PW 161

S-DIAS Pulse Width Module

Instruction Manual

Translation of the Original Instructions

S-DIAS Pulse Width Module   PW 161

with 16 valve outputs

The S-DIAS PW 161 pulse width module has 16 valve outputs for valves with a starting current of up to 1 A and a 0.5 A stopping current. The 16 valve outputs are divided into two supply groups of 8 outputs each. Each supply group provides a current measurement for the switch point detection of the valve.

The supply voltages are monitored for under voltage.

Contents

1   Introduction

1.1   Target Group/Purpose of this Operating Manual

This operating manual contains all information required for the operation of the product.

This operating manual is intended for:

- Project planners
- Technicians
- Commissioning engineers
- Machine operators
- Maintenance/test technicians

General knowledge of automation technology is required.

Further help and training information, as well as the appropriate accessories can be found on our website www.sigmatek-automation.com.

Our support team is happily available to answer your questions.
Please see our website for our hotline number and business hours.

1.2   Important Reference Documentation

This and additional documents can be downloaded from our website or obtained through support.

1.3   Contents of Delivery

1x PW 161

2   Basic Safety Directives

2.1   Symbols Used

The following symbols are used in the operator documentation for warning and danger messages, as well as informational notes:

DANGER

Danger indicates that death or serious injury **will occur**, if the specified measures are not taken.

⇨   To avoid death or serious injuries, observe all guidelines.

Danger indique une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨   Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

WARNING

Warning indicates that death or serious injury **can** occur, if the specified measures are not taken.

⇨   To avoid death or serious injuries, observe all guidelines.

Avertissement d'une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨   Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

CAUTION

Caution indicates that moderate to slight injury **can** occur, if the specified measures are not taken.

⇨   To avoid moderate to slight injuries, observe all guidelines.

Attention indique une situation dangereuse qui, faute de prendre les mesures adéquates, **peut** entraîner des blessures assez graves ou légères.

⇨   Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

INFORMATION

Information

⇨ Provides important information on the product, handling or relevant sections of the documentation, which require attention.

2.2   Disclaimer

INFORMATION

The contents of this operating manual were prepared with the greatest care. However, deviations cannot be ruled out. This operating manual is regularly checked and required corrections are included in the subsequent versions. The machine manufacturer is responsible for the proper assembly, as well as device configuration. The machine operator is responsible for safe handling, as well as proper operation.

The current operating manual can be found on our website. If necessary, contact our support.

Subject to technical changes, which improve the performance of the devices. The following operating manual is purely a product description. It does not guarantee properties under the warranty.

Please thoroughly read the corresponding documents and this operating manual before handling a product.

SIGMATEK GmbH & Co KG is not liable for damages caused through, non-compliance with these instructions or applicable regulations.

2.3   General Safety Directives

The Safety Directives in the other sections of this operating manual must be observed. These instructions are visually emphasized by symbols.

INFORMATION

According to EU Directives, the operating manual is a component of a product.

This operating manual must therefore be accessible in the vicinity of the machine since it contains important instructions.

This operating manual should be included in the sale, rental or transfer of the product, or its online availability indicated.

Regarding the requirements for Safety and health connected to the use of machines, the manufacturer must perform a risk assessment in accordance with machine directives 2006/42/EG before introducing a machine to the market.

Operate the unit with devices and accessories approved by SIGMATEK only.

CAUTION

Handle the device with care and do not drop or let fall.

Prevent foreign bodies and fluids from entering the device.

The device must not be opened!

Manipulez l'appareil avec précaution et ne le laissez pas tomber.

Empêchez les corps étrangers et les liquides de pénétrer dans l'appareil.

L'appareil ne doit pas être ouvert!

If the device does not function as intended or has damage that could pose a danger, it must be replaced!

En cas de fonctionnement non conforme ou de dommages pouvant entraîner des risques, l'appareil doit être remplacé!

The module complies with EN 61131-2.

In combination with a facility, the system integrator must comply with EN 60204-1 standards.

For your own safety and that of others, compliance with the environmental conditions is essential.

Le module est conforme à la norme EN 61131-2.

En combinaison avec une équipement, l'intégrateur de système doit respecter la norme EN 60204-1.

Pour votre propre sécurité et celle des autres, le respect des conditions environnementales est essential.

2.4   Software/Training

The application is created with the software LASAL CLASS 2 and LASAL SCREEN Editor.

Training for the LASAL development environment, with which the product can be configured, is provided. Information on our training schedule can be found on our website.

3   Standards and Directives

3.1   Directives

The product was constructed in compliance with the following European Union directives and tested for conformity.

3.1.1   EU Conformity Declaration

CE

EU Declaration of Conformity

The product PW 161 conforms to the following European directives:

- **2014/35/EU** Low-voltage Directive

- **2014/30/EU** Electromagnetic Compatibility (EMC Directive)

- **2011/65/EU** "Restricted use of certain hazardous substances in electrical and electronic equipment" (RoHS Directive)

The EU Conformity Declarations are provided on the SIGMATEK website. See Products/Downloads or use the search function and the keyword "EU Declaration of Conformity".

4   Type Plate

```
HW: X.XX
SW: XX.XX.XXX
Safety Version: SXX.XX.XX
SIGMATEK GMBH & CO KG
Sigmatekstrasse 1  A-5112 LAMPRECHTSHAUSEN

Serial No.
Article Number    Product Name   Short Name
```

Exemplary nameplate (symbol image)

```
HW: 1.00
SW: 01.00.000
Safety Version: S01.00.00
SIGMATEK GMBH & CO KG
Sigmatekstrasse 1  A-5112 LAMPRECHTSHAUSEN

12345678
12-246-133-3      Handbediengerät Wireless HGW 1033-3
```

HW: Hardware version
SW: Software version

5   Technical Data

5.1   Valve Output Specifications

Number	16
Execution	GND switching
Short-circuit proof	yes[1]
Maximum starting current/channel	1 A
Maximum stopping current/channel	0,5 A (1 A[2])
Maximum total current/group	4 A
Brake voltage during shutdown	39 V
Maximum braking energy of outputs (inductive load)	maximum 1 Joule/for all channels maximum 0.25 Joules/channel
Turn-on delay	100 µs can be set through the software in 0-255 increments
Excitation time	100 µs can be set through the software in 0-255 increments
PWM frequency	20 kHz
Current measurement/group	0-1.4 A 10-bit ADC 100 µs conversion time
Derating variants[3]	50 % switch-on time[4] of all channels, 100 % simultaneity of all channels, 100 % of the maximum stopping current per channel. 100 % switch-on time of all channels, 50 % simultaneity of all channels, 100 % of the maximum stopping current per channel. 100 % switch-on time of all channels, 100 % simultaneity of all channels, 50 % of the maximum stopping current per channel.

[1] Short-circuit proof since HW version 1.3 since FPGA version 1.1 and firmware version 1.42 with connector cables ≥ 1 m and cable diameters ≤ 1.5 mm² for the supply and the valve outputs of the module. The short circuit current is limited by the stated specification of the connector cables, so that damage to the output is prevented.

