Instruction Manual
PSE2xxMod

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Purpose of instruction manual

This instruction manual describes the features of the PSE2xxMod positioning system and provides guidelines for its use.

Improper use of these devices or failure to follow these instructions may cause injury or equipment damage. Every person who uses the devices must therefore read the manual and understand the possible risks. 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 is state of the art. It complies with the legal requirements of EC directives. This is shown by the CE mark.

CE

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.

PSE2xxMod positioning systems are not stand-alone devices and may only be used if coupled to another machine.

Always observe the operating requirements — particularly the permissible 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

Assembly and the electrical connections should only be handled by professionals. They should be given proper training and be authorised by the operator of the facility.

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. The device must therefore be sent to a recycling plant when you no longer wish to use it. The environment codes of your particular country must be complied with.

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.

CAUTION! 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 PSE2xxMod 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 Modbus 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.

PSE2xxMod positioning systems convert a digital positioning signal into an angle of rotation.

2.2 Installation

PSE2xxMod with hollow shaft:
The PSE2xxMod 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(recommended diameter of the axis is 8 H9 or 10 H9). 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).

PSE2xxMod with solid shaft:
The PSE2xxMod 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 PSE2xxMod 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 PSE2xxMod 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	Modbus GND
2	Modbus D0 (resp. A/A' resp. TXD0/RXD0 resp. TxD/RxD-N)
3	Modbus D1 (resp. B/B' resp. TXD1/RXD1 resp. TxD/RxD-P)
4	GND control + motor
5	+24V control
6	+24V motor
7	GND control + motor
8	Case

2.5 Setting the device address and baud rate

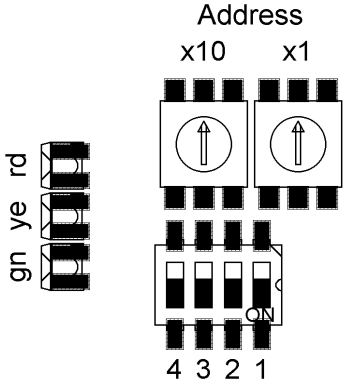
The rotary switches for setting the device address at the bus and a 2-pin sliding switch for setting the baud rate are located behind the terminals.

The rotary switches indicate the tens and ones places of the address selected. If the switches are resting in the position 00 the address can be changed via the Modbus with HR 38.
The delivery setting is 00, the PSE2xxMod reports to the bus with the address 1.

If the switches have been used to set the address (i.e. the switch setting is > 00), this value cannot be changed via the Modbus.

If the Modbus master uses the broadcast address (= 0), each PSE2xxMod on the bus will be addressed, regardless of the actual valid address in the device. However, no answer is being sent by the PSE2xxMod on broadcast messages.

Switch configurations:



Setting the baud rate:

4	3	Baud rate
OFF	OFF	baud rate is set via bus (default = 19200 bps)
OFF	ON	9600 bps
ON	OFF	19200 bps
ON	ON	57600 bps

‘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 Line Termination

By setting the two switches 1+2 to ON, a line termination of the Modbus can be realized. The line termination is necessary at the first and the last node on the line.

2.7 LEDs

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

Yellow LED
Switched ON during frame reception or sending.

Red LED
Switched ON: internal fault
Flashing: Other faults

Green LED
Switched ON: device powered (motor supply)

2.8 Start-up

Positioning sequence (with loop)

The PSE2xxMod differs 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 devices with multiturn encoder compare this position to the internal absolute encoder status. If a discrepancy is detected, the device 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 small distances involved in fine adjustments. In this case, each position is approached directly. This does NOT eliminate any backlash present in the spindle. The PSE2xxMod internal gear backlash does not play a role in this case, as position data is 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).

2.9 Modbus

The Modbus transmission mode “RTU” is used as the protocol at the Modbus EIA/TIA-485 interface. The transmission mode “ASCII” is not supported.

