Instruction Manual
PSE2xxDN

halstrup-walcher GmbH
Stegener Straße 10

D-79199 Kirchzarten, Germany

Phone: +49 (0) 76 61/39 63-0
Fax: +49 (0) 76 61/39 63-99

E-mail: info@halstrup-walcher.com
Internet: www.halstrup-walcher.com

Document 7100.004384D 07/2017

Table of Contents

Purpose of instruction manual

This instruction manual describes the features of PSE2xxDN positioning systems and provides guidelines for their use.

Improper use of these devices or failure to follow these instructions may cause injury or equipment damage. All individuals responsible for operating these devices must therefore be properly trained and aware of the hazards. The instruction manual, and in particular the safety precautions contained therein, must be followed carefully. **Contact the manufacturer if you do not understand any part of this instruction manual.**

Handle this manual with care:

- It must be readily available throughout the lifecycle of the devices.
- It must be provided to any individuals who assume responsibility for operating the device at a later date.
- It must include any supplementary materials provided by the manufacturer.

The manufacturer reserves the right to continue developing this device model without documenting such development in each individual case. The manufacturer will be happy to determine whether this manual is up-to-date.

Conformity

This device corresponds to the state of the art and meets all legal requirements set forth in EC directives as evidenced by the CE label.

CE

© 2011

1 Safety precautions

1.1 Appropriate use

Positioning systems are especially suitable for automatically setting tools, stops or spindles for wood-processing equipment, packing lines, printing equipment, filling units and other types of special machines.

PSE2xxDN positioning systems are not stand-alone devices and may only be used if coupled to another machine.

Always observe the operating requirements – particularly the allowed supply voltage – indicated on the rating plate and in the “Technical data” section of this manual.

The device may only be handled as indicated in this manual. Modifications to the device are prohibited. The manufacturer is not liable for damages caused by improper use or failure to follow these instructions. Violations of this type render all warranty claims null and void.

1.2 Shipping, assembly, electrical connections and start-up

Only technical personnel who are appropriately trained and authorized by the operator of the facility may assemble the device and set up its electrical connections.

The device may only be operated by appropriately trained individuals who have been authorized by the operator of the facility.

Specific safety precautions are given in individual sections of this manual.

1.3 Troubleshooting, maintenance, repairs, disposal

The individual responsible for the electrical connections must be notified immediately if the device is damaged or if errors occur.

This individual must take the device out of service until the error has been corrected and ensure that it cannot be used unintentionally.

This device requires no maintenance.

Only the manufacturer may perform repairs that require the housing to be opened.

The electronic components of the device contain environmentally hazardous materials and materials that can be reused. For this reason the device must be recycled in accordance with the environmental guidelines of the jurisdiction in question once it has been taken permanently out of service.

1.4 Symbols

The symbols given below are used throughout this manual to indicate instances when improper operation could result in the following hazards:

WARNING! This warns you of a potential hazard that could lead to bodily injury up to and including death if the corresponding instructions are not followed.

WARNING: This warns you of a potential hazard that could lead to significant property damage if corresponding instructions are not followed.

INFORMATION: This indicates that the corresponding information is important for operating the device properly

2 Device description

2.1 Features

The PSE2xxDN positioning system, an intelligent, compact, complete solution for positioning auxiliary and positioning axes, consists of an DC motor, gear power amplifier, control electronics, absolute or partially absolute measuring system and DeviceNet interface.

Variants with partially absolute measuring system (“singleturn encoder”) indicate the position of the output shaft after power up without executing a movement. Additionally the number of turns is being loaded out of the flash memory, thus after power up the correct position of the output shaft will be indicated (assumed the shaft has been turned for less than half a turn while powered down).

Variants with absolute measuring system (“multiturn encoder”) also indicate the position of the output shaft after power up without executing a movement. To detect the number of turns, instead of a flash memory a measurement gearbox is used. So always the true position is indicated, even if the shaft has been moved while powered down. This eliminates the need for a time-consuming reference run.

Connecting to a bus system simplifies the wiring. A hollow shaft with adjustable collar or a solid shaft makes assembly quite simple. The positioning system is especially suitable for automatically setting tools, stops or spindles for wood-processing equipment, packing lines, printing equipment, filling units and other types of special machines.

PSE2xxDN positioning systems convert a digital positioning signal into an angle of rotation.

2.2 Installation

PSE2xxDN with hollow shaft:
The PSE2xxDN is mounted onto the machine by sliding the hollow shaft of the positioning gear onto the axis to be driven and then securing it with an adjustable collar. The adjustable collar should be tightened only just to the point where it can no longer rotate freely.
Securing the pin under the hollow shaft into an appropriate bore will prevent further rotation (see drawing).

PSE2xxDN with solid shaft:
The PSE2xxDN has to be fixed at the four holes on the bottom plate.
The shaft has to be connected via a clutch to avoid forces caused by tensions that result on missing alignment from bottom plate and driven shaft.

Never apply force to the housing cover, e.g., for supporting weight.

Driving the PSE2xxDN rearward is prohibited (e.g. it's not allowed to turn the output shaft by an external force).

2.3 Electrical connection

Open the cover, put the cable through glands and connect supply and bus to terminals. The PSE2xxDN has a 8-pin spring-type terminal for cable with a profile of maximum 1.5 mm^2.By turning the cover 90°, 3 different positions of the cable glands are possible (see drawing).
The maximum torque of the cover screw is 0,6 Nm.

2.4 Pin assignment

Pin	Function
1	GND control + motor
2	CAN_L
3	Shield
4	CAN_H
5	+24V control
6	+24V motor
7	GND control + motor
8	Case

2.5 Setting the device address and baud rate (Option)

The rotary switches for setting the device address at the bus and a 2-pin sliding switch for setting the baud rate are located behind the terminals.

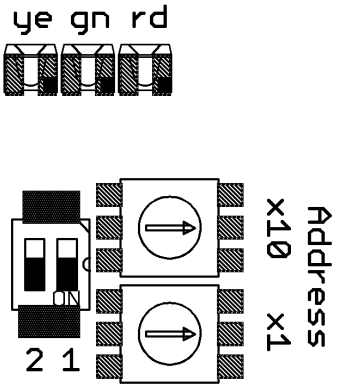
The rotary switches indicate the tens and ones places of the address selected. If the switches are resting in a position between 64 and 99, the address is set via DeviceNet (PSE object; class 100, instance 1, attribute 38).

The delivery setting is 99, the PSE2xxDN reports to the bus with the address 63.

If the switches are used to set the address (i.e. the switch setting is < 64), this value cannot be changed via DeviceNet.

