Programmable logic valve control type PLVC 4

CE

See also other electronic valve controls/accessory:

Type PLVC 2	acc. to D 7845-2
Type PLVC-CAN	acc. to D 7845 Z
Type CAN-HMI	acc. to D 7845 HMI

1. General information

The programmable logic valve control of type PLVC 4 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:

- Cranes, crane systems
- Construction machinesss
- Complex hoisting equipment
- Logging equipment
- Hydraulic clamping systems for machine tools
- Presses

The various control tasks are realized through:

- Modular system with extension and supplementary modules
  - Basic module
  - Extension module (additional inputs/outputs)
  - Extension possibilities via CAN-Bus
- Flexible programming according to IEC 61131-3 standard (PLC-programming via instruction list (IL), function block diagram (FBD), or structured text (ST))
- 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

All relevant standards regarding personal safety, EMC, vibration- and shock-proofness are complied with.

The main performance parameters include furthermore:

- Basic module type PLVC 4, PLVC 4/4 and PLVC 4 E
  - 4 analog inputs (for joysticks, potentiometers, sensors, such as analog pressure sensors)
  - 3 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 and CAN-Bus
  - 4 outputs for prop. or ON/OFF valves (current-controlled), 8 outputs with type PLVC 4/4
  - 1 output 0...10 VDC
  - 1 auxiliary voltage supply 5 VDC (voltage monitored), max. 150 mA (for supply of joystick, potentiometer etc.)
  - 3 relay outputs (NO-contact) max. 5 A, omitted with type PLVC 4/4
  - Power supply 10...30 VDC

  Attention: Emergency stop of the basic module does not apply to the digital outputs of the extension!

- Extension module type PWM
  - 8 analog inputs (for joysticks, potentiometers, sensors such as analog pressure sensor)
  - 8 digital inputs (for limit switches, pressure switches, push buttons etc.)
  - 8 PWM - output for prop. or ON/OFF valves
  - 8 outputs for lights or LED, max. 500 mA
  - Power supply 10 ... 30 VDC, max. 10 A

- Extension module type IPWM
  - 8 analog inputs (for joystick, potentiometer, sensors such as analog pressure sensor)
  - 8 digital inputs (for limit switches, pressure switches, push buttons etc.)
  - 8 outputs for prop. or ON/OFF valves (current-controlled)
  - Power supply 10 ... 30 VDC

- Extension module type POW
  - 8 analog inputs (for joysticks, potentiometers, sensors such as analog pressure sensor)
  - 8 digital inputs (for limit switches, pressure switches, push buttons etc.)
  - 8 relay outputs (6x change-over contact, 2x NO-contact) max. 15 A
  - 8 outputs for lights or LED, max. 500 mA
  - Power supply 10 ... 30 VDC

  A maximum of 3 extension modules can be connected to the basic module, with a maximum of two extension modules of the same type being employed at the same time.

- Functional software features
  - PLC-programming via instruction list structured text (ST)
  - Parameterization during runtime
  - CAN-Bus integrated in the firmware

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2. Available versions

2.1 Basic module

Order examples:

PLVC 4 - G	**/VVVV**	**- OS/EN**	Basic module	
PLVC 4/4 - G	**/VVAA**	**- OS/DE**	Basic module with 4 additional prop. outputs	(1. Note page 3)
PLVC 4 E - G	**/AAAA**	**- OS/EN**	Basic module with cut-off delay	(2. Note page 3)
PLVC 4 - X	**/VVVV**			
- IPWM	**/VVVVJJAA**	**- OS/DE**	Basic module with extension module	

Basic module

Firmware: OS/DE - German
OS/EN - English

Analog inputs: V - 0...10 V DC
J - 0...5 V DC
A - 4...20 mA

Extension module,
see sect. 2.2

Note on the specification of analog inputs:

All analog inputs are delivered with the default assignment 0...10 V DC (coding V).
Differing specification can be specified in the coding, e.g. coding A = 4...20 mA or coding J = 0...5 V DC.

General data

Casing, protection class	IP 20 acc. to IEC 60529
Temperature range	-40°C to +80°C
Power supply	10 VDC to 30 VDC
Max. total current	Basic module, POW: 5 A IPWM, PWM: 10 A
Required external fusing	5 A or 10 A (slow blow)
Protection	Reverse polarity protection Load dump protection (DIN 40839) Shockproof (vibration: IEC 68-2-6, shock: IEC 68-2-27) EMV (EN 50081-1, EN 50081-2, EN 58082-1, EN 58082-2)
Service life relay	PLVC 4 (Basic modul) - resitive load 100000 cycles at 5 A/30 VDC 300000 cycles at 2 A/30 VDC - inductive load 100000 cycles at 2 A/30 VDC 300000 cycles at 1 A/30 VDC PLVC 4 - POW 100000 cycles at 20 A/14 VDC
Monitoring	Short-circuit Under-voltage, Over-voltage Cable break
Cable connections	In- / Outputs: by means of spring-cage connector Co. PHOENIX type FK-MCP, pitch 3.5 mm max. 8 A Power supply: Blade type terminals 6.3 mm Relay outputs: Blade type terminals 2.8 mm
Micro-controller	80C167CR, 16 bit
Basic parameter memory	EEPROM 256 words
Memory	Flash: 256 kByte RAM: 128 kByte
Accessories	Software CAN-Bus power relays (see D 7845 Z) CAN-Bus nodes CAN-HMI (see D 7845 HMI)
Mounting	6 x M3
Casing material	Stainless-steel, brushed
Mass (weight)	approx. 0.5 kg (basic module) approx. 0.25 kg (extension module)

