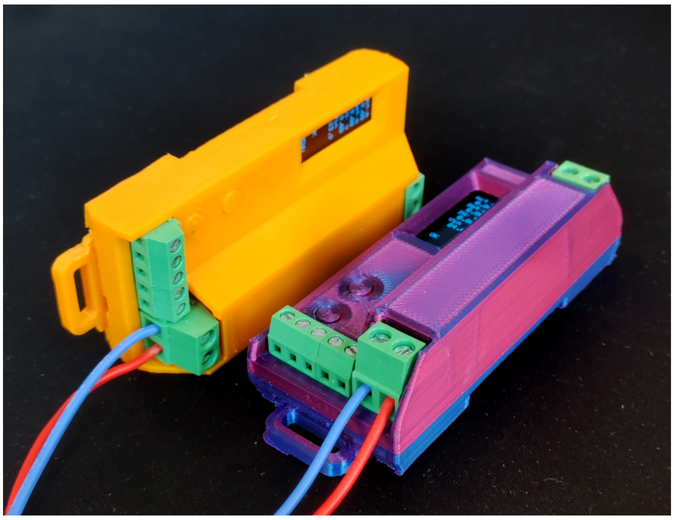
Proportional Valve Driver

User Manual

Version 0.7 · January 2026 · Author — VlasovLab



1. Purpose and Scope of Application

VL-PVD1-24 is an electronic solenoid current driver for controlling proportional hydraulic valves/directional valves without spool-position feedback. The control action is generated by the coil current.

Typical applications:

- proportional pressure-reducing / relief / throttling valves (1 solenoid);
- proportional directional valves (2 solenoids) — using two VL-PVD1-24 units or a two-channel version (VL-PVD1-24).

Application limitations:

- the device is not a servo amplifier and is not intended for valves with a spool-position sensor and closed-loop position control;
- the device does not include a voltage boost converter — the maximum achievable current is limited by the supply voltage and coil resistance. For coil and supply selection, see Section 15.

2. Key Features

- Supply: **12…30 VDC**, compatible with industrial **24 V** systems; absolute maximum: **35 V**.
- Output: current control **0…3.0 A** (adjustable **maximum and minimum current** limits).
- Separate **rise** and **fall** time settings: **0…10,000 ms**.
- **Dither** (superimposed command ripple): frequency **10…300 Hz**, amplitude **0…0.4 A peak-to-peak**, triangular waveform.
- **3 current-loop dynamics modes**: FAST / NORM / SLOW.
- Current command sources: **0–10 V**, **4–20 mA (0–20 mA)**, **PWM**, UART serial interface.
- Flexible and convenient **input and output scaling**: independent **minimum/maximum** settings for each source (implements **offset/gain** and input/output deadband).
- Indication/diagnostics: short circuit, coil open circuit, input overrange, power-supply status.
- Interfaces: display + 2 buttons, UART serial interface 115200 8N1, **PC interface and open communication format**.

3. Specifications

Table 1: Device specifications

Section	Parameter	Value
Supply	Operating supply range	12…30 VDC
	Absolute input maximum	35 V
	Supply overvoltage protection	output shutdown at > 32.0 V
	Low-voltage indication	< 11.5 V (warning; output remains active)
	Reverse-polarity protection	yes
	Current consumption (no load)	50 mA
Output	Topology	Low-side N-channel MOSFET (coil to +V, switch to GND)
	Control type	closed current loop
	Current range	0…3.0 A (adjustable)
	Power-stage PWM frequency	16 kHz;
	Current regulation accuracy	± 1 % of range*
	Short-circuit protection	yes; output shutdown
	Short-circuit protection response time	1…5 ms
	LPF cutoff frequency (-3 dB)	~ 1.1 kHz
	Coil open circuit	indication; output is not shut down
Command inputs	Voltage (0–10 V)	$R_{\text{in}} = 15$ kΩ; warning > 10.7 V; up to 20 V allowed
	Current (4–20 mA)	R_{in} (shunt) = 150 Ω; warning > 21.5 mA; up to 30 mA allowed
	PWM input	1…20 kHz; 0…100 %; level 8…15 V; shared input with 0–10 V
	LPF cutoff frequency (-3 dB)	200 Hz
Interfaces	Display	OLED
	Buttons	2 pcs.
	UART	115200 baud, 8N1, no galvanic isolation
Operation	Mounting	DIN rail
	Dimensions	36×88×24 mm
	Weight	≈ 50 g
	Operating temperature	$-35 \ldots +55$ °C
	Maximum continuous current 3 A	at $+25$ °C
	Thermal protection	none
	Settings memory (write endurance)	5000 cycles
	Recommended ventilation	free convection; clearance ≥ 20 mm around the device

* Depends on solenoid parameters.

4. Connection

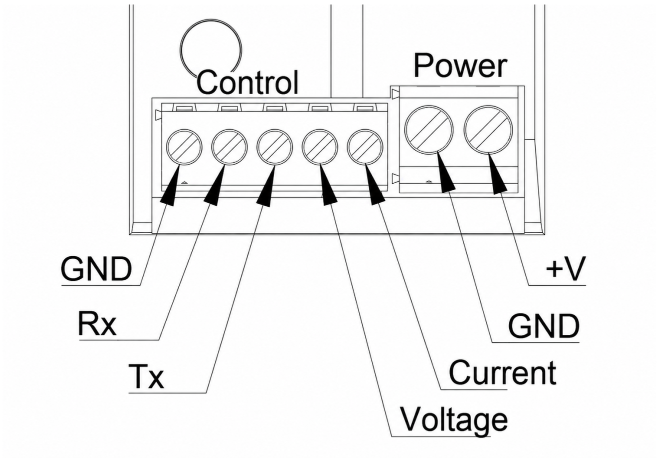


Figure 1: Connection diagram: power supply, command input (0–10 V, 4–20 mA, PWM), UART.

4.1 General Installation and Cable Routing Requirements

- Power circuits (supply and coil): conductor cross-section up to 1.5 mm² is recommended.
- Signal circuits: conductor cross-section up to 0.5 mm² is recommended.
- Grounding / 0 V: a star topology is recommended — power ground and signal ground should meet at one point (typically at the power supply or at a common cabinet grounding point).

Important

The power supply "−" terminal and the signal "GND" terminal are electrically connected inside the device. If the power "−" conductor is interrupted or has poor contact, the load return current may partially flow through the signal "GND" circuit, causing measurement/control errors and possible damage to the signal wiring. Ensure a reliable power "−" connection with adequate conductor cross-section.

4.2 Cable Length and EMC Recommendations

4.2 Power Cable (12…30 V)

- Recommended length: up to 5…10 m.
- Permitted: up to 50 m (in some cases up to 100 m) if conductor cross-section, voltage drop, and EMC requirements are satisfied. For long power lines, consultation with a qualified specialist is recommended.

