Integrated amplifier and controller electronics for proportional hydraulic valves

- **Interface:**
  - analogue
  - CANopen or J1939
  - Profibus DP
- 24 VDC or 12 VDC
- Electronic card setting via PC (USB)
- Optimisation of characteristic curve

**Description**
Wandfluh offers proportional valves with integrated, intelligent electronics. With protection class IP67 these valves are suitable for rough ambient conditions. The term “Digital Smart Valve” stands for digital amplifier or controller electronics requiring the smallest space. As a result of the compact construction, Wandfluh is in the position to also offer miniature valves of the nominal size 4 in an optimum, slender design. In addition to this, Wandfluh as the only manufacturer offers proportional screw-in cartridges M22 and M33 with integrated electronics. The electronics are mounted onto a slip-on coil.

**Function**
The actuation takes place via an analogue interface or a fieldbus interface (CANopen/J1939 or Profibus DP). The parameterisation takes place by means of the free-of-charge parameterisation and diagnosis software “PASO” or via the fieldbus interface.

“PASO” is a Windows program in the flow diagram style, which enables the intuitive adjustment and storing of all variable parameters. The data remain saved in case of a power failure and can also be reproduced and transferred to other DSVs.

As an option, these valves are available with an integrated controller. As feedback value generators sensors with voltage or current outputs can be directly connected. The available controller structures have been optimised for applications with hydraulic actuators.

**Application**
The “DSV” electronics are used by Wandfluh exclusively for proportional hydraulic valves. They are factory set and adjusted in order to guarantee the highest valve-to-valve reproducibility. The hydraulic valves have their application where a good valve-to-valve reproducibility, a simple installation, convenient operation and the highest precision are of great importance. The integrated controller relieves the machine control and operates the axis (position, angle, pressure, etc.) in a closed control loop. The applications are in the industrial as well as in the mobile hydraulics for the smooth control of hydraulic actuations.

**TYPE CODE**

<table>
<thead>
<tr>
<th>Type designation according to type list, (derived from valve designation basic execution)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: BVPPM33 - 200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard nominal voltage $U_{n}$:</th>
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</thead>
<tbody>
<tr>
<td>12 VDC</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Slip-on coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal housing, square</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connection execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated electronics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hardware configuration:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog command value signal 12-pole</td>
</tr>
<tr>
<td>Analog command value signal 12-pole</td>
</tr>
<tr>
<td>Analog command value signal 12-pole</td>
</tr>
<tr>
<td>CANopen according to DSP-408</td>
</tr>
<tr>
<td>Profibus DP acc. to Fluid Power Technology CAN J1939 (on request)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplifier</td>
</tr>
<tr>
<td>no remark</td>
</tr>
<tr>
<td>Controller with current feedback value signal (0...20 mA / 4...20 mA)</td>
</tr>
<tr>
<td>Controller with voltage feedback value signal (0...10 V)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sealing material / manual override</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design-Index (Subject to change)</td>
</tr>
</tbody>
</table>

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Illustrations not obligatory  
Data subject to change