The yellow LED represents the state of the motor supply voltage, the red and green LEDs represent the DeviceNet state.

Switch configurations:



Setting the baud rate:

1	2	
OFF	OFF	125 kBaud
OFF	ON	500 kBaud
ON	OFF	250 kBaud
ON	ON	baud rate is set via bus (default = 125 kBaud)

‘x’ in the device name stands for a number in the range 0..9. ‘xx’ in the device name stands for a number in the range 10..999.

2.6 Start-up

Positioning sequence (with reference loop)

The PSE2xxDN distinguishes between the following steps of a positioning sequence (Presumption: the target position is always approached through forward motion):

1. New position value is larger than the current value: Position approached directly.

2. New position value is smaller than the current value: The device reverses an additional 5/8 of one rotation and approaches the exact position after resuming forward motion.
3. New position value after reverse run without loop: The device always approaches the position by moving in forward direction; if necessary, it will first reverse by 5/8 of a rotation.

Once the target position has been reached, the device compares it to the internal absolute encoder status. If a discrepancy is detected, the device then sets the “Flash memory or encoder error” bit (bit 9 in the status word).

Positioning sequence (without loop)

The “positioning without loop” mode is used primarily for moving the small distances involved in fine adjustments. In this case, each position is approached directly. This does NOT eliminate any play present in the spindle in question. The PSE2xxDN internal gear backlash does not play a role in this case, as position data are acquired directly at the output shaft.

Runs which involve specifically a block run (e.g. reference runs on block), may only be started with reduced torque (max. torque max. 10% of the nominal torque).

2.7 CAN Bus

A DeviceNet protocol corresponding to ODVA CIP Networks Library Volume One Edition 3.1 and Volume Three Edition 1.3 is the protocol used for the CAN bus interface:

- A group 2 server with UCMM support
- 2 explicit connections to the master
- 4 fixed mapping assemblies
- I/O messages via poll, bit strobe and change-of-state/cyclic
- Multicast poll is not supported
- Heartbeat, default = inactive
- DeviceNet LED that displays status as follows:
  - off:
    either the device is switched off or no CAN bus is connected
  - green, steady:
    CAN communication OK, device operational
  - green, flashing:
    either no UCMM connection to the master or no learning run has been performed
  - red, flashing:
    relatively minor error, at least one I/O connection has timed out
  - red, steady:
    major error, e.g., bus conflict with another station
  - red-green, flashing:
    communication error

a) Table of implemented attribute entries

The following attributes are part of the PSE object (class ID 100), 1st instance:

Description	Attr. No.	Function	Range of value	Back up	Delivery State	R/W
target value	1	target position to be achieved value in 1/100 mm (for default settings of numerator, Attr. 16 and denominator, Attr. 17)	±31 bit	no	0	R/W
actual value	3	current actual position value in 1/100 mm (for default settings of numerator, Attr. 16 and denominator, Attr. 17) Writing onto this index number causes the current position to be "referenced" onto the transferred value	±31 bit	no		R/W
reference value	4	correction factor for the target, actual and limit switch values	±31 bit	yes	0	R/W
drag error	5	maximum drag error before the “drag error" bit is set. Value given in increments (at a resolution of 0.5 mm)	20...1000 16 bit	yes	100	R/W
positioning window	6	allowed difference between target and actual values for “position reached” bit The maximum value that can be set changes according to the same factor as the resolution	1...100 16 bit	yes	5	R/W
actual value assessment, numerator	16	These values can be used to set a desired user resolution to the drive. For a numerator factor of 400, the denominator factor holds the spindle pitch per resolution e.g.: spindle pitch 1.5 mm with resolution 1/100 mm: numerator = 400, denominator = 150	1...10000 16 bit	yes	400	R/W
actual value assessment, denominator	17		1...10000 16 bit	yes	400	R/W
target rpm posi	18	maximum rpm to be used for positioning runs value in rpm	see table 16 bit	yes	see table	R/W
target rpm hand	19	maximum rpm to be used for manual runs value in rpm	see table 16 bit	yes	see table	R/W
maximum torque	20	Applies after completion of start phase (during start phase the value of Attr. 24 applies); value in cNm	see table 16 bit	yes	see table	R/W
upper limit	22	maximum/minimum allowed target value allowed values for signleturn variants: $-2^{23}…2^{23}$ allowed values for multiturn variants: (upper mapping end - 800…26400 * denominator / numerator)	±31 bit	yes	2^{23} (singleturn) 26400 (multiturn)	R/W
lower limit	23		±31 bit	yes	-2^{23} (singleturn) 800 (multiturn)	R/W

Name	Attr. No.	Function	Range of value	Back up	Delivery State	R/W
maximum start-up torque	24	value in cNm	see table 16 bit	yes	see table	R/W
time period for start-up torque	25	value in msec	10...1000 16 bit	yes	200	R/W
rpm limit for aborting run	26	value in % of the target rpm	10...90 16 bit	yes	30	R/W
time elapsed until speed falls below rpm limit for aborting run	27	value in msec	50...500 16 bit	yes	200	R/W
length of loop	31	minimum number of increments which the drive moves in a pre-defined direction when approaching a target position value in increments (value = 0 → no loop)	0.025…1 rotations (10…400 at del. state) or 0 32 bit	yes	250	R/W
maximum rpm, counter-clockwise	32	value in rpm	see table 16 bit	yes	see table	R/W
maximum rpm, clockwise	33	value in rpm	see table 16 bit	yes	see table	R/W
step width for single step	34	number of increments when activating a jog run bit for a short-time	1...100 16 bit	yes	1	R/W
idle period for manual run	35	Span of time which a jog run bit must be activated in order to begin a manual run value in steps of 5 msec	20...2000 16 bit	yes	200	R/W

Name	Attr. No.	Function	Range of value	Back up	Delivery State	R/W
control word	36	Bit 0: manual run to larger values Bit 1: manual run to smaller values Bit 2: transfer target value (when transferring a target value with the help of the poll I/O connection, a positioning run is only started if this bit is set) Bit 3: release for manual run in jog run mode: if this bit is not set, only single steps are possible in jog run mode Bit 4: release: the axle will only run if this bit is set (exception is the jog run mode with bits 8/9) Bit 6: run without loop Bit 7: start initial reference loop Bit 8: jog run to larger values Bit 9: jog run to smaller values Bit 10: release readjustment Bit 11: execute braking-free-run Bit 12: run with drag error correction All other bits must be set to 0!	16 bit	no	0	R/W
status word	37	Bit 0: target position reached Bit 1: drag error Bit 2: reserved Bit 3: reserved Bit 4: motor power present Bit 5: positioning run aborted Bit 6: drive is running Bit 7: temperature exceeded Bit 8: movement opposite loop direction Bit 9: flash memory or encoder error Bit 10: positioning error (block) Bit 11: manual displacement Bit 12: incorrect target value Bit 13: motor power was missing Bit 14: positive range limit Bit 15: negative range limit	0...FFFF h 16 bit			R
CAN address	38	address of drive (if set by CAN bus) This value cannot be changed if the address switches are used (i.e. the switch setting is < 64).	0...63 8 bit	yes	63	R/W