The default baudrate is 19200 bps. The supported setting for the serial port is 8-N-2 (8 data bits, no parity, 2 stop bits).

There are up to 32 devices allowed without a repeater.

Implemented function codes:

Function code (hex)	Sub code (hex)	Description
0x03		Read holding register For reading the holding register HR0-HR127
0x06		Write single register For writing a 16 bit holding register
0x10		Write multiple register For writing a 32 bit holding register (HR48-49, HR52-53, …) and for writing the control word + target value (HR32-34) at once.
0x2B	0x0E	Read device identification Object id 0x00: VendorName 0x01: ProductCode 0x02: MajorMinorRevision 0x03: VendorUrl 0x80: production date, year and week of manufacturing (YYWW) 0x81: serial number Response is given as ASCII String

There are several combined registers: Two 16-bit holding registers are combined to a 32-bit value. In order to write these 32-bit values, always first write to the high word, after that to the low word. After a write access to the low word, the internal 32-bit value will be changed. Between these two write accesses no other write access to another register may be requested, otherwise the write access to the low word will be rejected and answered with an exception code.

Here’s a list of the implemented result codes:

Function code (dez)	Description
00	idle (execution succeeded)
01	illegal function code
02	illegal data address
03	illegal data value
04	slave device failure (execution failed)
11	Frame-Error

A write request to a reserved register will always return “idle”. It is recommended to write the value 0. Reading a reserved register returs the value 0. Read or Write accesses to addresses ≥ 256 are rejected with an exception code.

Table of all Holding Registers:

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Status requests						
0	status word	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	16 bit unsigned			R
1	actual rpm	value in rpm	16 bit signed			R
2	actual value High (Byte 3-2)	current actual position value in 1/100 mm (for default settings of numerator HR 45 and denominator HR 46) Writing onto this register causes the current position to be "referenced" onto the transferred value	32 bit signed	no		R/W
3	actual value Low (Byte 1-0)					
4	actual torque	value in cNm	16 bit unsigned			R
5	maximum torque	maximum torque occurring during the most recent run (start phase, during which the maximum start-up torque applies, see HR 76/84, and the phase when the drive is braking down, are not considered) value in cNm	16 bit unsigned			R
6	U control	current supply voltage for control unit given in increments of 0.1 V	16 bit unsigned			R
7	U motor	current supply voltage for motor given in increments of 0.1 V	16 bit unsigned			R
8	device temperature	internal device temperature in °C	16 bit signed			R
9	position consistent	0: position is not consistent 1: position is consistent (register exists only in singleturn variants)	16 bit unsigned 0…1		1	R

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Status requests (continued)						
10-11	reserved		16 bit			R
12	production date	year and week of manufacturing (given as an integer)	16 bit unsigned YYWW			R
13	serial number	serial device number	16 bit unsigned			R
14	device model	device model within the PSE series (5-digit numbers show the diameter of the output shaft in their last 2 places)	16 bit unsigned			R
15	version	software version number	16 bit unsigned			R
16-31	reserved	-	16 bit			R
Run commands						
32	control word	Bit 0: manual run to larger values Bit 1: manual run to smaller values Bit 4: release: the axle will only run if this bit is set Bit 6: run without loop Bit 7: start initial reference loop Bit 10: release readjustment Bit 12: run with drag error correction All other bits must be set to 0!	16 bit unsigned	no	0	R/W
33	target value Hi (Byte 3-2)	target position to be achieved value in 1/100 mm (for default settings of numerator HR 45 and denominator HR 46)	32 bit signed	no	0	R/W
34	target value Lo (Byte 1-0)					
35-37	reserved	-	16 bit	no	0	R/W
Bus settings						
38	slave address	address of drive (if set by Modbus) This value cannot be changed if the address switches are used (i.e. the switch setting is > 00). Save the parameters (set HR 116 to 1) and restart the device for changes to take effect.	16 bit unsigned 1…247	yes	1	R/W

