PROFIBUS Positioner
Type 3785
PA Device Profile Version 3.0

Fig. 1 · Type 3785

Mounting and Operating Instructions

EB 8382-2 EN

Firmware version R 1.4x/K 2.2x

Edition February 2005

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General safety instructions

- *The positioner may only be assembled, started up or operated by trained and experienced personnel familiar with the product.*
  According to these mounting and operating instructions, trained personnel is referred to as individuals who are able to judge the work they are assigned to and recognize possible dangers due to their specialized training, their knowledge and experience as well as their knowledge of the relevant standards.
- *Explosion-protected versions of this positioner may only be operated by personnel who have undergone special training or instructions or who are authorized to work on explosion-protected devices in hazardous areas.*
- *Any hazards that could be caused by the process medium, the operating pressure, the signal pressure or by moving parts of the control valve are to be prevented by means of the appropriate measures.*
- *If inadmissible motions or forces are produced in the actuator as a result of the supply pressure level, it must be restricted by means of a suitable supply pressure reducing station.*
- *Proper shipping and appropriate storage are assumed.*

- ***Note!** The device with a CE marking fulfils the requirements of the Directives 94/9/EC (ATEX) and 89/336/EEC (EMC).*
  The declaration of conformity is available on request.

Modifications in the positioner firmware compared to earlier version	
Old	New
Control R 1.23	R 1.31
	Firmware adaption for new hardware version Hardware version device index .01
Control R 1.31	R 1.4
Actuator type	When the actuator type is set from "linear actuator" to "rotary actuator", the following applies: Initialization method . . . . . Based on maximum range Transmission code. . . . . S90 Nominal angle . . . . . 90 Final position for w < . . . . . 1 % Final position for w > . . . . . 99 % Rotat. angle range begins . . 0° Rotational angle range ends 90°
	When the actuator type is set from "linear actuator" to "rotary actuator", the following applies: Attachment. . . . . Integral . . . . . According to NAMUR Type of initialization . . . . . Based on nominal range . . . Based on nominal range Mounting position. . . . . Arrow towards actuator. . . . Arrow away f. actuator Transmission code. . . . . D1 . . . . . – Pin position . . . . . – . . . . . A Rated travel . . . . . 15 mm . . . . . 15 mm Final position for w < . . . . . 1 % . . . . . 1 % Final position for w > . . . . . 125 % . . . . . 125 % Lower travel range value . . . 0 mm . . . . . 0 mm Upper travel range value. . . 15 mm . . . . . 15 mm Lever length . . . . . – . . . . . 42 mm
Type of initialization	When the initialization method is set from "maximum range" to "nominal range", the following applies: Final position for w < 1 % . . Final position for w > 125 % When the initialization method is set from "maximum range" to "nominal range", the following applies: Final position for w < 1 % . . Final position for w > 99 %
Desired transit time Open/Closed	The adjustment range of the desired transit times was limited to 75 seconds.

Initialization	During initialization, the minimum control signals from 20 % to 80 % of the range of the manipulated variable are determined and saved in the EEPROM.
Proportional-action coefficients KP_Y1 and KP_Y2	The coefficients are adapted to the selected actuator type and the measured transit times.
Control R 1.41	R 1.4.2
	Correction in case of zero adjustment triggered via communication.
Communication K 1.34	K 1.41
	Firmware adaption for new hardware version Hardware version device index .01
Communication K 1.41	K 1.51
	The current status of control loop monitoring is indicated by bit 7 of the CHECK_BACK parameter. Contrary to bit 13, bit 7 is automatically reset when no further error is detected by control loop monitoring. The function of bit 13 remains unchanged. Messages are only issued by bit 7 if control firmware version R 1.41 or higher is used. The message "Warm start" indicated by bit 11 of the DIAGNOSIS parameter is automatically reset after 10 sec. In operating mode "Local override", bit 2 of the CHECK_BACK parameter is set.
Communication K 1.51	K 1.60
	In operating mode "Manual", the out value is preset by the parameter OUT.