Name	Attr. No.	Function	Range of value	Back up	Delivery State	R/W
baud rate	39	0: 125 kBaud 1: 250 kBaud 2: 500 kBaud This value cannot be changed if the baud rate switch is used (i.e. the switch setting is not ON-ON).	0...2 8 bit	yes	0	R/W
upper mapping end	40	definition of the positioning range relative to the absolute measuring system allowed values: (1 + ref.value) … (54400 * denominator / numerator - 1 + ref.value) (object exists only in multiturn variants)	±31 bit	yes	27200	R/W
position consistent	42	0: position is not consistent 1: position is consistent (object exists only in singleturn variants)	0 or 1 8 bit		1	R
direction of rotation	44	0: clockwise (as seen at the output shaft) 1: counter-clockwise	0 or 1 8 bit	yes	0	R/W
running direction for approaching target positions	45	0: with 5/8 forward rotation 1: with 5/8 reverse rotation (5/8 rotations is the default value, see attr. 31)	0 or 1 8 bit	yes	0	R/W
idle period	46	idle period in msec when reversing the direction of rotation	10...10000 16 bit	yes	10	R/W
actual rpm	48	value in rpm	16 bit			R
maximum torque	49	maximum torque occurring during the most recent run (start phase, during which the maximum start-up torque applies, see attr. 24/25, and the phase when the drive is braking down, are not considered) value in cNm	16 bit			R
actual torque	51	value in cNm	16 bit			R
U control	58	current supply voltage for control unit given in increments of 0.1 V	16 bit			R
U motor	59	current supply voltage for motor given in increments of 0.1 V	16 bit			R
Umot limit	60	voltage limit for bit ‘motor power present’ given in increments of 0.1 V	180...240 16 bit	yes	185	R/W
Umot filter	61	average time for measuring current power to motor; given in 5 msec increments	100... 1000 16 bit	yes	100	R/W
temperature limit	62	upper temperature limit in °C	10...70 16 bit	yes	70	R/W
device temperature	63	internal device temperature in °C	16 bit			R

Name	Attr. No.	Function	Range of value	Back up	Delivery State	R/W
production date	64	year and week of manufacturing (given as an integer)	YYWW 16 bit			R
serial number	65	serial device number	0...65535 16 bit			R
version	78	software version number	16 bit			R
delivery state and saving	79	writing '-1': generates the delivery state without modifying the CAN address and the baud rate (starts initial reference loop, then positioning to target value 0 if singleturn or to the middle of the measurement range if multiturn) writing '-2': generates the delivery state (sets CAN address attr. 38 to 63, baud rate attr. 39 to 125 kBaud, starts initial reference loop, then positioning to target value 0 if singleturn or to the middle of the measurement range if multiturn) A different CAN address or baud rate is only active after reset or reset communication! writing '1': saves all parameters in the EEPROM reading directly after boot: 0 → content of memory correct ≠ 0 → content of memory incorrect reading after saving: 0 → saving finished successfully ≠ 0 → saving is still in progress or is finished incorrectly (the time for saving is up to 2000 msec)	-1, -2 or 1 16 bit	no		R/W
control word, bit 0	80	manual run to larger values	0,1 8 bit	no		R/W
control word, bit 1	81	manual run to smaller values	0,1 8 bit	no		R/W
control word, bit 2	82	transfer target value	0,1 8 bit	no		R/W
control word, bit 3	83	release for manual run in jog run mode	0,1 8 bit	no		R/W
control word, bit 4	84	release	0,1 8 bit	no		R/W
control word, bit 6	86	run without loop	0,1 8 bit	no		R/W

Name	Attr. No.	Function	Range of value	Back up	Delivery State	R/W
control word, bit 7	87	start initial reference loop	0,1 8 bit	no		R/W
control word, bit 8	88	jog run to larger values	0,1 8 bit	no		R/W
control word, bit 9	89	jog run to smaller values	0,1 8 bit	no		R/W
control word, bit 10	90	release readjustment	0,1 8 bit	no		R/W
control word, bit 12	92	run with drag error correction	0,1 8 bit	no		R/W
status word, bit 0	96	target position reached	0,1 8 bit			R
status word, bit 1	97	drag error	0,1 8 bit			R
status word, bit 4	100	motor power present	0,1 8 bit			R
status word, bit 5	101	positioning run aborted	0,1 8 bit			R
status word, bit 6	102	drive is running	0,1 8 bit			R
status word, bit 7	103	temperature exceeded	0,1 8 bit			R
status word, bit 8	104	movement opposite loop direction	0,1 8 bit			R
status word, bit 9	105	flash memory or encoder error	0,1 8 bit			R
status word, bit 10	106	positioning error (block)	0,1 8 bit			R
status word, bit 11	107	manual displacement	0,1 8 bit			R
status word, bit 12	108	incorrect target value	0,1 8 bit			R
status word, bit 13	109	motor power was missing	0,1 8 bit			R
status word, bit 14	110	positive range limit	0,1 8 bit			R
status word, bit 15	111	negative range limit	0,1 8 bit			R
acceleration	155	value in rpm per sec.	see table 16 bit	yes	see table	R/W
deceleration	156	value in rpm per sec.	see table 16 bit	yes	see table	R/W
10 general purpose registers	157… 166	to archive any kind of data (e.g. the function of a drive within an installation)	16 bit	yes	0	R/W

Table of rated speed and torque values for the various device models

	Device model	211-08	212-08	231-08	232-08
Name	Attribute No.	value range delivery state	value range delivery state	value range delivery state	value range delivery state
target rpm posi	18	6…60 50	6…30 25	6…120 100	6…60 50
target rpm hand	19	6…60 15	6…30 8	6…120 30	6…60 15
max. rpm, counter-clockwise	32	6…60 50	6…30 25	6…120 100	6…60 50
max. rpm, clockwise	33	6…60 50	6…30 25	6…120 100	6…60 50
maximum torque	20	2…100 100	4…200 200	2…100 100	4…200 200
maximum start-up torque	24	2…125 125	4…250 250	2…125 125	4…250 250
acceleration	155	20…150 150	10…75 75	20…150 150	10…75 75
deceleration	156	20…150 150	10…75 75	20…150 150	10…75 75

b) UCMM connection

Because the PSE2xxDN is UCMM capable, the only way to communicate with the device is through a UCMM-compliant connection.