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Bus settings (continued)						
39	baud rate	0: 1200 bps, 1: 2400 bps, 2: 4800 bps, 3: 9600 bps, 4 :19200 bps, 5: 38400 bps, 6: 57600 bps, 7: 76800 bps, 8: 115200 bps This value cannot be changed if the baud rate switch is used (i.e. the switch setting is not OFF-OFF). Save the parameters (set HR 116 to 1) and restart the device for changes to take effect.	16 bit unsigned 0…8	yes	4	R/W
40	communication timeout	value in msec If the value is 0, the timeout detection is deactivated. A value > 0 sets the time within the master must send a new and valid request to keep the connection alive. A timout in the device will result in aborting the run.	16 bit unsigned 0…10000	yes	0	R/W
41-43	reserved	-	16 bit	no	0	R/W
Position settings						
44	direction of rotation	0: clockwise 1: counter clockwise (if looking at the output shaft)	16 bit unsigned 0…1	yes	0	R/W
45	actual value assessment, numerator	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	16 bit unsigned 1…10000	yes	400	R/W
46	actual value assessment, denominator		16 bit unsigned 1…10000	yes	400	R/W
47	change referencing value	When set to 1, a subsequent write access to the referencing value within a “write multiple” request will be executed. This refers only, if within this “write multiple” request more registers are accessed than the referencing value registers. If only one or both of the referencing value registers are being accessed within a write request, the write request will be executed.	16 bit unsigned 0…1	no	0	R/W
48	referencing value High (Byte 3-2)	correction factor for the target, actual and limit switch values	32 bit signed	yes	0	R/W

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Position settings (continued)						
49	referencing value Low (Byte 1-0)	correction factor for the target, actual and limit switch values				
50	upper mapping end High (Byte 3-2)	definition of the positioning range relative to the absolute measuring system permissible values: (1 + ref.value) … (54400 * denominator / numerator - 1 + ref.value) (register exists only in multiturn variants)	32 bit signed	yes	27200	R/W
51	upper mapping end Low (Byte 1-0)					
52	upper limit High (Byte 3-2)	maximum/minimum allowed target value allowed values for singleturn variants: $-2^{23}…2^{23}$ allowed values for multiturn variants: (upper mapping end - 800…26400 * denominator / numerator)	32 bit signed	yes	2^{23} (singleturn) 26400 (multiturn)	R/W
53	upper limit Low (Byte 1-0)					
54	lower limit High (Byte 3-2)		32 bit signed	yes	-2^{23} (singleturn) 800 (multiturn)	R/W
55	lower limit Low (Byte 1-0)					
56	positioning window	permissible 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	16 bit unsigned 1…100	yes	5	R/W
57	length of loop High (Byte 3-2)	minimum number of increments which the drive moves in a predefined direction when approaching a target position value in increments (value = 0 → no loop)	32 bit unsigned 0.025…1 rotations (10…400 at delivery state) or 0	yes	250	R/W
58	length of loop Low (Byte 1-0)					
59	drag error	maximum drag error before the ‘drag error’ bit is set. Value given in increments (at a resolution of 0.5 mm)	16 bit unsigned 20…1000	yes	100	R/W
60	running direction for approaching target position	0: with forward rotation 1: with reverse rotation (5/8 rotation is the default value, see HR 57/58)	16 bit unsigned 0…1	yes	0	R/W
61-65	reserved	-	16 bit	no	0	R/W

*) Values depend on device type (see following table).