Communication K 1.60	K 2.00
	This firmware version implements the PROFIBUS PA Profile 3.0, Class B for control valves according to PROFIBUS PA Profile for Process Control Devices Version 3.0-Actuator. The positioner can be connected to the TROVIS-VIEW Configuration and Operator Interface via the serial interface for adjustment and operation.
Communication K 2.00	K 2.10
	When a zero point error or self-resetting control loop error (transit time exceeded) is detected, or when the limit value for the total valve travel is exceeded, the status of the parameters READBACK or POS_D is set to GOOD_MAINTENANCE_REQUIRED.

Positioner	**Type 3785**	X	X	X	X	X	**3**	X
Not explosion protected		0						
⟨Ex⟩ II 2 G EEx ia IIC T6 /II 2 D IP 65 T 80 °C acc. to ATEX		1						
Ex ia FM/CSA		3						
Additional accessories								
Inductive limit switch	without		0					
	with Type SJ 2-SN		2					2
with forced venting	without			0				
	24 V DC			1				2
PA device profile	Version 2.0				0			
	Version 3.0				1			
Pneumatic connections	NPT ¼ - 18					1		
	ISO 228 / - G ¼					2		
Electrical connections	Cable gland M20 x 1.5 with Shielding, nickel-plated brass Quantity 1							1
	Quantity 2							2

1 Design and principle of operation

The digital PROFIBUS PA positioner is attached to pneumatic control valves. It assigns the valve position (controlled variable) to the control signal (reference variable). The positioner compares the digital control signal transmitted from the control equipment to the travel of the control valve and issues a pneumatic signal pressure (output variable). To achieve this, a supply air pressure of 1.4 to 6 bar is required. The electric power is supplied by the bus connection of the PROFIBUS PA segment in accordance with IEC 61158-2 regulations. The positioner consists of an inductive, frictionless displacement sensor system and an electrically controlled valve block with two on-off valves, as well as the electronics including the two microcontrollers to edit the control algorithm and manage PROFIBUS communication.
When a system deviation occurs while comparing set point and actual value, the microcontroller returns binary pulse-pause-modulated signals which are used to control two on-off valves with subsequent boosters. One valve controls the exhaust air, the other the supply air. The supply air valve (3) connects the supply air (7, supply air pressure 1.4 to 6 bar) and the actuator (filling). The exhaust air valve (4) connects the actuator and the atmosphere (venting). These on-off valves can either have the switching states continuously open or continuously closed, or they can generate single pulses of variable width. Controlling the two valves causes the actuator of the valve to move the plug stem to a position corresponding to the reference variable. If there is no system deviation, both the exhaust and supply air valves are closed. By default, the positioner is equipped with a binary input for floating contacts, which serves to signalize the switching state of an additional field device via PROFIBUS. The write protection switch in the hinged cover (located near the bus address adjustment) prevents that positioner settings are overwritten via PROFIBUS communication on activation.

Positioner with forced venting function:
The positioner is controlled by a 6 to 24 V signal, causing the signal pressure to be applied to the actuator. When this voltage signal decreases, the signal pressure is shut off and the actuator is vented. Additionally, the control valve is moved to its fail-safe position by the integrated springs. All positioners are equipped with the forced venting function, which can be activated and deactivated using a switch (also see section 4.3).

1.1 Options

The standard positioner version can be supplemented with limit switches. Two proximity switches suitable for fail-safe circuits can be used to signalize the valve's final positions.

1.2 Communication

The positioner is completely controlled via digital signal transmission according to PROFIBUS PA Profile Class B based on DIN EN 50170 and DIN 19245 Part 4. Data is transmitted as bit synchronous current modulation with a transfer rate of 31.25 kbps using twisted-pair cables as specified in IEC 61158-2. The positioner

settings are usually made on a computer. By using a segment coupler, one or more positioners can be connected to the PC's PROFIBUS segment. After mechanically setting the positioner to zero, it can be automatically started up by an initialization procedure. During this initialization, zero is adjusted automatically and the preset span is checked. The positioner is delivered with a standard configuration for a control valve with a rated travel of 15 mm, designed for integral positioner attachment. The positioner can be individually configured to adapt it to other actuators only by means of communication.

