31 This value is valid only when ground offset is turned on.	
	Voltage The measured voltage in volts.	
	Returns 0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.2.4 VHDevGetCurrent

Syntax	<code>long VHDevGetCurrent (long handle, long range, double current[1])</code>	
Function	Retrieves the measured current at the terminals 30/15. VH1100: The caller is responsible to set an appropriate range selector.	
Parameters	handle A handle referencing the VH device.	
	range > 0=low up to 200 mA > 1=high up to 2 A VH1150: parameter is ignored.	
	current The measured current in milli amps (mA).	
	Returns 0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.2.5 VHDevSetVoltageVBatt

Syntax	long VHDevSetVoltageVBatt (long handle, double voltage)	
Function	Sets the output voltage V_{batt} of the device.	
Parameters	handle A handle referencing the VH device.	
	voltage Output voltage in volts.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.2.6 VHDevSetVoltageVBattEx

Syntax	long VHDevSetVoltageVBattEx (long handle, double voltage, long settleTime)	
Function	Sets the output voltage V_{batt} of the device. This function should be used for special applications only, in most applications <code>VHDevSetVoltageVBatt</code> can be used instead.	
Parameters	handle A handle referencing the VH device.	
	voltage Output voltage in volts.	
	settleTime Settle time in ms. The function sends the set voltage command to the device, waits the specified settleTime, and returns to the caller. A settleTime of zero is valid.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	•	•

4.2.7 VHDevSetCurrentMeasurementRange

Syntax	long VHDevSetCurrentMeasurementRange(long handle, long range)	
Function	Sets the current measurement range.	
	Note: It is not possible to select the low current measurement range.	
	Note: This function requires Hardware Revision Number ≥ 5 .	
Parameters	handle A handle referencing the VH device.	
	range <ul style="list-style-type: none"> > 0=automatic, device selects the current measurement range. This is the default behavior. > 2=high range. 	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.3 Ground Offset and LIN Recessive Limit

4.3.1 VHDevSetGroundOffset

Syntax	<code>long VHDevSetGroundOffset (long handle, double offsetVoltage)</code>	
Function	VH1150: Shifts the ECU ground voltage by the specified value. <hr/> Note: Enabling the ground offset will turn off the features LIN Recessive Level and Analog Output. <hr/>	
Parameters	handle A handle referencing the VH device. <hr/> offsetVoltage Range 0.0 – 10.0 V. A value of ≤ 0.0 turns off the ground offset feature.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•
Example	If the ECU is supplied with a voltage of 14.4 V and the ground offset is set to 2.0 V, the actual ECU supply voltage measured between the pins IGN and GND' (connector 31') amounts to 12.4 V. Note that the battery voltage, measured between the pins IGN and GND (connector 31), remains unchanged (ie. 14.4 V). Depending on the ECU current and offset voltage, the ground offset feature may considerably increase the power dissipation of the VH1150 . This may cause the VH1150 to transit into its Overload state.	

4.3.2 VHDevSetTesterBusGroundOffset

Syntax	long VHDevSetTesterBusGroundOffset (long handle, double offsetVoltage)	
Function	<p>VH1150: Shifts the bus ground line on the tester side by the specified value. This feature is intended to be used in LIN networks.</p> <hr/> <p>Note: Enabling the ground offset will turn off the features Ground Offset, LIN Recessive Level and Analog Output.</p> <hr/> <p>Note: Please ensure that the LINcab is externally supplied. Please refer to the function VHdevSetLinCabSupplyMode.</p> <hr/> <p>Note: This function requires Hardware Revision Number ≥ 2.</p> <hr/>	
Parameters	<p>Handle A handle referencing the VH device.</p> <hr/> <p>offsetVoltage Range 0.0 – 20.0 V. A value of ≤ 0.0 turns off the ground offset feature.</p>	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•
Example	<p>On a LIN network, the bus ground offset (on the tester side) is set to a value of 2.0 V. If the LIN line has a recessive level, the ground offset has no primary effect. Both, the tester and the ECU, measure the recessive level on the LIN bus.</p> <p>If the tester sets its dominant level, the ECU sees a LIN voltage of about 2.7 V. This value results from the 2.0 V offset and a 0.7 V voltage over a diode in the drain – source path of the tester transceiver transistor. Thus, the Tester Ground Offset feature allows to increase the dominant level recognized by the ECU.</p> <p>Typically, the LIN transceiver of the tester is supplied by the VH1150. Even if the tester transceiver is setup to generate its own supply voltage, the Tester Ground Offset feature can be used.</p>	