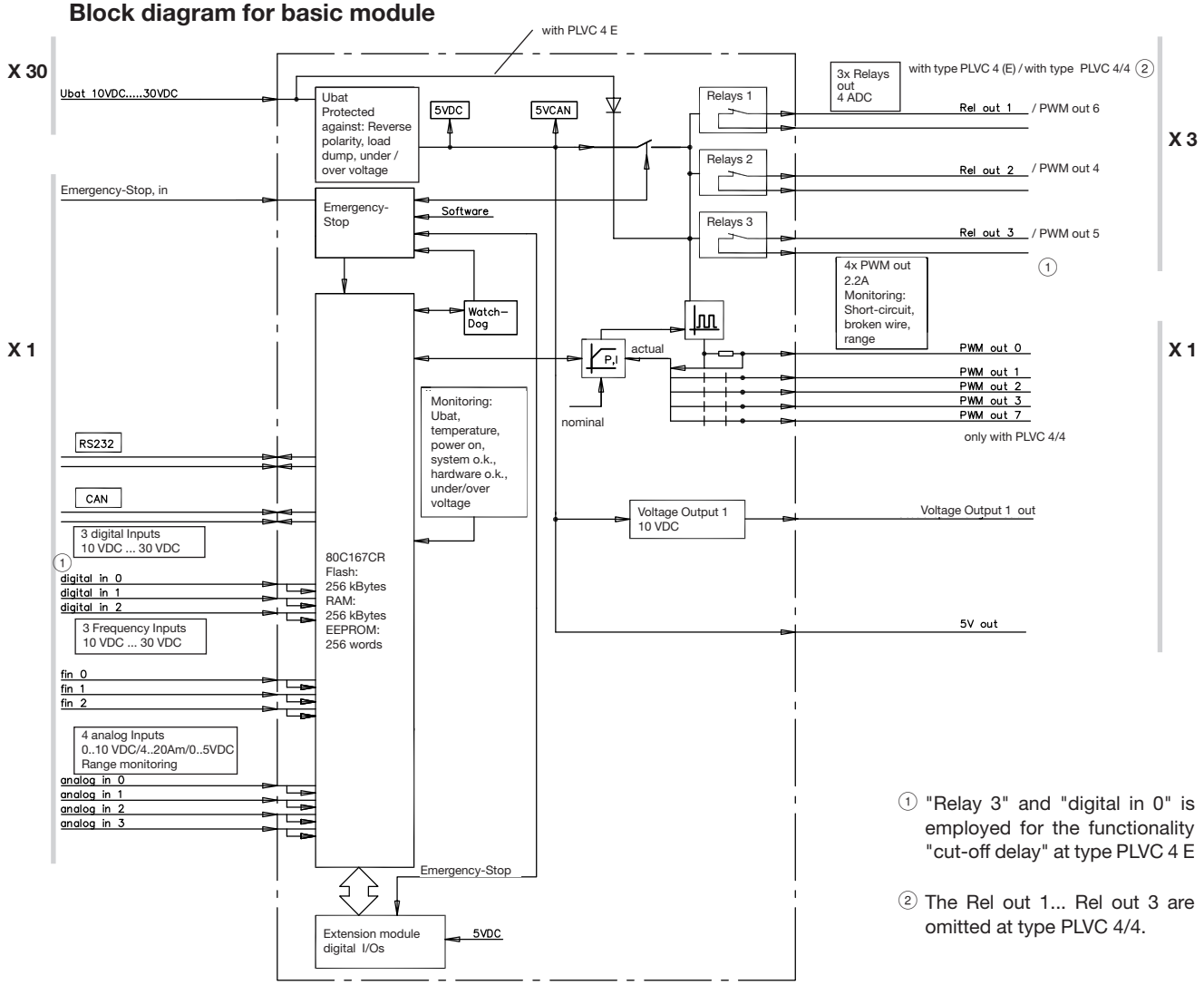
1. Note regarding type PLVC 4/4:

If Prop outputs PWM out 0 and PWM out 1 are used for a twin solenoid (e.g. for type PSL and/or PSV), the measurement input can be used for another twin solenoid at PWM out 4 and PWM out 5. The same applies for the outputs PWM out 2 and PWM out 3. The three relay outputs Rel out 1 (2,3) are omitted.

2. Note regarding type PLVC 4 E:

Type PLVC 4 E is prepared for use with cut-off delay. The voltage supply for the PLVC is via an additional, permanent source (e.g. car battery) connected at relay terminal 3. This enables a cut-off delay during which operational data can be saved on the EPROM or final operations can be performed even when the switchable power supply is already cut-off. The delay period can be set without time restrictions.
Attention: PLVC 4 E offers one relay output and one digital input less. (“digital in 0”).

Block diagram for basic module



① "Relay 3" and "digital in 0" is employed for the functionality "cut-off delay" at type PLVC 4 E

② The Rel out 1... Rel out 3 are omitted at type PLVC 4/4.

Power specifications of connections

Connector rail	Function	Description	Parameters
X 30	- Power supply	Rated voltage U_N Max. total current (power)	10 ... 30 VDC 5 A
	- Digital inputs 0 - 2	Voltage range Debouncing for increasing/decreasing signal edge can be activated separately	10 ... 30 VDC / 5 kOhm
	- Analog inputs 0 - 3 (for joysticks, potentiometers, sensors etc.) Range monitoring	10 bit ADC ≙ 1024 steps	4 ... 20 mA 0 ... 10 VDC (default) 0 ... 5 VDC
	- Frequency input 0 - 2 [1)]	Limit frequency	f_{lim} = 5 kHz
X 1	- Auxiliary voltage Voltage output	For sensors, potentiometers Max. current as control signal	5 VDC / 150 mA 0 ... 10 VDC / 10 mA
	- Emergency-Stop input	Opto-decoupled	
	type PLVC 4 (E) - prop. and/or ON/OFF outputs 0 - 3 type PLVC 4/4 - prop. and/or ON/OFF outputs 0 - 7 (with low-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...50% 2 ... 35 Ohm
X 3	- Relay outputs 1, 2, 3 (omitted with type PLVC 4/4)	Voltage	10 ... 30 VDC / 4 A
X 1	- Interface CAN-Bus		max. 1 MBaud
	- Interface RS232	Interface parameter	19.2 kBaud

[1)] Can be used also as digital input

2.2 Extension module PWM, IPWM and POW

Order examples:

PLVC 4 - X /VVVV — Basic module acc. to sect. 2.1 with two extensions
- IPWM /AAAA
- PWM /AAJJ - OS/DE

PLVC 4/4 - X /VVAA — Basic module with one extension
- POW /VVVVJJJJ - OS/EN

General data

Supply voltage	10 to 30 VDC
Max. total current	POW: 5 A IPWM, PWM: 10 A
Required external fusing	5 A or 10 A (slow blow)
All other data	see sect. 2.1
Mounting	with 4 screws onto the basic module

