User Manual VT7870

VT System

Version 1.3

English

Imprint

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Table of Contents

1 Introduction

This chapter contains the following information:

1.1 About this User Manual

1.1.1 Navigational Aids and Conventions

To find information quickly

This user manual provides you with the following navigational aids:

> At the beginning of each chapter you will find a summary of the contents
> The header shows which chapter and paragraph you are located in
> The footer shows which version the user manual refers to

Conventions

The following two charts show the spelling and symbol conventions used in this manual.

Style	Utilization
bold	Fields, interface elements, window and dialog names in the software. Accentuation of warnings and notes. **[OK]** Buttons are denoted by square brackets **File** | **Save** Notation for menus and menu commands
CANoe	Legally protected proper names and side notes.
`Source code`	File name and source code.
Hyperlink	Hyperlinks and references.
<Ctrl>+<S>	Notation for shortcuts.

Symbol	Utilization
	You can obtain supplemental information here.
	This symbol calls your attention to warnings.
	You can find additional information here.
	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.

1.1.2 Latest Information

Additional technical information

You may find additional technical information about your VT System:

- in the CANoe online help,
- on the Vector website www.vector.com (e.g. application notes), and
- in your CANoe installation.

Reference: You may find the **latest version of VT System user manual** in your CANoe installation as well as a **technical user manual** which explains more technical background details, limitations, application tips or connection possibilities of the VT System (start menu ⇨ CANoe ⇨ Help).

1.1.3 Certification

Certified Quality Management System

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

CE Compliance

All VT System products comply with CE regulations.

1.1.4 Warranty

Limitation of warranty

We reserve the right to change the contents of the documentation and the software as well as the hardware design without notice. Vector Informatik GmbH assumes no liability for correct contents or damages which are resulted from the usage of the user manual. We are always grateful for references to mistakes or for suggestions for improvement, so as to be able to offer you even better-performing products in the future.

1.1.5 Support

Need support?

You can get through to our hotline by calling +49 (711) 80670-200

or you can send a problem report to CANoe Support.

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- dLAN® is a registered trademark of devolo AG

2 General Information

This chapter contains the following information:

2.1 Purpose

VT7870

The VT7870 is a dedicated module for testing the smart charge communication of electric vehicles. It is an application board which is mounted on the VT7900 extension module. The module can simulate both communication partners, the electric vehicle supply equipment (EVSE) and the electric vehicle (EV) itself and offers the following features:

- Control pilot (CP) circuit for PWM communication according to IEC 61851-1 Annex A
- Electrically isolated from the remaining VT System
- Power line communication (PLC) with Devolo dLAN® Green PHY Module which is integrated on the VT7870 and communicates with CANoe via a RJ45 connector
- Voltage measurement of proximity contact (PP)
- Several possibilities to simulate errors and vary component values
- PWM signal will be generated and measured on the application board, but external measurement and stimulation is also possible
- Parameters of the PWM signal and the relays to switch the signal paths can be controlled in CANoe via system variables

2.2 Installation

Installation

Please follow the general installation instructions in the installation section of the VT System user manual.

The dLAN® Green PHY Module is already mounted on the application board. The processor on this module is used also for stimulation and measurement of the PWM signal and communication with CANoe and is therefore necessary for a correct function of the VT7870.

Caution: As the processor on the dLAN® Green PHY Module is also used for other tasks than PLC, the module must not be removed, even though the PLC functionality is not used.

2.3 Usage

2.3.1 Basic Connection Scheme

For testing the smart charge communication the following signals of a charging plug can be connected.

Communication connection

- **Connecting of control pilot**
  For the control pilot signal there are two identical connectors available. At CP_EVSE the electric vehicle supply equipment will be connected and at CP_EV the electric vehicle will be connected. So it is also possible to connect EV and EVSE to the VT7870 at the same time.
- **Connecting of PE**
  With this connector the PE (protective earth) will be connected to the ground of the VT7870, which is electrically isolated from the remaining VT System (including the main module VT7900).
- **Connecting of proximity contact**
  At this connector the proximity contact signal for detection of the possible charging current can be connected.

For stimulation and measurement of the PWM signal also external instruments can be connected.