4.3.3 VHDevSetLINRecessiveVoltageLimit

Syntax	<code>long VHDevSetLINRecessiveVoltageLimit (long handle, double recessiveVoltage)</code>	
Function	VH1150: Limits the recessive LIN voltage level to the specified value. <hr/> Note: Turning on the LIN recessive voltage will turn off the features Analog Output and Ground Offset.	
Parameters	handle A handle referencing the VH device. <hr/> recessiveVoltage Range 0.0 – 28.0 V. A value of ≤ 0.0 turns the feature off.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•
Example	The ECU is supplied with a voltage of 14.4 V and the recessive voltage is set to 9.5 V. This limits a LIN recessive bit (high) to 9.5 V. If the LIN recessive voltage is set to a value larger than the master's battery voltage (in this example > 14.5 V) the recessive voltage remains unchanged.	

4.4 Device Inputs/Outputs

4.4.1 VHDevSetAnalogOutput

Syntax	<code>long VHDevSetAnalogOutput (long handle, double analogOutputVoltage)</code>	
Function	VH1150: Sets the Analog Output voltage to the specified value. The output voltage is derived from the battery voltage V_{batt} . This means the analog output voltage will never exceed V_{batt} . <hr/> Note: Turning on the Analog Output will turn off the features LIN recessive voltage and Ground Offset.	
Parameters	handle A handle referencing the VH device. <hr/> analogOutputVoltage Range 0.0 – 28.0 V. A value of ≤ 0.0 turns off the feature.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.4.2 VHDevSetDigitalOutput

Syntax	long VHDevSetDigitalOutput (long handle, long state)	
Function	VH1150: Sets the digital output to the specified state.	
Parameters	handle A handle referencing the VH device.	
	state > 0=false=low > 1=true=high	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.4.3 VHDevSetLINCabSupplyMode

Syntax	long VHDevSetLINCabSupplyMode (long handle, long mode)	
Function	VH1150: Sets the voltage supply mode of the LINcab connected to the Cab/Piggy connector of the VH1150 Y cable.	
Parameters	handle A handle referencing the VH device.	
	mode > 0=internal LINcab produces its own 12V supply voltage. > 1=external/internal If an external supply voltage > 12V is available (pin 9) it will be used. Otherwise, the LINcab produces its own supply voltage. > 2=external The LINcab uses the external supply voltage (pin 9). If there is none, the LINcab is not supplied!	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.4.4 VHDevGetAnalogInput

Syntax	<code>long VHDevGetAnalogInput (long handle, double analogInputVoltage[1])</code>	
Function	VH1150: Retrieves the digital input state.	
Parameters	handle A handle referencing the VH device.	
	analogInputVoltage Measured voltage in volts.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.4.5 VHDevGetDigitalInput

Syntax	<code>long VHDevGetDigitalInput (long handle, long digitalInputState[1])</code>	
Function	VH1150: Retrieves the digital input state.	
Parameters	handle A handle referencing the VH device.	
	digitalInputState Function returns: > 0=false (low voltage) > 1=true (high voltage)	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.5 Bus Line Disturbance

4.5.1 VHDevSetBusFaults

Syntax	long VHDevSetBusFaults (long handle, long passThru, long CanH, long CanL)	
Function	<p>VH1150: Interrupts or connects the CAN/LIN lines to ground or V_{batt}. The mode is specified by three parameters. In the following description CAN_H corresponds to LIN.</p> <hr/> <p>Note: Enabling this function will turn off the LIN periodical short to ground.</p> <hr/>	
Parameters	<p>handle A handle referencing the VH device.</p>	
	<p>passThru</p> <ul style="list-style-type: none"> > 0=normal operation CAN_H and CAN_L are not interrupted > 1=CAN_H interrupted / LIN interrupted > 2=CAN_L interrupted > 3=CAN_H and CAN_L are interrupted 	
	<p>CanH / LIN</p> <ul style="list-style-type: none"> > 0=nomal operation > 1=connected to GND > 2=connected to V_{batt} > 3=connected to CAN_L, parameter CanL is ignored (CAN only) 	
	<p>CanL</p> <ul style="list-style-type: none"> > 0=nomal operation > 1=connected to GND > 2=connected to V_{batt} 	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.5.2 VHDevSetPeriodicalLINBusFault