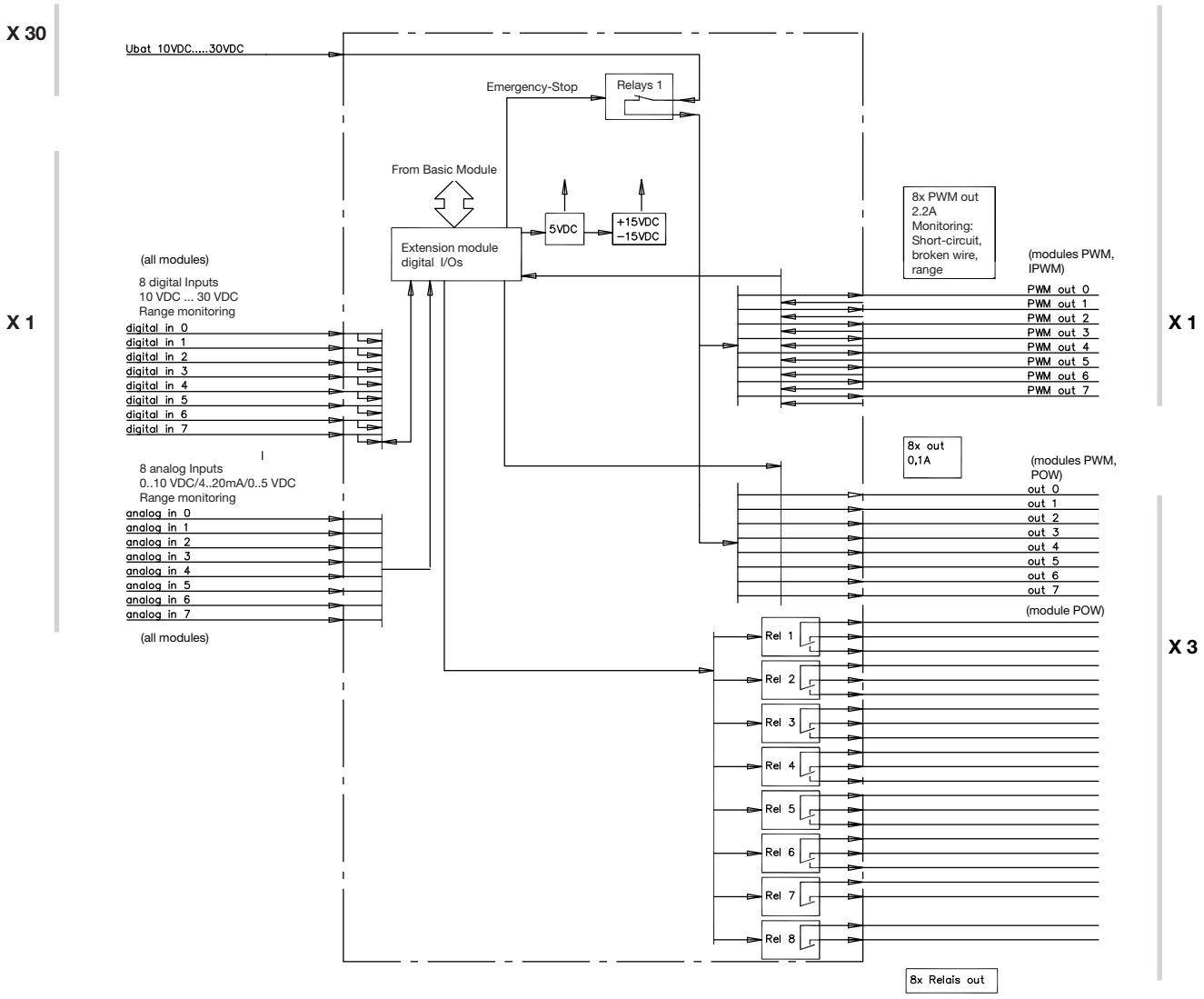
Note:

A maximum of 3 extension modules can be connected to the basic module with a maximum of two extension modules of the same type being employed at the same time. (Exception: POW only one)

Maximally 16 current-controlled outputs are available (basic module plus extension module X-IPWM). When employing two extension modules X-IPWM, the 4 outputs of the basic module will be deactivated.

Restriction type PLVC 4/4:
The basic module, type PLVC 4/4, cannot be equipped with two extension module IPWM or PWM.

Block diagram for extension module (all versions)



All inputs and outputs are shown in the block diagram.

Power specifications of connections

Connector	Function	Description	Parameters	PWM	IPWM	POW
X 30	- Voltage supply	Rated voltage U_N Max. total current (power)	10 ... 30 VDC 5 A 10 A	● ●	● ●	● ●
	- Digital inputs 0 - 7	Voltage range	10 ... 30 VDC / 5 kOhm	●	●	●
	- Analog inputs 0 - 7 (Selection) Range monitoring	10 bit ADC ≙1024 steps	4 ... 20 mA 0 ... 10 VDC (default) 0 ... 5 VDC	●	●	●
X 1	- prop. and/or ON/OFF outputs 0 - 7 IPWM: with low-side measuring PWM: without low-side measuring (PMW out 0-7)	I_{min} I_{max} Dither frequency Dither amplitude (in relation to PWM) Cold resistance max. 4 prop. and/or ON/OFF used at the same time	100 ... 1200 mA 100 ... 2200 mA 25 ... 200 Hz 0 ... 50 % 2 ... 35 Ohm outputs can be	●	●	
X 3	- Digital outputs 0 - 7 (out 0 - 7) (connecting to ground)	I_{max}	100 mA	●		●
	- Relay outputs 1 - 8	I_{max}	15 A			●

3. Software, programming, diagnosis

3.1 Software

The scope of delivery includes the following software package as standard:

- Firmware ("C"-programmed real-time operating system) with integrated CAN functionality as well as PLC-capability
- Functionality of prop. amplifier outputs
- 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:
- Load sensing control
- Synchronicity / Positioning
- Position control (e.g. via option W with prop. directional spool valves type PSL(V) acc. to D 7700 ++)
- Flow control (e.g. via prop. flow control valves type SE and SEH acc. to D 7557/1)
- Pressure control (e.g. prop. pressure limiting valve type PMV acc. to D 7485/1 and electrical pressure transducer type DT 1 acc. to D 5440 T 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.
- CAN-HMI display (see D 7845 HMI), connected via CAN-Bus, for error detection and adjustment parameterization
- 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.
All settings can alternatively be controlled, adjusted and saved into the EEPROM as well as in a file using the terminal program that is part of the delivery package and/or the VT software. 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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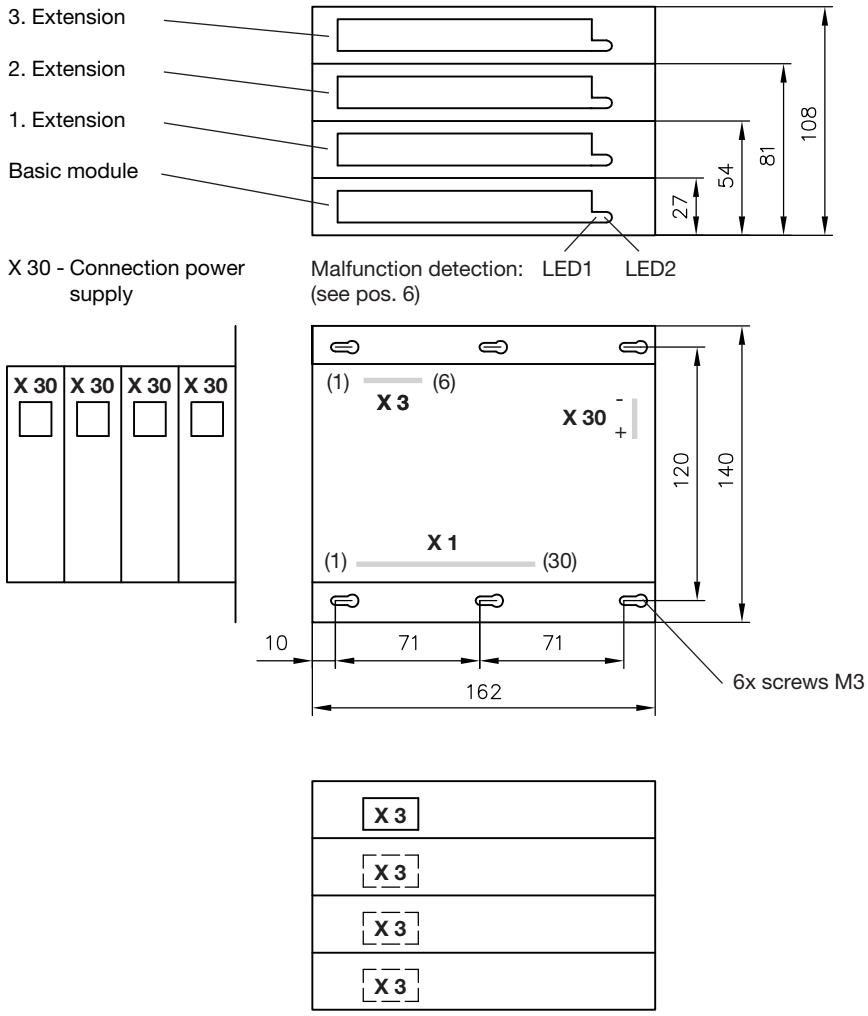
4. Dimensions

Basic and extension module type PLVC 4



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 cus-tomer 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 controls must be installed and made operational by a professional electrician (programmer and/or service technician).

