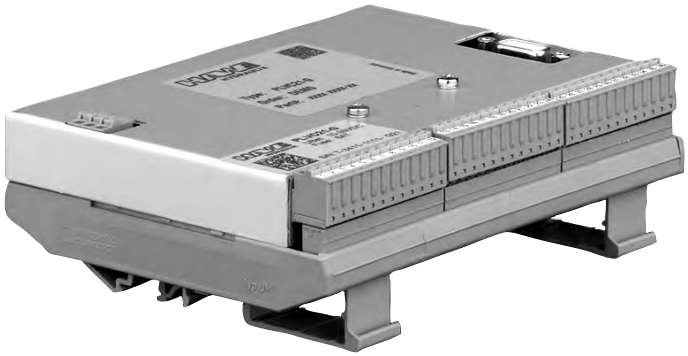
Programmable logic valve control with PROFIBUS type PLVC 21

CE

See also other electronic valve controller/accessory:
Type PLVC 41 acc. to D 7845-41



1. General information

The programmable logic valve control of type PLVC 21 consists of a complex PLC-enabled micro-control unit with integrated amplifiers for mobile and stationary hydraulic applications. The wide range of possible application includes, among others:

- Hydraulic clamping systems for machine tools
- Presses
- PROFIBUS/CAN-Bus gateway
- Hoisting equipment

The various control tasks are realized through:

- Modular system with extension modules
  - Basic module
  - Extension module (additional inputs/outputs, CAN-Bus)
- Flexible programmability according to IEC 61131-3 standard (PLC-programming via instruction list (IL), function block diagram (FBD) or structured text (ST))
- Various interfaces (RS232, PROFIBUS, CAN-Bus)
- Free parameterization of all outputs as well as complete diagnosis capability and short-circuit protection
- Remote diagnosis via modem or mobile phone
- Combination of multiple PLVC's via CAN-Bus within one integrated unit for the control of complex systems
- Conversion from PROFIBUS to CAN-Bus and vice versa.

The main performance parameters include furthermore:

- Basic module PLVC 21
  - 4 analog inputs (for joysticks, potentiometers, sensors such as analog pressure sensors) (selectable range 4...20, 0...100, 0...50)
  - 5 digital inputs (for limit switches, pressure switches, push buttons etc.)
  - 3 frequency inputs (for rotary sensors, speed sensors, incremental encoder etc.)
  - Emergency-Stop (opto-decoupled)
  - Interface for RS232, PROFIBUS and CAN-Bus
  - 4 outputs for prop. or ON/OFF valves (current-controlled, high side) 2 A
  - 8 digital outputs for resistant or inductive loads 1.2 A
  - Power supply 10 ... 30 V DC, max. 5 A
- Extension module PLVC 21 - EW
  - 8 analog / digital inputs
  - 8 digital outputs for resistant or inductive loads 1.2 A
  - 4 relay outputs (optional, possible with changed layout that omits 4 digital outputs), change-over contact, rating 1.7 A
  - CAN-Bus
  - Power supply 10 ... 30 V DC, max. 5 A

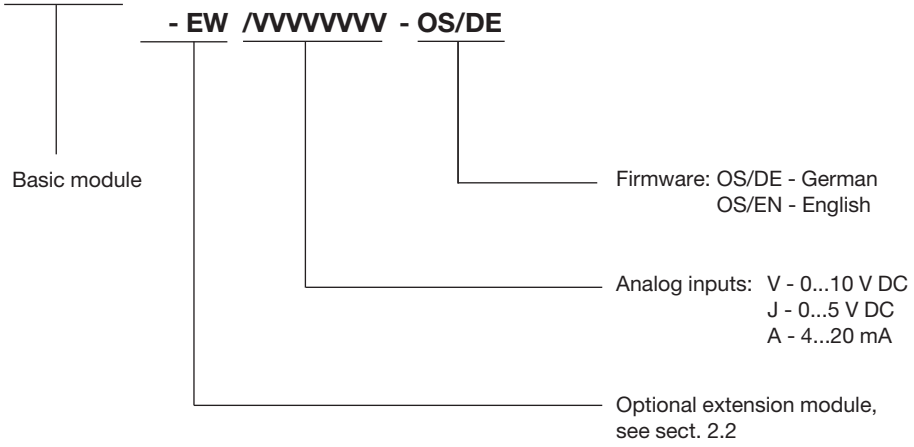
  Attention: Emergency stop of the basic module does not apply to the digital outputs of the extension!
- Functional software features
  - PLC programming via IL or ST
  - Parameterization during operation
  - PROFIBUS and CAN-Bus are integrated in the firmware