[2] A stopping current of up to 1 A is allowed, as long as the total current/group is not exceeded. With a stopping current > 0.5 A only every second output can be used, so that there is an even heat distribution in the module, which guarantees reliable functionality of the module up to the maximum ambient temperature. → see 4.1. Wiring Examples

[3] To avoid exceeding the maximum loss of the S-DIAS modules one of the derating variants mentioned above must be used. The derating can be achieved by a 50 % switch-on time of all channels, 50 % simultaneity of all channels or a reduction of the stopping current to 50 % of the maximum stopping current. The stopping ratio of 3 valves were measured and calculated using the maximum braking energy of the number of switching cycles:
1.)   Valve   MAC   BV210A-CB0=-00-BEBA-CTA
Braking energy/switching at 0.8 A stopping current: 2 mJ => 500 switching cycles per module per second possible
2.)   Valve   MAC   GET0
Braking energy/switching at 0.2 A stopping current: 4.2 mJ => 238 switching cycles per module per second possible
3.)   Valve   MPVZ   1018
Braking energy/switching at 0.2 A stopping current: 3.2 mJ => 313 switching cycles per module per second possible

[4] Intermittent periodic duty with 50% switch-on time (based on of 5 seconds).

5.2 Electrical Requirements

Supply voltage of valve +UV /1-2	18-52 V DC	
Current consumption of valve supply +UV /1-2	corresponds to the load on the valve outputs	
Voltage supply from S-DIAS bus	+24 V	
Current consumption on the S-DIAS bus (+24 V power supply)	typically 45 mA	maximum 50 mA

Wiring S-DIAS Safety in S-DIAS System

- each S-DIAS module is an active module (active node)
- Safety CPU is connected to the S-DIAS bus (incl. +5 V supply)
- Safety bus is independent and separated from the S-DIAS bus

a.n. = active node
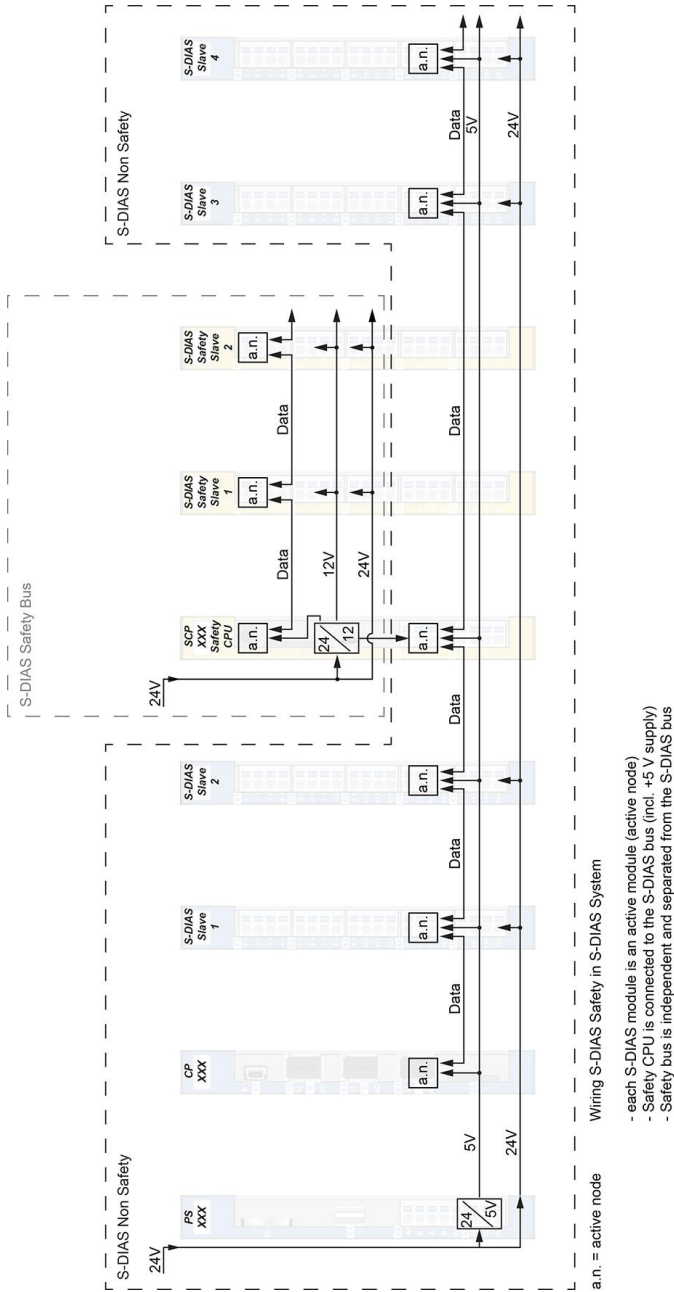
5.3   Voltage Monitor

Supply voltage of valve +UV /1-2	supply voltage > 18 V (corresponding DC OK-LED lights green)

5.4   Miscellaneous

Article number	20-030-161
Standard	UL 508 (E247993)
Approbations	UL, cUL, CE, UKCA

5.5   Environmental Conditions

Storage temperature	-20 ... +85 °C	
Environmental temperature	0 … +55 °C	
Humidity	0-95 %, non-condensing	
Installation altitude above sea level	0-2000 m without derating > 2000 m with derating of the maximum environmental temperature by 0.5 °C per 100 m	
Operating conditions	Pollution degree 2 altitude up to 2000 m	
EMC resistance	in accordance with EN 61000-6-2:2007 (industrial area)	
EMC noise generation	in accordance with EN 61000-6-4 (industrial area)	
Vibration resistance	EN 60068-2-6	3.5 mm from 5-8.4 Hz 1 g from 8.4-150 Hz
Shock resistance	EN 60068-2-27	15 g
Protection type	EN 60529	IP20