Syntax	<code>long VHDevSetPeriodicalLINBusFault(long handle, long mode, double frequency)</code>	
Function	Switches the LIN line periodically to either GND or V_{batt} .	
	Note: Enabling this function will turn off the LIN bus faults.	
	Note: This function requires hardware revision number ≥ 4 .	
Parameters	handle A handle referencing the VH device.	
	modes > 0=normal operation, short connection disabled > 1=fast periodic short connection to GND > 2=fast periodic short connection to V_{batt}	
	frequency Frequency of short connection in Hertz. $1/(2*f)$ = time span of connection to GND or VBatt. Allowed range: 2 Hz - 50 kHz.	
	Returns 0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.6 CAN Network

4.6.1 VHDevMeasureCANTermResistor

Syntax	<pre>long VHDevMeasureCANTermResistor(long handle, double termResPosMeasVoltage[1] , double termResNegMeasVoltage [1])</pre>	
Function	<p>Measures the CAN termination resistor between the CAN_H and CAN_L lines. The termination resistor is measured twice by inverting the polarity of the measurement voltage. One measurement uses a positive CAN_H to CAN_L voltage, whereas the other measurement puts CAN_L on a higher voltage than CAN_H.</p> <hr/> <p>Note: This function requires hardware revision number ≥ 4.</p> <hr/>	
Parameters	<p>handle A handle referencing the VH device.</p>	
	<p>termResPosMeasVoltage The measured termination resistor value in Ohm. The measurement is carried out with a positive CAN_H to CAN_L measurement voltage.</p>	
	<p>termResNegMeasVoltage The measured termination resistor value in Ohm. The measurement is carried out with a negative CAN_H to CAN_L measurement voltage.</p>	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.6.2 VHDevSetCANCapacitors

Syntax	<code>long VHDevSetCANCapacitors (long handle, long enable)</code>	
Function	Switches capacitors to the CAN_H and CAN_L lines. The other ends of the capacitors are connected to GND. Each capacitor has capacitance of 1.6 nF. Note: This function requires hardware revision number ≥ 4 .	
Parameters	handle A handle referencing the VH device. enable > 0=capacitors are switched off, i.e. they are not connected to the CAN lines. > 1=capacitors are switch on, i.e. they are connected to the CAN lines.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.6.3 VHDevMeasureCANDiffVoltage

Syntax	<code>long VHDevMeasureCANDiffVoltage (long handle, double measurementPeriod, double vRecessive[1], double vDominant[1])</code>	
Function	Measures the recessive and dominant voltage of the differential CAN signal. Note: This function requires hardware revision number ≥ 4 .	
Parameters	handle A handle referencing the VH device. measurementPeriod Duration of measurement in ms. If <code>measurementPeriod</code> is ≤ 0 , the de-fault value of 1000 ms is used. vRecessive Measured recessive (logic level H or 1) voltage of U_CAN_diff in Volts. vDominant Measured dominant (logic level L or 0) voltage of U_CAN_diff in Volts.	
Returns	0 on success. Otherwise see Error Codes .	
Support	VH1100	VH1150
	–	•

4.7 Error Codes

Error Code	Error No.	Comment
ERR_OK	0	
ERR_FAILED	-1	
ERR_INVALID_HANDLE	2	
ERR_NOT_IMPLEMENTED	3	
ERR_INVALID_PARAMETER	4	
ERR_DEVICE_INUSE	5	
ERR_VIA_NL	6	
ERR_VIA_CAST	7	
ERR_AINFAILED	8	
ERR_AINNODATA	9	
ERR_DRIVERDLL_NOT_LOADED	10	Unable to load driver DLL
ERR_INTERNAL_NONL	11	Internal error, node layer not available
ERR_VOLTAGEPROFILE_RUNNNG	12	Function call not allowed at this time
ERR_HARDWARE_REV_NUMBER_TOO_LOW	13	Newer hardware required
ERR_CALIB_FAILED	14	
ERR_OPEN_NO_REPLACEMENT_FOUND	15	Open of specified device failed. Too many or no compatible devices found
ERR_INCOMPATIBLE_DEVICE	16	This type of device cannot handle the command
ERR_NO_ANSWER_FROM_INTERFACE	17	Interface is not responding

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