2. Available Versions

2.1 Basic module

Order examples:

PLVC 21 - G **- OS/EN** Basic module
PLVC 21 - X - EW **- OS/DE** Basic module with extension module
- EW /VVVVVVVV - OS/DE



Note on the specification of analog inputs:

The analogous inputs of the extensions are set for 0...10 V DC (coding V) in std. delivery state. This can be specified otherwise in the order code (4...20 mA, coding A or 0...5 V DC, coding J). The analogous inputs at the basic unit can be parameterized via software for input signals 4...20 mA or 0...5 V DC.

General data

Casing, protection class	IP 20 (IEC 60529)
Temperature range	-40°C to +80°C
Power supply	10 V DC to 30 V DC
Max. total current	10 A (basic module)
Required external fusing	10 A (slow blow)
Protection	Reverse polarity protection Load dump protection (DIN 40839) Shock proof (vibration: IEC 68-2-6, shock: IEC 68-2-27) EMV (EN 61000-6-4, EN 61000-6-1, EN 61000-6-2, EN 61000-6-3)
Monitoring	Short-circuit, under-voltage, and over-voltage Cable break
Cable connections	By means of via spring-cage connectors Phoenix for up to 1.5 mm^2 diameter
Micro-controller	ST10F276, 16 bit
Basic parameter memory	EEPROM 1000 words
Memory	Flash: 830 kBytes RAM: 188 kBytes
Mounting	Phoenix clip type casing for clip-rails
Casing material	Plastic; cover in light alloy (anodized)
Mass (weight)	approx. 0.3 kg (basic module) approx. 0.1 kg (extension module)

Power specifications of connections (Block diagram basic module, see page 4)

Connector rail	Function	Description	Parameter
	- Power supply	Rated voltage U_N Max. total current (power)	10 ... 30 V DC 10 A
	- Proportional and/or ON/OFF outputs 0 - 3 (with high-side measuring)	I_{min} I_{max} Dither frequency Dither amplitude (in relation to PWM) Cold resistance	100 ... 1200 mA 100 ... 2200 mA 25 ... 200 Hz 0 ... 48 % 2 ... 35 Ohm
X 1	- Frequency input 0 - 2	Limit frequency	f_{lim} = 5 kHz
	- Digital inputs 0 - 4	Voltage range individually switchable debouncing for increasing/decreasing signal flank	10 ... 30 V DC / 5 kOhm
	- Digital outputs 0 - 7	for ON/OFF-valves and consumers with resistance characteristics	10 ... 30 V DC / 1.2 A
	- Emergency-Stop input	opto-decoupled	
	- Interface RS232	Interface parameter	19.2 kBaud
	- Analog interface 0 - 3 (for joysticks, potentiometers, sensors, etc.) Range monitoring	10 bit A DC ≙ 1024 steps	4 ... 20 mA 0 ... 10 V DC (default) 0 ... 5 V DC
X 2	- Interface PROFIBUS	DP-Slave	max. 6 MBaud
X 7	- CAN-Bus		max. 1 MBaud