6   Mechanical Dimensions
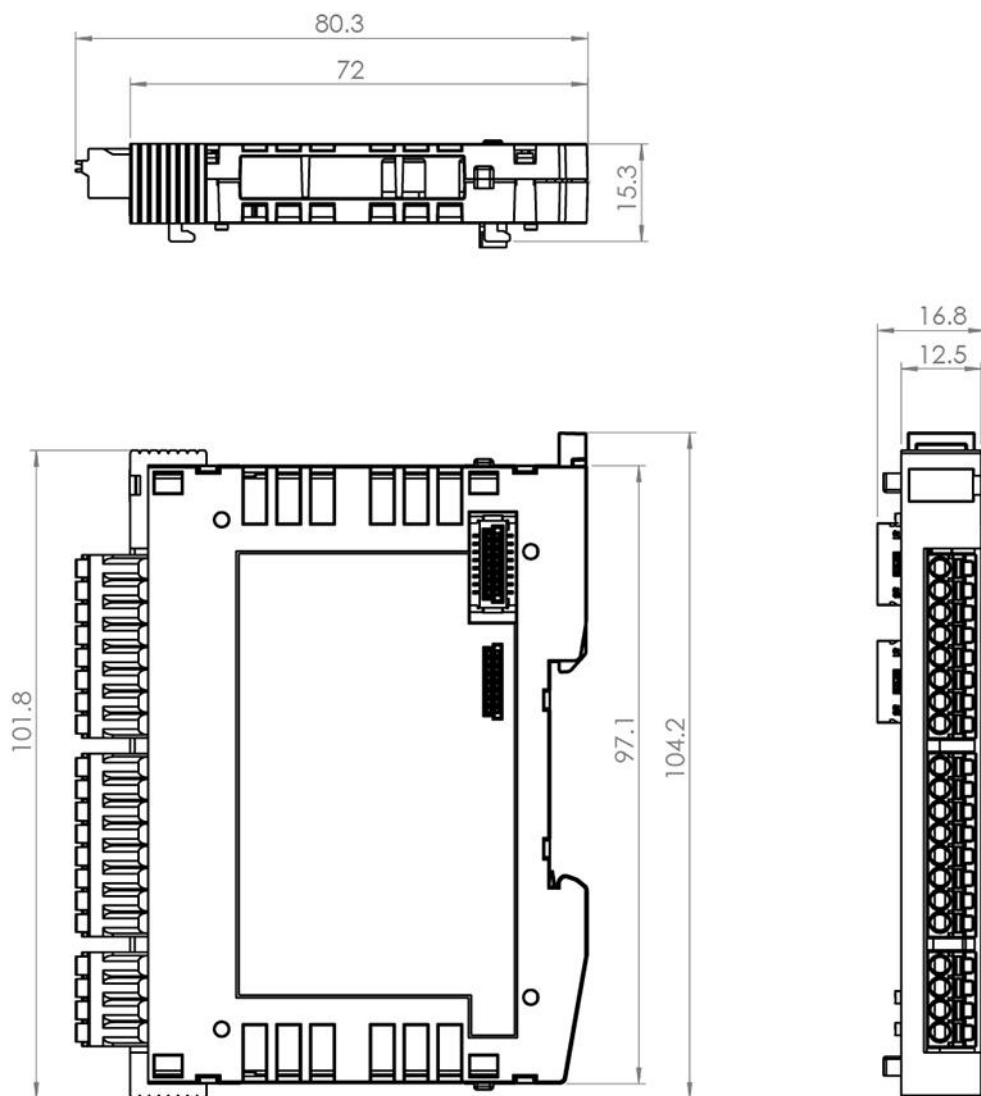
7   Connector Layout
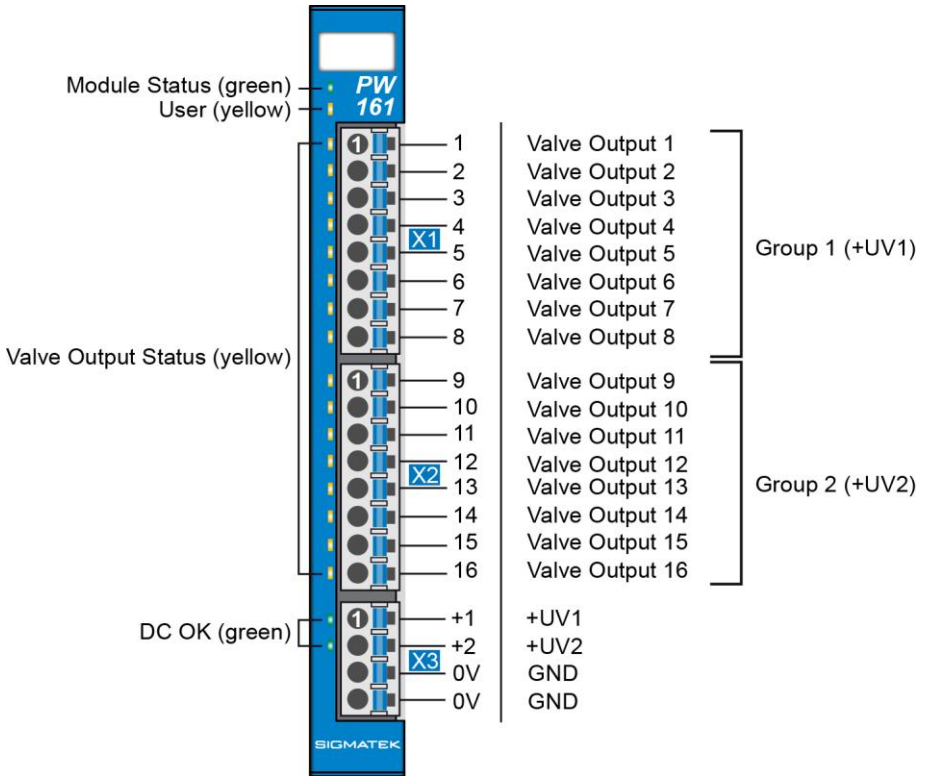
INFORMATION

The GND supply (X3: Pin 3 and Pin 4) is internally bridged. Only one GND pin (pin 3 or pin 4) is required to power the module. The bridged connections may be used for further looping of the GND supply. However, it must be taken into account that a total current of 6 A per connection is not exceeded by the forward looping!

7.1   Status LEDs

Module Status	green	ON	module active
		OFF	no supply available
		BLINKING (5 Hz)	no communication
User	yellow	ON	can be set from the application
		OFF	(e.g. the module LED can be set to blinking through the visualization so that the module is easily found in the control cabinet)
		BLINKING (2 Hz)	
		BLINKING (4 Hz)	
Valve Output Status	yellow	ON	valve output ON
		OFF	valve output OFF
DC OK	green	ON	the corresponding output group is powered

7.2   Applicable Connectors

Connectors:
X1-X3: Connectors with spring terminals (included in delivery)
The spring terminals are suitable connecting ultrasonically compacted (ultrasonically welded) strands.

Connections:

Stripping length/Sleeve length:	10 mm
Plug-in direction:	parallel to conductor axis or to PCB
Conductor cross section, rigid:	0.2-1.5 mm^2
Conductor cross section, flexible:	0.2-1.5 mm^2
Conductor cross section, ultrasonically compacted:	0.2-1.5 mm^2
Conductor cross section AWG/kcmil:	24-16
Conductor cross section flexible, with ferrule without plastic sleeve:	0.25-1.5 mm^2
Conductor cross section flexible, with ferrule with plastic sleeve:	0.25-0.75 mm^2 (ground for reducing d2 of the ferrule)

d2 = max. 2.8 mm
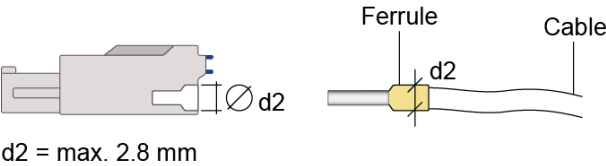
7.3   Label Field
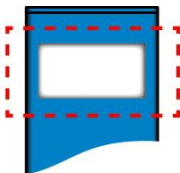
Manufacturer	Weidmüller
Type	MF 10/5 CABUR MC NE WS
Weidmüller article number	1854510000
Compatible printer	Weidmüller
Type	Printjet Advanced 230V
Weidmüller article number	1324380000

