Digital Controller Module SD7

• For position, pressure and volume flow controls
• Interface: - analogue
  - CANopen / J1939
  - Profibus DP
  - HART
• Analogue or SSI sensors for the feedback signal
• Integrated final power stage
• Adjustment via PC
• For snapping on to dome rail
• Also available as amplifier module (see data sheet 1.13-101)

DESCRIPTION
Digital controller module for installation on dome rail for driving proportional or switching valves with one or two solenoids. Regulation of pressure, volume flow or position can be realized. The parameterisation takes place by means of menu-controlled parameterisation- and diagnostics software «PASO» from Wandfluh (USB-interface). The electronics are optionally available with different field bus interfaces.

FUNCTION
The controller module has two Pulse-Width-Modulated current outputs with superimposed dither signal. The analog and digital inputs as well as the digital outputs are individually programmable. With the Enhanced controller, the command value (position, pressure, force, etc.) can also be specified by means of freely adjustable travel profiles. The fieldbus connection enables reading the command value signal respectively the feedback value signal as well as the parameterisation directly via the fieldbus.

APPLICATION
As snap-on module, the controller module is mainly utilised in the industrial field. The module can be mounted on dome rails. Thanks to numerous digital inputs and outputs, the controller module can be connected to a higher-level machine control. Alternatively, the Enhanced controller can be used to control valves with integrated controllers (e.g. DSV, servo valves, etc.) via the analog output.

GENERAL SPECIFICATIONS
Execution Module for control cubicle, housing made of plastic
Installation on 35 mm dome rail according to EN 60715
Weight
  • Basic controller analog 130 g
  • Basic controller fieldbus 220 g
  • Enhanced controller analog 220 g
  • Enhanced controller fieldbus 240 g
Connections Screw terminals, max. cable cross-section 2,5 mm²
Working temperature -20…+70°C

Further information can be found in the Operating instructions.

COMMISSIONING
Information regarding installation and commissioning are contained in the information leaflet supplied with the controller module and in the operating instructions. Further information can be found on our website: www.wandfluh.com
Free-of-charge download:
  • «PASO» Parameterisation software
  • Operating instructions (.pdf)
  • Device description data: (EDS file «WAGSD7C1.eds»)
    (GSD file «SD7-0B8E.gsd»)

ADDITIONAL INFORMATION
Wandfluh electronics general Register 1.13
Proportional spool valves Register 1.10
Proportional pressure valves Register 2.3
Proportional flow valves Register 2.6

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Illustrations not obligatory
Data subject to change Data sheet no. 1.13-106E
Edition 21 20
### TYPE CODE

<table>
<thead>
<tr>
<th>Control cubicle</th>
<th>S</th>
<th>D7</th>
<th>3</th>
<th>2</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adjustable with PASO

#### Software configuration (function of card):
- **Basic controller** 3
- **Enhanced controller** 0

#### 2-solenoid version

#### Supply voltage:
- 24 VDC
- 12 VDC

#### Basic controller:
- Analog input 1: voltage 0
- Analog input 2: current 1
- Analog input 1 and 2: both voltage 2
- Analog input 1 and 2: both current 3
- Analog input 3: always current (with HART only)

#### Enhanced controller:
- Analog input 1 and 3: both voltage 4
- Analog input 2 and 4: both current 5
- Analog input 1 to 4: all voltage 6
- Analog input 1 to 4: all current 7
- Analog input 1 and 2: both voltage 8
- Analog input 3 and 4: both current 9
- Analog input 1 and 2: both current (with HART only) 10
- Analog input 3 and 4: always current (with HART only) 11