2.2 Extension module PLVC 2 - EW

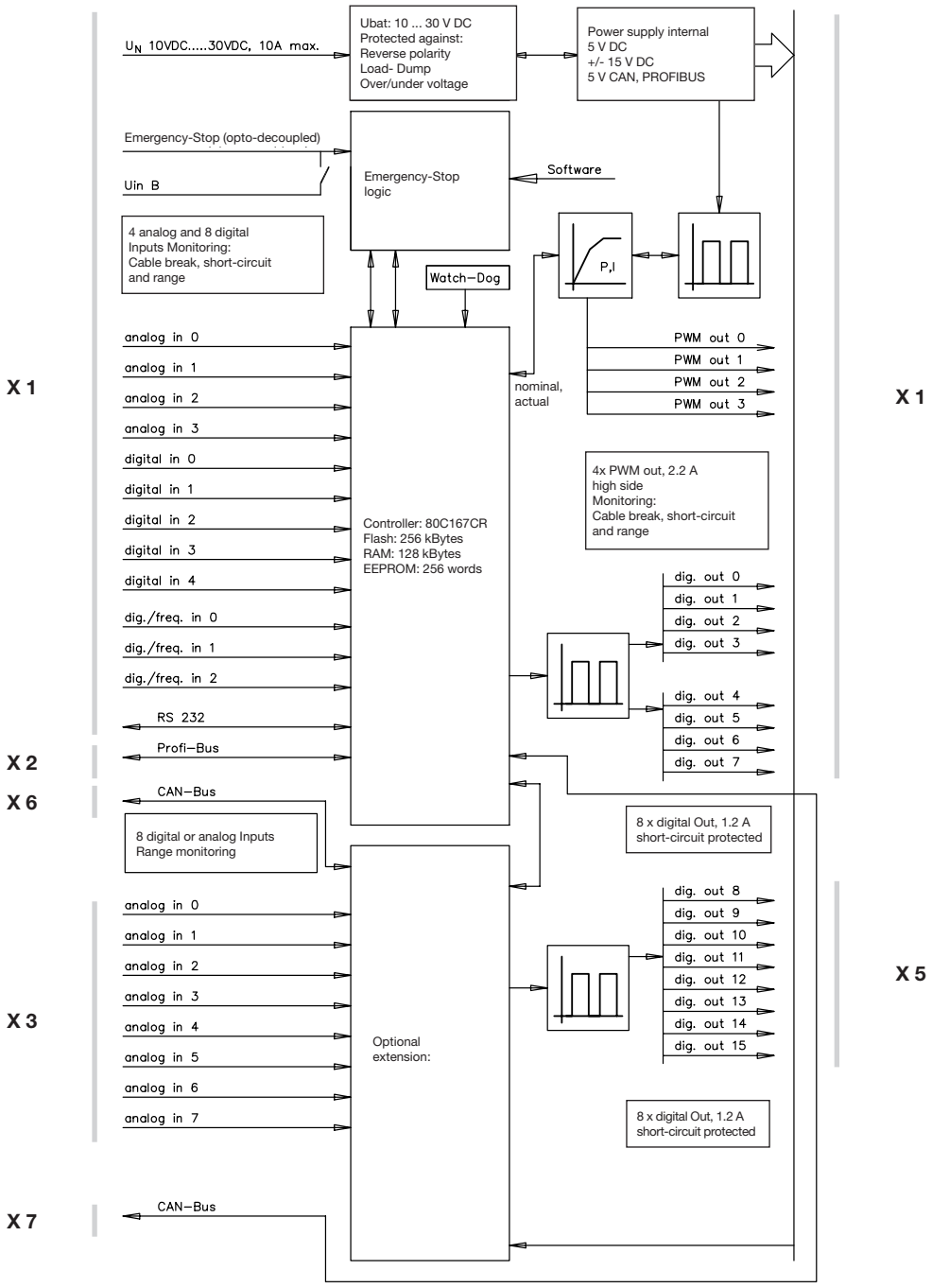
General data

Power supply	10 to 30 V DC
Max. total current	5 A
Required external fusing	5 A (slow blow)
Mounting	Installed into the basic system