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Velocity settings						
66	target rpm posi	value in rpm maximum rpm to be used for positioning runs	16 bit unsigned *)	yes	*)	R/W
67	target rpm, counter-clockwise	value in rpm maximum rpm to be used for positioning runs counter-clockwise	16 bit unsigned *)	yes	*)	R/W
68	target rpm, clockwise	value in rpm maximum rpm to be used for positioning runs clockwise	16 bit unsigned *)	yes	*)	R/W
69	target rpm hand	value in rpm maximum rpm to be used for manual runs	16 bit unsigned *)	yes	*)	R/W
70	rpm limit for aborting run	value in % of the target rpm	16 bit unsigned 30 .. 90	yes	30	R/W
71	acceleration	value in rpm per sec.	16 bit unsigned *)	yes	*)	R/W
72	deceleration	value in rpm per sec.	16 bit unsigned *)	yes	*)	R/W
73-75	reserved	-	16 bit	no	0	R/W
Torque settings						
76	maximum start-up torque	value in cNm	16 bit unsigned *)	yes	*)	R/W
77	maximum torque	value in cNm Applies after completion of start phase (during start phase the value HR 76 applies)	16 bit unsigned *)	yes	*)	R/W
78-82	reserved	-	16 bit	no	0	R/W
Time settings						
83	time elapsed until speed falls below rpm limit for aborting run	value in msec (see HR 70)	16 bit unsigned 50…500	yes	200	R/W

*) Values depend on device type (see following table).

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Time settings (continued)						
84	time period for start-up torque	value in msec (see HR 76)	16 bit unsigned 10…1000	yes	200	R/W
85	reserved	-	16 bit	no	0	R/W
86	idle period for direction change	value in msec idle period when reversing the direction of rotation	16 bit unsigned 10… 10000	yes	10	R/W
87-89	reserved	-	16 bit	no	0	R/W
90	Umot filter	average time for measuring current power to motor; given in 5 msec increments	16 bit unsigned 100 .. 1000	yes	100	R/W
91-93	reserved	-	16 bit	no	0	R/W
Other settings						
94-103	general purpose	10 general purpose registers	16 bit unsigned	yes	0	R/W
104	Umot limit	voltage limit for bit ‘motor power present’ given in increments of 0.1 V	16 bit unsigned 180 .. 240	yes	185	R/W
105	temperature limit	upper temperature limit in °C	16 bit unsigned 10...70	yes	70	R/W
106-115	reserved	-	16 bit	no	0	R/W

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Other commands						
116	delivery state	reading directly after boot: (value) = 0 → content of memory correct (value) > 0 → content of memory incorrect reading after saving: (value) = 0 → saving finished successfully (value) AND (0xFC00) > 0 → saving is still in progress (the time for saving is up to 2000 msec) (value) AND (0xFC00) = 0 AND (value) AND (0x03FF) > 0 → saving is finished incorrectly writing '-2': generates the delivery state (sets the device address to 1, baud rate 19200 bps, starts initial reference loop, then positioning to the middle of the measurement range) A different device address or baud rate is only active after a device reset! writing '-1': generates the delivery state without modifying the device address and the baud rate (starts initial reference loop, then positioning to the middle of the measurement range) writing '0': no action writing '1': saves all parameters in the EEPROM writing '2': generates the delivery state (sets the device address to 1, baud rate 19200 bps, no movement) A different device address or baud rate is only active after a device reset! writing '3': generates the delivery state without modifying the device address and the baud rate (no movement)	16 bit signed -2…3	no	0	R/W

Reg. Nr.	Name	Function	Type/ Range	Back up	Delivery State	R/W
Other commands (continued)						
117	device reset	reading: always 0 writing '0': no action writing '1': resets the device	16 bit unsigned 0…1	no	0	R/W
118-127	reserved	-	16 bit	no	0	R/W

Table of rated speed and torque values for various models of gears

	device model	211-08	212-08	213-10	231-08	232-08
Name	Reg	value range delivery state	value range delivery state	value range delivery state	value range delivery state	value range delivery state
target rpm posi	HR 66	6…60 50	6…30 25	6…20 17	6…120 100	6…60 50
target rpm hand	HR 69	6…60 15	6…30 8	6…20 6	6…120 30	6…60 15
maximum rpm, counterclockwise	HR 67	6…60 50	6…30 25	6…20 17	6…120 100	6…60 50
maximum rpm, clockwise	HR 68	6…60 50	6…30 25	6…20 17	6…120 100	6…60 50
acceleration	HR 71	20…150 150	10…75 75	7…50 50	20…150 150	10…75 75
deceleration	HR 72	20…150 150	10…75 75	7…50 50	20…150 150	10…75 75
maximum torque	HR 77	2…100 100	4…200 200	6…300 300	2…100 100	4…200 200
maximum start-up torque	HR 76	2…125 125	4…250 250	6…375 375	2…125 125	4…250 250