Configuration

The positioner is configured and operated from the computer via the SSP interface (13) using TROVIS-VIEW. Alternatively, a segment coupler can be used together with, for example, the COMMUWIN II interface by Endress + Hauser or the SIMATIC PDM software by SIEMENS.

During configuration, you can enter parameters such as characteristic, operating direction, travel limitation, travel range, transit time and fault alarms.

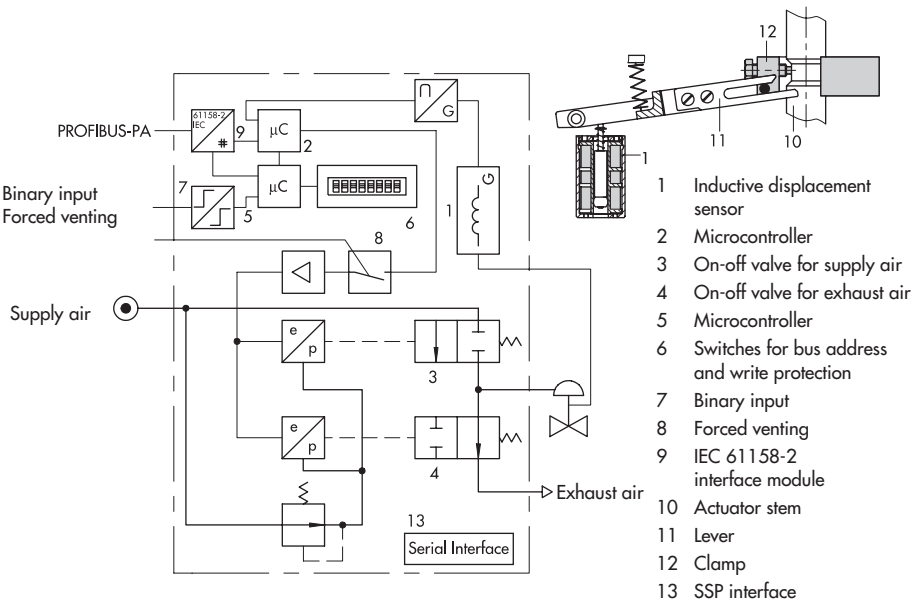


Fig. 2 · Functional diagram

1.3 Technical data

Positioner	
Travel, adjustable	Direct attachment to Type 3277: 5 to 30 mm Attachment acc. to IEC 60534 (NAMUR): 5 to 255 mm or 30° to 120° for rotary actuators
Bus connection	Fieldbus interface as per IEC 61158-2 Field device acc. to FISCO (Fieldbus intrinsically safe concept)
Permissible operating voltage	9 to 32 V DC; The limits specified in the EC Type Examination Certificate additionally apply for explosion-protected devices. Supplied over the bus line
Destruction limit	35 V
Maximum operating current	10 mA
Fault current	0 mA
Supply air	Supply pressure from 1.4 to 6 bar (20 to 90 psi), Air quality acc. to ISO 8573-1 Edition 2001: Max. particle size and density: Class 4; Oil content: Class 3, pressure dew point: Class 3 or at least 10 K beneath the lowest ambient temperature to be expected
Signal pressure (output)	0 bar up to supply pressure
Characteristic, adjustable	Linear, equal percentage, reverse equal percentage, user-definable Deviation from terminal-based conformity ≤ 1 %
Dead band (related to rated travel/angle)	Adjustable from 0.1 to 10.0 %, predefined 0.5 %
Resolution	< 0.05 % (internal measured data recording)
Required transit time	Separately adjustable up to 75 seconds for supply air and exhaust air
Direction of action	Reversible, adjustable over software
Air consumption	Independent from supply pressure < 90 l_n/h
Air capacity output	Actuator pressurized: at Δp = 6 bar 9.3 m_n^3/h, at Δp = 1.4 bar 3.5 m_n^3/h Actuator vented: at Δp = 6 bar 15.5 m_n^3/h, at Δp = 1.4 bar 5.8 m_n^3/h
Permissible ambient temperature	–40 to 80 °C; The limits specified in the EB Type Examination Certificate additionally apply for explosion-protected devices.
Influences	Temperature: ≤ 0.15 %/10 K, supply air: None, Vibration: None up to 250 Hz and 4 g
Explosion protection	Ⓔx II 2 G SEX ia IIC T6 /II 2 D IP 65 T 80 °C
Degree of protection	IP 65 on using enclosed filter check valve
Electromagnetic comparability	Complying with EN 61000-6-2, EN 61000-6-3 and NAMUR Recommendation NE 21