Data sheet no. 1.13-76E  
Edition 21 20
Electrical SPECIFICATIONS

<table>
<thead>
<tr>
<th>Protection class</th>
<th>IP 67 acc. to EN 60 529</th>
<th>Input resistance</th>
<th>Voltage input &gt;18 kΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With suitable mating connector and closed electronics housing cover</td>
<td>Load for current input = 250 Ω</td>
<td></td>
</tr>
<tr>
<td>Device receptacle (male)</td>
<td>M23, 12-pole or Connector DIN EN175201 - 804, 7-pole</td>
<td>Command value signal</td>
<td>via CANopen / J1939</td>
</tr>
<tr>
<td>Analog interface</td>
<td>CANopen/J1939 interface</td>
<td>Differential signal transmission</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M12, 4-pole</td>
<td>Command value signal</td>
<td>via Profinbus</td>
</tr>
<tr>
<td>Fieldbus interface</td>
<td>Profinbus</td>
<td>Shielded, twisted wire</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Directed in delivery</td>
<td>Differential signal transmission</td>
<td></td>
</tr>
<tr>
<td>Mating connector (female)</td>
<td>Plug M23, 12-pole or Plug DIN EN175201 - 804, 7-pole or Plug M12, 4-pole (not incl. in delivery)</td>
<td>Feedback value signal: (controller only)</td>
<td>Differential input not galvanically separated, for earth potential difference up to 1.5 V</td>
</tr>
<tr>
<td></td>
<td>M12, 5-pole</td>
<td>• Type R1</td>
<td>4…+20 mA / 0…+20 mA</td>
</tr>
<tr>
<td>Sensor (controller only)</td>
<td>B coded (according to DRP 303-1)</td>
<td>• Type R2</td>
<td>0…+10 V / -10…+10 V</td>
</tr>
<tr>
<td></td>
<td>CANopen / J1939</td>
<td>Resolution ±12 bit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M12, 5-pole</td>
<td>M12, 5-pole, B coded (according to CANopen / J1939)</td>
<td></td>
</tr>
<tr>
<td>Mating connector (female)</td>
<td>CANopen / J1939</td>
<td>CANopen / Profibus to DSV 500 VDC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plug M12, 5-pole (not incl. in delivery)</td>
<td>Digital inputs</td>
<td>Switching level high 6…30 VDC</td>
</tr>
<tr>
<td>Device receptacle (female)</td>
<td>CANopen / J1939</td>
<td>(analog interface only with M23 connector, 12-pole)</td>
<td>Switching level low 0…1 VDC</td>
</tr>
<tr>
<td></td>
<td>IEC 947-5-2</td>
<td>Utilisable as frequency input (frequencies 0…5 kHz) and as PWM-input (automatic frequency recognition)</td>
<td></td>
</tr>
<tr>
<td>Mating connector (male)</td>
<td>Plug M12, 5-pole, B coded (not incl. in delivery)</td>
<td>Digital output</td>
<td>Low-Side-Switch:</td>
</tr>
<tr>
<td>Profinbus</td>
<td></td>
<td>(analog interface only with M23 connector, 12-pole)</td>
<td>$U_{max} = 40$ VDC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$I_{max} = -700$ mA</td>
<td></td>
</tr>
<tr>
<td>Voltage range:</td>
<td>• 24 VDC 21…30 VDC</td>
<td>Ramps adjustable</td>
<td>0…500 s</td>
</tr>
<tr>
<td></td>
<td>• 12 VDC 10,5…15 VDC</td>
<td>Temperature drift</td>
<td>&lt;1% at ∆T = 40 ºC</td>
</tr>
<tr>
<td>Ripple on supply voltage</td>
<td>&lt;10%</td>
<td>Parameterisation</td>
<td>via USB or CANopen / J1939 (CANopen / J1939 only)</td>
</tr>
<tr>
<td>Fuse</td>
<td>Low</td>
<td>or Profinbus (Profinbus only)</td>
<td></td>
</tr>
<tr>
<td>Stabilised output</td>
<td>10 VDC (with version 24 VDC)</td>
<td>Interface</td>
<td>USB (Mini B)</td>
</tr>
<tr>
<td>voltage</td>
<td>8 VDC (with version 12 VDC)</td>
<td>for parameterisation with «PASO» under the closing screw of the housing cover factory preset</td>
<td></td>
</tr>
<tr>
<td>max. load 10 mA</td>
<td>Max. load 10 mA</td>
<td>EMC</td>
<td>Immunity</td>
</tr>
<tr>
<td>Current consumption:</td>
<td>• No load current: approx. 40 mA</td>
<td>EN 61 000-6-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 35 mm square size solenoid $I_{max} = 1500$ mA (with version 24 VDC)</td>
<td>EN 61 000-6-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$I_{max} = 2000$ mA (with version 12 VDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 45 mm square size solenoid $I_{max} = 1200$ mA (with version 24 VDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$I_{max} = 2400$ mA (with version 12 VDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Maximum current $I_{max} = 1534$ mA (with version 24 VDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$I_{max} = 2557$ mA (with version 12 VDC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Command value signal:</td>
<td>Input voltage/current and signal range are adjustable by software. Diff. inputs not galvanically separated, for ground potential differences up to 1.5 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog interface</td>
<td>4…+20 mA / 0…+20 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0…+10 V (-1 or 2-solenoid valve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-10…+10 V (only 2-solenoid valve)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Resolution ±12 bit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DIMENSIONS