5.1 Installation

Electrical connection, grounding, arrangement of the wiring:

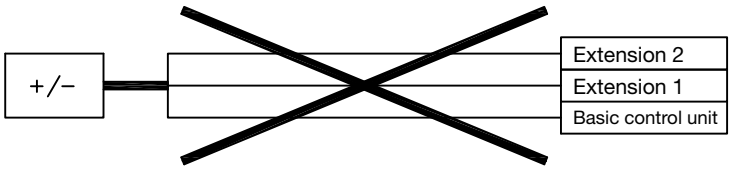
- Connect housing with GND (electrical interference protection), select shortest connection between casing and machine (independent of negative terminal and voltage supply)
- Wiring in accordance with safe protective low voltage and/or electrically separated from other electric circuits
- Faulty switching 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 conditiones

- It must not be mounted nearby heat generating components or sub-assemblies (exhaust etc.).
- 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 with several extensions has to be split-up as near-by to the controller as possible, see illustrations below.

Correct:

Wrong:



- All terminals for the power supply of the controller type PLVC have to be conntected 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).

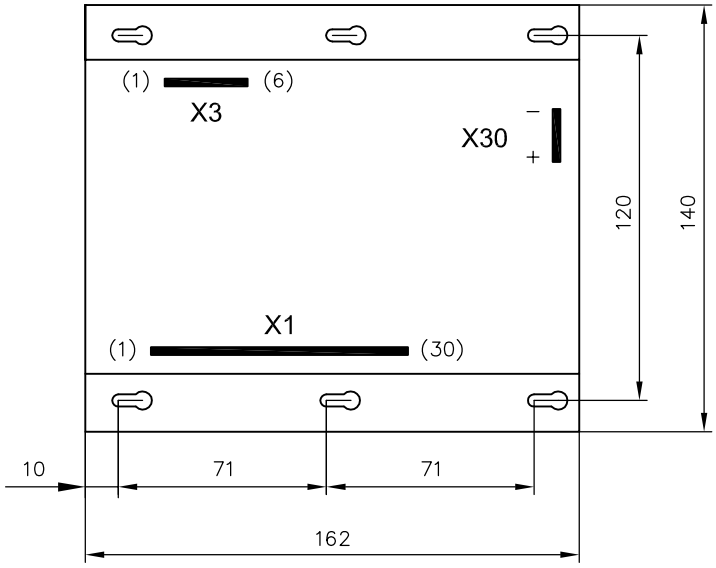
Procedure
- Connect controller and PC via the serial interface.
- Cut-off the controller
- Short-cut the two pins, accessible via the cutout (see pict. below), with a conducting tool e.g. a small screw- driver.
- Switch-on the controller, while both pins are short-cut. The LEDs on the side must be off.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

Cutout on the left site of the housing

5.4 Mechanical installation

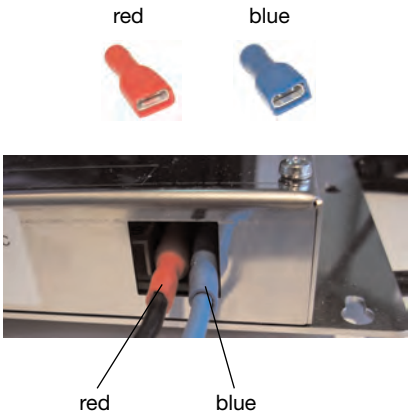
5.4.1 Mounting

For dimensions, see sect. 4, mounting with 6x screws M3



5.4.2 Power supply

Power supply via two blade type terminals 6.3 mm.



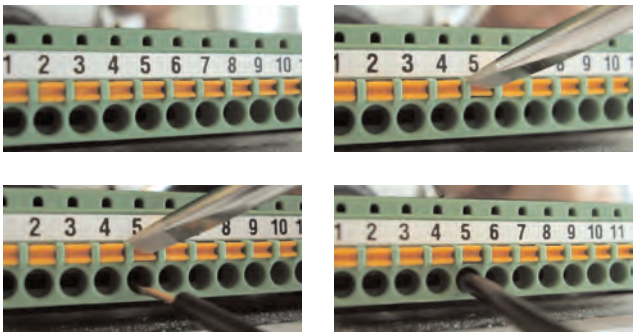
5.4.3 Spring-cage connectors

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

Best tear-out resistance is achiveved, 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.



5.4.4 Relay contacts

Connections via blade type terminals 2.8 mm.

5.5 Components of the control system

5.5.1 Communication

a) Serial interface

The basic modul PLVC 4 features a serial interface.

It is positioned at terminal rail X1 Pins 1, 2 and 3:

Serial interface PLVC 4 – Pins 1, 2 and 3

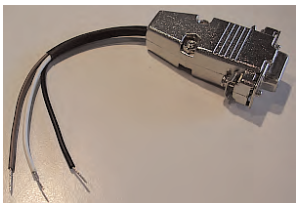
Functionality via the serial interface:

- Monitoring current signals from the PLVC
- Setting adjustment for prop. outputs and analog inputs
- Creation of measurement plots (oszilloscope 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 4	Pin of D-sub-socket
X1.1	3
X1.2	2
X1.3	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 legth is e.g.. 40 m for 1 Mbit/s, 100 m for 500 kbit/s or 500 m for 125 kbit/s.

The basic module of PLVC 4 feature a CAN port, where additional controller type PLVC 4 or sensors (industrial standard CanOpen) may be connected.

The CAN-bus interface supports protocolls CanOpen and J1939.

CAN-Bus baud rate

The transfer rate via CAN-bus can be set to folowing 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 4. They can be activated when the is a connection between X1.29 (CAN low) and X1.30, in case the PLVC is the final unit of a CAN-network.

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
- The outupts of the extensions IPWM-, and PWM feature integrated free-wheeling diodes.

Proportional outputs of extension IPWM

The extension IPWM 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.

Proportional outputs of extension PWM

The extension PWM proviedes PWM-outputs with out current control.

The dither frequency can be switched between 50 Hz and 100 Hz.

The puls ratio can be set between 5% and 100% within 5%steps. It controls the voltage to monitor short cuts.

b) Relais

The basic module of PLVC 4 features three potential-free relays. The relays switch contacts X3.1/X3.2, X 3.3/X3.4, X3.5/X3.6

The maximum switchable current is 5 A.