The PSE2xxDN only supports the 8/8 body format, which means that the UCMM request parameters are fixed as follows:

- Source MAC ID = address of the master
- Service code = 0x4B
- Requested message body format = 0
- Group select = 3
- Source message ID = 0

The PSE2xxDN will then confirm the connection request, whereby the connection instance ID is 5 (provided this is the first time the device is establishing a UCMM connection).

A (random) message must now be sent to the device on a cyclical basis (the standard expected packet rate is 10 sec.) in order to keep the connection active. Otherwise, this value must be changed (a value of 0 deactivates the monitoring function).

Explicit messages may be sent to the device from now on, whereby the corresponding ID can be determined from the following parameters:

- Message ID = 0
- Source MAC ID = address of the master
- Message group = 3

Deactivating timeout monitoring for the UCMM connection, for instance, requires the following explicit message:

- Message ID = 0
- Destination MAC ID = slave address
- Service code = 0x10
- Class ID = 5
- Instance ID = 5
- Attribute ID = 9 (expected packet rate)
- Value = 0x0000 (16 bit)

c) Explicit connection

Explicit messages can be used to read and write the attributes from a).
Identifier:

- Message ID = 0
- Source MAC ID = address of the master
- Message group = 3

Content:

- Destination MAC ID = slave address
- Service code = 0x10 (write); 0x0E (read)
- Class ID = 100
- Instance ID = 1
- Attribute ID according to list a)
- Value (if written)

d) I/O connections

The PSE2xxDN supports the following types of I/O messages:

- Poll (class ID 5, instance 2)
- Bit strobe (class ID 5, instance 3)
- Change-of-state/cyclic (class ID 5, instance 4), with or without master acknowledge

Setting up an I/O connection first requires the use of an explicit connection to allocate the desired I/O connection; the corresponding identifiers are then reserved and the connection is set to "configuring" status. The next step is to set the expected packet rate, after which point the I/O connection will be in place.
The expected packet rate is always attribute 9 (for a given instance in class 5).

WARNING: Activating the change-of-state/cyclic connection may cause the CAN bus to be flooded with messages as soon as the EPR has been set; to prevent this from occurring, the inhibit time (class ID 5, instance 4, attribute 17), which indicates the minimum amount of time that must elapse before a change-of-state event actually triggers an I/O message, should be set prior to establishing this type of connection. Only then should the EPR be set.

e) Mapping I/O assemblies

The following 4 assemblies are permanently stored in the PSE2xxDN:

Assembly object (class ID 4), **instance 100**, attribute 3:

Bit	Byte	Meaning	Source
0-31	0-3	actual value	PSE object (class ID 100), instance 1, attr. 3
32-47	4-5	status word	PSE object (class ID 100), instance 1, attr. 37
48-63	6-7	actual rpm	PSE object (class ID 100), instance 1, attr. 48

Assembly object (class ID 4), **instance 101**, attribute 3:

Bit	Byte	Meaning	Source
0-16	0-1	status word	PSE object (class ID 100), instance 1, attr. 37

Assembly object (class ID 4), **instance 103**, attribute 3:

Bit	Byte	Meaning	Source
0-31	0-3	target value	PSE object (class ID 100), instance 1, attr. 1
32-47	4-5	control word	PSE object (class ID 100), instance 1, attr. 36

Assembly object (class ID 4), **instance 104**, attribute 3:

Bit	Byte	Meaning	Source
0-7	0	control word, bit 4 (release)	PSE object (class ID 100), instance 1, attr. 36

These assemblies cannot be changed and no additional assemblies may be added.

f) Assigning mapping I/O assemblies to available I/O connections

The PSE2xxDN allows the user to change how mapping I/O assemblies are assigned to available I/O connections. The current settings for each type of I/O connection are recorded in the connection object (class ID 5), instance 0, attr. 100-104. The following provides possible settings and default values:

Name	Attr. No.	Function	Range of values	Back up?	Delivery state	R/W
select input_poll	100	assembly instance that the device uses when establishing a poll connection for sending messages to the master (i.e., for a poll response message)	100, 101 8 bit	no	100	R/W
select output_poll	101	assembly instance that the device uses when establishing a poll connection for receiving messages from the master (i.e., for a poll command message)	103 8 bit	no	103	R/W
select input_bit strobe	102	assembly instance that the device uses when establishing a bit-strobe connection for sending messages to the master (i.e., for a bit-strobe response message)	101 8 bit	no	101	R/W
select output_bit strobe	103	assembly instance that the device uses when establishing a bit-strobe connection for receiving messages from the master (i.e., for a bit-strobe command message)	104 8 bit	no	104	R/W
select input_COS	104	assembly instance that the device uses when establishing a change-of-state/cyclic connection for sending messages to the master	100, 101 8 bit	no	100	R/W

g) Identifiers used for available I/O connections

The identifiers used for available I/O connections can be determined from the predefined master/slave connection set:

Bits for identifier											Meaning
10	9	8	7	6	5	4	3	2	1	0	
1	0	slave MAC ID						1	0	1	poll command message (master)
0	1	1	1	1	slave MAC ID						poll response message (slave)
1	0	master MAC ID						0	0	0	bit-strobe command message (master)
0	1	1	1	0	slave MAC ID						bit-strobe response message (slave)
0	1	1	0	1	slave MAC ID						change-of-state/cyclic message (slave)
1	0	slave MAC ID						0	1	0	change-of-state/cyclic acknowledge message (master)

h) Detailed description of status bits

Bit 0: target position reached
This bit is set:
- when a transferred target position has been reached successfully
- after running an initial reference loop, when the actual value corresponds to the previously transferred target value

This bit is reset:
- after transferring a target position if the difference from the actual value is larger than the positioning window (PSE object; class 100, instance 1, attribute 6)
- by a manual run
- if an invalid target value has been transferred
- if rotated manually when on standstill

Bit 1: drag error
This bit is set:
- if, after the acceleration phase, the maximum speed setting has not been achieved

This bit is reset:
- with each new run command

Bit 2: reserved

Bit 3: reserved

Bit 4: motor power present
This bit is set:
- if the supply voltage to the motor is above the Umot limit (PSE object; class 100, instance 1, attribute 60)