Power specifications of connections

Connector rail	Function	Description	Parameter
X 1	- Power supply	Rated voltage U_N max. total current (power)	10 ... 30 V DC 5 A
X 3	- 8 analog inputs	10 bit A DC ≙ 1024 steps	4 ... 20 mA 0 ... 10 V DC (default) 0 ... 5 V DC
X 5	- Digital outputs 8 - 15	for ON/OFF-valves and consumers with resistance characteristics	10 ... 30 V DC / 1.2 A
X 6	- CAN-Bus interface		100, 125, 250, 500 kBaud

Block diagram (basic and extension module)



3. Software, Programming, Diagnosis

3.1 Software

Scope of delivery includes the following software package as standard:
- Firmware („C“-programmed real-time operation system) with integrated PROFIBUS und CAN-Bus functionality as well as PLC-capability
- Functionality of prop. amplifiers
- Initializing functions for all inputs and outputs
- Diagnosis software

Available as additional options:
- Diagnosis for CAN-Bus (incl. continuous chart logger)
- Function module, adapted for specified applications (on request)

Examples:
- Max. load control
- Synchronicity / Positioning
- Flow control (e.g. via prop. flow control valves type SE and SEH acc. to D 7557/1)
- Pressure control (e.g. via prop. pressure limiting valves type PMV acc. to D 7485/1 and electrical pressure transducer type DT 11 acc. to D 5440 T/2 and / or type DT 2 acc. to D 5440 T/1)

3.2 Configuration software „PLVC Visual tool“

a) Standard version

The Windows based software „PLVC Visual tool“ (availably free of charge) for configuration and supervision of controller type PLVC. This software provides the following functionality:
- Supervision and configuration of all in- and outputs of the control
- Generation of projects for each control
- Freely selectable nomenclature of all in- and outputs
- Export of the layout in various formats (PDF, Excel)
- Loading and saving of program and parameters
- Transfer of a new firmware
- Update via Internet
- etc.

b) Extended version

In addition to the standard version of this software there is also an extended version available (not free of charge). This versions contains an integrated oscilloscope.
The oscilloscope has the following functionality:
- Monitoring of up to 20 signals (in- and outputs as well as internal variable values from the running control program)
- storage period up to 24 h
- Graphics/scope export of the stored files as Bitmap, JPEG, GIF, Postscript, PDF, PCX, SVG
- Export of the indiv. values as text, HTML, XML or Excel
- Import of saved data
- Automatic scaling
- Legend either displayed or masked
- Displayed statistics
- etc.

3.3 Programming environment OpenPCS

The controller type PLVC can be freely programmed conforming IEC 61131-3 (best with structured text (ST)). Basically, the customer can program his control himself. The software OpenPCS, available from HAWE Hydraulik, is required for programming. Additional to the user interface there are also manufacturer specific function blocs e.g. controls for prop. outputs, input of frequencies available from HAWE Hydraulik.

Additional HAWE Hydraulik offers customer oriented programming tutorials.

3.4 Diagnosis

The following output equipment can be used for diagnosis:
- PC - connected to interface CAN-Bus or RS232, for parameterization, programming, error detection as well as remote diagnosis via modem.
- VT-software, this software tool enables the diagnosis and parameterization of the PLVC (see sec. 3.2) .

3.5 Function blocks

General:
The manufacturer-specific function blocks serve to indicate to the PLC-programmer the interfaces to the actual system. They are structured into the following two groups.

Group 1: Initializing functions (INI-functions)

These functions are used for parameterization and/or configuration of the inputs and outputs - normally only once at start-up. It is also possible to apply this parameterization through the firmware. All these parameters and configurations are included in the system‘s EEPROM. Thus they are preset and can be overwritten by the PLC-system.
The terminal program (scope of delivery), allows to check , change and save (EPROM and/or file) all settings. Due to these configurations and parameterizations all data is available at runtime in an already converted and standardized form, which even can include a ramp or debouncing information. This makes it possible to write the data directly onto the outputs without conversion and supplemented with ramp information and/or other time-related information.