It is strongly recommended to fuse every single relay separately.

It is to avoid the switch-on of inductive loads because of short-term high currents which could cause damages at the relays (welded) or at the PLVC-conductor board.

c) 5 V DC-output

The basic module of PLVC 4 features a stabilized 5V DC-output at contact X1.17.

The maximum load is limited to 200 mA. As higher the temperature at the PLVC and as higher the actual load at the output as lower the actual output voltage.

Sensors and joysticks with a 5 V DC-supply voltage could be connected.

The output is monitored internally. Changes at the output voltage could be compensated by the control, by means enabling a stable sensor signal.

d) 10 V DC-output

The basic module of PLVC 4 features a programmable 10V DC-output for high-resistance measuring instruments at contact X1.18.

The maximum current is limited to 10 mA.

The output is programmable via the OpenPCS-software.

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 VDC systems are prone for this.

All lines should be shielded twisted pair cables.

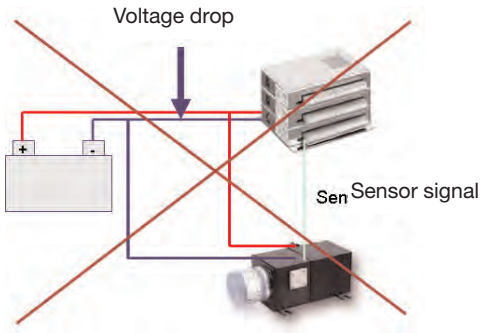
The different configurations of the analog inputs have the following input impedances:

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 possibile	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 already supplied 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. Troubleshooting

6.1 Malfunction detection

- Display via flash pattern of LEDs (see below)
- The power outputs are supplied by separate connections that are independent of the electronics.
- The firmware will centrally switch off all proportional and switch outputs in case of disturbances in the program sequence.

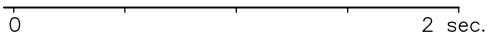
Error detection is made via the flash pattern of two independent LEDs.

- LED1 for the system
- LED2 for the CAN-Bus and others

LED1 (System)

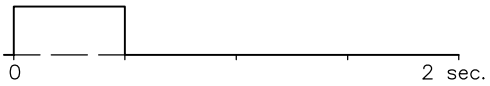
Indicated malfunction

Off

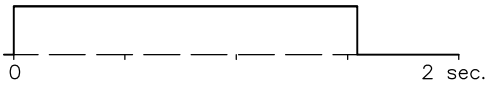


Emergency-Stop

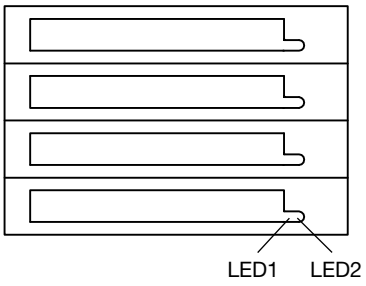
Slow (2-second period):



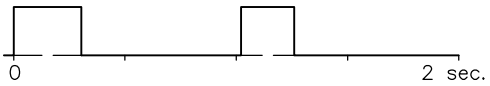
Emergency-Stop
Radio control



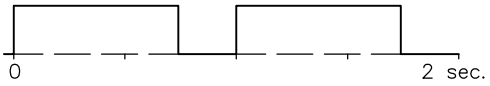
PLC internal error



Medium (1-second period):

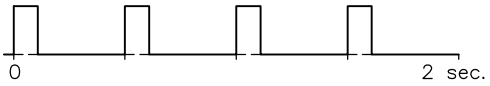


Error digital output

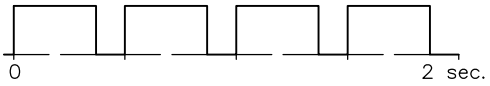


Error analogue input

Quick (0.5-second period):

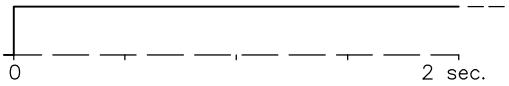


Prop. valve open



Prop. valve shortcut

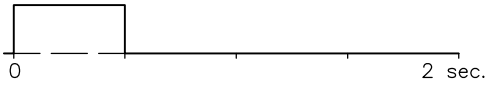
On (permanent)



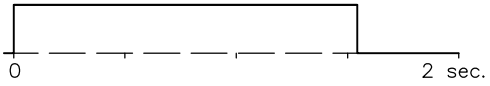
System o.k.

LED2 (CAN)

Slow (2-second period):

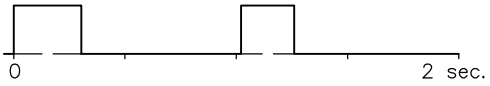


CAN-Bus Off

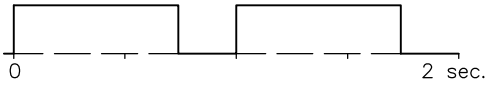


CAN-Warning

Medium (1-second period):

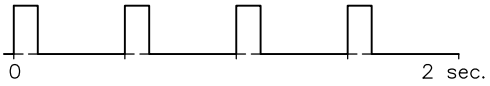


Error EEPROM

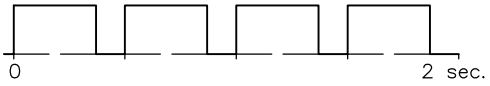


Wrong supply voltage

Quick (0.5-second period):

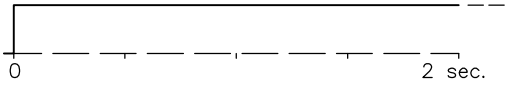


Error digital input



No radio signal

On (permanent)



CAN o.k. (and no other errors for LED2)