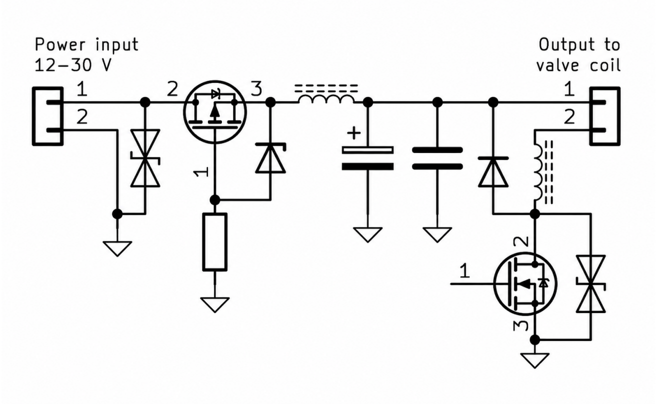


Figure 2: Simplified internal diagram (power stage)

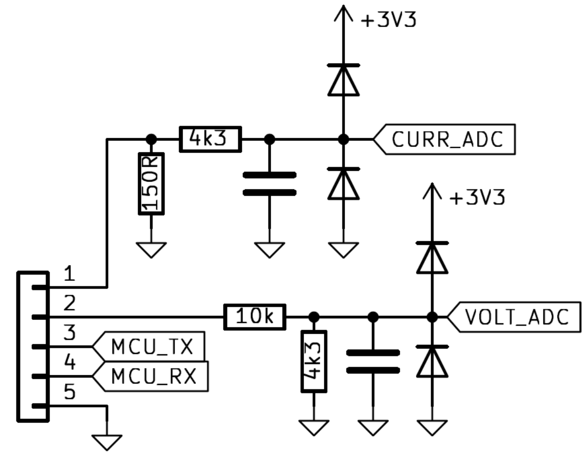


Figure 3: Simplified internal diagram (signal inputs)

- For long power cables, it is recommended to install decoupling capacitors near the device: 470…2200 µF (electrolytic) + 0.1 µF (ceramic). The capacitors should be installed in parallel across the supply rails as close as possible to the device terminals.

4.2 Solenoid Coil Cable (Output)

- Recommended length: up to 5…10 m.
- Permitted: up to 30 m if conductor cross-section, voltage drop, and EMC requirements are satisfied. For long lines, consultation with a qualified specialist is recommended.
- For the coil circuit, use a twisted pair or route both coil conductors close together (minimizing current-loop area).
- Do not route coil conductors together with motor/variable-frequency-drive power cables; if necessary, maintain separation and/or use separate cable ducts.
- A ferrite filter may be installed on the coil cable at the device side (this may reduce emissions).

> **Warning!**
>
> It is **forbidden** to install additional components on the coil-cable side (capacitors, diodes, resistors, etc.), because this may disturb proper driver operation and/or increase interference.

Exception: low-current LED indication of 2…10 mA (LED + current-limiting resistor) may be installed according to the indication manufacturer's recommendations.

4.2 0–10 V Input

- Most sensitive to induced noise.
- Recommended length without shielding: up to 3…5 m.
- Shielded twisted pair: up to 10…20 m (up to 30 m in low-noise environments).
- The signal wire and its GND should be routed together (one cable/pair). The shield is recommended to be connected to ground at one end, typically at the signal-source side.

4.2 4–20 mA Input

- Most preferred for long lines.
- Typical lengths: 50…200 m.
- 200…500 m is possible, but depends on the current-loop source (allowable load voltage) and the noise level.

4.2 PWM Input

- Recommended length: up to 5…10 m.
- Around 20 m is close to the practical limit and requires careful routing, common ground, and shielding if necessary.

4.2 UART (for Configuration/Debugging)

- Recommended for local connection.
- Typical length: up to 1 m (in some cases up to 2 m with good routing and low noise).
- Purpose: parameter setup and diagnostics as an alternative to manual input.
- Critical: when connecting to a PC, it is recommended to use a USB isolator (galvanic isolation on the USB side) at the PC side.

5. Quick Start

1. Connect the solenoid coil and signal lines according to the connection diagram.
2. Apply **12…30 V** DC power.
3. Select the command source: **VOLT / CURR / PWM / UART** (0–10 V / 4–20 mA / PWM / UART).
4. Set $\mathbf{I}_{\mathbf{max}}$ according to the coil datasheet (for example, **1.6 A**).
5. If necessary, set $\mathbf{I}_{\mathbf{min}}$ (for dead-zone compensation / bias current).
6. Set the **rise time** and **fall time** (for example, **200 ms / 100 ms**).
7. If necessary, enable **Dither** (amplitude > 0).
8. On the parameter screens, execute **SAVE** to apply the settings (on each screen).

6. Input Signal to Output Current Scaling

VL-PVD1-24 allows the **lower and upper input-signal limits** to be set, corresponding to the minimum and maximum output (coil) current. The minimum and maximum **coil current** values can also be set.

This provides:

- input dead-zone correction (ignoring the range below the lower input-signal threshold);
- output deadband correction;
- offset and gain/scale adjustment;
- maximum-current limiting.

6.1 Conversion Rule (General)

For the selected input-signal source (0–10 V voltage, 4–20 mA current, PWM), the following are set:

- input limits: X_{min}, X_{max} (for example $V_{\text{min}}/V_{\text{max}}$, $I_{\text{min}}/I_{\text{max}}$, $PWM_{\text{min}}/PWM_{\text{max}}$);
- output limits: $I_{\text{min\_out}}$, $I_{\text{max\_out}}$ (coil current).

The conversion is a piecewise-linear function:

- at $X < X_{\text{min}} \to I = 0$;
- at $X_{\text{min}} \leq X \leq X_{\text{max}} \to I$ changes linearly from $I_{\text{min\_out}}$ to $I_{\text{max\_out}}$;
- at $X > X_{\text{max}} \to I = I_{\text{max\_out}}$.

6.2 Setup Example (0–10 V)

Setting:

- output range: **0…3.0 A**, set to **0.5…2.0 A**;
- 0–10 V input, set to **2…8 V**.

Result:

- at 1 V → 0 A;
- at 2 V → 0.5 A;
- at 8 V → 2.0 A;
- at 10 V → 2.0 A.

Thus, the input threshold (deadband), offset and scaling (offset/gain), as well as maximum-current limiting are implemented.

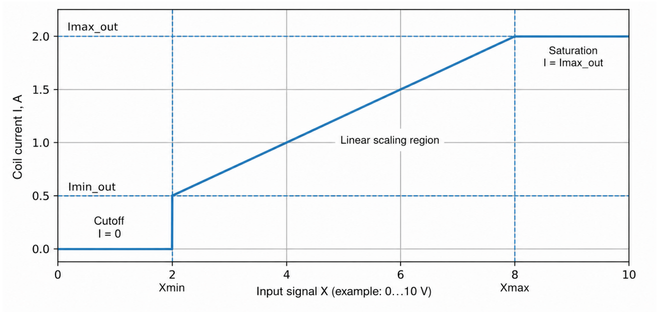


Figure 4: "Input X ⟶ current I" graph (piecewise-linear, with saturation)

7. Current Rise and Fall Time

The rise-time and fall-time parameters define the rate of change of the average coil current when the command changes. They are used for:

- limiting shock loads in the hydraulic system (smooth start and stop);
- suppressing oscillations and jerks;
- matching valve dynamics with the mechanics and the system control loop.