Group 2: Functions that are normally invoked cyclically during runtime (runtime module)

These functions are used to read input data, logically link them and to write them onto the outputs.

The documentation of the existing function blocks is included in the software package of the PLVC.

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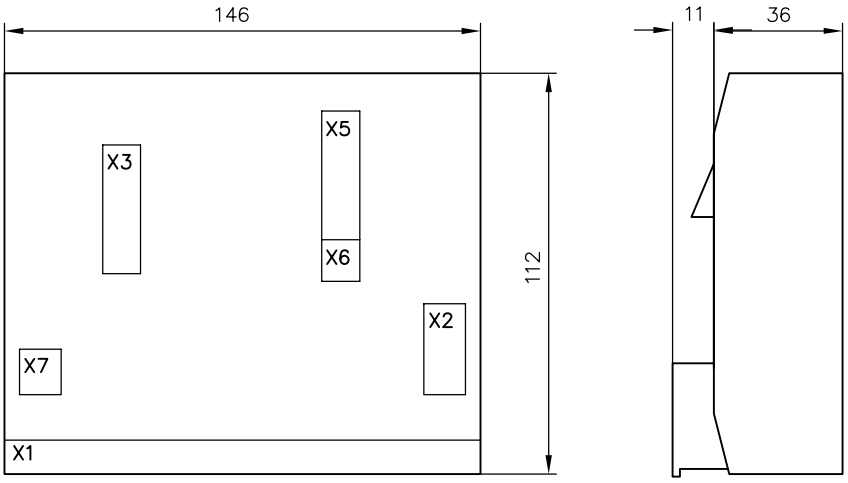
4. Dimensions of basic and extension module



5. Safety and installation notes

General information

The scope of delivery for the programmable logic valve control type PLVC includes an firmware and - on special agreement - a customized software. It is the duty of the customer to test the requested functionality of the PLVC as he is responsible for the faultless operation and final application of the PLVC.

Attention: Whenever a PLVC is replaced it is additionally necessary to order the current version of the software including the operation parameter by the manufacturer of the machine.

The customer is responsible to take care that the requested functionality and safety of the application program is fulfilled. When local laws make an approval by a notified body (testing or approval organization) necessary the customer has to apply for it.

Liability

This description is integral part of the device. It contains information regarding the correct use of the PLVC and must be read prior to installation or prior to use. Make sure to follow the instructions of this description.
Failure to comply with the notes or any operation that falls outside the intended usage, wrong installation or faulty handling can cause serious impairment of the safety of people and machinery and as such will prejudice any liability and warranty claims. This instruction is written for personnel, who can be considered to be „technically knowledgeable" in the understanding of the EMC-guideline 89/336 EEC and the low-voltage guideline 73/23 EEC. The controller must be installed and made operational by a professional electrician (programmer and/or service technician).

5.1 During installation

Electrical connection, grounding, arrangement of the wiring:

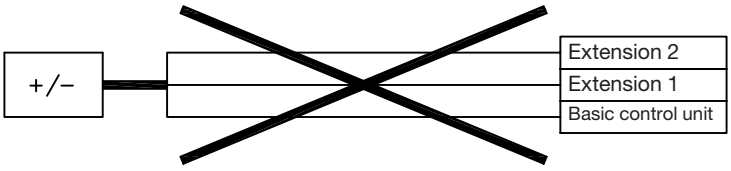
- Connect housing with GND (electrical interference protection), select shortest connection between casing and machine (independent of negative terminal and voltage supply)
- Wiring in accordance with safe protective low voltage and/or electrically separated from other electric circuits
- Faulty switching can trigger unintended signals at the outputs of the control device.
  Attention: The parallel switching of external voltage sources (e.g. emergency activation via push button) and the outputs of the PLVC is not permitted!
- Pay attention to application-relevant documents (circuit diagrams, software descriptions, etc.).
- Recommended cross sections of the connection lines
  Power supply, relays: >= 1 mm²
  Other inputs and outputs: >= 0.5 mm²
- Only use shielded signal lines
- Do not install any wiring for electronic systems close to other power-fed lines in the machine.
- Make sure to use only additional accessory approved by HAWE Hydraulik SE
- A safety switch must be installed to interrupt the power supply of the electronic system to deactivate system in case of emergencies. This safety switch must be installed within easy reach for the operator. If the safety switch is activated the machine must be brought into standstill in a "safe status". The system's design must guarantee this feature.