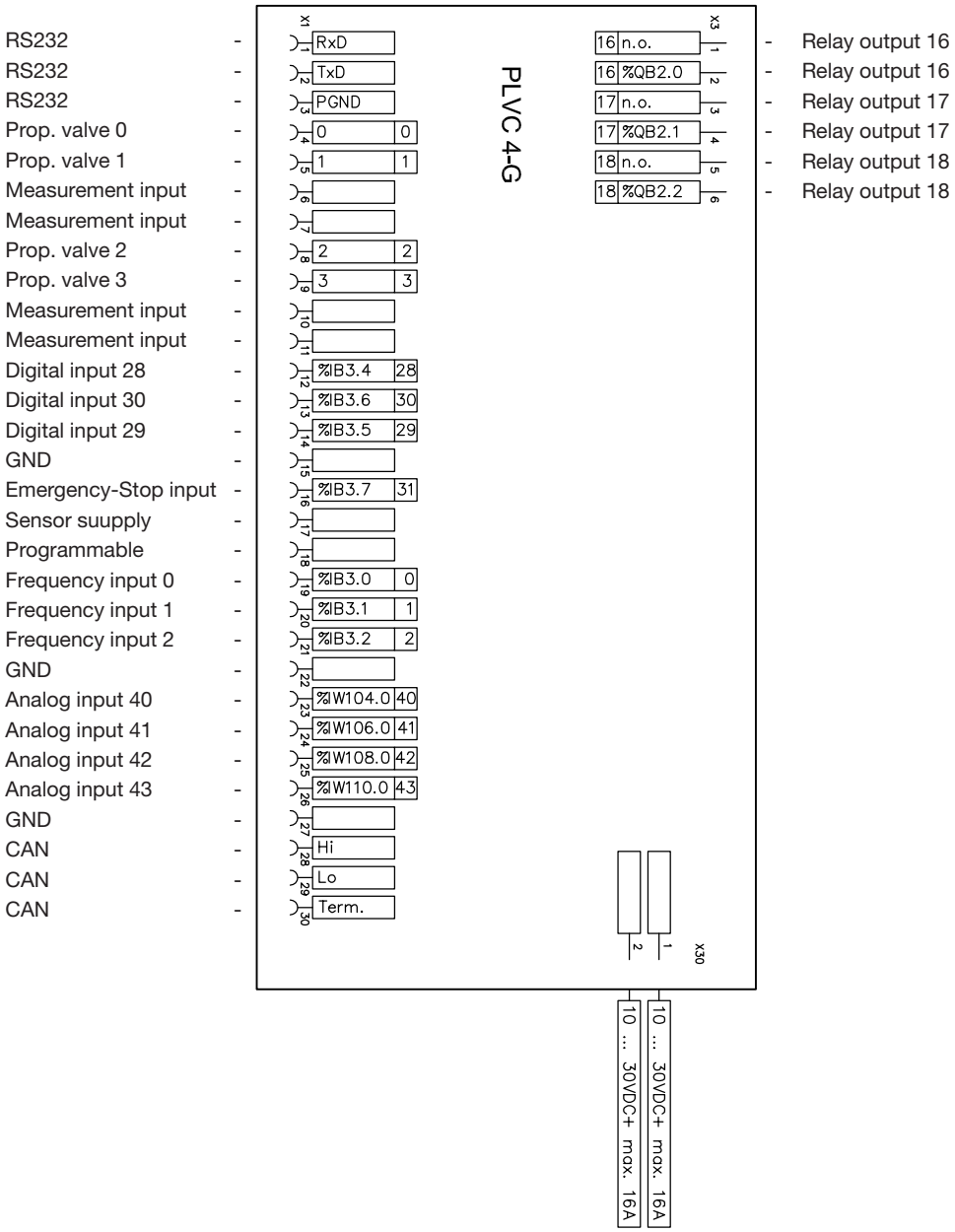
6.2 Failure remedy

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.