Parameters:

- rise time: **0…10,000 ms**, step **1 ms**;
- fall time: **0…10,000 ms**, step **1 ms**.

Important

Rise/fall times are specified over the full scale.
The **"Rise time"** and **"Fall time"** parameters are specified as the time required to change **from 0 to the device full-scale maximum current** (3.0 A), not to the current user-defined **Imax** value.
This means that for a lower target current, the actual transition time will be proportionally shorter.
Example: the setting is **200 ms** (over the 0…3.0 A scale). If the target current is **1.0 A**, the time to reach it will be approximately:

$$t \approx 200\,\text{ms} \cdot \frac{1.0}{3.0} \approx 67\,\text{ms}$$

Practical advice: if the transition **to your operating Imax** must take the specified time, multiply the setting by the factor $\frac{3.0}{I_{target}}$.

7.1 What Exactly Is Limited

The specified times are applied to the average coil current I_{avg}. When dither is enabled, the AC component is superimposed on the average current:

$$I_{\text{cmd}} = I_{\text{avg}} + i_{\text{Dither}}(t)$$

Thus:

- rise and fall times define the rate of change of the base (average) current;
- dither does not change the specified rise or fall time, but only adds modulation around the average value with automatic limiting at the current boundaries.

7.2 Why the Actual Time May Differ from the Setting

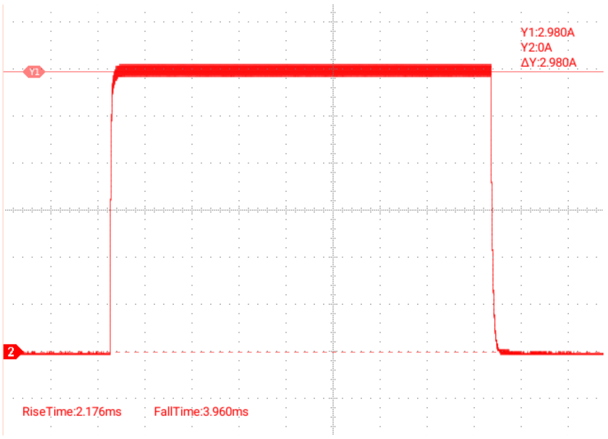


Figure 5: Current waveform. 3 A step command, without dither. Coil 10 mH, 5 Ω

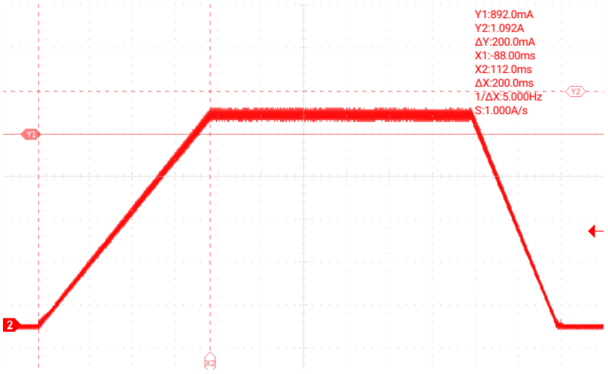


Figure 6: Current waveform. 1 A step command, without dither. Rise 600 ms (=200 ms for 1 A), fall 300 ms (=100 ms for 1 A). Coil 10 mH, 5 Ω

The actual current slew rate is determined not only by the VL-PVD1-24 settings, but also by the coil electrical parameters and by the supply voltage.

The coil is an R–L load, so the current cannot change faster than the physical limits. As an approximation:

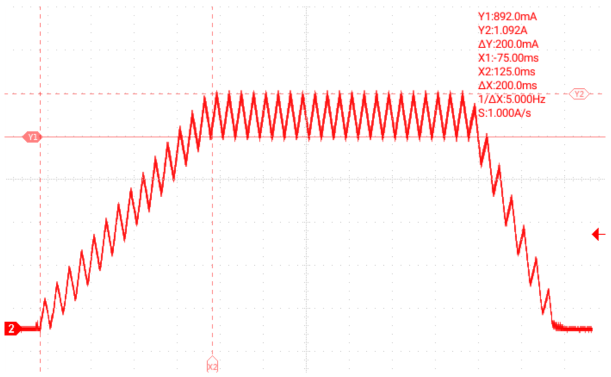


Figure 7: Current waveform. 1 A step command, with dither. Dither 70 Hz, 200 mA. Coil 10 mH, 5 Ω

- during current rise, the current increases faster when the supply voltage is higher and when the inductance-to-resistance ratio is lower;
- during current fall, the rate is determined by the demagnetization method and the coil parameters.

Practical rule: if the specified rise or fall time is shorter than allowed by the R, L, and supply-voltage parameters, the current will follow the maximum physically possible dynamics, and the actual time will be longer than the setting.

7.3 Recommendations for Selecting Rise and Fall Times

- For initial setup, it is recommended to start with 200…500 ms for rise and 100…300 ms for fall, then adjust the values according to system behavior.
- If jerks or hydraulic shocks occur, increase the rise and/or fall time.
- If the system lacks dynamics, the rise time may be reduced, while monitoring for absence of overshoot and coil overheating.
- With long wires and “heavy” coils (high inductance), it is recommended to use **SLOW** regulator mode or increase the rise and fall times.

7.4 Current Fall Specifics (Demagnetization)

VL-PVD1-24 uses a freewheel diode for coil demagnetization, providing coil-current circulation when the power switch turns off and limiting voltage spikes.

With this method, the level of electromagnetic interference is generally lower compared with “hard” overvoltage-clamping methods.

For most common proportional-valve coils, the current-fall dynamics are more than sufficient for practical applications. Exceptions may include very fast devices (for example, servo directional valves) with full spool-travel times of about **4…10 ms**. In such cases, additional clarification and compatibility calculation are required.

8. Dither

Dither is an AC current component superimposed on the average coil-current command. Its purpose is to reduce the effect of static friction and mechanical hysteresis in a valve or directional valve, improve repeatability at low flow rates and small movements, and stabilize operation near the dead zone.

A typical effect of correctly adjusted dither:

- reduced spool “sticking” at small commands;
- lower actuation threshold (in some hydraulic-equipment mechanical designs);
- smoother and more repeatable control at low flow rates and pressures.

8.1 Operating Principle

The device generates the current command:

$$I_{\text{cmd}} = I_{\text{avg}} + i_{\text{Dither}}(t)$$

where:

- I_{avg} is the average (base) current defined by the input signal with scaling and rise/fall time applied;
- $i_{\text{Dither}}(t)$ is the variable current addition.

Dither does not change the specified average current value; it only applies symmetrical modulation around it.

8.2 Parameters

- frequency: **10…300 Hz**, step **1 Hz**;
- amplitude: **0…0.4 A peak-to-peak** (equivalent to **0…0.2 A zero-to-peak**);
- waveform: **triangular**;
- dither is active when **amplitude** > 0 (0 A amplitude means dither is disabled).