Amplifier with analog interface, plug 12-pole

Amplifier with analog interface, plug 7-pole

Amplifier with CANopen / J1939 interface

Amplifier with Profibus interface

Controller with analog interface, plug 12-pole

Controller with analog interface, plug 7-pole

Controller with CANopen / J1939 interface

Controller with Profibus interface
## CONNECTOR WIRING DIAGRAM

### X1 Analog interface (Main)

**Device receptacle**
- 7 pole male
  - A = Supply voltage +
  - B = Supply voltage 0 VDC
  - C = Not connected
  - D = Command value signal +
  - E = Command value signal -
  - F = Not connected
  - G = Chassis

**Connector**
- DIN EN 175201 - 804

**Command value signal:**
- Current (D3/D4) or voltage (D1/D2) to specify when placing the order

---

### X1 Fieldbus interface (Main)

**Device receptacle**
- M12, 4 pole male
  - 1 = Supply voltage +
  - 2 = Reserved for extensions
  - 3 = Supply voltage 0 VDC
  - 4 = Chassis

---

### X2 Parameterisation interface

**USB, Mini B**
- Under the screw plug of the housing cover
- Factory set

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### X3 Profibus interface according to IEC 947-5-2

**Device receptacle**
- M12, 5 pole female B-coded
  - 1 = VP
  - 2 = RxD / TxD - N
  - 3 = DGND
  - 4 = RxD / TxD - P
  - 5 = Shield

---

### X3 CANopen interface according to DRP 303-1

**Device receptacle**
- M12, 5 pole male
  - 1 = Not connected
  - 2 = Not connected
  - 3 = CAN Gnd
  - 4 = CAN High
  - 5 = CAN Low

---

### X4 (controller only) Feedback value interface (sensor)

**Device receptacle**
- M12, 5 pole female
  - 1 = Supply voltage (output) +
  - 2 = Feedback value signal +
  - 3 = Supply voltage 0 VDC
  - 4 = Not connected
  - 5 = Stabilised output voltage

**Feedback value signal:**
- Current (R1) or voltage (R2) to specify when placing the order

---

Note! The mating connector is not included in the delivery.
Configuration analog inputs

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Analog input 1</th>
<th>Analog input 2</th>
<th>Analog input 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1..</td>
<td>Voltage</td>
<td>Current</td>
<td></td>
</tr>
<tr>
<td>A2..</td>
<td>Voltage</td>
<td>Current</td>
<td></td>
</tr>
<tr>
<td>A3..</td>
<td>Voltage</td>
<td>Current</td>
<td></td>
</tr>
<tr>
<td>A4..</td>
<td>Voltage</td>
<td>Current</td>
<td></td>
</tr>
<tr>
<td>D1..</td>
<td>Voltage</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>D2..</td>
<td>Voltage</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>D3..</td>
<td>Current</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>D4..</td>
<td>Current</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>C1..</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>P1..</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>J1..</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>R1..</td>
<td>Current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2..</td>
<td>Voltage</td>
<td></td>
<td></td>
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</table>
EXAMPLE OF CONNECTION

Connection of the supply voltage
with 12-pole connector with 7-pole connector with fieldbus interface

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>F = Fuse low</th>
<th>Supply voltage</th>
<th>F = Fuse low</th>
<th>Supply voltage</th>
<th>F = Fuse low</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>X1-1</td>
<td></td>
<td>X1-A</td>
<td></td>
<td>X1-3</td>
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<tr>
<td></td>
<td>X1-2</td>
<td></td>
<td>X1-B</td>
<td></td>
<td>X1-3</td>
</tr>
<tr>
<td></td>
<td>F = Fuse low</td>
<td></td>
<td>F = Fuse low</td>
<td></td>
<td>F = Fuse low</td>
</tr>
</tbody>
</table>

Connection of the digital inputs / outputs (only with 12-pole connector)

Supply voltage Digital input
R = Consumer resistance for max. current 0.7 A

Connection command value with potentiometer (not differential)
with 12-pole connector with 7-pole connector

Connection with external command value generator (voltage differential)*
with 12-pole connector with 7-pole connector

Connection CANopen /J1939

Connection Profibus

Connection voltage or current feedback value of a pressure sensor

2 conductor

3 conductor

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Illustrations not obligatory
Data sheet no. 1.13-76E 6/10
Edition 21 20
Amplifier electronics

CONSTRUCTION

General

• The „DSV“ electronics is an integral part of the valve.
• All inputs and outputs are to be contacted via the device receptacle.
• Under the closing screw of the housing cover there is a USB - interface, through which with the menu-controlled Windows program „PASO“ the parameterisation and diagnostics can be carried out.
• At the factory the “DSV” electronics are adapted to the valve, so that, as a rule, no intervention of the user is necessary.