Measurement connection

- **Connecting external PWM stimulation (PWM_Stim)**
  At this connector for example a signal generator can be connected to create the PWM signal externally. A voltage between 0V and 3.3V at this connector results to a level of +/-15V at the control pilot, whereat a voltage of 1.65V corresponds to a CP level of 0V.
- **Connecting external PWM measurement of CP (PWM_Meas)**
  At this connector for example a frequency counter can be connected to measure the PWM parameters of the control pilot signal. The CP signal is available with a level of max. +/-15V.
- **Connecting external voltage measurement of CP (V_CP_Meas)**
  At this connector for example a voltmeter can be connected to measure the high and low voltage level of the Control Pilot signal. The CP signal is available with a level of max. +/-15V.
- **Connecting external voltage measurement of PP (V_PP_Meas)**
  At this connector for example a voltmeter can be connected to measure the voltage of the proximity contact signal, which has a range from 0V to 5V.
- **Connecting the ground for external measurement and stimulation devices**
  With this connector the ground of the external measurement and stimulation devices can be connected to the ground on the application board. The ground of the application board is electrically isolated from the remaining VT System (including the main module VT7900) and is usually connected to protective earth (PE) of the charge plug.

Caution: The application board (signals, supply voltages and ground) is electrically isolated from the remaining VT System. So care has to be taken when connecting external measurement devices (e.g. oscilloscope) that no ground connection to the VT System is established via the power network. It is recommended to use an isolation transformer.

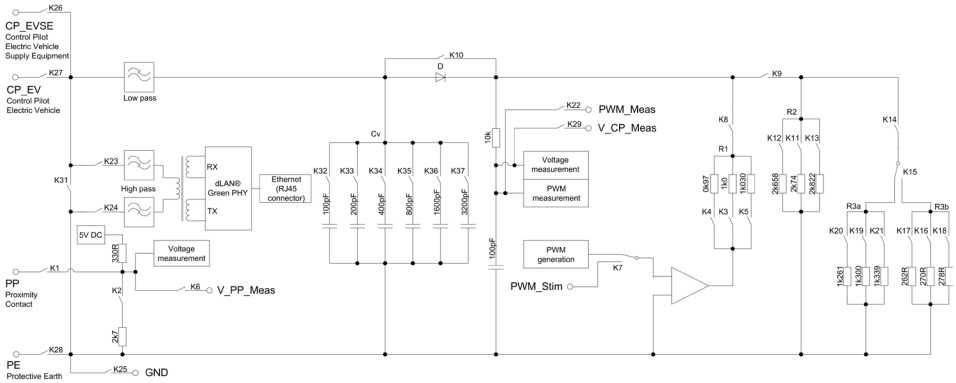
Ethernet connection

For the connection of the converted PLC signal to CANoe, a RJ45 connector is placed directly on the application board nearby the dLAN® Green PHY Module.

2.3.2 Signal Path Switching

Signal paths and switching options

The figure below shows the various signal paths and switching options.



For a detailed view see chapter 3.

The VT7870 has circuits to simulate either the electric vehicle supply equipment (EVSE) or the electric vehicle (EV). To vary between these two possibilities the signal path will be set by switching the relevant relays.

2.3.3 System Variables

The stimulation parameters for the PWM communication (frequency, duty cycle, high voltage, low voltage) can be controlled via system variables in CANoe. Also the measurement values of all PWM parameters and the proximity contact voltage are available permanent via system variables, independent if the VT7870 is used for simulation of EVSE or EV. The relays are accessible via system variables, too.

System variables reference

The namespace is the name of the module specified in the VT System configuration:

Value/Setting	System Variable	R/W	Value Semantic
Relay function according to schematic in chapter 2.3.2	Relay_K1 … Relay_K37	W	Integer (0 = open, 1 = closed)
Proximity contact voltage measurement value	MeasPPVoltage	R	Float, in volt (0…5)
Control pilot PWM frequency measurement value	MeasFrequency	R	Float, in hertz (900…1100)
Control pilot PWM duty cycle measurement value	MeasDutyCycle	R	Float, in percent (0…100)

Value/Setting	System Variable	R/W	Value Semantic
Control pilot PWM high voltage measurement value	MeasVoltageHigh	R	Float, in volt (-15…15)
Control pilot PWM low voltage measurement value	MeasVoltageLow	R	Float, in volt (-15…15)
Control pilot PWM frequency stimulation value	StimFrequency	W	Float, in hertz (900…1100)
Control pilot PWM duty cycle stimulation value	StimDutyCycle	W	Float, in percent (0…100)
Control pilot PWM high voltage stimulation value	StimVoltageHigh	W	Float, in volt (-15…15)
Control pilot PWM low voltage stimulation value	StimVoltageLow	W	Float, in volt (-15…15)

Reference: As the VT7870 is based on the VT7900, the system variables can be edited (e.g. rename) with the Application Board Configurator, which is included in the CANoe installation (start menu ⇨ CANoe ⇨ Tools).