#### Basic controller without HART
- Analog input 1 and 2: 10-bit resolution A

#### Basic controller with HART
- Analog input 1 and 2: 10-bit resolution B
- Analog input 3: 16-bit resolution B

#### Enhanced controller
- Analog input 1 and 2: 10-bit resolution B
- Analog input 3 and 4: 16-bit resolution B

#### Option fieldbus:
- Without fieldbus A
- With Profinet DP P
- With CANopen C
- With J1939 J
- With HART H

### Design-index (Subject to change)
**ELECTRICAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection class</td>
<td>IP30 according to EN 60 529</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 VDC or 12 VDC</td>
</tr>
<tr>
<td>Voltage range:</td>
<td></td>
</tr>
<tr>
<td>• 24 VDC</td>
<td>21...30 V</td>
</tr>
<tr>
<td>• 12 VDC</td>
<td>10,5...15 V</td>
</tr>
<tr>
<td>Residual ripple</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Fuse</td>
<td>Low</td>
</tr>
<tr>
<td>Current consumption:</td>
<td></td>
</tr>
<tr>
<td>• No-load current</td>
<td>approx. 40 mA</td>
</tr>
<tr>
<td>• Maximum current consumption</td>
<td>No-load current + 1.8 A per solenoid (with 24 VDC)</td>
</tr>
<tr>
<td></td>
<td>Consumption no-load current + 2.3 A per solenoid (with 12 VDC)</td>
</tr>
<tr>
<td>Command value signal:</td>
<td>Selectable by means of software</td>
</tr>
<tr>
<td></td>
<td>Differential input not galvanically separated, for ground potential difference up to 1.5 V</td>
</tr>
<tr>
<td></td>
<td>4...+20 mA/0...+20 mA</td>
</tr>
<tr>
<td></td>
<td>0...+10 V (1- or 2-solenoid version)</td>
</tr>
<tr>
<td></td>
<td>-10...+10 V (2-solenoid version only)</td>
</tr>
<tr>
<td></td>
<td>Input 3 (option):</td>
</tr>
<tr>
<td></td>
<td>Galvanically separated for HART signal</td>
</tr>
<tr>
<td>Resolution</td>
<td>10-bit (for analog inputs 1 and 2)</td>
</tr>
<tr>
<td></td>
<td>16-bit (for analog inputs 3 and 4)</td>
</tr>
<tr>
<td>Input resistance</td>
<td>Voltage input &gt;18 kΩ</td>
</tr>
<tr>
<td></td>
<td>Load for current input = 250 Ω</td>
</tr>
<tr>
<td>Measuring system input</td>
<td>DSUB plug coupling 9-pole (female) to front panel according to RS422 standard</td>
</tr>
<tr>
<td></td>
<td>selectable by software</td>
</tr>
<tr>
<td></td>
<td>- Absolutely via Start/Stop</td>
</tr>
<tr>
<td></td>
<td>- Absolutely via SSI (1... 32 bit, gray or binary)</td>
</tr>
<tr>
<td>Analog output</td>
<td>Enhanced controller:</td>
</tr>
<tr>
<td></td>
<td>Voltage output ± 10 VDC</td>
</tr>
<tr>
<td></td>
<td>Max. output current ± 3 mA</td>
</tr>
<tr>
<td></td>
<td>Enhanced controller with HART:</td>
</tr>
<tr>
<td></td>
<td>Current output 0...20 mA</td>
</tr>
<tr>
<td></td>
<td>Max. output voltage 12 VDC</td>
</tr>
<tr>
<td>Stabilised output voltage</td>
<td>10 VDC (with 24 VDC)</td>
</tr>
<tr>
<td></td>
<td>8 VDC (with 12 VDC)</td>
</tr>
<tr>
<td></td>
<td>Max. load 30 mA</td>
</tr>
</tbody>
</table>

**Solenoid current:**
- Minimal current $I_{\text{min}}$
- Maximal current $I_{\text{max}}$

- Adjustable 0...950 mA
- Factory setting 150 mA
- $I_{\text{min}}$...2.3 A (with 12 VDC)
- Factory setting 700 mA

**Digital inputs:**
- Switching threshold high 6...30 VDC
- Switching threshold low 0...1 VDC

**Digital outputs:**
- Low-Side-Switch:
  - $U_{\text{max}}$ = 40 VDC
  - $I_{\text{max}}$ = -700 mA
- Ramps adjustable
  - 0...500 s
- Serial interface
  - USB (plug type B) for parameterising with «PASO»

**EMV:**
- Immunity: EN 61 000-6-2
- Emission: EN 61 000-6-4

**DIMENSIONS**

![Dimensions diagram]

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**Fieldbus (option):**
- Device receptacle: DSUB, 9-pole, CANopen, J1939, Profibus
- Screw terminals: HART
- Bus topology: Line, differential signal transmission
- Potential separation: 500 VDC

**SolenoId current:**
- Adjustable 0...950 mA
- Factory setting 150 mA
- $I_{\text{min}}$...2.3 A (with 12 VDC)
- Factory setting 700 mA

**Accumulated current limitation:**
- The accumulated current of the simultaneously controlled solenoids depends on the ambient temperature. Further information can be found in the Operating instructions.

**Dither:**
- Frequency adjustable 2...500 Hz
- Factory setting 100 Hz
- Level adjustable 0...400 mA
- Factory setting 100 mA

**Temperature drift:**
- <1 % at ΔT = 40 °C

**Serial Interface USB (plug type B) for parameterising with «PASO»**
**Digital controller module SD7**

**CONNECTOR WIRING DIAGRAM / PIN ASSIGNMENT**

**USB-interface, USB Type B X2**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VBUS</td>
</tr>
<tr>
<td>2</td>
<td>D-</td>
</tr>
<tr>
<td>3</td>
<td>D+</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
</tr>
</tbody>
</table>

The parameterisation cable is not included in the delivery (commercially available USB cable, plug type A to plug type B)

**Device receptacle CANopen, J1939 (male) X4 (option)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reserved</td>
</tr>
<tr>
<td>2</td>
<td>CANLow</td>
</tr>
<tr>
<td>3</td>
<td>CANGnd</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
</tr>
<tr>
<td>5</td>
<td>CANSheild</td>
</tr>
</tbody>
</table>

The mating connector (plug female, DSub, 9-pole) is not included in the delivery.