Binary input	Internal supply 5 V DC, Ri = 100 kW for alarm function e.g. connection to a pressure switch
Forced venting, activated over internal switch	Input: 6 to 24 V DC, static destruction limit 45 V, Ri approx. 6 kΩ with 24 V DC (voltage dependent, switching point "1" signal at ≥ 3 V, "0" signal only at 0 V, Kv 0.17)
Communication	Data transmission as per PROFIBUS-PA, Profile Class B Version 3.0 acc. to DIN EN 50170 and DIN 19245 Part 4 (Version 2.0 is also available)
Local interface	SAMSON SSP interface for configuration and start-up
Bus address	Adjustable over software or microswitch, delivered state: 126
Additional equipment	
Inductive limit switch	Two SJ 2SN Proximity Switches for connection to switching amplifier acc. to EN 60947-5-6
Materials	
Housing	Die-cast aluminum, chromated and plastic coated, external parts: Stainless steel 1.4571 und 1.4301
Weight	Approx. 1.3 kg

2 Attaching the positioner

The positioner can be attached either directly to the SAMSON Type 3277 Actuator, or according to IEC 60534-6 (NAMUR) to control valves with cast or rod-type yokes. In combination with an intermediate piece, the device can also be attached to rotary actuators as rotary positioner.
As the positioner unit is delivered without accessories, refer to the appropriate tables for the order numbers of the required mounting parts.

Note!
For faster control valves with small travel volumes (transit time <0.6 sec.), replace the filter in the signal pressure output (output 38) with a screw-in throttle (see Accessories table), if necessary, to improve the control properties. See also sections 2.1, 2.2 and 2.3.

Important!
The positioner does not have its own vent plug. The air is exhausted via vent plugs located on the accessories (also see Figs. 3, 5 and 7).
Each positioner comes with a filter check valve for the exhaust air located below the transparent protective cap on the back of the positioner.
The standard vent plug available as an accessory must be replaced with this filter check valve to achieve degree of protection IP 65 protecting the device against dirt and moisture.

2.1 Direct attachment to Type 3277 Actuator

Refer to Tables 1, 2 and 3 on page 15 for the required mounting parts.

When looking onto the signal pressure connection or the switchover plate (120 cm² actuator) from the top, the positioner is to be attached to the left side of the actuator. The **arrow** on the black case cover (Fig. 11) must point **towards the diaphragm chamber**.

Exception: Control valves in which the plug only closes the seat area when the actuator stem retracts. In this case, the positioner has to be attached to the right side of the yoke with the arrow pointing away from the diaphragm chamber.

1. Screw the clamp (1.2) to the actuator stem, ensuring that the fastening screw is located in the groove of the actuator stem.
2. Screw associated lever D1 or D2 (for 700 cm² actuator) to the transmission lever of the positioner.
3. Attach distance plate (15) with the seal pointing towards the actuator yoke.
4. Place positioner onto the plate so that the lever D1 or D2 slides centrically over the pin of the clamp (1.2). Screw positioner to distance plate (15).
5. Mount the cover (16).