2.3.4 Error Simulation

The module features various error simulation and parameter variation possibilities:

- Simulation of broken wire
- Simulation of short circuit between control pilot (CP) and protective earth (PE)
- Variation of PWM frequency, PWM duty cycle and PWM high and low level
- Variation of capacitive load
- Variation of resistors between minimum, maximum and nominal values

The variation range of the parameters and values can be found in the section technical data, chapter 2.5.

The simulation of short and broken wires, the variation of the resistor values and the capacitive load will be done by relays. The necessary relay settings can be found in the figure in the section 2.3.2.

2.3.5 QCA7000

Boot mode

Between the dLAN® Green PHY Module and the RJ45 connector on the application board a small switch is located. With this switch the boot mode of the QCA7000 after a power-on reset of the VT7870 can be selected. In off-position the device will boot from the flash memory on the dLAN® Green PHY Module. In on-position booting from an external host is possible.

2.3.6 Displays

Front panel LEDs

The LEDs on the front panel of the main module VT7900 are not used for this application.

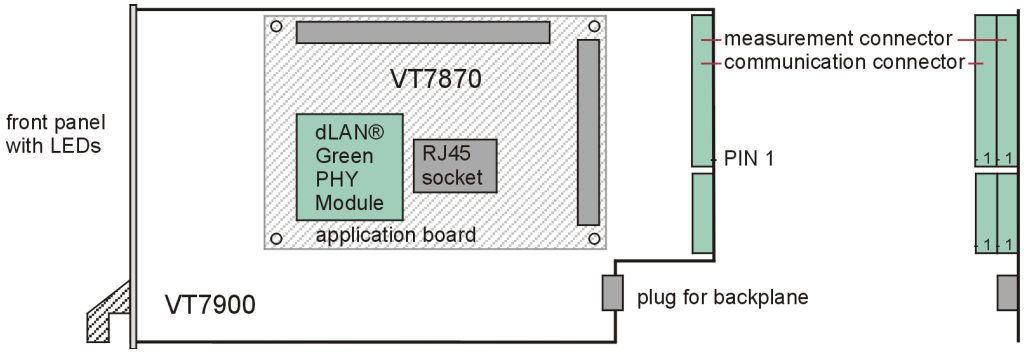
Application board LEDs

The state of the PLC and Ethernet connection will be display with various LEDs on the application board.

LED	Description
PLC-Link/Activity	…orange LED located between the dLAN® Green PHY Module and the RJ45 connector shows PLC-Link/Activity.
Ethernet-Link/Activity	…orange LED integrated in RJ45 connector shows Ethernet-Link/Activity.
Ethernet-Speed	…green LED integrated in RJ45 connector indicates the data speed (10/100 Mbps).

2.4 Connectors

Connectors



2.4.1 Communication Connector

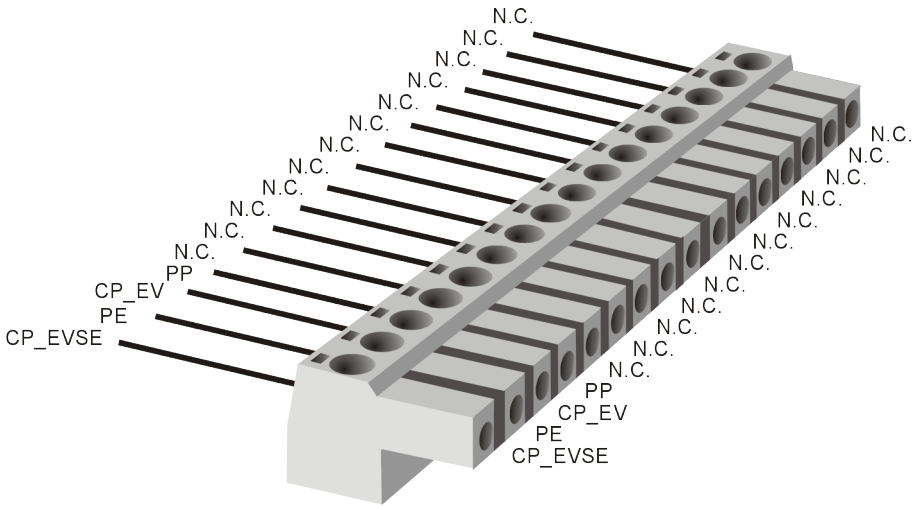
Plug type

Plug type: Phoenix Contact MC 1,5/16-ST-3,81

Plug allocation

Plug allocation (from top to bottom, viewed from the rear after installation):