Installation conditions

- It must not be mounted nearby heat generating components or sub-assemblies.
- It must not be placed near-by to radio facilities.
- An emergency cut-off has to be provided. This emergency cut-off has to be positioned at the machinery in such a manner that it is easily accessible by the operator. It has to be made sure by the manufacturer of the machinery that it can achieve a save position after the emergency cut-off is activated.
- The control lines must nor be routed nearby power supply lines.
- Line disruption and short-cut detection for the control lines have to be provided.
- The power supply lines (+ and -) for controller and extensions has to be split-up as close to the controller as possible, see illustrations below.

Correct:

Wrong:



- All terminals for the power supply of the controller type PLVC have to be connected always
- All signal lines should be shielded
- Take care that sensors connected are properly grounded.

5.2 Installation, operation and maintenance

- Make sure to stay within the temperature range for operations between -40°C to +80°C
- Surfaces may encounter higher temperatures
- Do not install in the vicinity of machine parts and modules that develop great heat (e.g. exhaust)
- Prior to any welding work to be done on the machine (the vehicle), all PLVC devices must be disconnected from the power supply (positive and negative terminal) and/or a potential separation must be guaranteed
- Make sure to keep sufficient distance to radio-engineering installations.

Notes on proportional and switching solenoids and other switched inductive consumers:

- Make sure to test the PLVC's correct function only with connected proportional solenoids
- Make sure to connect all other switched inductive consumers, which are not connected to the PLVC, close to inductivity with spark arrester diodes.

Contact tech_support@hawe.de in case of doubt or in case of malfunctioning.

5.3 Loading of the firmware

Each controller type PLVC comes with the current version of the firmware. It can be updated via Windows ® based computer (PC/Laptop) according to customer specifications or with additional functionality.

5.3.1 Firmware is working

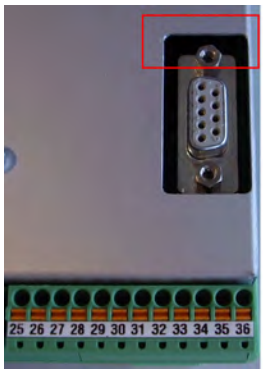
A new firmware can be installed over the operative one. All functionality needed for such an upload is integrated in the current firmware. Connect the controller type PLVC and PC via the serial interface and start the respective upload program of the firmware.

5.3.2 Firmware is not working

A new firmware can even be installed, when the apparent firmware won't start-up (e.g. after discontinued upload of an firmware).

Procedure
- Connect controller and PC via the serial interface.
- Cut-off the controller
- Short-cut the two pins, accessible via the cutout (see pict. below), with a conducting tool e.g. a small screw- driver.
- Switch-on the controller, while both pins are short-cut. The LEDs on the side must be off.
- Start download of the firmware

Cutout of the housing:



5.4 Mechanical installation

5.4.1 Mounting

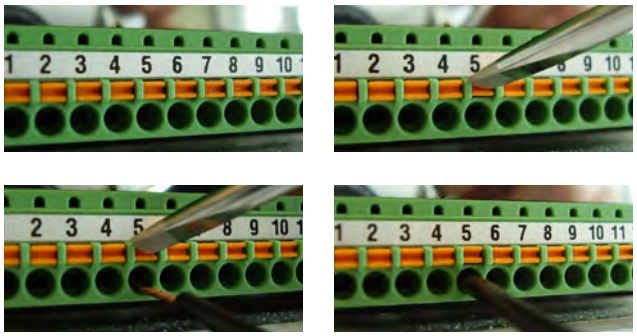
For dimensions, see sect. 4, Mounting with clip type housing for clip-rails Co. PHOENIX

No wire end sleeves should be used when connecting the individual lines to the terminal rail of the PLVC.