This bit is reset:
- if the supply voltage to the motor is below the Umot limit

Bit 5: positioning run aborted
This bit is set:
- if a positioning run is aborted because release in the control word has been withdrawn

This bit is reset:
- when a new run command is transmitted

Bit 6: drive is running
This bit is set:
- when the drive is rotating

This bit is reset:
- when the drive is on standstill

Bit 7: temperature exceeded
This bit is set:
- if the internal device temperature device exceeds the limit value (PSE object; class 100, instance 1, attribute 62)

This bit is reset:
- if the internal device temperature falls below the limit value by 5°C

Bit 8: movement opposite loop direction
This bit is set:
- during a manual run in the direction opposite that of the loop direction (a subsequent manual run in the loop direction will not reset this bit)
- during a positioning sequence in the direction opposite that of the loop direction

This bit is reset:
- when a transferred target position has been reached successfully (in the loop direction)
- after the initial reference loop

Bit 9: flash memory or encoder error
This bit is set:
- if an unrecoverable error in flash memory occurred
- if an internal problem is detected when calculating a position

No run commands (except the initial reference loop) can be executed when the error bit is set!

This bit is reset:
- when an initial reference loop is completed correctly

Bit 10: positioning error (block)
This bit is set:
- if a positioning run is aborted because the device is overloaded (block, extreme difficulty while running)

This bit is reset:
- by transmitting a new positioning command
- after an initial reference loop has been executed correctly

Bit 11: manual displacement
This bit is set:
- if, while on standstill, the drive is turned externally by more than the value in the positioning window

This bit is reset:
- by transmitting a new positioning command
- after an initial reference loop has been executed correctly

Bit 12: incorrect target value
This bit is set:
- when a transferred target value lies outside of the limit switches; also caused, for instance, because of the actual value of the reference value (attr. 4)
- when a transferred target value lies inside of the limit switches; but because of a necessary loop run the specified interval would be left

This bit is reset:
- by transmitting a valid target value

Bit 13: motor power was missing
This bit is set:
- if the motor power is less than the Umot limit when initiating a positioning run or an initial reference loop (PSE object; class 100, instance 1, attribute 60)
- if during a run the voltage falls below the Umot limit
- if during a run an overcurrent error occurs

This bit is reset:
- if the power to the motor is above the Umot limit when initiating a positioning run or an initial reference loop

Bit 14 / 15: positive / negative range limit

This bit is set:
- if the limit value is reached during a manual run (but not if reached during a positioning run)
- if a limit value is modified such that the current position lies beyond the limit
- if, while on standstill, by means of an external force the drive is moved to a position which is outside the area which is defined by the range limits

This bit is reset:
- by initiating a positioning run, an initial reference loop or a manual run

i) Detailed description of control bits

Bit 0: manual run to larger values

Bit 1: manual run to smaller values

Bit 2: transfer target value: When transferring a target value with the help of an I/O connection, a positioning run is only started if this bit is set.
When commanding a manual run or a jog run with the help of an I/O connection, this bit must not be set.

Bit 3: Release for manual run in jog run mode: This bit must be set in order to switch from jog run mode (bits 4 and 5 in the control word are not set; bit 8 or 9 set) to manual run mode if a jog run bit is activated for a longer time. Single increments are the only option in jog run mode if this bit is reset.

Bit 4: Release: Run commands will only be executed if this bit is set (exception is the jog run mode with bits 8/9 of the control word).
This bit must be set for positioning runs, manual runs and must not be set for jog runs.
If this bit is cleared during a run, the run will be aborted and status bit 5 will be set (‘positioning run aborted’).

Bit 5: reserved, must be programmed to 0

Bit 6: Run without loop: If this bit is set at the start of a positioning run, the target will be approached directly (without loop).

Bit 7: Start initial reference loop: the device performs 5/8 of one rotation opposite to the loop direction; it will then perform 5/8 of a rotation in loop direction at manual run speed.

Bit 8: Jog run to larger values. Bits 4 and 5 must not be set in this mode!

Bit 9: Jog run to smaller values. Bits 4 and 5 must not be set in this mode!

Bit 10: Release readjustment: Only if this bit is set the drive readjusts when it is displaced out of its position in the direction opposite to that of the loop direction at the end of a run. If bit 6 („run without loop“) is being set, the drive readjusts the position in both directions.

Bit 11: reserved, must be programmed to 0

Bit 12: Run with drag error correction: If the bit is set, the drive trys (under consideration of the configured maximum torque) to compensate a drag error which has been developped. By controling the rpm on a value which is slightly above or below the configured 'target rpm posi' (attr. 18), the drag error decreases. The drag error correction operates only in positioning runs, i.e. not in manual runs or in jog run mode. Furthermore it operates only while accelerating and cruising with constant rpm, not while decelerating. The time-dependent setting value for the rpm while accelerating arises out of the rpm at beginning of the positioning as well as the acceleration setting (attr. 155).

Bit 13: reserved, must be programmed to 0

Bit 14: reserved, must be programmed to 0

Bit 15: reserved, must be programmed to 0

j) Quick test for checking the drive and the DeviceNet interface

- Switch device off.
- Set device address to 63.
- Set baud-rate selector switch to 125 kBaud.
- Connect both plugs for the motor supply voltage and the CAN plug.
- Set the CAN receiver to 125 kBaud and activate.
- Switch the device on.
- The device will send 2 messages at an interval of precisely 1 sec. along with the duplicate MAC ID check message (ID 0x5FF). The message contains the serial number and production date.
- Establish the UCMM connection:
  `781  3F 4B 00 30`
- Set the expected packet rate to 0 within 10 sec.:
  `601  3F 10 05 05 09 00 00`
- Set the target value to 5000, fragment 1:
- `601  BF 00 10 64 01 01 88 13`
- Set the target value to 5000, fragment 2:
- `601  BF 81 00 00`
- Set the control word to 0x14:
- `601  3F 10 64 01 24 14 00`
- The drive will move to position 5000.
- Set the target value to 50000, fragment 1:
- `601  BF 00 10 64 01 01 50 C3`
- Set the target value to 50000, fragment 2:
- `601  BF 81 00 00`
- The drive will move to position 50000.