Pin	Description
16	CP_EVSE, Control Pilot Electric Vehicle Supply Equipment
15	PE, Protective Earth
14	CP_EV, Control Pilot Electric Vehicle
13	PP, Proximity Contact
12	N.C.
11	N.C.
10	N.C.
9	N.C.
8	N.C.
7	N.C.
6	N.C.
5	N.C.
4	N.C.
3	N.C.
2	N.C.
1	N.C.



2.4.2 Measurement Connector

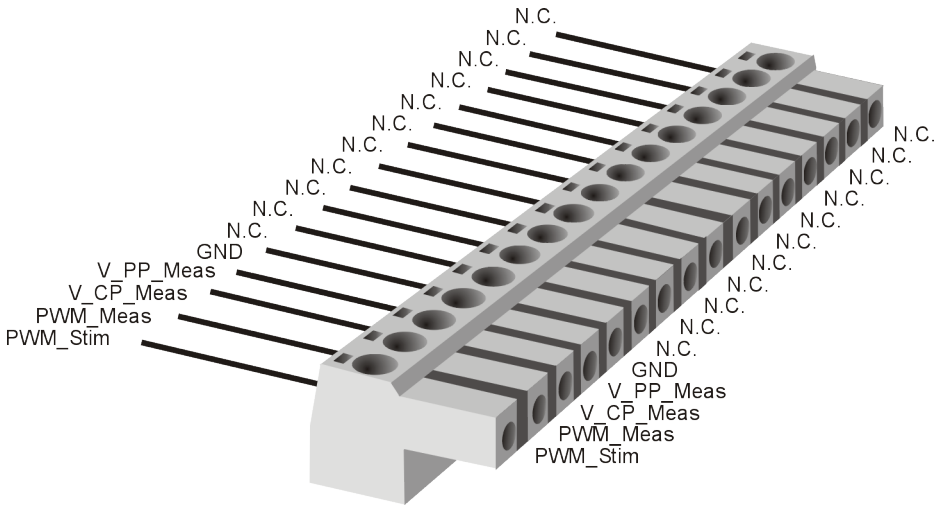
Plug type

Plug type: Phoenix Contact MC 1,5/16-ST-3,81

Plug allocation

Plug allocation (from top to bottom, viewed from the rear after installation):

Pin	Description
16	PWM_Stim
15	PWM_Meas
14	V_CP_Meas
13	V_PP_Meas
12	GND
11	N.C.
10	N.C.
9	N.C.
8	N.C.
7	N.C.
6	N.C.
5	N.C.
4	N.C.
3	N.C.
2	N.C.
1	N.C.



2.5 Technical Data

2.5.1 General

Parameter	Min.	Typ.	Max.	Unit
Supply voltage (via the backplane)	10.8	12	13.2	V
Power consumption at 12.0 V > all relays off > 10 relays switched on > 20 relays switched on		 5.5 7.7 9		 W W
Temperature range	0		+55	ºC
Dimensions (length × width × depth)	300 × 173 × 36			mm
Total weight including application board	approx. 500			g

2.5.2 Control Pilot PWM Stimulation

Parameter	Min.	Typ.	Max.	Unit
Voltage > range > accuracy	 -15 -1		 15 1	 V %
Signal rise time (±12V, 10% to 90%) > no load, PLC coupler disconnected > no load, PLC coupler connected > max. capacitive load (6.3 nF), PLC coupler disconnected > max. capacitive load (6.3 nF), PLC coupler connected		 1.0 3.6 14.2 16.8		 µs µs µs µs
Signal fall time (±12V, 90% to 10%) > no load, PLC coupler disconnected > no load, PLC coupler connected > max. capacitive load (6.3 nF), PLC coupler disconnected > max. capacitive load (6.3 nF), PLC coupler connected		 1.4 3.7 14.0 16.8		 µs µs µs µs
Frequency > range > accuracy	 900	 0.1	 1000	 Hz Hz
Duty cycle > range > accuracy	 1	 0.1	 99	 % %