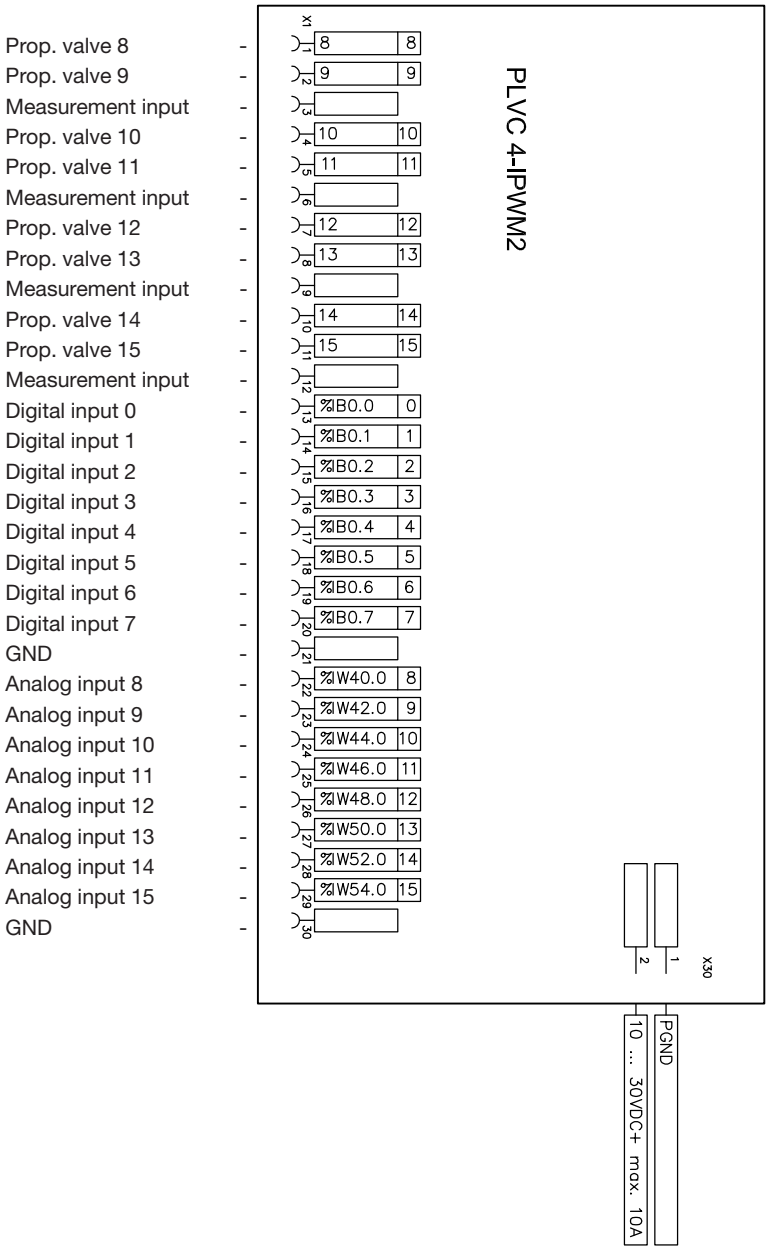
7. Circuitry plan

7.1 Basic controller PLVC 4-G



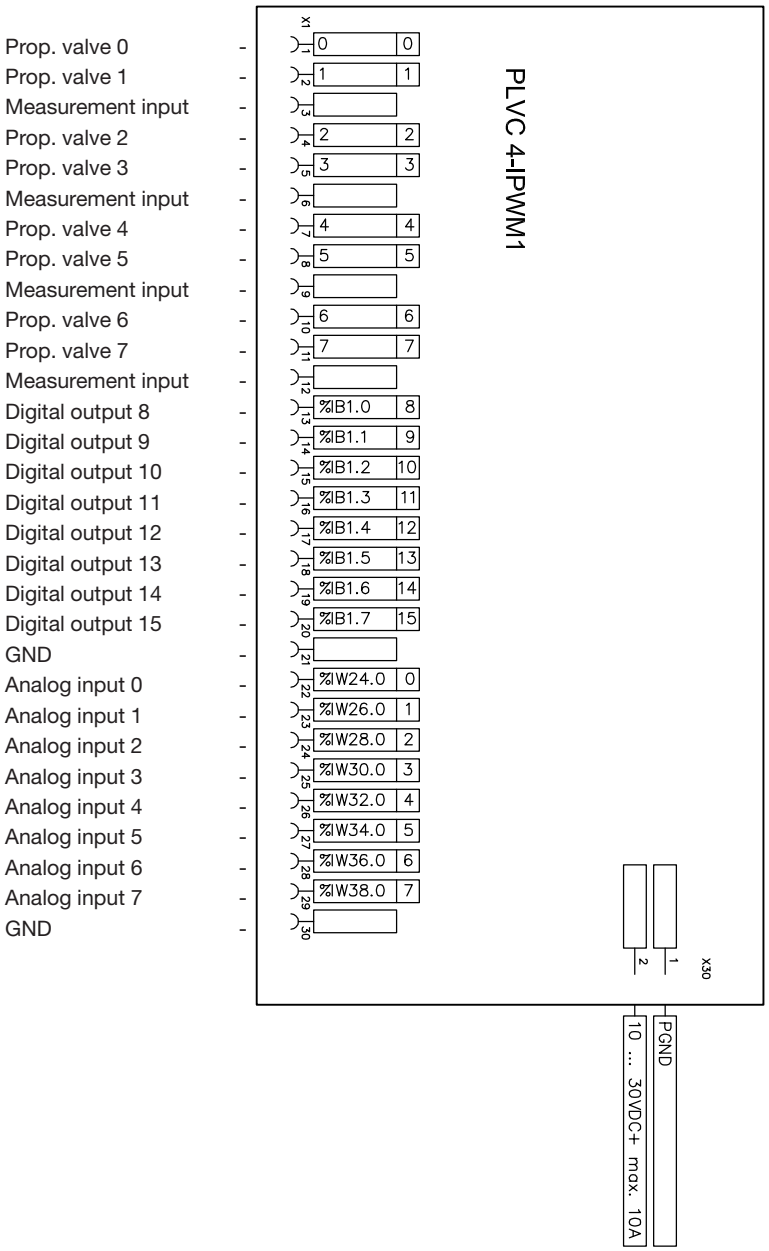
7.2 Extemsion type IPWM 2

(used as first IPWM-extension)



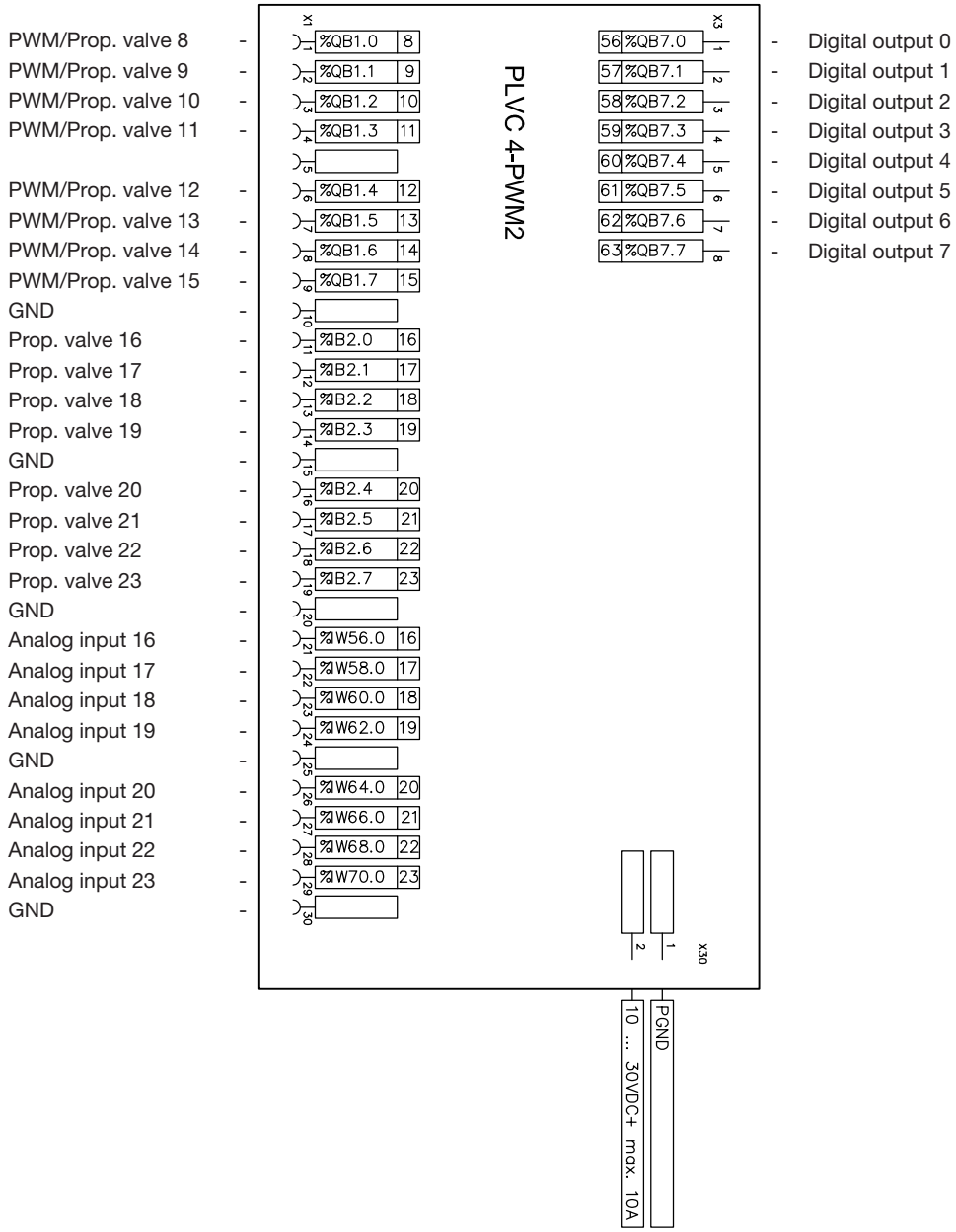
7.3 Extension type IPWM 1

(used as second IPWM-extension)