3 Sequence of positioning

a) Positioning run

- In order to control the drive using I/O connections, you must first establish an explicit connection using the UCMM; this connection is then used to allocate and configure the desired I/O connection.
- Transfer target value:
  - Poll I/O message with control word 14h and target value
  OR
  - If release has not been set in the control word: set target value explicitly (using the PSE object; class 100, instance 1, attribute 1); bit-strobe message, bit is set.
  OR
  - If release has been set in the control word: set explicit target value (using the PSE object; class 100, instance 1, attribute 1).
  → Drive begins run.
- Aborting a run by withdrawing release:
  - Poll I/O with control word 0
  OR
  - Bit strobe; bit is reset
  OR
  - Control word set explicitly to 0
- If a new target value is transferred during a positioning run, the device will immediately proceed to the new target. This will occur with no interruption provided the direction of rotation does not need to be altered.
- If a manual run is transmitted during a positioning run, the positioning run will be aborted (speed will be reduced to that of a slow run) and the operator may proceed with the manual run.

The following sequence of steps is also possible:
Starting condition:
- release has not been set
- Target value has already been transferred (in case of poll I/O transfer the release in the control word was not set already)

Set release: drive begins run

b) Positioning run without a reference loop

The sequence corresponds to that of a positioning run with a loop; in addition to setting the release, however, bit 6 in the control word also has to be set to execute the run without loop.

c) Manual run

- Transfer manual run:
  - Poll I/O with control word 11h or 12h
  OR
  - Set control word explicitly to 11h or 12h (using the PSE object; class 100, instance 1, attribute 36)
  → Drive begins run.
- End manual run by withdrawing manual run:
  - Poll I/O with control word 10h

OR
- Set control word explicitly to 10h (using the PSE object; class 100, instance 1, attribute 36)

- End manual run by withdrawing release:
  - Poll I/O with control word 0h
  OR
  - Bit strobe with bit 0
  OR
  - Set control word explicitly to 0h (using the PSE object; class 100, instance 1, attribute 36)
- Transferring a target value during a manual run will end the run and the device will immediately move on to the transmitted position.

4 Special features

a) Speed, acceleration and deceleration

The initial reference loop and the manual run are performed at the maximum speed specified in the PSE object; class 100, instance 1, attribute 19; positioning runs are performed at the maximum speed specified in attr. 18. When the run is counter-clockwise, additionally the maximum speed in attr. 32 applies, when the run is clockwise, the one in attr. 33 applies. For all runs the maximum acceleration of attr. 155 and the maximum deceleration of attr. 156 apply. At the end of each run the maximum deceleration decreases during the approach to the destination successively in order to realize a harmonic transient behaviour.

b) Response of drive in case of block or manual displacement

If during a run the achievable rate of speed falls below the threshold parameter (30% of the selected maximum speed; attr. 26) for longer than 200 ms (attr. 27), the device detects blocking, aborts the run and sets the "positioning error" bit (here the default values are given).
New run commands can then be transmitted with no further steps to take. An exception is, if the run should go to the same target than before. In this case, deassert the release (bit 4 of the control word) and assert it again, then transfer the target position one more time (either by Poll I/O or explicit).
If the PSE2xxDN is displaced by external force during standstill opposite to the loop direction and the release bit (bit 4) as well as the release readjustment bit (bit 10) in the control word are being set, the device will attempt to reach the previously transmitted target value once again (readjustment). The device does not attempt to readjust if rotated in the loop direction; it merely sets the ‘manual rotation’ bit. If bit 6 („run without loop“) is being set, the drive readjusts the position in both directions. Deasserting the release and/or the release readjustment bit can completely stop the readjustment process.

c) Internal measuring system (applys for “singleturn” variants)

The singleturn variants of the PSE2xxC actuator include a partial absolute measuring system. This means that the position within one turn is measured absolute und the turns are counted.
These ‘counted turns’ are stored in internal flash every time a run has been finished

or if the actual position value changes during standstill. The value is available after power up without further commands.

There are two cases that cause the counted turns to be invalid:
1) The output shaft is externally displaced during control power off for more than 36°.
2) Control power is turned off while the PSE2xxDN is turning.

In these cases attr. 42 of the PSE object (class 100, instance 1) has value 0 (“actual position is not consistent”).

Now there are three possible ways to continue depending on the amount of displacement during control power off:
1) No special actions have to be taken if the displacement has been less than 180° (½ turn): The actual position value is still correct.
2) If the displacement has been more than 180° (½ turn), the correct actual position value has to be sent to the PSE2xxDN (by writing to attr. 3).
3) First move to a reference position, then write the actual position value with attr. 3 (if the displacement has been more than ½ turn and the actual position is not available otherwise).

The removal of the **motor** power supply has no affect on the internal measuring system.

Remarks:
1) The 3 attributes referencing value (attr. 4), actual value assessment, numerator (attr. 16) and actual value assessment, denominator (attr. 17) have an influence on the increment and position values: With the help of the referencing value a shift can be reached, with the help of the actual value assessment numerator and denominator a stretching or distension can be reached (see below).
2) When changing the direction of rotation (attr. 44), the referencing value (attr. 4) and the upper and lower limit (attr. 22 and 23) are set to delivery state.
3) When changing the actual value assessment numerator (attr. 16) or denominator (attr. 17), the target value, the actual value, the referencing value, the upper and lower limit, the positioning window (attr. 6) and the length of loop (attr. 31) are re-calculated.
4) When changing the referencing value (attr. 4), the target value, the actual value and the upper and lower limit are re-calculated.
5) If the user wants to go over any automatic re-calculation of values when setting up the device, the optimum order of transfering the parameter is the following:
   a) direction of rotation (attr. 44),
      actual value assessment, numerator (attr. 16),
      actual value assessment, denominator (attr. 17)
   b) referencing value (attr. 4)
   c) upper limit (attr. 22),
      lower limit (attr. 23),
      positioning window (attr. 6),
      length of loop (attr. 31)
6) In order to save the settings permanently in the EEPROM, write 1 to attr. 79. As soon as reading of attr. 79 shows 0, the saving is finished.

Referencing value (attr. 4):
The referencing process affects all transferred values, i.e., the target value, actual value and upper and lower limit.
There are two ways of setting the referencing value:

1) Directly, by writing the referencing value to attr. 4.
2) Indirectly, by writing an actual value to attr. 3. This makes it possible to assign any "true" actual value to the current, physical actual value. The resulting difference is then the referencing value. This value will immediately be included in calculations for each transferred value and can also be read via attr. 4.

When changing the referencing value, automatically the target value, the actual value and and the upper and lower limit are re-calculated.

d) Internal measuring system (applys for "multiturn" variants)

The multiturn variants of the PSE2xxDN actuator include an absolute measuring system with measurement range of 68 rotations. This allows the user to determine the direction of rotation for any desired portion of these 68 rotations.
The mapping of the desired positioning range to the physical positioning range is done with the help of the parameter 'upper mapping end' (attr. 40).
In the delivery state, the drive is at position 13600, the upper limit switch is set to 26400 and the lower limit switch is set to 800, yielding a positioning range of ±32 rotations (±12800 increments). So if the desired positioning range doesn't exceed ±32 rotations, in delivery state none of the following actions to adjust the positioning range have to be taken.