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 (HR 56)
- 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 (HR 104)

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 (HR 105)

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 (HR 48/49)
- 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 power to the motor is less than the Umot limit (HR 104) when initiating a positioning run or an initial reference loop
- 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

d) Detailed description of control bits

Bit 0: manual run to larger values

Bit 1: manual run to smaller values

Bit 2: reserved, must be programmed to 0

Bit 3: reserved, must be programmed to 0

Bit 4: Release: Run commands will only be executed if this bit is set.
This bit must be set for positioning runs and manual 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 during positioning runs, all target positions 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.
In earlier versions, this command had to be executed after switching on the device; that is no longer the case.

Bit 8: reserved, must be programmed to 0

Bit 9: reserved, must be programmed to 0

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’ (HR 66), the drag error decreases. The drag error correction operates only in positioning runs, i.e. not in manual runs or in jog key 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 (HR 71).

Bit 13: reserved, must be programmed to 0

Bit 14: reserved, must be programmed to 0

Bit 15: reserved, must be programmed to 0

3 Sequence of positioning

a) Positioning run

- Transfer target value (control word HR 32 = 0x0010h and target value HR 33/34): drive begins run
- Abort run by resetting the release bit (control word HR 32 = 0x0000h).
- If a new target value is transferred during a positioning run, the device will immediately proceed to the new target. There will be no interruption if 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 manual run) and the device proceeds with the manual run.

The following sequence of steps is also possible:
Starting situation:
- release has not been set
- Target value has already been transferred

Set release (bit 4 in the control word HR 32): drive begins run

b) Positioning run without loop

The sequence corresponds to that of a positioning run with 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

- start manual run (control word HR 32 = 0x0011h resp. 0x0012h): device begins to run
- End manual run by clearing the manual run command (control word HR 32 = 0x0000h).
- Transferring a target value during a manual run will end the manual run and the device will immediately move on to the transmitted position.

4 Specials

a) Speed, acceleration and deceleration

The initial reference loop and the manual run are performed at the maximum speed specified in HR 69; positioning runs are performed at the maximum speed specified in HR 66. When the run is counterclockwise, additionally the maximum speed in HR 67 applies, when the run is clockwise, the one in HR 68 applies. For all runs the maximum acceleration in HR 71 and the maximum deceleration in HR 72 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 due to load the speed falls below the threshold parameter of 30% (HR 70) of the selected maximum speed for longer than 200 msec (HR 83), 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.
If the PSE2xxMod 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.

If at standstill the drive continuously looses its position, the attempt to readjust starts exactly when the actual position is leaving the positioning window (assumed that all the conditions above are being fulfilled). If the motor power is missing at the time when this transition happens, the readjustment fails and bits10 (‘positioning error’) and 13 (‘motor power was missing’) will become active. If later the motor power comes back again, there will be **no** further attempt to readjust. This is to prevent a situation that suddenly a drive begins to run if motor power is being switched on.

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

The singleturn variants of the PSE2xxMod actuator include a partial absolute measuring system. This means that the position within one turn is measured absolute and 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 PSE2xxMod is turning.

In these cases HR 9 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 PSE2xxMod (by writing to HR 2/3).
3) First move to a reference position, then write the actual position value with HR 2/3 (if the displacement has been more than ½ turn and the actual position is not available otherwise).