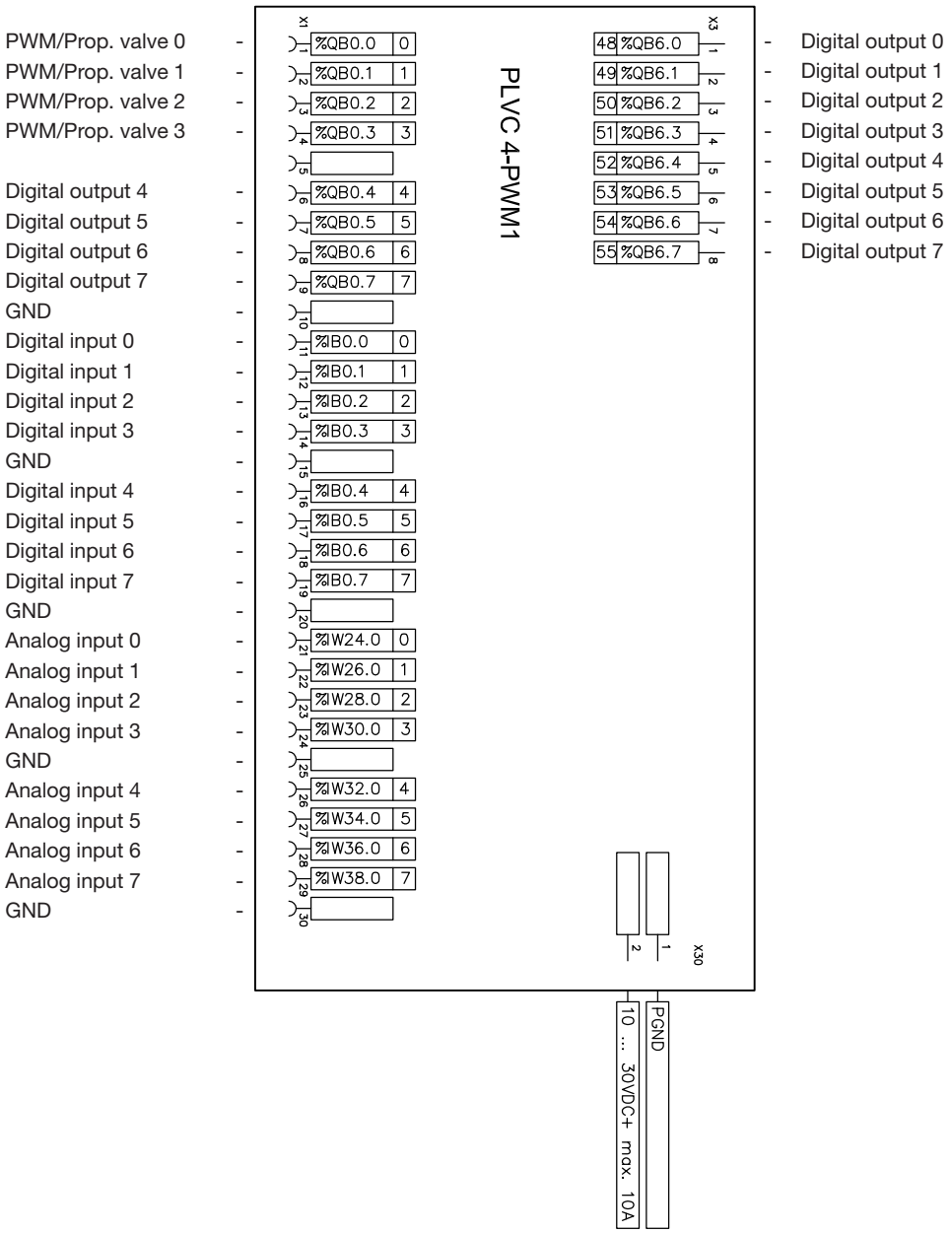
7.4 Extension type PWM 2

(used as first PWM-extension)

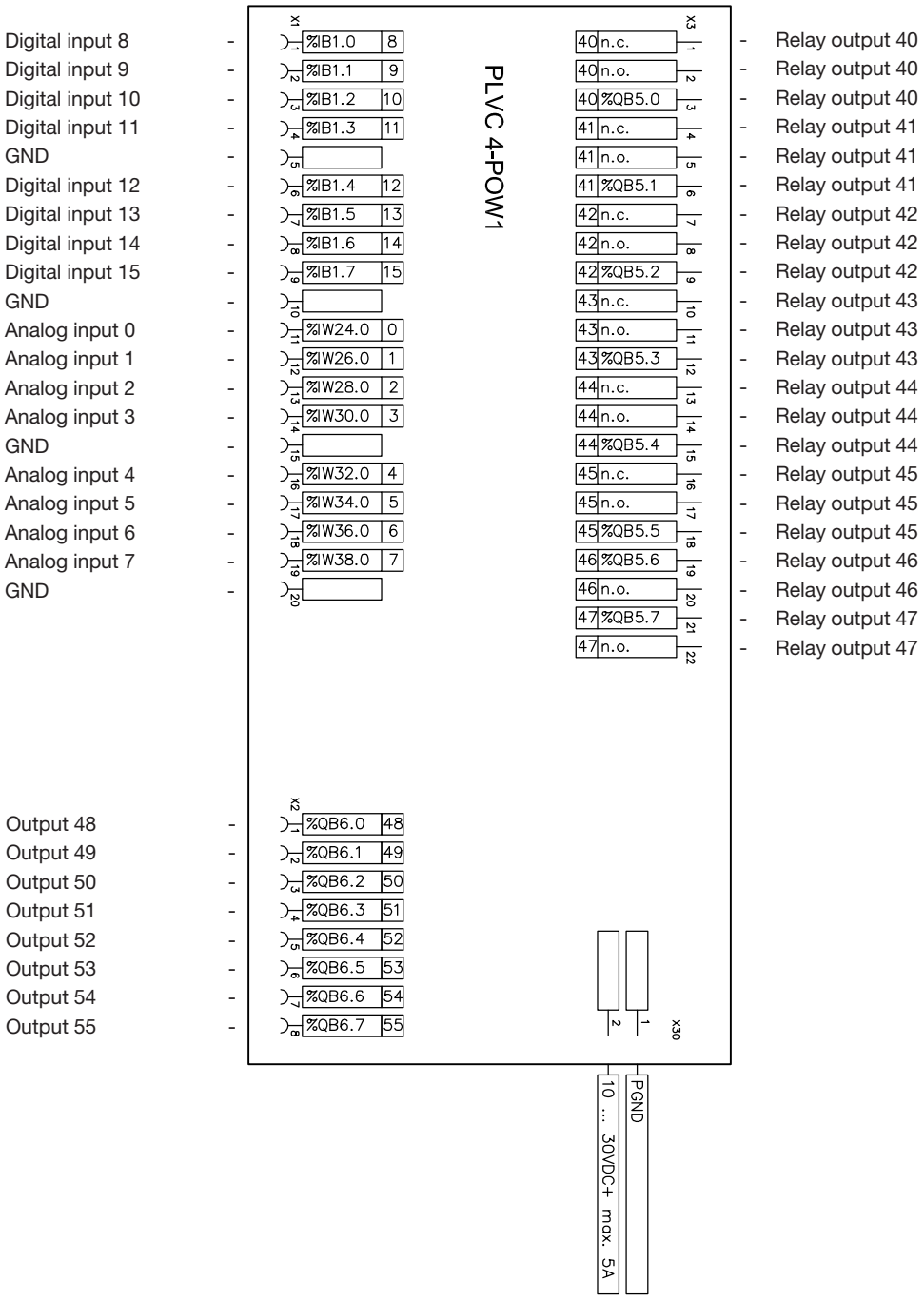


7.5 Extension type PWM 1

(used as second PWM-extension)



7.6 Extension type POW 1



Digital input 8 -
Digital input 9 -
Digital input 10 -
Digital input 11 -
GND -
Digital input 12 -
Digital input 13 -
Digital input 14 -
Digital input 15 -
GND -
Analog input 0 -
Analog input 1 -
Analog input 2 -
Analog input 3 -
GND -
Analog input 4 -
Analog input 5 -
Analog input 6 -
Analog input 7 -
GND -

- Relay output 40
- Relay output 40
- Relay output 40
- Relay output 41
- Relay output 41
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- Relay output 47

Output 48 -
Output 49 -
Output 50 -
Output 51 -
Output 52 -
Output 53 -
Output 54 -
Output 55 -