**Device receptacle Profibus (female) X4 (option)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reserved</td>
</tr>
<tr>
<td>2</td>
<td>Reserved</td>
</tr>
<tr>
<td>3</td>
<td>RxD/TxD-P</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
</tr>
<tr>
<td>5</td>
<td>DGNd</td>
</tr>
</tbody>
</table>

The mating connector (plug male, DSub, 9-pole) is not included in the delivery.

**Device receptacle Sensor (female) X3**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Digital input +</td>
</tr>
<tr>
<td>2</td>
<td>Digital input -</td>
</tr>
<tr>
<td>3</td>
<td>Reserved</td>
</tr>
<tr>
<td>4</td>
<td>Reserved</td>
</tr>
<tr>
<td>5</td>
<td>Clock output +</td>
</tr>
</tbody>
</table>

The mating connector (plug male, DSub, 9-pole) is not included in the delivery.

**FUNCTION DESCRIPTION**

The controller module can be parameterised by means of the parameterisation software «PASO» through the USB-interface. In addition, the parameterisation software makes a data analysis possible.

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CONTROLLER MODULE SD7

Command value scaling
The command value can be applied via the fieldbus or as a voltage, current, digital, frequency or PWM signal. The input used can be selected for each command value. The scaling is carried out via the «Interface» and «Reference» parameters. Furthermore, each command value can be monitored for cable break (except HART, voltage and 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.

Profiles/Fixed command values (Enhanced controller only)
There are 7 fixed command values available, which can be selected via 3 digital inputs. Optionally, travel profiles can also be used. The SD7 controller module is able to store and to travel whole travel profiles, which have been previously generated by the user in the profile generator. A travel profile consists of the following data:
- Target position (target or end position of the sequence)
- Speed (of the travel)
- Acceleration (to reach the speed)
- Deceleration (starting from the speed)
- Stop time (after reaching the end position of the sequence)
- Setting of a digital output when reaching the end position of the sequence
- Adjust whether the command value or the feedback value for the end of the sequence is to be queried

Command value generator
In the open-loop controller modes, there are two linear ramps for up and down per solenoid output are available, which can be adjusted separately. In the closed-loop controller modes, there is a positive and a negative travel speed available.

HOLD command value (option Fieldbus only)
If via fieldbus the device is put into the «HOLD» state, the respective command value is activated.

Feedback value scaling
The feedback value can be applied via HART or as voltage, current, frequency or PWM signal. For the feedback value, the input used can be selected. The scaling is carried out via the «Interface» and «Reference» parameters. In addition, the feedback value can be monitored for cable break (except HART and voltage signal).

Manual operation (Enhanced controller only)
The commands Enable, Forward, Reverse and Fast speed are available. This makes it possible to move the cylinders through a superimposed control without specifying a command value.

Window
A target, tracking error and solenoid stop window is available. The threshold and delay time can be set for each window.

Controller
The SD7 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 (1-sol)»
Control of a 1-solenoid pressure relief, pressure reducing, throttle or flow control valve in closed control circuit (with feedback value signal). Only one solenoid can be controlled with it (corresponds to the solenoid driver 1).

Controller mode «Pressure control (2-sol)»
Control of two 1 solenoid throttle valves in closed control circuit (with feedback value signal) as pressure control. The one throttle valve serves as a loading valve and the other as an 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 (2-sol)»
Control of a 2-solenoid spool valve in closed control circuit (with feedback value signal) as pressure control. The one throttle valve serves as a loading valve and the other as an unloading valve. The loading valve corresponds to the solenoid driver 1, the unloading valve corresponds to the solenoid driver 2.
Controller mode «Speed control (2-sol)»
Control of a 2-solenoid spool, throttle or flow control valve in closed control circuit (with feedback value signal). Two solenoids can be controlled with it.

Controller mode «2-point controller (2-sol)»
Control of a 2-solenoid valve with switching solenoid or of two 1 solenoid valves with switching solenoid in closed control circuit (with feedback value signal). Two solenoids can be controlled with it.

Controller mode «2-point controller (1-sol)»
Control of a 1-solenoid valve with switching solenoid in closed control circuit (with feedback value signal). Only one solenoid can be controlled with it (corresponds to the solenoid driver 1).

Controller mode «3-point controller (2-sol)»
Control of a 2-solenoid valve with switching solenoid or of two 1-solenoid valves with switching solenoid in closed control circuit (with feedback value signal). Two solenoids can be controlled 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. Therewith for each output a power reduction can be adjusted separately.