Amplitude note. In this document, dither amplitude is specified as a peak-to-peak value (span). For example, with amplitude $A_{\text{pp}} = 0.4\ A$, the actual current addition varies approximately within $\pm 0.2\ A$ around the average value.

8.3 Setup Recommendations

Frequency. A frequency that is too low may cause noticeable pressure or flow pulsations, as well as vibration. A frequency that is too high may be ineffective because of coil inductance and limited mechanical sensitivity of the assembly.

A practical starting value is **100…150 Hz**, followed by on-site adjustment.

Amplitude. Select the minimum amplitude at which “sticking” disappears and repeatability improves. A typical order of magnitude is a few percent of the operating current (for example

5…15 % of I_{max}), but the final value is determined by the valve mechanics and by requirements for noise and pulsations.

8.4 Quick Setup Procedure (Practical)

1. Set the frequency to **120 Hz** (typical starting value).
2. Set the amplitude to **0.05…0.10 A peak-to-peak**.
3. Check system behavior at a small command (near the start of opening or movement).
4. If a "step", "sticking", or poor repeatability is observed, increase the amplitude in small steps (for example by **0.02…0.05 A peak-to-peak**) until stable behavior is obtained.
5. If vibration, noise, or noticeable pressure and flow pulsations occur, reduce the amplitude and/or increase the frequency (for example to **150…250 Hz**).
6. After selecting the minimum sufficient amplitude, check several operating modes (small and medium commands, different loads) and adjust the parameters if necessary.

8.5 Side Effects (Normal and Expected)

When dither is enabled, the following may occur:

- slight vibration or noise of the assembly (especially in the audible-frequency range);
- a small increase in coil heating due to the AC current component;
- pressure or flow pulsations in sensitive hydraulic systems (especially at low frequency and high amplitude).

If the system is sensitive to pulsations, it is recommended to:

- increase the dither frequency;
- reduce the amplitude;
- disable dither if necessary.

8.6 Automatic Dither Limiting at the Lower and Upper Current Boundaries (Anti-Clipping)

To preserve the correct average current value and prevent modulation "clipping" at the range boundaries, VL-PVD1-24 implements automatic dither-amplitude limiting when approaching zero current and the upper current limit.

Operating principle:

- the user sets the dither amplitude A_{pp} (peak-to-peak);
- the device generates the effective amplitude A_{eff}, limiting it so that the instantaneous current remains within the allowed limits.

Limits:

- lower: $I \geq 0\ A$;
- upper: $I \leq 3.1\ A$ (built-in hardware limit).

Condition (idealized, for triangular modulation):

$$A_{\text{eff}} \leq 2 \cdot I_{\text{avg}}$$

$$A_{\text{eff}} \leq 2 \cdot (I_{\text{upper}} - I_{\text{avg}}), \qquad I_{\text{upper}} = 3.1\ A$$

That is, as the average current approaches zero or the upper boundary, the actual dither amplitude is automatically reduced.

Practical effect:

- no modulation clipping at the range boundaries;
- the average current remains predictable;
- stable dither operation is ensured both at low currents and near the maximum value.

Note. When operating near 0 A or 3.1 A, the actual dither amplitude may be lower than the specified value — this is normal and correct anti-clipping behavior.

9. Current Regulator Modes

The mode defines the current-loop tuning behavior (roughly, "stiffness" and response dynamics to command changes) and affects current settling time, overshoot, and stability with different coil and line parameters.

- **SLOW** — priority is stability and "soft" behavior. Recommended for coils with high inductance, long wires, increased-noise environments, and systems prone to oscillation. A slower response to fast command changes and reduced dynamics are possible.
- **FAST** — priority is current-settling speed and minimum delay. Recommended for short rise/fall times and maximum response speed. With coils having a low R/L ratio and during sharp transitions, overshoot and increased current "nervousness" are possible (especially with high dither amplitude).
- **NORM** — balanced default mode. Recommended for most applications and as the starting point during initial setup.

Selection recommendation. Start with **NORM**. If dynamics are insufficient, switch to **FAST**; if there are signs of instability or overshoot, use **SLOW** or increase the rise and fall times.

10. Power-Stage PWM Frequency

The PWM frequency defines how often the power switch commutates the coil voltage to generate the specified current. The selected frequency affects acoustic noise, power-stage heating, current ripple, and electromagnetic emissions.

Available values: 2 / 4 / 8 / 16 kHz.
Default value: 16 kHz.

10.1 Effect of PWM Frequency

- **Acoustic noise.** Low frequencies (2–8 kHz) may fall within the audible range and cause squeal or hum from the coil and mechanical components. **16 kHz** is usually less audible.

- **Power-stage heating.** As frequency increases, switching losses in the power switch increase, therefore at the same current a higher frequency may slightly increase device heating.
- **Current ripple and interference.** In some configurations (low-inductance coil, short rise and fall times, wiring specifics), the PWM frequency selection affects current ripple and electromagnetic interference.

10.2 Effect on Dither Operation

Dither is low-frequency current modulation. To generate dither correctly, the power stage must have sufficient PWM-frequency margin.

- At **high dither frequencies** (for example **300 Hz**), it is recommended to use **16 kHz** — modulation is generated more correctly and smoothly.
- At **2 kHz**, the quality of dither generation at high frequencies may deteriorate because there are fewer PWM periods per dither period, which appears as stepping, pulsation, and reduced dither effectiveness.

Practical rule. When using dither at **200…300 Hz**, select a PWM frequency of **16 kHz** (or at least **8 kHz** if necessary).

10.3 Selection Recommendations

- **16 kHz** — recommended value for most applications (minimum audibility, best mode for high-frequency dither).
- **8 kHz** — compromise between heating and noise if using 16 kHz is undesirable thermally.
- **2–4 kHz** — use when switching losses must be minimized, provided that acoustic noise and possible ripple are acceptable; not recommended for 200…300 Hz dither.

Practical rule. If the device and coil operate stably and acoustic noise is not an issue — leave **16 kHz**. If heating is elevated and there is no “quiet operation” requirement, try **8 kHz**, then **4 kHz**.

11. Indication and Protection

11.1 Event Indication

The device indicates the following events and states:

- output short circuit;
- low supply voltage: $< 11.5\ V$;
- high supply voltage: $> 32.0\ V$;
- coil open circuit;
- input current overrange: $> 21.5\ mA$;
- input voltage overrange: $> 10.7\ V$.

11.2 Protection Behavior

The output is **shut down** only in the following cases:

- output short circuit;
- supply voltage exceeds $> 32.0\ V$.

For other warnings, the output continues operating.
Fault indication is reset by pressing the **lower button**.

12. UART: Configuration and Control

12.1 Line Parameters

- 115200 baud, 8N1;
- no galvanic isolation.