2.5.3 Control Pilot PWM Measurement

Parameter	Min.	Typ.	Max.	Unit
Voltage				
> range	-15		15	V
> accuracy	-1		1	%
Frequency				
> range	900		1000	Hz
> accuracy		0.1		Hz
Duty cycle				
> range	1		99	%
> accuracy		0.1		%

2.5.4 Proximity Contact Measurement

Parameter	Min.	Typ.	Max.	Unit
Voltage				
> range	0		5	V
> accuracy	-1		1	%
Resistance values				
> R4		2.7		kΩ
> R5		0.33		kΩ

2.5.5 Error Simulation

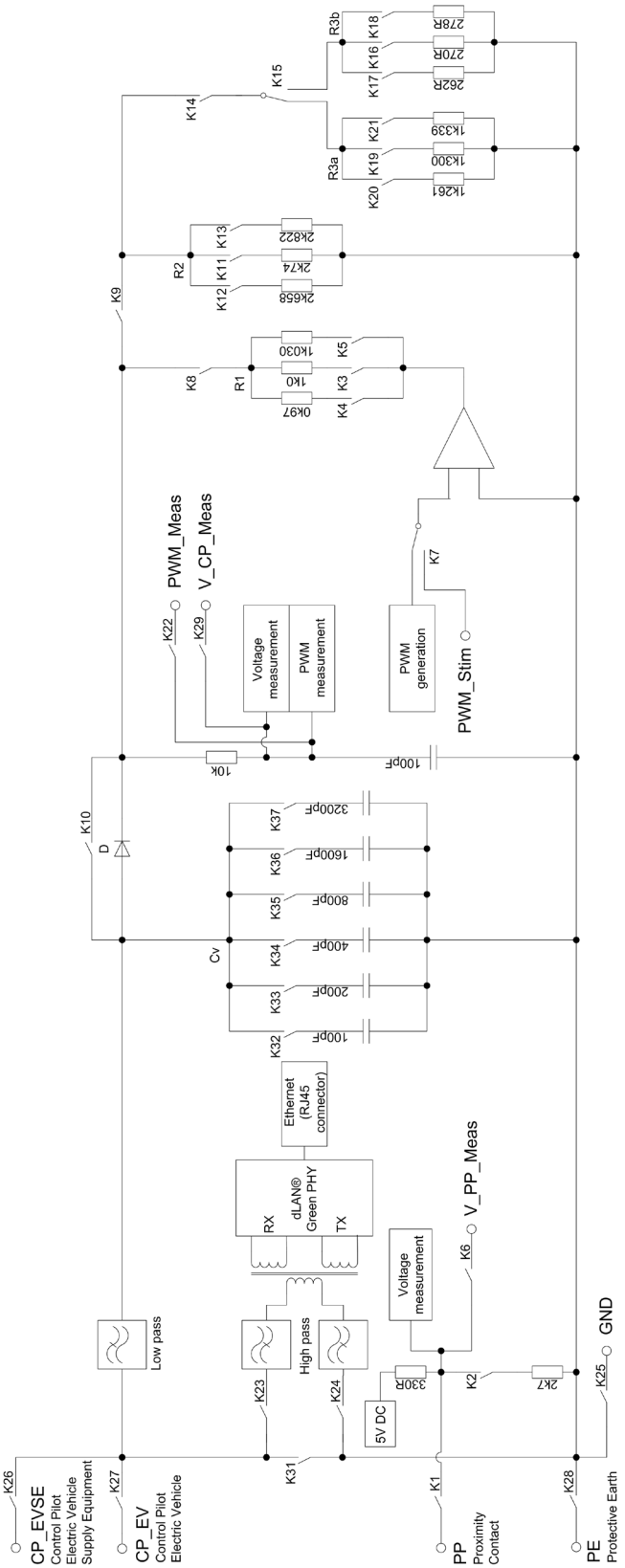
Parameter	Min.	Typ.	Max.	Unit
Capacitive load				
> range	0		6.3	nF
> step width		100		pF
Resistance values				
> R1	0.97	1	1.03	kΩ
> R2	2.658	2.70	2.822	kΩ
> R3a	1.261	1.3	1.399	kΩ
> R3b	0.262	0.270	0.278	kΩ

2.5.6 Power Line Communication

Parameter	Min.	Typ.	Max.	Unit
Low pass filter PLC rejection		20		dB
PLC insertion loss				
> RX path		7		dB
> TX path		7		dB
PLC transformer turn ratio (PL:RX:TX)	1:1:1			

3 Appendix

Detailed view signal path and switching options



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