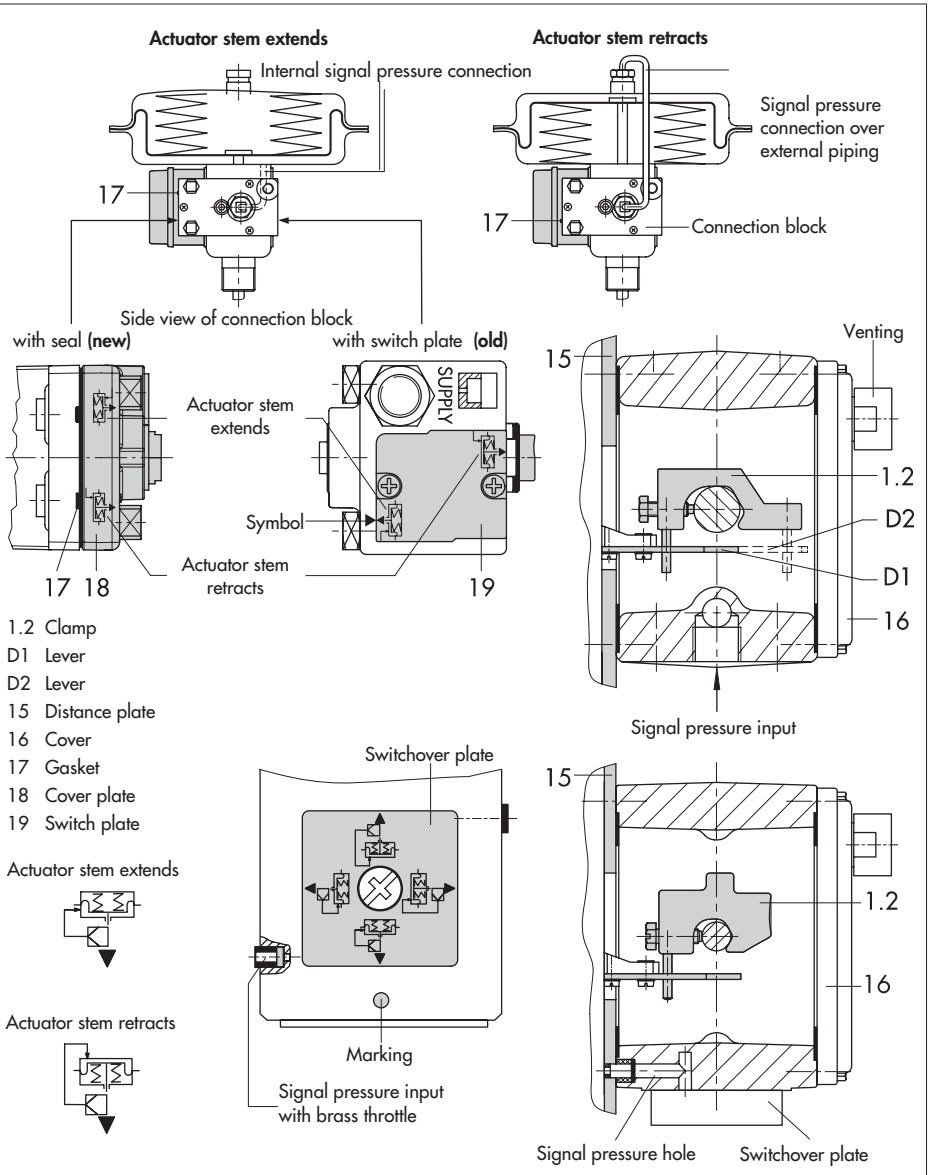


Fig. 3 · Attachment - Signal pressure connection for Type 3277 (top) and Type 3277-5 with 120 cm² (bottom)

240, 350 and 700 cm² actuators

6. Check whether the tongue of the seal (17) is properly aligned at the side of the connection block with the actuator symbol "actuator stem extends" or "actuator stem retracts" to match the actuator version used. If not, remove the three fastening screws and the cover plate (18), turn the seal (17) by 180° and reinsert it.
   When the old connection block is used, turn the switch plate (19) to align the actuator symbol with the arrow.
7. Place the connection block with its sealing rings against the positioner and actuator yoke, and screw it tight using the fasting screw. For actuators with fail-safe action "Actuator stem retracts" additionally install the prefabricated signal pressure tube between connection block and actuator.