For the realization of any desired positioning range independent of the possible positioning range which is defined by the mounting situation (physical positioning range) there are the following two possibilities:

1) Move the axle (for example a spindle) to the desired position, then move the drive (with opened collar) to the position value which belongs to the physical position of the axle, only then close the collar.
   Examples:
   a) Move the axle in middle position, then move the drive at no-load (with opened collar) also to middle position (position 13600), then close the collar. The drive is now capable of moving 32 rotations (±12800 increments by default) in each direction.
   b) Move the axle completely to the left (resp. bottom), then move the drive at no-load (with opened collar) without loop to the lowest position (position 800), then close the collar. The drive is now capable of moving 64 rotations (±25600 increments by default) to the right (resp. top).
   c) Move the axle completely to the right (resp. top), then move the drive at no-load (with opened collar) to the highest position (position 26400), then close the collar. The drive is now capable of moving 64 rotations (±25600 increments by default) to the left (resp. bottom).
2) Mount the drive in any position on the axle, close the collar, then adjust the positioning range with the help of attr. 40. Attr. 40 defines the upper end of the positioning range. By default, the upper end is at +68 rotations (position 27200). If the positioning range doesn't suit to the actual displayed position after mounting the drive, the upper end of the positioning range can be adjusted between -68 rotations and +136 rotations.
   Examples:
   a) After mounting the drive, the displayed position is 13600 (which corresponds the delivery state). But the positioning range shall solely spread to the right (resp. top) → Set attr. 40 to 40000.
   b) After mounting the drive, the displayed position is 26400. But the positioning range shall solely spread to the right (resp. top) → Set attr. 40 to 52800.
   c) After mounting the drive, the displayed position is 800. But the positioning range shall solely spread to the left (resp. bottom) → Set attr. 40 to 1600.

Remarks:
1) When calculating the upper mapping end (attr. 40), a security reserve of 2 rotations has to be kept in mind (800 increments by default, see the examples above), because the highest possible position value is 2 rotations below the upper mapping end. The lowest possible position value is 66 rotations below the upper mapping end.
2) The above given increment and position values relate to the following settings, which correspond to the delivery state:
   a) referencing value (attr. 4) = 0
   b) actual value assessment, numerator (attr. 16) = 400
   c) actual value assessment, denominator (attr. 17) = 400
   These 3 attributes have an influence on the above given increment and position values: With the help of the referencing value a shift can be reached, with the help of the actual value assessment numerator and denominator a stretching or distension can be reached (see below).
3) When changing the direction of rotation (attr. 44), the referencing value (attr. 4), the upper mapping end (attr. 40) and the upper and lower limit (attr. 22 and 23) are set to delivery state.
4) When changing the upper mapping end (attr. 40), the upper and lower limit (attr. 22 and 23) are set to delivery state.
5) When changing the actual value assessment numerator or denominator (attr. 16 or 17), the target value, the actual value, the referencing value, the upper mapping end, the upper and lower limit, the positioning window (attr. 6) and the length of loop (attr. 31) are re-calculated.
6) When changing the referencing value (attr. 4), the target value, the actual value, the upper mapping end and the upper and lower limit are re-calculated.
7) If the user wants to go over any automatic re-calculation of values when setting up the device, the optimum order of transfering the parameter is the following:
   a) direction of rotation (attr. 44),
      actual value assessment, numerator (attr. 16),
      actual value assessment, denominator (attr. 17)
   b) referencing value (attr. 4)
   c) upper mapping end (attr. 40)
   d) upper limit (attr. 22),
      lower limit (attr. 23),
      positioning window (attr. 6),
      length of loop (attr. 31)
8) In order to save the settings permanently in the EEPROM, write 1 to attr. 79. As soon as reading of attr. 79 shows 0, the saving is finished.

Referencing value (attr. 4):
The referencing process affects all transferred values, i.e., the target value, actual value, upper mapping end and upper and lower limit.
There are two ways of setting the referencing value:
1) Directly, by writing the referencing value to attr. 4.
2) Indirectly, by writing an actual value to attr. 3. This makes it possible to assign any “true” actual value to the current, physical actual value. The resulting difference is then the referencing value. This value will immediately be included in calculations for each transferred value and can also be read via attr. 4.

When changing the referencing value, automatically the target value, the actual value, the upper mapping end and the upper and lower limit are re-calculated.

The removal of the **motor** power supply has no affect on the internal measuring system (applys for signleturn and multiturn variants).

e) Using actual value assessment factors to set the spindle pitch

The PSE object; class 100, instance 1, attribute 16 (numerator factor) and attribute 17 (denominator factor) can be used to represent any desired spindle pitch.
Both factors are set to a value of 400 by default, resulting in a resolution of 0.01 mm at a spindle pitch of 4 mm.
The denominator factor serves as a simple means of setting the spindle pitch and resolution.
The numerator factor is primarily used for setting "unlevel" resolutions.

Examples:

Spindle pitch	Resolution	Numerator factor	Denominator factor
4 mm	1/100 mm	400	400
1 mm	1/100 mm	400	100
2 mm	1/10 mm	400	20

Numerator and denominator factors may take on values between 1 and 10,000.

f) Drag error

During a positioning run, the device compares the computed target position with the current actual value. If the difference is larger than the “drag error” value (PSE object; class 100, instance 1, attribute 5), the device sets the corresponding bit in the status word. This applies in particular if the target speed cannot be achieved due to external influences (required torque, motor voltage too low).

g) Aborted run when the master fails

If the connection to the master is interrupted during a positioning run, the master cannot abort a run that is already underway. Automatically aborting a run in this case requires an I/O connection with an expected packet rate greater than 0; this connection must be set up in advance and used for initiating the positioning run. Poll I/O and bit-strobe I/O may be considered for this connection. Another option would be to set up a change-of-state/cyclic connection with master acknowledge and an expected packet rate greater than 0. In this case, the run could be aborted regardless of how the positioning run had been initiated (i.e., even when using an explicit connection).

h) Jog run mode

With the help of the jog run bits in the control word (bit 8 for “jog run to larger values” and bit 9 for “jog run to smaller values”) a manual run can be performed, provided that bit 4 (release) is inactive. The release of positioning runs and manual runs (control word bit 4) and the control word bits for jog runs (bits 8 and 9) cannot be set simultaneously. Changing the control word bits while running (for example from positioning run to jog run) aborts a run in the other operation mode.