Fieldbus

• The „DSV“ electronics is an integral part of the valve.
• The fieldbus is to be contacted through the corresponding device receptacle.
• CAN open resp. Profibus DP is used as transmission protocol.
• The characteristics and functions of the „DSV“ electronics are described through the device profile DSP-408 „Device Profile Fluid Power Technology“. A detailed description can be found on our website (see Set-up instructions).
• With the fieldbus the „DSV“ electronics can be controlled and parameterised.
• The utilisation of J1939 has to be jointly specified by the customer and Wandfluh.

DESCRIPTION OF THE FUNCTION

Amplifier electronics

HOLD

Command value

Fieldbus only

Command value

Command value 1

Command value 2

Command value Scaling

Command

value

Selection

DigInp

Error

DigInp

Fixed command values

Number

DigInp

Enable

Command value generator

Solenoid 2

Solenoid driver

Current measurement

Solenoid output

Enable

Error

Valve type

DigInp

Solenoid driver 1

Solenoid output

Current measurement

DigInp

Enable

Error

DigInp

Selection

Error

DigInp

Number

Enable

DigInp

Fixed command values

Valve type

Command value generator

Command value

Command value 1

Command value 2

Command value Scaling

Command

value
Command value scaling
The command value can be applied as a voltage, current or digital signal, or via fieldbus. For every command value, the input utilised can be selected. The scaling takes place via the parameters „Interface“ and „Reference“. Furthermore every command value can be monitored for a cable break (except for digital signal). For every command value a dead band can also be set. Optionally one can operate with two command values. The characteristic of these command values can be adjusted.

Fixed command values
• One fixed command value is available, which can be selected via a digital input (only DSV electronics with analog interface and 12-pole connector).

Command value generator
For each solenoid output two linear ramps for up and down are available which can be adjusted separately.

HOLD command value (fieldbus option only)
If via Profibus DP the device is put into the “HOLD” condition, the respective command value is activated.

Valve type
Here the mode of operation mode is set.

Mode of operation „Command value unipolar (1-sol)“
Dependent on a unipolar command value (voltage, current), the solenoid is driven (e.g. 0…10V correspond to 0…100 % command value, 0…100 % command value correspond to Imin…Imax solenoid driver 1).

Mode of operation „Command value unipolar (2-sol)“
Dependent on a unipolar command value signal (voltage, current), according to the signal level one of the two solenoids is driven. The switching threshold between the two solenoids as standard is in the middle of the values range of the command value signal (e.g. 0….+10V correspond to -100….+100 % command value, -100….0 % command value correspond to Imin….Imax solenoid driver 2, 0….+100 % command value correspond to Imin….Imax solenoid driver 1).

Mode of operation „Command value bipolar (2-sol)“
Dependent on a bipolar command value signal (voltage), according to the signal level one of the two solenoids is driven. The switching threshold between the two solenoids as standard is at 0V (e.g. -10….+10V correspond to -100….+100 % command value, -100….0 % command value correspond to Imin….Imax solenoid driver 1).

Signal recording
The DSV electronics has a signal recording function. This, by means of PASO, enables the recording of various system signals, such as command value, solenoid currents, etc., which can be represented on a common time axis.

Solenoid driver
Two Pulse-Width-Modulated current outputs are available. To each output, a dither signal is superimposed, whereas dither frequency and dither level can be adjusted separately. For each output, the minimum (Imin) and maximum (Imax) current can be adjusted separately. The solenoid outputs can also be configurated as switching outputs. Therewith for each output a power reduction can be adjusted separately.