8   Wiring

8.1   Wiring Example

8.1.1   16 Valves with 1 A Starting Current and 0.5 A Stopping Current
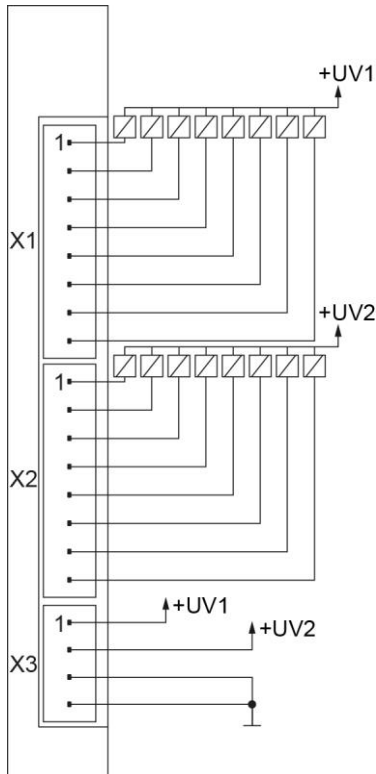
8.1.2   8 Valves with 1 A Starting Current and 1 A Stopping Current
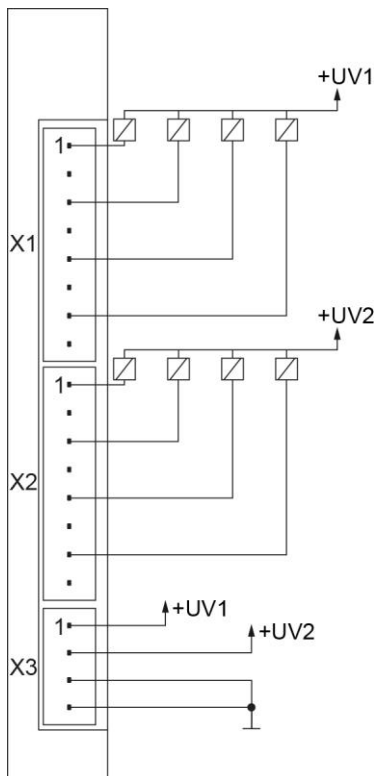
8.2   Output Scheme
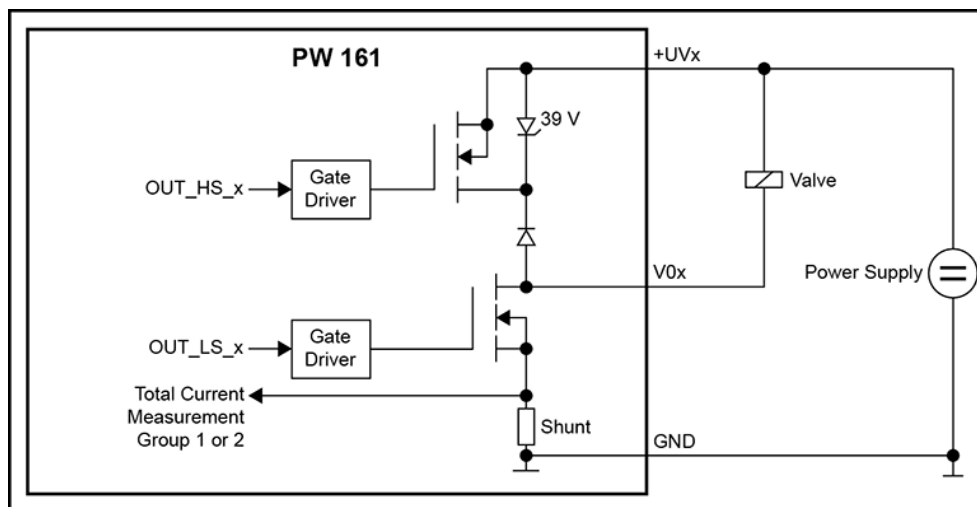
8.3   Note

INFORMATION

Connect the ground bus to the control cabinet.

The S-DIAS module CANNOT be connected/disconnected while voltage is applied!

In order to keep the voltage ripple at the PW 161 module supply within the permissible range (< 2 Vpp) during PWM operation of the valves with long supply lines (due to line resistance and line inductance), it may be necessary to connect an external capacitor as close as possible to the module supply for the PWM outputs.

9   Assembly/Installation

9.1   Check Contents of Delivery

Ensure that the contents of the delivery are complete and intact. See chapter 1.3 Contents of Delivery.

INFORMATION

On receipt and before initial use, check the device for damage. If the device is damaged, contact our customer service and do not install the device in your system.

Damaged components can disrupt or damage the system.

9.2   Mounting

The S-DIAS modules are designed for installation into the control cabinet. To mount the modules a DIN-rail is required. The DIN rail must establish a conductive connection with the back wall of the control cabinet. The individual S-DIAS modules are mounted on the DIN rail as a block and secured with latches. The functional ground connection from the module to the DIN rail is made via the grounding clamp on the back of the S-DIAS modules. The modules must be mounted horizontally (module label up) with sufficient clearance between the ventilation slots of the S-DIAS module blocks and nearby components and/or the control cabinet wall. This is necessary for optimal cooling and air circulation, so that proper function up to the maximum operating temperature is ensured.
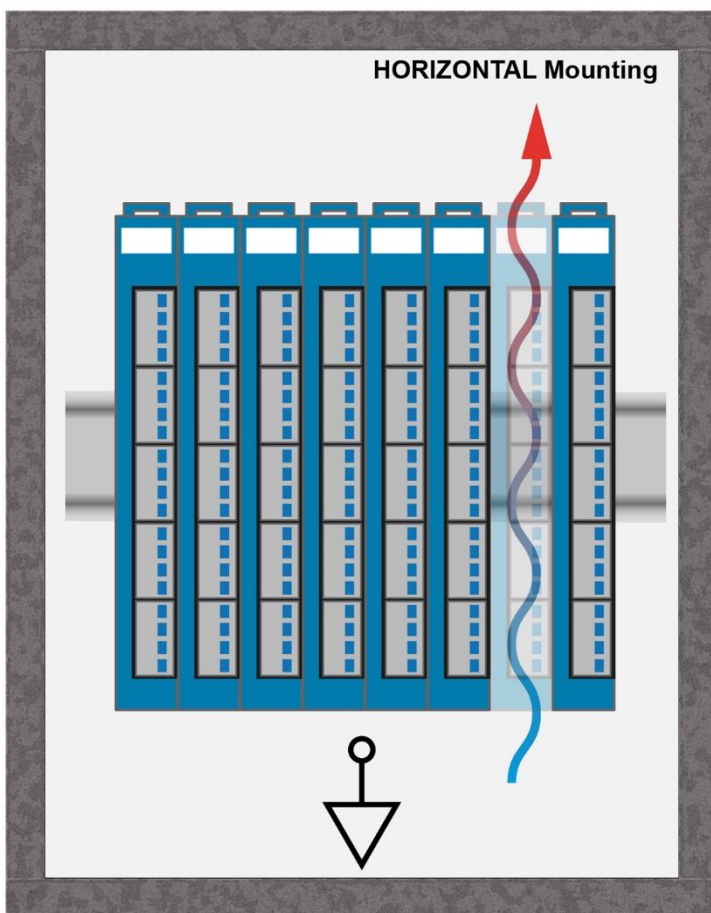
Recommended minimum distances of the S-DIAS modules to the surrounding components or control cabinet wall:

a	b	c
30 mm (1.18˝)	**30 mm** (1.18˝)	**100 mm** (3.94˝)
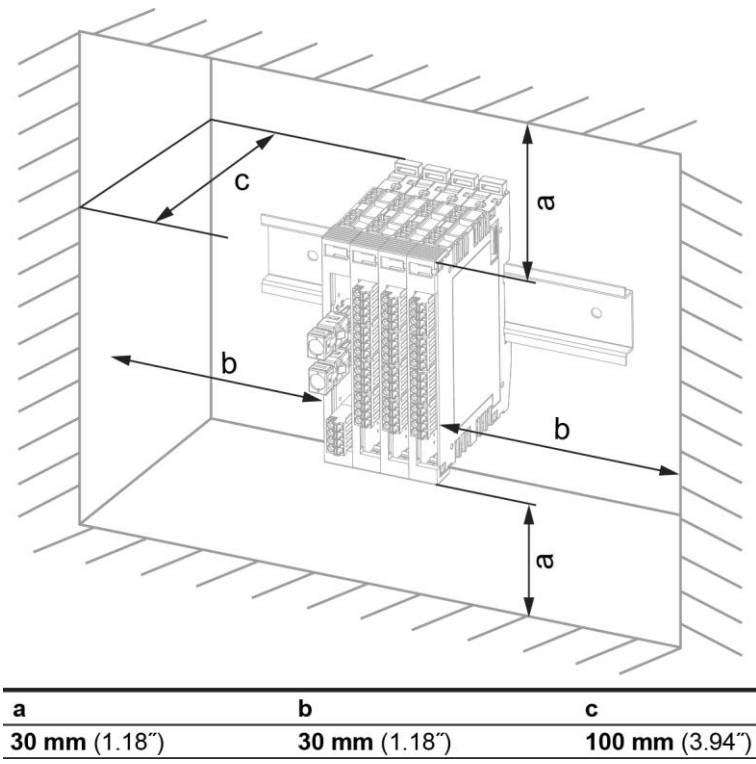
a, b, c … distances in mm (inches)

10 Addressing

Address (hex)	Size (bytes)	Access Type	Description
0000	**128**	W	**Cyclic Data for Firmware (mem-address range)**
0000	1	W	PWM output µC1 Bit 0 Output 1, group 1 Bit 1 Output 2, group 1 Bit 2 Output 3, group 1 Bit 3 Output 4, group 1 Bit 4 Output 5, group 1 Bit 5 Output 6, group 1 Bit 6 Output 7, group 1 Bit 7 Output 8, group 1
0001	8	W	Enable / disable time delay output 1-8 (0 to 25000 µs) Bit 0..7 enable time delay [100 µs] / disable time delay => depends on the output status: Status = 1 => time delay on Status = 0 => time delay off
0009	1	W	PWM output µC2 Bit 0 Output 9, group 2 Bit 1 Output 10, group 2 Bit 2 Output 11, group 2 Bit 3 Output 12, group 2 Bit 4 Output 13, group 2 Bit 5 Output 14, group 2 Bit 6 Output 15, group 2 Bit 7 Output 16, group 2
000A	8	W	Enable / disable time delay output 9-16 (0 to 1000 µs) Bit 0..7 enable time delay [100 µs] / disable time delay => depends on the output status: Status = 1 => time delay on Status = 0 => time delay off
0080	**128**	**r**	**Cyclic Data for the HW Class (mem-address range)**
0080	2	r	Status µC1 Bit 0 tbd Bit 1 not synchronized Bit 2 FLASH data CRC error Bit 3 RAM data CRC error Bit 4 non Safe FLASH data Bit 5 Overload (current consumption too high)

0082	2	r	Status µC2 Bit 0 tbd Bit 1 not synchronized Bit 2 FLASH data CRC error Bit 3 RAM data CRC error Bit 4 non Safe FLASH data Bit 5 Overload (current consumption too high)

0100	128	r/w	CFG for the Firmware (mem-address range)
0100	2	r/w	CRC16 (length depends on the command, start at 0104)
0102	2	r/w	Data length (depending on the command)
0104	1	r/w	Info (special purpose or status bits) Bit 0　　　　PMB mode 　　　　　　0 ... normal Mode 　　　　　　1 ... PMB mode, value preset with RAW data Bit 1　　　　boot loader / update request Bit 2 – 6　　reserve Bit 7　　　　Toggle bit for achieving a CRC change
0105	1	r/w	Command Type
	Standard Module (info register bit 0 = 0)		
0105	Command byte = 0		
	Channel configuration PWM ratio　　　　　　　　　　　　　　　　0 … 100　　= 0 % … 100 % Starting process duration　　　　　　　　1 … 255　　= 100 µs … 25500 µs PWM ratio during starting process　　　0 … 100　　= 0 % … 100 %		
0106	1	r/w	PWM ratio output 1 group 1
0107	1	r/w	Starting process duration output 1 group 1
0108	1	r/w	PWM ratio during starting process output 1 group 1
0109	1	r/w	PWM ratio output 2 group 1
010A	1	r/w	Starting process duration output 2 group 1
010B	1	r/w	PWM ratio during starting process output 2 group 1
010C	1	r/w	PWM ratio output 3 group 1
010D	1	r/w	Starting process duration output 3 group 1
010E	1	r/w	PWM ratio during starting process output 3 group 1
010F	1	r/w	PWM ratio output 4 group 1
0110	1	r/w	Starting process duration output 4 group 1
0111	1	r/w	PWM ratio during starting process output 4 group 1
0112	1	r/w	PWM ratio output 5 group 1
0113	1	r/w	Starting process duration output 5 group 1
0114	1	r/w	PWM ratio during starting process output 5 group 1

0115	1	r/w	PWM ratio output 6 group 1
0116	1	r/w	Starting process duration output 6 group 1
0117	1	r/w	PWM ratio during starting process output 6 group 1
0118	1	r/w	PWM ratio output 7 group 1
0119	1	r/w	Starting process duration output 7 group 1
011A	1	r/w	PWM ratio during starting process output 7 group 1
011B	1	r/w	PWM ratio output 8 group 1
011C	1	r/w	Starting process duration output 8 group 1
011D	1	r/w	PWM ratio during starting process output 8 group 1
011E	1	r/w	PWM ratio output 9 group 2
011F	1	r/w	Starting process duration output 9 group 2
0120	1	r/w	PWM ratio during starting process output 9 group 2
0121	1	r/w	PWM ratio output 10, group 2
0122	1	r/w	Starting process duration output 10 group 2
0123	1	r/w	PWM ratio during starting process output 10 group 2
0124	1	r/w	PWM ratio output 11, group 2
0125	1	r/w	Starting process duration output 11 group 2
0126	1	r/w	PWM ratio during starting process output 11 group 2
0127	1	r/w	PWM ratio output 12, group 2
0128	1	r/w	Starting process duration output 12 group 2
0129	1	r/w	PWM ratio during starting process output 12 group 2
012A	1	r/w	PWM ratio output 13, group 2
012B	1	r/w	Starting process duration output 13 group 2
012C	1	r/w	PWM ratio during starting process output 13 group 2
012D	1	r/w	PWM ratio output 14, group 2
012E	1	r/w	Starting process duration output 14 group 2
012F	1	r/w	PWM ratio during starting process output 14 group 2
0130	1	r/w	PWM ratio output 15, group 2
0131	1	r/w	Starting process duration output 15 group 2
0132	1	r/w	PWM ratio during starting process output 15 group 2
0133	1	r/w	PWM ratio output 16, group 2