Actuator with 120 cm²

For Type 3277-5 Actuators with 120 cm², the signal pressure is transmitted to the diaphragm chamber via the switchover plate (Fig. 3, bottom).
For a rated travel of 7.5 mm, a brass throttle (see Accessories table on page 15) must be pressed into the seal located in the signal pressure input on the actuator yoke.
With 15 mm rated travel, this is only required if the supply pressure exceeds 4 bar.

6. Remove the screw at the back of the positioner and close the signal pressure output (output 38) at the side with the associated plug included in the accessory kit.
7. Mount the positioner so that the bore in the distance plate (15) is aligned with the seal located in the bore of the actuator yoke.
8. Align the switchover plate with the corresponding symbol for attachment on the left side, and screw the plate to the actuator yoke.

Note!
If, in addition to the positioner, a solenoid valve or a similar device is attached to the 120 cm² actuator, the rear M3 screw must not be removed. In this case, the signal pressure has to be fed from the signal pressure output to the actuator via the required connecting plate (see Table 2). The switchover plate is no longer required.

Note!
For faster control valves with a transit time <0.6 sec., replace the filter in the signal pressure output (output 38) with a screw-in throttle (see Accessories table), if necessary.

Air purging function

If the spring chamber of the Type 3277 Actuator must be filled with the air exhausted from the positioner, the spring chamber (version "Actuator stem extends") can be connected to the connection block by means of a tube (Table 3). To do so, remove the vent plug on the connecting block.
With Type 3277-5, version "Actuator stem retracts", the air exhausted from the positioner is constantly applied to the spring chamber via an internal bore.

Table 1			Mounting kit
Required lever with associated clamp and distance plate		Actuator size [cm²]	Order no.
D1 with stopper for Output (38) threaded connection	G ¼ ¼ NPT	120	1400-6790 1400-6791
D1 (33 mm in length with clamp 17 mm in height)		240 and 350	1400-6370
D2 (44 mm in length with clamp 13 mm in height)		700	1400-6371
Table 2			Order no.
Switchover plate for actuator 120 cm²	Actuator 3277-5xxxxxx.**00** (old)		1400-6819
Switchover plate **new**	Actuator Type 3277-5xxxxxx.**01** and larger (new)		1400-6822
Connecting plate for additional attachment of a solenoid valve	Actuator Type 3277-5xxxxxx.**00** (alt), G ⅛ Actuator Type 3277-5xxxxxx.**00** (alt), ⅛ NPT		1400-6820 1400-6821
Connecting plate **new**	Actuator Type 3277-5xxxxxx.**01** and larger (new)		1400-6823
***Note**: Only new switchover and connecting plates can be used with new actuators (Index 01). Old and new plates are not interchangeable.*			
Required connection block for 240, 350, 700 cm² actuator (including seals and screw)		G ¼	1400-8811
		¼ NPT	1400-8812
Table 3	Actuator size [cm²]	Material	Order no.
Required piping with screw fittings for "Actuator stem retracts" or when the top diaphragm chamber is filled with air	240	Steel	1400-6444
	240	Stainless steel	1400-6445
	350	Steel	1400-6446
	350	Stainless steel	1400-6447
	700	Steel	1400-6448
	700	Stainless steel	1400-6449
Accessories			Order no.
Pressure gauge mounting kit (output and supply)		Stainless steel/Brass	1400-6957
		Stainless steel/Brass	1400-6958
Signal pressure throttles (screw-in and brass throttles)			1400-6964
Filter check valve, replacing the exhaust plugs and increasing the degree of protection to IP 65 (one valve is included in the scope of delivery)			1790-7408

2.2 Attachment according to IEC 60534-6

Refer to Tables 4 and 5 on page 19 for required accessories.