Best tear-out resistance is achieved, when the line end (insulation removed) is inserted into the spring-cage.

This way the spring will bend the line end for additional strength - slightly tear at the line to ensure proper installation.

The pictures below show the proper working sequence.



5.5 Components of the control system

5.5.1 Communication

a) Serial interface

The basic PLVC 21 features one serial interface.

It is positioned at terminal rail X1, Pin 34, 35, and 36.

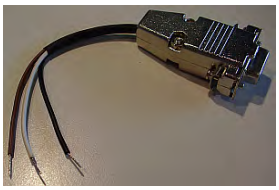
Functionality via the serial interface:

- Monitoring current signals from the PLVC
- Setting adjustment for prop. outputs and analog inputs
- Creation of measurement plots (oscilloscope of the Visual Tool)

The PLVC is connected via a standard serial 9-pin interface line and the respective adapter to the PC.
The adapter can easily be self-made.
Take a 9-pin D-sub-socket, solder Pin 2 to RX, 3 to TX and 5 to GND. These lines are connected later to terminal rail X1.

The transfer rate can be set between 9600 and 57000 kBaud.

Adapter for serial interface



Terminals at basic PLVC 2	Pin of D-sub-socket
X1.34	3
X1.35	2
X1.36	5

b) CAN-Bus

CAN-bus (Controller Area Network) is a asynchrone, serial bus system, where only two lines are required. Twisted-Pair-lines with a wave resistance of 108…132 Ohm are recommended acc. to ISO 11898-2 (High-Speed Medium Access Unit). The max. (theoretical) line length is e.g.. 40 m for 1 Mbit/s, 100 m for 500 kbit/s or 500 m for 125 kbit/s.

The PLVC features a CAN port, where additional controller type PLVC or sensors (industrial standard CanOpen) may be connected.

The CAN-bus interface supports protocols CanOpen and J1939.

CAN-Bus baud rate

The transfer rate via CAN-bus can be set to following rates:

- 50 kBaud
- 75 kBaud
- 100 kBaud
- 125 kBaud
- 250 kBaud
- 500 kBaud
- 1000 kBaud

CAN-bus termination

Two terminal resistors of 120 Ohm (between CAN_HIGH and CAN_LOW) must be positioned at the lead ends of the bus lines and there only.

These terminal resistors are integrated at the PLVC. They can be activated when there is a connection between X6.2 (CAN low) and X6.1, in case the PLVC is the final unit of a CAN-network.

c) PROFIBUS

PLVC 21 features a PROFIBUS interface, enabling data exchange with a superordinated PLC control. The transfer rate is max. 6 MBit/s. PLVC 21 will adjust automatically to the respective transfer rate. A GSD-file must be available.

A PROFIBUS-CAN-Bus gateway can be generated via the optional extensions of the PLVC 21.

5.5.2 Outputs

a) Proportional solenoids

- Other consumers switched-on and –off, which are not connected to the PLVC must be provided with clamp diodes nearby the source of inductivity

Proportional outputs

PLVC provides current controlled PWM-outputs, i.e. the set current is maintained via return current measurement no matter whether the resistance of the coil fluctuates due to temperature changes.

PWM frequency is 1 kHz. The pulse ratio can be set between 10% and 94%. Both, dither frequency (on and off frequency) and dither amplitude can be adjusted as well.

5.5.3 Inputs

a) Emergency-stop input

There is an emergency-stop input at terminal X1.23 of the basic PLVC, which has to be fed with 10-30 V to ensure that the valve ports are energized.