0134	1	r/w	Starting process duration output 16 group 2
0135	1	r/w	PWM ratio during starting process output 16 group 2
0105	Command byte = 1		
	Start current measurement for a valve		
0106	1	r/w	Select valve to measure (1-16)
0107	2	r/w	Desired duration of recording (Number of samples 1 – 800)
0105	Command byte = 2		
	Retrieve measured ADC data		
0106	1	r/w	Channel to use
0107	1	r/w	section of the ADC data: 0-79 (10 values of 2 bytes)
		PMB mode (info register bit 0 = 1)	
0180	**128**	**r**	**CFG/version for HW class (mem-address area)**
0180	2	r	CRC16
0182	2	r	Data length
0184	2	r	Firmware version µC1
0186	2	r	Firmware version µC2
0190	**128**	**r**	**CFG/ADC for HW class (mem-address area)**
0190	2	r	CRC16
0192	1	r	Data length
0193	1	r	Section of the ADC data
0194	2	r	First measurement value
:	:		:
01A6	2	r	Tenth measurement value
0300	**128**	**r/w**	**SDO access (mem-address range)**
0300	128	w	SDO request
0380	128	r	SDO return message

11 Supported Cycle Times

11.1 Cycle Times below 1 ms (in µs)

FW	50	100	125	200	250	500
V1.00				x		x

11.2 Cycle Times equal to or above 1 ms (in ms)

FW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
V1.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

FW	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
V1.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

12 Transport/Storage

INFORMATION

This device contains sensitive electronics. During transport and storage, high mechanical stress must therefore be avoided.

For storage and transport, the same values for humidity and vibration as for operation must be maintained!

Temperature and humidity fluctuations may occur during transport. Ensure that no moisture condenses in or on the device, by allowing the device to acclimate to the room temperature while turned off.

When sent, the device should be transported in the original packaging if possible. Otherwise, packaging should be selected that sufficiently protects the product from external mechanical influences. Such as cardboard filled with air cushioning.

13 Storage

INFORMATION

When not in use, store the operating panel according to the storage conditions. See chapter 12.

During storage, ensure that all protective covers (if available) are placed correctly, so that no contamination, foreign bodies or fluids enter the device.

14 Maintenance

INFORMATION

During maintenance as well as servicing, observe the safety instructions from chapter 2 Basic Safety Directives.

14.1 Service

This product was constructed for low-maintenance operation.

14.2 Repair

INFORMATION

In the event of a defect/repair, send the device with a detailed error description to the address listed at the beginning of this document.

For transport conditions, see chapter 12 Transport/Storage.

15 Disposal

INFORMATION

Should you need to dispose of the device, the national regulations for disposal must be followed.

The device appliance must not be disposed of as household waste.

16 Hardware Class PW161

Hardware Class PW161 for the S-DIAS PW161 valve output module

```
SDIAS:56, PW161 (PW1611)
    S  Class State (ClassState) <-[]->
    S  Device ID (DeviceID) <-[]->
    S  FPGA Version (FPGAVersion) <-[]->
    S  Hardware Version (HwVersion) <-[]->
    S  Serial Number (SerialNo) <-[]->
    S  Retry Counter (RetryCounter) <-[]->
    O  LED Control (LEDControl) <-[]->
    S  SDOState (SDOState) <-[]->
    S  Firmware Version µC1 (FirmwareVersion_uC1) <-[]->
    S  Firmware Version µC2 (FirmwareVersion_uC2) <-[]->
    S  Status Bits of µC (StatusBits_uC) <-[]->
    I  Voltage OK +24V1 (VoltageOk_V1) <-[]->
    I  Voltage OK +24V2 (VoltageOk_V2) <-[]->
    I  HighCurrent Output 1-8 (HighCurrent_Out1_8) <-[]->
    I  HighCurrent Output 9-16 (HighCurrent_Out9_16) <-[]->
```

```
⬤  DelayTime Channel 1 (DelayTime_Ch1) <-[]->
⬤  Output Channel 1 (Output_Ch1) <-[]->
⬤  DelayTime Channel 2 (DelayTime_Ch2) <-[]->
⬤  Output Channel 2 (Output_Ch2) <-[]->
⬤  DelayTime Channel 3 (DelayTime_Ch3) <-[]->
⬤  Output Channel 3 (Output_Ch3) <-[]->
⬤  DelayTime Channel 4 (DelayTime_Ch4) <-[]->
⬤  Output Channel 4 (Output_Ch4) <-[]->
⬤  DelayTime Channel 5 (DelayTime_Ch5) <-[]->
⬤  Output Channel 5 (Output_Ch5) <-[]->
⬤  DelayTime Channel 6 (DelayTime_Ch6) <-[]->
⬤  Output Channel 6 (Output_Ch6) <-[]->
⬤  DelayTime Channel 7 (DelayTime_Ch7) <-[]->
⬤  Output Channel 7 (Output_Ch7) <-[]->
⬤  DelayTime Channel 8 (DelayTime_Ch8) <-[]->
⬤  Output Channel 8 (Output_Ch8) <-[]->
⬤  DelayTime Channel 9 (DelayTime_Ch9) <-[]->
⬤  Output Channel 9 (Output_Ch9) <-[]->
⬤  DelayTime Channel 10 (DelayTime_Ch10) <-[]->
⬤  Output Channel 10 (Output_Ch10) <-[]->
⬤  DelayTime Channel 11 (DelayTime_Ch11) <-[]->
⬤  Output Channel 11 (Output_Ch11) <-[]->
⬤  DelayTime Channel 12 (DelayTime_Ch12) <-[]->
⬤  Output Channel 12 (Output_Ch12) <-[]->
⬤  DelayTime Channel 13 (DelayTime_Ch13) <-[]->
⬤  Output Channel 13 (Output_Ch13) <-[]->
⬤  DelayTime Channel 14 (DelayTime_Ch14) <-[]->
⬤  Output Channel 14 (Output_Ch14) <-[]->
⬤  DelayTime Channel 15 (DelayTime_Ch15) <-[]->
⬤  Output Channel 15 (Output_Ch15) <-[]->
⬤  DelayTime Channel 16 (DelayTime_Ch16) <-[]->
⬤  Output Channel 16 (Output_Ch16) <-[]->
▯  ALARM:00, Empty
```

This hardware class is used to control the PW 161 valve output module with 16 digital outputs. More information on the hardware can be found in the module documentation.