The step width for a short activation time of a jog run bit can be set via attr. 34. Such a single step is being executed if one of the jog run bits is being activated. If the jog run bit is being deasserted before the end of the single step, it will be completed

nevertheless. If the same jog run bit stays active further on, after a short waiting time a continuous manual run might join the single step under some circumstances. This continuous manual run will run as long as the jog run bit stays activated. For this, additionnally to the activation of the jog run bit also bit 3 (‘release for manual run in jog run mode’) has to be activated. If bit 3 is not set, each activation of a jog run bit results in a single step, even if the jog run bit is activated longer than the duration of the single step.

The idle period before the drive switches into manual run is specified with attr. 35. In manual run the drive runs maximum to the specified limit switch position (attr. 22 resp. 23).

If during an jog run both jog run bits are being activated, the run is aborted immediately. A new jog run is only possible if both jog run bits are deasserted.

i) Reference runs

The PSE2xxDN positioning system is equipped with an absolute or partially absolute measuring system, therefore there’s no need for a reference run when powering on the drive. However, if in certain cases a reference run onto a hard block should be desired (e.g. uniquely when installing the drive at a machine), the course of action should be the following:

1) Before commanding the reference run the following settings have to be carried out:
   - set the maximum torque (attr. 20) and the maximum start-up torque (attr. 24) to max. 10% of the nominal torque
   - set the rpm limit for aborting run (attr. 26) to 60
   - set the time elapsed until speed falls below rpm limit for aborting run (attr. 27) to 100
     (The span of time in which the drive trys to get over the block, decreases: With the reduced values the positioning will be aborted if the speed stays below 60% of the target speed for longer than 100ms. By default, these values are 30% and 200ms.)
   - set the corresponding upper and lower limit (attr. 22 or 23) in a way that the block location lays considerable within the area between the upper and lower limit
     (Otherwise there’s the danger that the block is located within the positioning window and consequently won’t be recognized.)
   - Where appropriate, reduce the target speed for manual run (attr. 19).
2) Now start the reference run as manual run (set bit 0 or 1 in the control word).
3) Wait for the drive moving (bit 6 in the status word is set).
4) Wait for the drive has stopped and a positioning error has appeared (bit 6 in the status word is cleared, bit 10 is set).
5) Start a manual run in the opposite direction with the same settings (move a certain distance away from the hard stop in order the drive can move freely).
6) Only now adjust the desired settings of the adove mentioned attributes for normal operation.

5 Technical data

Ambient conditions

ambient temperature	0 °C to +45 °C
storage temperature	-10 °C to +70 °C
shock resistance according to DIN IEC 68-2-27	50 g 11 ms
resistance to vibration according to DIN IEC 68-2-6	10 Hz to 55 Hz 1.5 mm 55 Hz to 1000 Hz 10 g 10 Hz to 2000 Hz 5 g
EMC standards	CE
conformity	CE declaration of conformity available upon request
protection class	IP 54
duty cycle	30 % (base time: 300 s)

Electrical data

nominal power output	PSE21xDN	4 W with 30 % duty cycle
	PSE23xDN	8 W with 30 % duty cycle
supply voltage	24 VDC ±10 % advice: use regulated power supplys	
nominal current, control unit	0.1 A	
nominal current, motor	0.7 A	
positioning resolution	0.9°	
positioning accuracy	0.9°	
CAN protocol	DeviceNet (ODVA CIP Networks Library Volume One Edition 3.1 and Volume Three Edition 1.3) CAN address setting via decade switch (option) or bus: addresses 0...63 baud rate setting via sliding switch (option) or bus: 125 kBaud, 250 kBaud, 500 kBaud	
absolute value acquisition	Variants with partially absolute measuring system (“singleturn“): magnetic within one turn, turns are counted and automatically stored in flash memory Variants with absolute measuring system (“multiturn“): magnetic with gearbox	
electrical connection	spring-type terminal max. 1.5 mm^2	

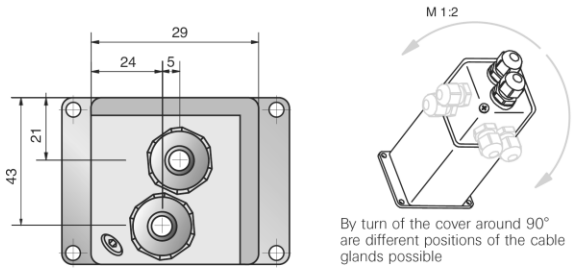
Physical data

positioning range	Variants with partially absolute measuring system (“singleturn“): value range for positions: $-2^{23}…2^{23}$, no mechanical limits Variants with absolute measuring system (“multiturn“): 64 rotations, no mechanical limits	
torsional rigidity (angle of rotation when switching from operation without backlash to maximum torque)	max. 0.2°	
gear backlash (without spindle compensation run)	max. 0.5°	
spindle lash compensation	automatic loop after every positioning run (may be deactivated)	
output shaft	PSE2xxDN-H	8 H 9 hollow shaft with adjustable collar
	PSE2xxDN-V	8 H 8 solid shaft
maximum radial force	40 N	
maximum axial force	20 N	
weight (approx.)	600 g	

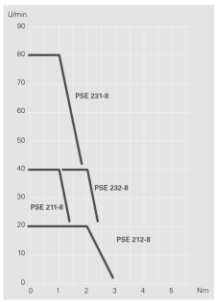
6 Dimension drawings

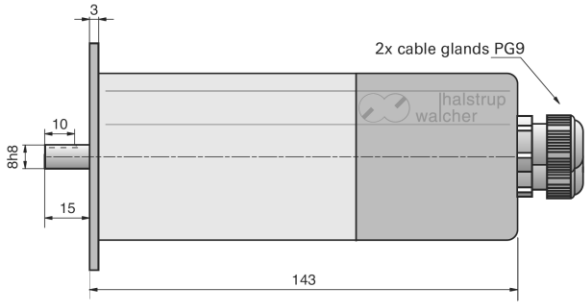
PSE 21_/23_-8

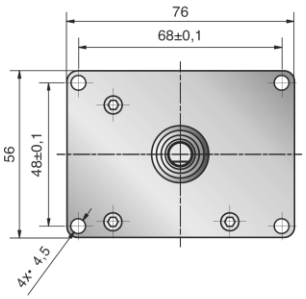
Dimension drawing



Characteristic line







optional hollow shaft