Remarks:
1) The 3 parameters “referencing value” (HR 48/49), “actual value assessment, numerator” (HR 45) and “actual value assessment, denominator” (HR 46) 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 (HR 44), the referencing value (HR 48/49) and the upper and lower limit (HR 52/53 and HR 54/55) are set to delivery state.
3) When changing the actual value assessment numerator or denominator (HR 45 or HR 46), the target value, the actual value, the referencing value, the upper and lower limit, the positioning window (HR 56) and the length of loop (HR 57/58) are recalculated.
4) When changing the referencing value (HR 48/49), the target value, the actual value and the upper and lower limit are recalculated.
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 (HR 44),
      actual value assessment, numerator (HR 45),
      actual value assessment, denominator (HR 46)
   b) referencing value (HR 48/49)
   c) upper limit (HR 52/53),
      lower limit (HR 54/55),
      positioning window (HR 56),
      length of loop (HR 57/58)
6) In order to save the settings permanently in the EEPROM, write 1 to HR 116. As soon as reading of HR 116 shows 0, the saving is finished.

Referencing value (HR 48/49):
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 HR 48/49.
2) Indirectly, by writing an actual value to HR 2/3. 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 HR 48/49.

When changing the referencing value, the target value, the actual value and and the upper and lower limit are recalculated automatically.

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

d) Internal measuring system (applys for “multiturn” variants)

The multiturn variants of the PSE2xxMod actuator include an absolute measuring system with measurement range of 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’ (HR 50/51).
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 HR 50/51. HR 50/51 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 HR 50/51 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 HR 50/51 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 HR 50/51 to 1600.

Remarks:

1) When calculating the upper mapping end (HR 50/51), 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 (HR 48/49) = 0
   b) actual value assessment, numerator (HR 45) = 400
   c) actual value assessment, denominator (HR 46) = 400
   These 3 parameters 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 (HR 44), the referencing value (HR 48/49), the upper mapping end (HR 50/51) and the upper and lower limit (HR 52/53 and HR 54/55) are set to delivery state.
4) When changing the upper mapping end (HR 50/51), the upper and lower limit (HR 52/53 and HR 54/55) are set to delivery state.

5) When changing the actual value assessment numerator or denominator (HR 45 or HR 46), the target value, the actual value, the referencing value, the upper mapping end, the upper and lower limit, the positioning window (HR 56) and the length of loop (HR 57/58) are recalculated.
6) When changing the referencing value (HR 48/49), the target value, the actual value, the upper mapping end and the upper and lower limit are recalculated.
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 (HR 44),
      actual value assessment, numerator (HR 45),
      actual value assessment, denominator (HR 46)
   b) referencing value (HR 48/49)
   c) upper mapping end (HR 50/51)
   d) upper limit (HR 52/53),
      lower limit (HR 54/55),
      positioning window (HR 56),
      length of loop (HR 57/58)
8) In order to save the settings permanently in the EEPROM, write 1 to HR 116. As soon as reading of HR 116 shows 0, the saving is finished.

Referencing value (HR 48/49):
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 HR 48/49.
2) Indirectly, by writing an actual value to HR 2/3. 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 HR 48/49.

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

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

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

HR 45 (numerator factor) and HR 46 (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 (HR 59), the device sets the corresponding bit in the status word. This situation is especially likely to occur if external factors (required torque, voltage to motor too low) prevent the device from achieving the target rpm.

g) Abort run when the master fails

If the connection to the master is interrupted during a positioning run, the master cannot abort an actual run. An automatic run abort can be generated by using HR 40. A value greater than 0 sets the time within the Master must send a new and valid request to keep the connection alive. A timout in the device will result in aborting the run.

h) Reference runs

The PSE2xxMod 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 (HR 77) and the maximum start-up torque (HR 76) to max. 10% of the nominal torque
   - set the rpm limit for aborting run (HR 70) to 60
   - set the time elapsed until speed falls below rpm limit for aborting run (HR 83) 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 (HR 52/53 or HR 54/55) 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 (HR 69).
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 holding registers 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 msec
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