16.1   Interfaces

16.1.1   Clients

SdiasIn	The client must be connected to an S-DIAS port, an "SdiasOut"_[x]" server.
Place	The physical location of the hardware module is entered in this client. Up to 64 modules, 0 to 63, can be assigned.
Required	This client is active by default, which means that the S-DIAS hardware module at this position is mandatory for the system and can under no circumstances be disconnected or return an error. Otherwise, the entire hardware deactivated. If the hardware module is missing or removed, an S-DIAS error is triggered. If his client is initialized with 0, the hardware module located in this position is not mandatory. This means that it can be inserted or removed at any time. However, which components identified as "not required" should be selected with regard to the safety of the system.

16.1.2   Servers

ClassState	This server shows the actual status of the hardware class.	
DeviceID	The device ID of the hardware module is shown in this server.	
FPGAVersion	FPGA version of the module in 16#XY (e.g. 16#10 = version 1.0).	
SerialNo	The serial number of the hardware module is shown in this server.	
RetryCounter	This server increments when a transfer fails.	
LEDControl	With this server, the application LED of the S-DIAS module can be activated to find the module in the network more quickly. The following statuses are possible:	
	0	LED off
	1	LED on
	2	blinks slowly
	3	blinks rapidly
SDOState	The status of the SDO transfer is shown in this server.	
	Ready	Data transfer is complete.
	Busy	Data transfer is currently running.
	Error	An error has occurred during the data transfer
FirmwareVersion_uC1	The Firmware version of the micro controller shown in this server.	
FirmwareVersion_uC2	The Firmware version of micro controller 2 is shown in this server.	
StatusBits_uC	In this server, the status bits of both micro controllers are shown. The respective bits mean the following:	
	Bit 0	DC voltage OK
	Bit 1	no Sync available
	Bit 2	Flash Data CRC Error
	Bit 3	Ram Data CRC Error
	Bit 4	invalid EEProm version
	Bit 5	output current too high
	Bit 6	current measurement active

VoltageOk_V[1-2]	The voltage supply for output 1-8 and 9-16 is displayed in this server.	
	0	power supply error
	1	power supply ok
HigheCurrent_Out1-8, 9-16	This server displays an over current for outputs 1-8 and 9-16.	
	0	no over current
	1	over current detected
DelayTime_Ch[1-16]	With this server, the delay time 1-16 is set to 100 µs after the next Sync for outputs 1-16. (Value from 0 – 255 [100 µs]) Output [1-16]	
	0	delayed cutoff
	1	delayed turn on
Output_Ch[1-16]	With this server, the outputs 1-16 is set with the specified delay time.	
	0	output turned off after the delay time
	1	output is turned on after the delay time

16.1.3   Communication Interfaces

ALARM	Downlink	With this downlink the corresponding alarm class can be placed via the hardware editor.

16.2   Global Methods

16.2.1   SetOutput

Function turns on an output with the specified delay time.

Transfer parameters	Type	Description	
Channel	USINT	Number of the output to which the pulse signal should be sent (0 – 15 for output 1 to 16).	
SwitchOnDelay	USINT	Delay time in increments of 0-255 [100 µs]	
Return parameters	**Type**	**Description**	
retcode	DINT	Return code	
		1	OK
		-1	Output not available
		-10	Hardware not ready
		-11	Measuring currently active

16.2.2   ResetOutput

Function turns of an output with the specified delay time.

Transfer parameters	Type	Description	
Channel	USINT	Number of the output to which the pulse signal should be sent (0-15 for output 1 to 16).	
SwitchOffDelay	USINT	Delay time in increments of 0-255 [100 µs]	
Return parameters	**Type**	**Description**	
retcode	DINT	Return code	
		1	OK
		-1	Output not available
		-10	Hardware not ready
		-11	Measuring currently active

16.2.3   WriteGroupOutput

Function changes all outputs with a call.

Transfer parameters	Type	Description	
pGroup1	t_WriteSingleGroup	Pointer to the outputs 1-8	
pGroup2	t_WriteSingleGroup	Pointer to the outputs 9-16	
Return parameters	**Type**	**Description**	
retcode	DINT	Return code	
		1	OK
		-7	Pointer is invalid
		-10	Hardware not ready
		-11	Measuring currently active

16.2.4   ChangePWMSettings

The function sets the PWM for the respective output. Settings can be made for multiple outputs. The settings are then sent via SDO's in the next cycle.

Transfer parameters	Type	Description	
Channel	USINT	Number of the output to which the pulse signal should be sent (0-15 for output 1 to 16).	
StimulationPWM	USINT	PWM in percent during on time (0-100 %)	
StimulationTime	USINT	On time in increments of 0-255 [100 µs]	
SwitchedOnPWM	USINT	PWM in percent while the output is on (0-100 %)	
Return parameters	**Type**	**Description**	
retcode	DINT	Return code	
		1	OK
		-1	Output not available
		-3	StimulationPWM can be set from 0-100 % only
		-4	Can be set from 0-255 only
		-5	SwitchedOnPWM can be set from 0-100 % only

16.2.5   StartMeasure

Function measures the time of a specific output. All outputs are turned off automatically and are not automatically restarted. The measured values are 2-byte values in 100 µs increments. If all possible values are recorded, 1600 bytes are required.

Transfer parameters	Type	Description	
Channel	USINT	Number of the output to which the pulse signal should be sent (0 – 15 for output 1 to 16).	
pData	^VOID	Pointer to a memory area in which the values should be stored. This area must be large enough so that the data volume defined in MaxDataLength has sufficient space. The transferred measurement values are to be considered as 2-byte signed values.	
MaxDataLength	UDINT	Specifies the number of measurement points to record. Maximal 1600 bytes (corresponds to 800 values per every 2bytes).	
CloseDelay	UINT	Specifies how long the output remains active after the measurement. The transfer value corresponds to the delay in 100 microsecond steps.	
Mode	USINT	Defines the mode of the measurement value transfer and calculation.	
		0	Measurement values are transferred as 1-byte value. However, the values are only cleaned-up through the adjustment offset and the value is shortened to an 8-bit value (8LSB are transferred).
		1	Measurement values are transferred as 2-byte value and are completely adjusted and scaled.
Return parameters	Type	Description	
retcode	DINT	Return code	
		1	OK
		-1	Output not available
		-2	Supply voltage is not ok
		-7	Pointer is invalid
		-8	Another measurement is currently active
		-9	In MaxDataLength, an incorrect data length was entered.
		-10	Hardware not ready

16.2.6   GetMeasureState

Function reads the status of the StartMeasure function.

Return parameters	Type	Description	
retcode	IprStates	Return code	
		Ready	Measurement is complete and the data was copied to the assigned memory area.
		Busy	Measuring and data transfer currently running.
		Error	An error has occurred during the data transfer.