12.2 Frame Format

Frame format (in bytes):

AA 55 | VER | TYPE | LEN (16 bits, LE) | PAYLOAD | CRC16 (16 bits, LE)

- PREAMBLE = 0xAA 0x55
- VER = 0x01
- TYPE = 0x10 (SET_PARAMS)
- LEN — PAYLOAD field length in bytes (expected: **56**)
- CRC16 — **CRC16-CCITT**, poly 0x1021, init 0xFFFF, calculated over bytes **VER..PAYLOAD** (without PREAMBLE and without CRC).

12.3 PAYLOAD (56 bytes, little-endian)

Field order (as they appear in the payload):

- uint32 disp_on (0..60000)
- uint32 inp_sig_sel
- int32 curr_max (A×10000)
- int32 inp_set_volt_max (mV)
- int32 curr_min (A×10000)
- int32 inp_set_volt_min (mV)
- int32 inp_set_curr_max (mA×1000)
- int32 inp_set_curr_min (mA×1000)
- int32 inp_set_pwm_max (0..1000)
- int32 inp_set_pwm_min (0..1000)
- uint32 ramp_rise (ms)
- uint32 ramp_fall (ms)
- uint8 brightness
- uint8 pid_mode
- uint16 dither_freq (Hz)
- int32 dither_ampl (A×10000, peak-to-peak)

13. Menu and Parameters

13.1 Entering the Menu and Navigation

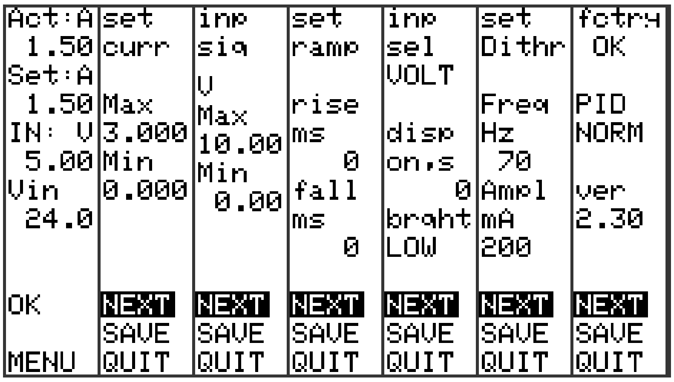


Figure 8: Menu screen map

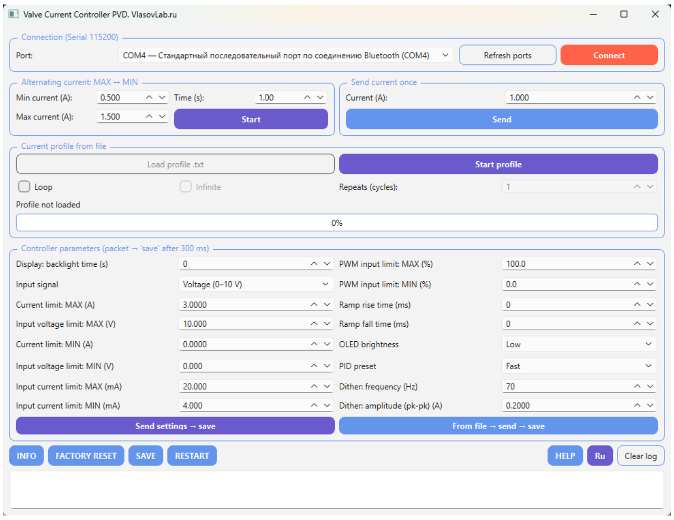
- entering the menu: long-press the **upper** button for 2–3 s → “MENU” appears; short-press the upper button — enter the menu;
- moving through menu items — **upper** button;
- selecting an item or entering edit mode — **lower** button;
- in edit mode: upper button — move through digits or characters, lower button — change the value;
- changes take effect **only after selecting “SAVE”** on the current screen.

13.2 Parameter Table (Menu / UART)

Table 2: Device parameter table (menu and UART)

Parameter	Unit	Range	Step	Factory	Note
Command source	—	VOLT / CURR / PWM / UART	—	VOLT	
Output current limits					
Maximum current	A	0.01…3.000	0.001	3.000	
Minimum current	A	0…2.990	0.001	0.000	offset / bias current
Input limits (scaling)					
Voltage: Vmin	V	0…9	0.01	0	lower limit
Voltage: Vmax	V	1…10.5	0.01	10	upper limit
Current: Imin	mA	0…18	0.01	4	lower limit
Current: Imax	mA	1…20.5	0.01	20	upper limit
PWM: PWMmin	%	0…90	0.1	0	duty cycle; in UART: 0…1000
PWM: PWMmax	%	10…100	0.1	100	duty cycle; in UART: 0…1000
Dynamics					
Rise time	ms	0…10000	1	0	
Fall time	ms	0…10000	1	0	
Dither frequency	Hz	10…300	1	70	
Dither amplitude	A (peak-to-peak)	0…0.4	0.001	0	0 = disabled
Power-stage PWM frequency	kHz	2 / 4 / 8 / 16	—	16	
PI regulator mode	—	FAST / NORM / SLOW	—	NORM	
Interface					
Brightness	—	LOW / MED / HIGH	—	LOW	
Display on time	s	0…60000	1	0	0 = always on
Service					
SAVE	—	—	—	—	apply settings
Factory reset	—	—	—	—	reset to factory defaults

14. PC Interface (Control Utility and Profiles)



Valve Current Controller PVD. VlasovLab.ru

Connection (Serial 115200)

Port: COM4 — Стандартный последовательный порт по соединению Bluetooth (COM4)

Alternating current: MAX ↔ MIN

Min current (A): 0.500

Time (s): 1.00

Max current (A): 1.500

Send current once

Current (A): 1.000

Current profile from file

☐ Loop

☐ Infinite

Repeats (cycles): 1

Profile not loaded

0%

Controller parameters (packet → 'save' after 300 ms)

Display: backlight time (s)	0	PWM input limit: MAX (%)	100.0
Input signal	Voltage (0–10 V)	PWM input limit: MIN (%)	0.0
Current limit: MAX (A)	3.0000	Ramp rise time (ms)	0
Input voltage limit: MAX (V)	10.000	Ramp fall time (ms)	0
Current limit: MIN (A)	0.0000	OLED brightness	Low
Input voltage limit: MIN (V)	0.000	PID preset	Fast
Input current limit: MAX (mA)	20.000	Dither: frequency (Hz)	70
Input current limit: MIN (mA)	4.000	Dither: amplitude (pk-pk) (A)	0.2000

Figure 9: PC utility screenshot

The device supports control and configuration from a PC via UART:

- Python source code is provided, as well as an executable file (.exe);
- the protocol format is open (see Section 12), and custom software or control by an external microcontroller is allowed.

Installation (brief):

1. Connect a UART adapter (USB–UART, not included) to the PC (pinout is shown in Fig. 1 “Connection diagram”).
2. Make sure a COM port appears in the system.
3. Run the utility (Python script or .exe file).
4. Select the COM port and **115200** baud rate.