Optimisation of characteristic curve
A characteristic curve adjustable per solenoid „Command value input – solenoid current output“ enables an optimised (e.g., linearised) characteristic of the hydraulic system.
Controller electronics

CONSTRUCTION

General

• The „DSV“ electronics is an integral part of the valve.
• All inputs and outputs are to be contacted via the device receptacle.
• Under the closing screw of the housing cover there is a USB - interface, through which with the menu-controlled Windows program „PASO“ the parameterisation and diagnostics can be carried out.
• At the factory the “DSV” electronics are adapted to the valve, so that, as a rule, no intervention of the user is necessary.

Fieldbus

• The fieldbus is to be contacted through the corresponding device receptacle.
• CANopen resp. Profibus DP is used as transmission protocol.
• The characteristics and functions of the „DSV“ electronics are described through the device profile DSP-408 „Device Profile Fluid Power Technology“. A detailed description can be found on our website (see set-up instructions).
• Via the fieldbus, the DSV electronics can be controlled and parameterised.
• The utilisation of J1939 has to be jointly specified by the customer and Wandfluh.

DESCRIPTION OF THE FUNCTION

Command value scaling

The command value can be applied via the fieldbus or as a voltage, current, digital, frequency or PWM signal. For every command value, the input utilised can be selected. The scaling takes place via the parameters „Interface“ and „Reference“. Furthermore every command value can be monitored for a cable break (except for digital signal). For every command value a dead band can also be set. Optionally one can operate with two command values. The characteristic of these command values can be adjusted.

Fixed command values

One fixed command value is available, which can be selected via a digital input (only DSV electronics with analog interface and 12-pole connector).

Command value generator

With the Open-Loop-Controller modes, for each solenoid output two linear ramps for up and down are available which can be adjusted separately. With the Closed-Loop-Controller modes, a positive and a negative traversing speed is available.

HOLD command value (fieldbus option only)

If via Proflbus DP the device is put into the “HOLD” condition, the respective command value is activated.

Feedback value scaling

The feedback value can be applied as voltage, current, frequency or PWM signal. For the feedback value, the input utilised can be selected. The scaling takes place via the parameters „Interface“ and „Reference“. Furthermore the feedback value can be monitored for a cable break.

Windows

A target, tracking error and magnetic stop window are available. The threshold and delay time can be set for each window.

Controller

The DSV controller module has a controller circuit. This is built up as PID controller. The following controller modes can be selected:

Controller mode Pressure/flow valve control

Control of a pressure relief, pressure reducing, throttle or flow control valve in open control circuit (without feedback value signal). The number of solenoids that can be controlled depends on the selected operating mode.
Controller mode Pressure/flow valve control (1-Sol)
Actuation of one solenoid pressure relief, pressure reducing, throttle, or flow control valve in closed-loop control circuit (with feedback value signal). Only one solenoid can be controlled with it (corresponds to the magnet driver 1).

Controller mode „Pressure control (2-Sol)“
Control of two 1 solenoid throttle valves in closed position Control loop (with feedback value signal) as pressure reducing control. The one throttle valve serves as a loading valve and the other as a unloading valve. The loading valve corresponds to the solenoid driver 1, the unloading valve corresponds to the solenoid driver 2.

Controller mode „Axis position controlled“
Control of a spool valve in the open control circuit (without feedback value signal). The number of solenoids to be controlled depends on the selected operating mode.

Controller mode „Axis position controlled (2-Sol)“
Control of a two solenoid spool valve in closed position control loop (with feedback value signal). Two solenoids can be used with it.

Controller mode „Speed control (2-Sol)“
Control of a two solenoid spool, throttle, or flow control valve in closed control loop (with feedback value signal). Two solenoid can be used with it.

Valve type
The operating mode is set here for the open loop controller modes. It is also possible to select whether proportional or switching solenoids are to be controlled.

Solenoid driver
Two Pulse-Width-Modulated current outputs are available. To each output, a dither signal is superimposed, whereas dither frequency and dither level can be adjusted separately. For each output, the minimum (Imin) and maximum (Imax) current can be adjusted separately. The solenoid outputs can also be configured as switching outputs. There-with for each output a power reduction can be adjusted separately.

Signal recording
The DSV controller module has a signal recording function. This, by means of PASO, enables the recording of various system signals, such as command value, solenoid currents, etc., which can be represented on a common time axis.

Optimisation of characteristic curve
A characteristic curve adjustable per solenoid „Command value input – solenoid current output“ enables an optimised (e.g., linearised) characteristic of the hydraulic system.