It is standard set-up of the controller, that the controller has to be rebooted after the emergency-stop had been activated. The PLVC has to be switched-off and subsequently switched-on after the emergency actuation had been actuated.

This behavior can be changed by resetting a parameter, that the controller will activate the valves immediately after the emergency stop port is energized again.

b) Analog sensors

All kind of sensors, which generate a output signal of 0-5 V, 0-10 V or 4-20 mA, can be connected to the PLVC.

The respective configuration of the analog inputs at the PLVC have to be specified in your order.

The power supply for analog sensors has to be properly grounded i.e. all via the PLVC, otherwise the sensor signal will be influenced. The power supply for the machinery must not drop below the power supply specification of the sensor – 12 V DC systems are prone for this.

All lines should be shielded twisted pair cables.

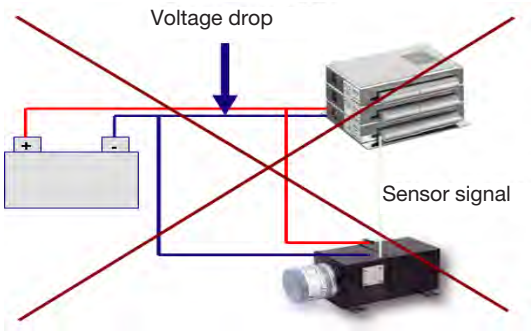
The different configurations of the analog inputs have the following input impedances:

Input type	Impedance
0-5 V	1 MOhm
0-10 V	94 kOhm
4-20 mA	220 Ohm

Ground connection for the sensors

WRONG: „+“ connected at the PLVC, but „-“ is connected to the battery directly
CORRECT: „+“ and „-“ are directly connected at the PLVC.

Wrong ground connection for the sensor



Comparison between 0-10 V and 4-20 mA

Basically, sensors with an output signal of 0-10 V or 4-20 mA can be used.

Both kind of sensors offer various pro‘s and con‘s, see table below.

Signal	Advantage	Disadvantage
0-10 V	Measurement in parallel is possible	More prone to failure Three lines necessary
4-20 mA	Failure resistant Integrated line disruption detection Two lines necessary	Generated voltage drop Correct input resistors are necessary

c) Joy-sticks

Usually joy-sticks generate a signal even in zero position (e.g. 2.5 V for supply voltage 5 V). This has to be taken in account when setting the parameters. Otherwise there may be undesired movement at the machinery, even when the joy-stick is in zero position.

d) Speed sensor

The basic PLVC unit offers three digital inputs, which can be employed for frequency measurements.

The measurable critical frequency is 5 kHz. The signal level must be < 0.8 V (OFF) and > 2.5 V (ON) .

e) Digital input signals

The switching threshold of the digital inputs is 10 V and 0.8 V.

6. Failure remedy

The table below lists failure states and shows possible ways for failure remedy. The use of software of VT of HAWE is mandatory:

Failure	Reason	Remedy
Controller won‘t boot (LEDs are OFF)	No power supply	Check power supply and fuses
	Firmware not completely copied	Reload firmware
	Line disruption at the input line	Replace line
No Login available	Controller are OFF	Switch-on controller
	Serial interface is wrongly or not connected	Check connection of the serial interface
	Firmware not completely copied	Reload firmware
Program does not run	Program was stopped via user parameter	User parameter 99 must not be set at 4711
	Program not completely copied	The program name must be visible on the first page after log in via the terminal program
Input signal (digital/analog) is not recognized	Line is not connected	Connect line
	No signal on the line	Check signal strength with a multimeter
Valve output without function	Line is not connected	Connect line
	Output is not actuated	Start via the Terminal Program / Visual Tool and check (failure message OPN = Open)
CAN communication disrupted	Wrongly adjusted baud rate	Check baud rate and readjust if necessary. All controller must be set on the same baud rate
	Interference via other lines	Use shielded lines. Do not route nearby power supply lines.

7. Circuitry plan

7.1 Basic controller PLVC 21-G