Use (critical points):

- when working via UART, take into account the absence of galvanic isolation (common ground between the device and the PC);
- when controlling current from a PC, it is recommended to use an additional USB galvanic-isolation device (for example, based on ADUM3160; not included);
- current profiles are defined in text format and executed by the device; extended help and profile examples are provided in the utility interface and may change between software versions.

15. Compatibility

15.1 What “Compatibility” Means for VL–PVD1–24

VL–PVD1–24 is intended for controlling **proportional solenoid coils** (proportional valves and proportional hydraulic directional valves) in an **open loop**, that is, **without spool-position feedback**.

The nominal coil and input-signal parameters from different manufacturers are often specified as typical or recommended values. Minor discrepancies in “coil rated voltage” or signal format **do not mean** that the device is incompatible.

In most cases, it is critical to stay within the allowable ranges for **supply voltage**, **achievable current**, and **input-signal type**; fine adjustment is performed using the minimum and maximum output-current settings, as well as the input limits.

Compatibility is determined by the following parameters.

15.1 Coil Supply (Voltage Matching)

- There is **no** internal boost converter.
- The power output is a **low-voltage low-side switch** (N-channel MOSFET). The coil is connected to **+$\mathbf{U_{sup}}$**, and the second terminal is connected to the device output.

What “12 V coil” or “24 V coil” means. Usually, this denotes the operating mode in which the coil reaches its rated current or power. In practice, coils often operate at other voltages as well, provided that the required current is achievable and the coil thermal limits are not exceeded.

Estimate of achievable steady-state current (upper estimate):

$$I_{\text{ach}} \approx \frac{U_{\text{sup}} - U_{\text{loss}}}{R_{\text{coil}}}$$

where:

- U_{sup} — actual device supply voltage, V;
- R_{coil} — coil resistance at 20°C, Ω;
- U_{loss} — total voltage drop in the power path (switch, current measurement, conductors), V.

For an engineering estimate, U_{loss} may be assumed in the range **0.5…1.0 V** (the exact value depends on current and wiring).

Example 1. 8 Ω coil, 24 V supply:

$$I_{\text{ach}} \approx \frac{24-1}{8} \approx 2.9\ A$$

A current close to 3 A is achievable.

Example 2. 18 Ω coil, 24 V supply:

$$I_{\text{ach}} \approx \frac{24-1}{18} \approx 1.28\ A$$

Currents above approximately 1.3 A are physically unachievable, even if the command is higher.

Note. Coil inductance affects dynamics (rise and fall time), but **does not increase** steady-state current for given U_sup and R_coil.

Practical conclusion: a coil rated for "12 V" is often **suitable** with a 24 V supply, provided that I_max is set according to the coil datasheet and coil heating is monitored.

15.1 Required Coil-Current Range

The device output-current range is: **0…3.0 A** (with I_min and I_max settings).

Example. If the coil requires 1.6 A, this is fully within the device range — it is sufficient to set $I_\text{max} = 1.6\ A$.

Even if the coil datasheet specifies "1.6 A at 12 V", there is no contradiction: control is performed **by current**, and the supply voltage only has to ensure that this current can be achieved according to the estimate above.

15.1 Command-Signal Type and Range Mismatch

Supported command sources:

- voltage **0–10 V**;
- current input (typically **4–20 mA**);
- **PWM** (1…20 kHz, levels 8…15 V);
- **UART**.

Important. Input-signal limits are adjustable ($X_\text{min}/X_\text{max}$), which allows adaptation to signals that do not formally match the classic standard.

Examples:

- the source outputs 0–20 mA, while the standard is 4–20 mA: set $I_\text{min,in} = 0\ mA$, $I_\text{max,in} = 20\ mA$;
- the source outputs 2–10 V instead of 0–10 V: set $V_\text{min,in} = 2\ V$, $V_\text{max,in} = 10\ V$;
- the coil operating range must be limited (for example 0.5…2.0 A): set $I_\text{min,out}/I_\text{max,out}$.

Practical conclusion. A mismatch between "4–20 mA" and "0–20 mA" or "0–10 V" and "2–8 V" usually only means that the limits must be set correctly, not that the device is incompatible.

Limitation. The **–10…+10 V** input signal is not supported.

15.2 Quick Compatibility Checklist

Before connection and setup, it is recommended to check the following points in sequence:

1. **Valve type:** proportional valve or directional valve **without position feedback** (without LVDT or position sensor) and **without integrated electronics** (the coil is driven directly).
2. **Device supply:** matches the datasheet and is within the **12…30 V DC** range.
3. **Required coil current:** the nominal or maximum coil current **does not exceed 3.0 A** (this value will be set as I_max).
4. **Command source and range:**
    - voltage **0–10 V**, or
    - current input **4–20 mA** (0–20 mA is allowed by setting $I_\text{min,in}/I_\text{max,in}$), or
    - **PWM** with a frequency of 1…20 kHz and levels of 8…15 V.

15.3 Examples of Compatible Valve Families (for Initial Cross-Checking)

Below are examples of valve families commonly found on the market. **This list is not exhaustive** and is provided solely for initial orientation.

Warning!

Many hydraulic directional valves have **two coils** (A/B). VL–PVD1–24 is a **single-channel device**; therefore, full control of a 4/3 directional valve usually requires **two devices** or a two-channel version **VL–PVD2–24**.

15.4 Proportional Hydraulic Directional Valves

Table 3: Examples of compatible proportional hydraulic directional valves (open-loop, without integrated electronics)

Manufacturer	Example family	Type	Application notes
Bosch Rexroth	**4WRA / 4WRAE (typical range, Size 6)**	Direct-acting proportional directional valve	Versions with external electronics and with integrated electronics (OBE) are available. For VL–PVD1–24, the target option is coil current control (external electronics / off-board).
Parker	**D1FB (NG06 / CETOP 03)**	Proportional directional valve	Available both without electronics and with onboard electronics (OBE). For use with VL–PVD1–24, select a version **without integrated electronics**.
Eaton (Vickers / Danfoss)	**KDG4V-3S / KTG4V-3S**	Proportional directional valve / throttle	“Non-feedback” (open-loop) class. Verify that an external driver is required (direct coil connection).
Eaton (Vickers)	**K(B)FDG4V / K(B)FTG4V**	Proportional directional valves (often two-stage)	Often used in industrial hydraulics. Check whether an external driver or integrated electronics is required.
HAWE	**POL / PRL / PIL (series without displacement transducer)**	Proportional directional valve	Documentation distinguishes versions **without displacement transducer** and with a sensor. For VL–PVD1–24, the target class is versions **without a sensor** (open-loop).
Wandfluh	**Proportional spool valve NG6 (ISO 4401-03)**	Proportional directional valve	Wandfluh commonly offers direct-coil versions as well as variants with integrated electronics. VL–PVD1–24 requires a version without integrated electronics and without a sensor.
Bucher Hydraulics	Proportional directional valves (versions without integrated electronics)	Proportional directional valve	Check the datasheet: “direct coil” (off-board driver) or “electronics on the valve”.
Atos	**DHZO-A / DKZOR-A (without position transducer)**	Direct-acting proportional directional valve	The documentation describes versions **without position transducer** and “A – to be coupled with off-board drivers” variants. This is the target class for VL–PVD1–24.
Duplomatic Motion Solutions	**DSE3 / DSE3B (ISO 4401-03)**	Direct-acting proportional directional valve	The manufacturer explicitly specifies operation from a “current-controlled power supply”.
Yuken	**EDFHG (E-Series)**	Proportional directional / flow-control valve (two-stage)	Widely used in machine-tool and industrial hydraulics. The coil/pilot electrical data and the need for external electronics must be checked.
Vickers by Danfoss	**KDG4V-3S / KTG4V-3S (current Danfoss catalogs)**	Proportional directional valve / throttle	When “Vickers by Danfoss” is specified, use current Danfoss catalogs as the primary data source.