Signal recording
The SD7 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.

Controller mode «2-point controller (1-sol)»
Control of a 1-solenoid valve with switching solenoid in closed control circuit (with feedback value signal). Only one solenoid can be controlled with it (corresponds to the solenoid driver 1).
**Digital controller module SD7**

### BLOCK DIAGRAM BASIC CONTROLLER

**Controller**

- Microcontroller
- Supply voltage
- Stabilised output voltage
- Analogue input 1 voltage
- Analogue input 2 current
- Digital input 1
- Digital input 2
- Analogue ground

**Option**

- Analogue input 3
- Current
- HART

**LED**

- Microcontroller LED green
- Solenoid A
- Solenoid B
- Digital output 1
- Digital output 2
- USB
- Fieldbus (option) CAN / S1939 Profibus

**Configuration Analogue inputs**

#### Basic controller

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Analog input 1</th>
<th>Analog input 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD7332Dx0-Ax</td>
<td>Voltage</td>
<td>Current</td>
</tr>
<tr>
<td>SD7332Dx1-Ax</td>
<td>Voltage</td>
<td>Voltage*</td>
</tr>
<tr>
<td>SD7332Dx2-Ax</td>
<td>Current</td>
<td>Current</td>
</tr>
</tbody>
</table>

* x = P only 0...10VDC possible

#### Enhanced controller

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Analog inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD7362Dx4-Bx</td>
<td>Voltage, Current, Voltage</td>
</tr>
<tr>
<td>SD7362Dx5-Bx</td>
<td>Voltage, Voltage*, Voltage, Voltage</td>
</tr>
<tr>
<td>SD7362Dx6-Bx</td>
<td>Current, Current, Current, Current</td>
</tr>
<tr>
<td>SD7362Dx7-Bx</td>
<td>Voltage, Voltage*, Current, Current</td>
</tr>
<tr>
<td>SD7362Dx8-Bx</td>
<td>Current, Current, Voltage, Voltage</td>
</tr>
</tbody>
</table>

#### Basic controller HART

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Analog inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD7332Dx0-BH</td>
<td>Voltage, Current, Current</td>
</tr>
<tr>
<td>SD7332Dx1-BH</td>
<td>Voltage, Current, Current</td>
</tr>
<tr>
<td>SD7332Dx2-BH</td>
<td>Current, Current, Current</td>
</tr>
</tbody>
</table>

#### Enhanced controller HART

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Analog inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD7362Dx4-BH</td>
<td>Voltage, Current, Current</td>
</tr>
<tr>
<td>SD7362Dx5-BH</td>
<td>Current, Current, Current</td>
</tr>
<tr>
<td>SD7362Dx6-BH</td>
<td>Voltage, Current, Current</td>
</tr>
</tbody>
</table>

**Illustrations not obligatory**

**Data sheet no.** 1.13-106E 7/11

**Edition** 21 20
BLOCK DIAGRAM ENHANCED CONTROLLER WITH HART

Supply voltage

0 VDC

Stabilised output voltage

Analogue input 1

Analogue input 2

Analogue input 3

Analogue input 4

Analogue ground

Digital input 1

Digital input 2

Digital input 3

Digital input 4

Microcontroller

PWM

Solenoid A

PWM

Solenoid B

LED red

LED yellow

SPI

Analogue output

Digital output 1

Digital output 2

Analogue output

Digital output 1

Digital output 2

USB

see "Pin Assignment"

Supply voltage

Stabilised output voltage

Analogue inputs

Digital inputs

Microcontroller

PWM

Solenoids

LEDs

SPI

Analogue output

Digital outputs

USB

See "Pin Assignment"
CONNECTION EXAMPLE

Position control (command value and feedback value as voltage signal)

Command value preset with potentiometer on analogue input 1 e.g. 10 kOhm

Feedback value on analogue input 2

Supply voltage +
Supply voltage 0V DC

Enable on digital input 1

Option Command value preset and enable via fieldbus

Option Command value preset and enable via HART

Error active
Target window reached

Fuse

Supply voltage +
on digital input 1
on digital input 2

Fieldbus Master
HART Master

Solenoid A
Solenoid B

Option
CONNECTION EXAMPLE

Position control (command value - voltage signal, feedback value via digital sensor)

Feedback value at sensor input x3

Command value preset with potentiometer at analogue input 1

Enable at digital input 1

Supply voltage + Supply voltage 0V DC

Option Command value preset and enable via fieldbus

Option

Fieldbus Master

Fuse

Supply voltage + at digital output 1

Target window reached at digital output 2

Error active

X1-1 X1-5 X1-6

X1-25 X1-26

X1-30

X3-9 X3-8 X3-1 X3-2 X3-5 X3-6

X3-9 X3-8 X3-1 X3-2 X3-5 X3-6

Solenoid A Solenoid B