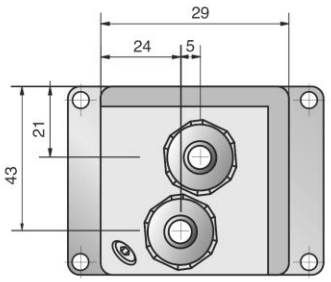
nominal power output	PSE21xMod	4 W with 30 % duty cycle
	PSE23xMod	8 W with 30 % duty cycle
supply voltage	24 VDC ±10 % advice: use regulated power supplys	
nominal current, control unit	0.1 A	
nominal current, motor	0.7 A	
positioning resolution	0.9°	
positioning accuracy	0.9°	
Modbus RTU	Address setting via decade switch: addresses 1...99 Address setting via bus: addresses 1...247 baud rate setting via sliding switch: 9600 bps, 19200 bps, 57600 bps baud rate setting via bus: 1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 76800 bps, 115200 bps	
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	

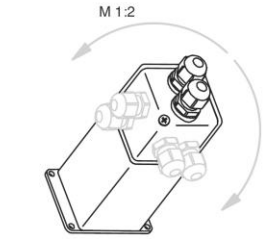
Physical data

positioning range	Variants with partially absolute measuring system (“singleturn”): value range for positions: -223…223, no mechanical limits Variants with absolute measuring system (“multiturn”): 64 rotations, no mechanical limits measuring system has a span of 68 turns, minus 2 turns security stock at upper and lower range limit	
torsional rigidity (angle of rotation when switching from operation without backlash to maximum torque)	max. 0.2°	
gear backlash (without spindle compenation run)	max. 0.5°	
spindle lash compensation	automatic loop after every positioning run (may be deactivated)	
output shaft	PSE2xxMod-H	8 H 9 hollow shaft with adjustable collar
		10 H 9 hollow shaft with adjustable collar
	PSE2xxMod-V	8 H 8 solid shaft
recommended diameter of spindle head	8 H 9 or 10 H 9	
maximum radial force	40 N	
maximum axial force	20 N	
dimensions (l x w x h)	see drawings	
weight (approx.)	600 g	

6 Dimension drawings

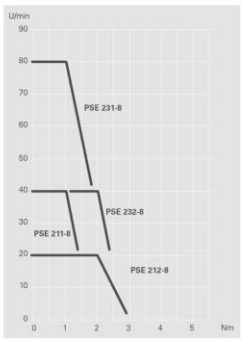
PSE 21_/23_-8
Dimension drawing

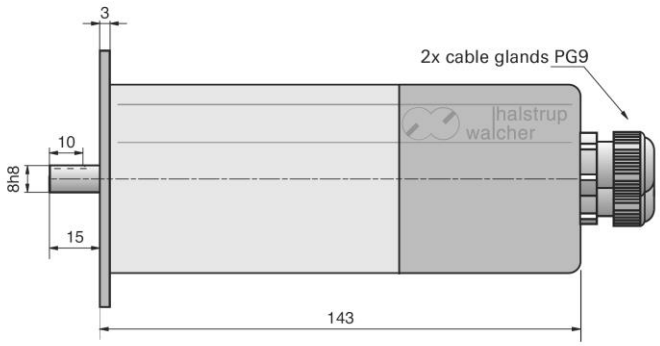


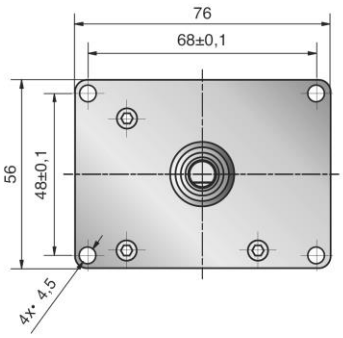


By turn of the cover around 90° are different positions of the cable glands possible

Characteristic line







optional hollow shaft