15.5 Proportional Pressure/Flow Valves (single-solenoid — convenient for a 1-channel driver)

Table 4: Examples of compatible proportional pressure/flow valves (single-solenoid, open-loop, without integrated electronics)

Manufacturer	Example family	Type	Application notes
Atos	**RZMO–A**	Direct-acting proportional pressure-relief valve	The documentation describes versions “without integrated driver” for operation with an external amplifier / current driver.
HAWE	**PMV / PMVS**	Proportional pressure-control / pressure-limiting valves	Used in industrial hydraulics. For VL–PVD1–24, the coil parameters and required current range are important.
Bosch Rexroth	Proportional pressure / flow valves **without integrated electronics**	Proportional valves	The product range is extensive; criteria: (a) coil without integrated electronics, (b) current ≤ 3 A, (c) required dynamics.
Parker	Proportional pressure / flow valves **without integrated electronics**	Proportional valves	Similarly: check coil current and dither / dynamics requirements.
Sun Hydraulics	**Electro-Proportional Cartridge Valves** (RPE* / RBA* / … families)	Proportional cartridges	Typical class for mobile / construction / municipal equipment (cartridges in manifolds). Check required coil current and recommended settings.
HydraForce	Electro-proportional cartridges	Proportional valves	The manufacturer produces both valves and valve drivers; control is often specified by coil current. Electrical data must be checked.
Wandfluh / Bucher / others	Proportional pressure / flow valves without integrated electronics	Proportional valves	As a rule, these are single-solenoid devices and are well suited for a 1-channel driver; current and dynamics requirements must be checked.
Bucher Hydraulics	**SDRPSA / SDRPSB** (ISO Size 03/05/07)	Proportional pressure-reducing valves	Datasheets explicitly state that pressure / setpoint is proportional to solenoid current (current loop).
Bucher Hydraulics	**DRVSA–7P…** (3-way pressure-reducing, ISO Size 05)	Proportional 3-way pressure-reducing valves	Explicit indication of proportionality to solenoid current. Convenient for single-solenoid applications.
Vickers by Danfoss	**KCG–3**	Proportional pressure-relief valve	The documentation describes an open-loop, single-stage class: a typical candidate for an external current driver if the coil electrical data are suitable.
HydraForce	**TS10–27**	Proportional pressure-relief valve (pilot operated, cartridge)	The adjustable pressure is specified as being related to input current. A typical valve for mobile / special-purpose machinery.

15.6 Examples of Amplifiers / Drivers for Which VL–PVD1–24 May Serve as a Functional Alternative

The references below are provided **for device-class orientation** and do not imply affiliation, endorsement, or a guarantee of 100% interchangeability.

VL–PVD1–24 may be considered as an **alternative** in systems where the following are used:

- **Bosch Rexroth VT–SSPA1…** (plug-in proportional amplifier) – amplifiers for proportional valves without position control.
- **Bosch Rexroth VT–MSPA…** – amplifiers for proportional valves (DIN-rail / panel-mount versions).
- **Parker PWDXXA–400** – digital amplifiers (DIN rail); typical functions: scaling, dither, rise/fall time.
- **HAWE EV1M… / EV1D** – proportional-valve amplifiers (EV1M family).
- **Duplomatic EDM–M** – digital amplifiers for proportional valves in open-loop operation (DIN rail; 1-coil version).
- **Wandfluh P02** – proportional amplifier with dither and rise/-fall time.
- **HydraForce EVDR1** (and analogs) – proportional-valve drivers with current scaling.

Warning!

Critical points to check when replacing:

- whether maximum current and voltage fall within the VL–PVD–24 range;
- whether **two-channel** control is required (two coils A/B);
- whether a **bipolar** input (± 10 V) is required – VL–PVD1–24 operates by default in the 0…10 V, 4…20 mA, and 0…20 mA ranges;
- whether **specific feedback signals** are required (for example, LVDT) or “ready/fault” outputs.

15.7 What Is Definitely NOT a Target Application

- servo valves and proportional valves with mandatory position feedback (LVDT / inductive sensor / encoder), if a specialized servo loop in the amplifier is required;
- valves with integrated electronics, where a “command” is applied to the valve rather than driving the coil directly;
- coils with rated current above 3 A (or requiring voltage above 30 V to achieve the required current).

15.8 Primary Documents (for Cross-Checking)

15.8 Bosch Rexroth

- 4WRA / 4WRAE – product page (Rexroth): https://www.boschrexroth.com/media/eb1ae2bf-3107-4f1a-8222-064368b9eca6

15.8 Parker

- D1FB – datasheet (PDF): https://www.parker.com/content/dam/Parker-com/Literature/Hydraulic-Valve-Division/hydraulicvalve/Catalog-sections-for-websphere/Proportional-Directional-Control/Catalog–Static-Files/D1FB.pdf
- D1FB – datasheet (PDF, EU/UK): https://www.parker.com/content/dam/Parker-com/Literature/Industrial-Systems-Division-Europe/Catalogues/Industrial-Valves-UK/03/D1FB-UK.pdf

15.8 Eaton / Vickers (including “Vickers by Danfoss”)

- KDG4V-3S / KTG4V-3S – datasheet (PDF): https://salushydraulics.pl/pdf/Eaton_Vickers_KDG4V-3S%2CKTG4V-3S.pdf
- K(B)FDG4V-3 / K(B)FTG4V-3 – datasheet (PDF): https://salushydraulics.pl/pdf/Eaton_Vickers_KFDG4V-3%2C_KFTG4V-3%2C_BFDG4V-3%2C_KBFTG4V-3.pdf

15.8 HAWE

- POL / PRL / PIL (size 10) – datasheet (PDF): https://productfinder.hawe.com/downloads/D6395-en.pdf
- PRL / PIL (current document) – datasheet (PDF): https://downloads.hawe.com/6/3/D6394-en.pdf

15.8 Wandfluh

- Proportional spool valve NG6 (example datasheet) – PDF: https://www.wandfluh.com/fileadmin/user_upload/Wandfluh/Products/Components/DataSheets/Englisch/1.10%20Proportional%20spool%20valves/1_10_77_e.pdf
- Proportional spool valve NG6 (example datasheet) – PDF: https://www.wandfluh.com/fileadmin/user_upload/Wandfluh/Products/Components/DataSheets/Englisch/1.10%20Proportional%20spool%20valves/1_10_88_e.pdf