16.3   Software Configuration

The configuration is done via the method interfaces of the hardware class.
The method "ChangePWMSettings()" offers the following parameters for each channel:

StimulationPWM	0-100 %
StimulationTime	0-255 (100 µs steps)
SwitchedOnPWM	0-100 %
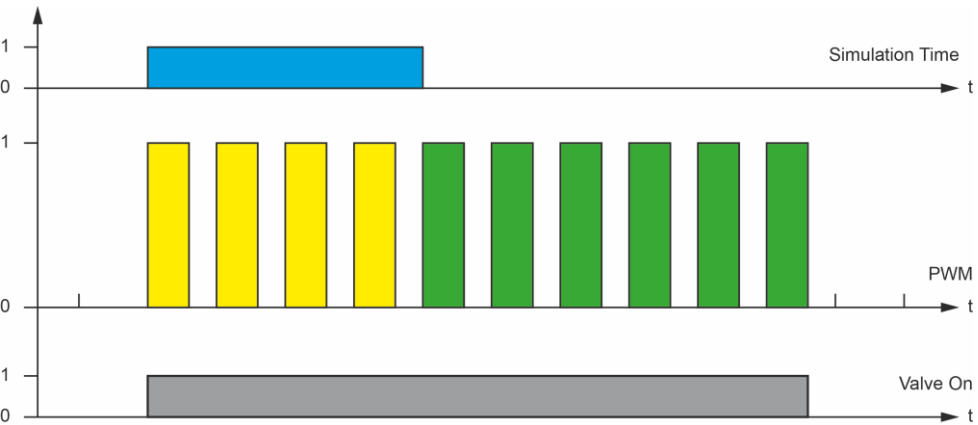
These setting parameters make it possible to control the valve as energy-saving as possible.
The valve needs a little more current in the tightening phase. Then a lower holding current is sufficient. In order to supply the required energy for the starting current, the PWM is initially set "higher" as a percentage than in the holding current phase. The time can be determined e.g. with an oscilloscope with current clamp.

The actual on/off switching of the valve is then controlled at runtime via the functions SetOutput() and ResetOutput() or via the function WriteGroupOutput().

16.4   Current History Recording

As an alternative to an oscilloscope measurement, the measurement system implemented in the module can be used.

For this the methods "StartMeasure()" and "GetMeasureState()" are to be used.

The method StartMeasure() draws up to 800 measuring points (one measuring point every 100 μs).
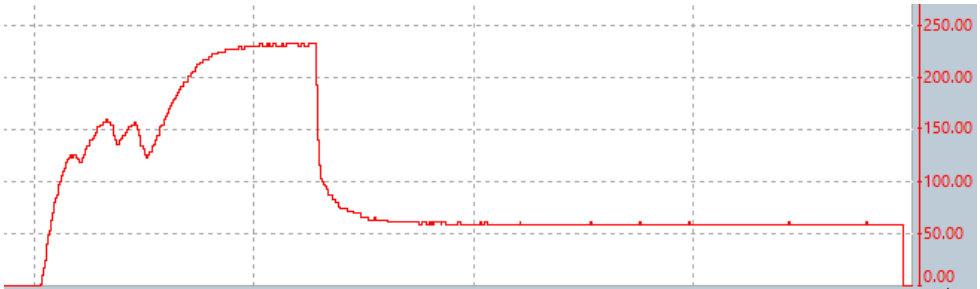

The StimulationTime should be selected so long that the valve is safely switched on.

16.4.1   Analysis of the Measured Values

The current rises rapidly at the switch-on time, the first 3 "dips" are due to a settling time of the armature. The subsequent current rise can now be intercepted by lowering the current into the holding current.

Our recommendation would be to change to the holding current at time 1 (approx. 115 ticks). A current, as it is lowered here at time 2, would then level off.
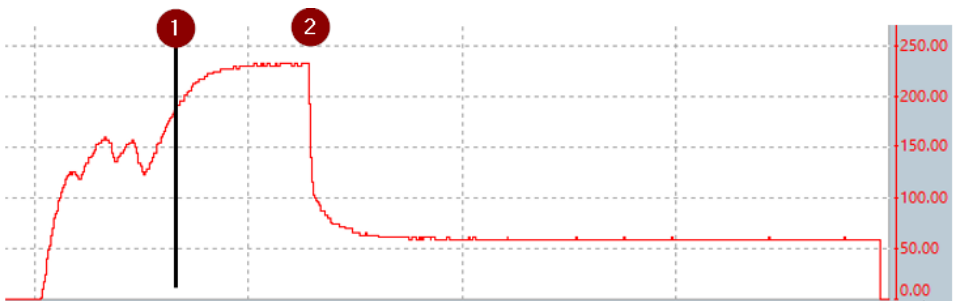
16.4.2   Testing the Setting Values

A test in which the PWM is changed from 100 % to 50 % after 115 ticks now shows a significantly reduced energy consumption.
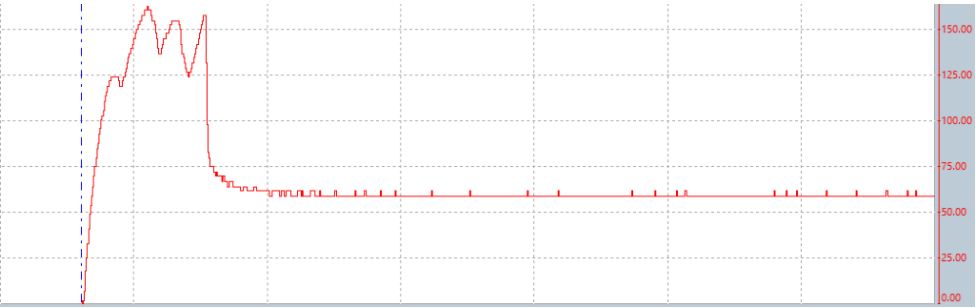
Documentation Changes

Change date	Affected page(s)	Chapter	Note
26.03.2015	7	3.2 Applicable Connectors	Added connections
20.04.2015	9	4.2 Output Scheme	New chapter
22.09.2015	3	1.1 Valve Output Specification	Execution added
06.10.2015	3	1.1 Valve Output Specification	Short-circuit proof Note added
20.10.2015	3	1.1 Valve Output Specification 4.1 Wiring Examples	Footnote added Example added
28.04.2016	14	5 Mounting	Graphics distances
08.05.2017	17, 18, 19	6 Addressing	Explanations corrected
17.08.2017	6 9	1.5 Environmental Conditions 3.2 Applicable Connectors	Added operating conditions Added sleeve length Added info regarding ultrasonically welded strands
18.10.2017	10 15	3.3 Label Field 5 Mounting	Added chapter Graphic replaced
20.09.2018		3 Connector Layout	Note added
18.07.2019	21	7 Supported Cycle Times	Chapter added
08.09.2020	23	8 Hardware Class PW161	Chapter added
04.11.2020	15	5 Mounting	Expansion functional ground connection
06.12.2022	7	1.4 Miscellaneous	UKCA conformity
20.04.2023	9	3 Connector Layout	Info box corrected
13.07.2023	14	4.3 Note	Note length supply lines added
26.07.2023		Document	General chapters added, design