15.8 Atos

- DHZO-A / DKZOR-A (without position transducer) – datasheet (PDF): https://www.atos.com/tables/english/FS160.pdf
- RZMO-A – datasheet (PDF): https://www.atos.com/tables/english/TF035.pdf

15.8 Duplomatic Motion Solutions

- DSE3 – datasheet (PDF): https://duplomaticmotionsolutions.com/docs/2025/83210-ed_125_b8facc0866.pdf
- DSE3 – product page: https://duplomaticmotionsolutions.com/en/dse3.html

15.8 Yuken

- EDFHG (E-Series) – catalog (PDF): https://www.yuken.co.jp/upload/tenant_1/15%20Cat.H-Edit2E_EDFHG.pdf
- Directional & Flow Control Valves (includes EDFHG references) – catalog (PDF): https://yuken-usa.com/wp-content/uploads/2014/09/Directional_and_Flow_Control_Valves.pdf

15.8 Bucher Hydraulics

- SDRPSB-5… (ISO Size 03) – datasheet (PDF): https://www.bucherhydraulics.com/ff/400-P-593451-en.pdf
- SDRPSA-5… (ISO Size 05) – datasheet (PDF): https://www.bucherhydraulics.com/ff/400-P-593501-en.pdf
- SDRPSA-5… (ISO Size 07) – datasheet (PDF): https://www.bucherhydraulics.com/ff/400-P-593551-en.pdf
- DRVSA-7P… (3-way pressure-reducing) – datasheet (PDF): https://www.bucherhydraulics.com/ff/400-P-596101-en.pdf

15.8 Sun Hydraulics

- Electro-Proportional Cartridge Valves – overview (PDF): https://www.sunhydraulics.com/sites/default/files/media_library/tech_resources/TT_US_Electro-Prop-N_0.pdf
- Electro-Proportional Cartridges – catalog (PDF): https://8758033.fs1.hubspotusercontent-na1.net/hubfs/8758033/CFC/Mfg%20collateral/Sun%20Hydraulics/Electro-Proportional%20Cartridges.pdf

15.8 HydraForce

- TS10-27 – product page: https://www.hydraforce.com/products/cartridge-valves/electro-proportional-valves/ts10-27/
- EVDR-0101A – product page (valve driver): https://www.hydraforce.com/products/electronic-vehicle-controls/valve-drivers/evdr-0101a/

15.8 Danfoss (Vickers by Danfoss)

- KCG-3 – datasheet (PDF): https://assets.danfoss.com/documents/latest/418270/BC451879228794en-000201.pdf

16. Overall and Mounting Dimensions

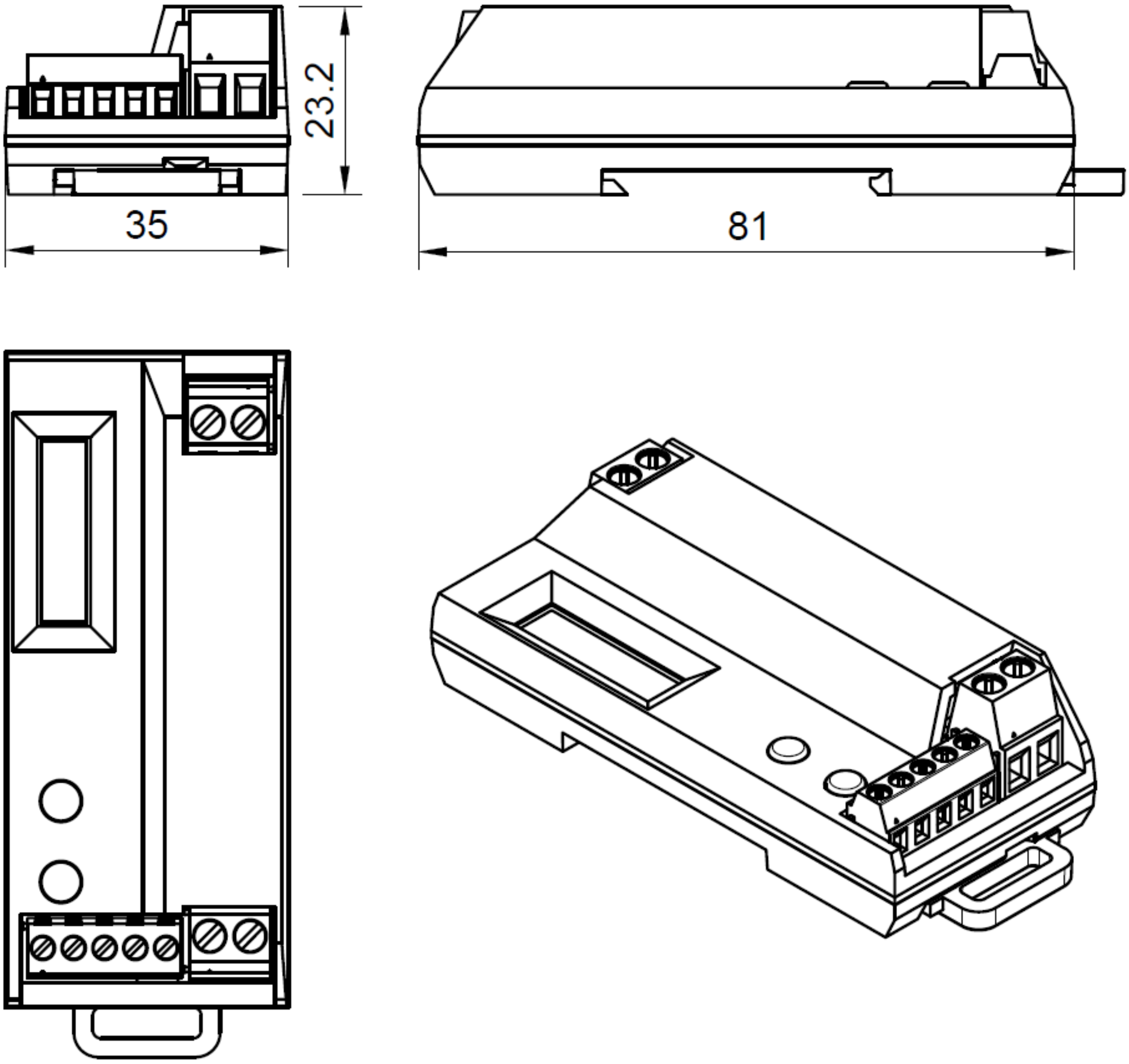


Figure 10: Overall drawing of the device.

17. Thank You for Choosing VlasovLab Products

We strive to make devices that are convenient to integrate into real systems and reliable in operation. If you have any questions about selection, connection, or setup of **VL–PVD1–24**, please contact technical support — we will help determine compatibility with your coil / valve.

Website: vlasovlab.ru
E-mail: info@vlasovlab.ru

We wish you a successful commissioning and stable operation of your hydraulic system!