For positioner attachment according to NAMUR as shown in Fig. 4, an adapter housing is required. The valve travel is transmitted via the lever (18) and the shaft (25) to the bracket (28) of the adapter housing and then to the pin (27) located at the positioner lever.
To attach the positioner, the mounting parts listed in Table 4 are required. Which lever is to be used depends on the rated valve travel.
The positioner must be attached with the **arrow** on the black case cover **pointing away from the diaphragm actuator** towards the valve.
Exception: Control valves in which the plug only closes the seat area when the actuator stem retracts. In this case, the arrow has to point towards the diaphragm actuator.
If the adapter housing cannot be mounted between the actuator and the valve (e.g. actuators by other manufacturers), the arrow on the case cover must point towards the control valve.

Note!
For faster control valves with a transit time <0.6 sec., replace the filter in the signal pressure output (output 38) with a screw-in throttle (see Accessories table), if necessary.

2.2.1 Mounting sequence

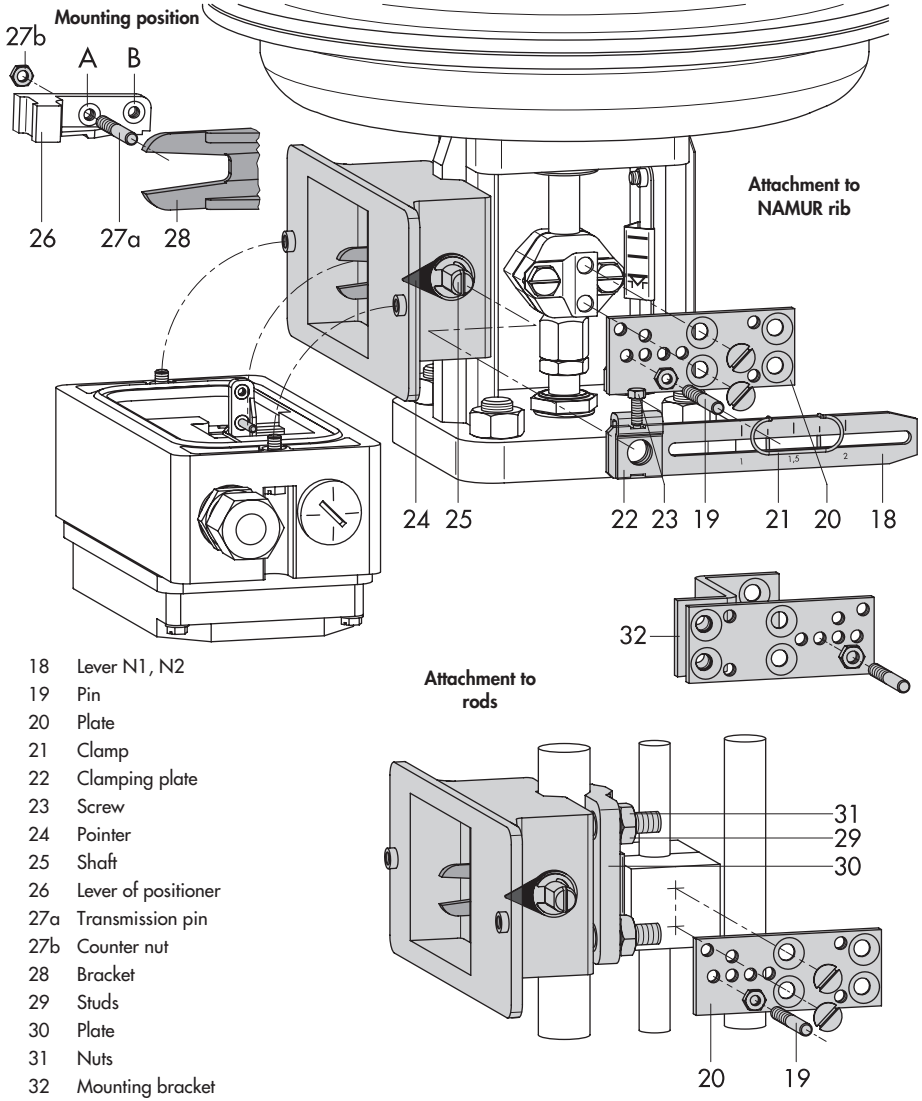
Note!
Before you mount the parts, apply a signal pressure to the actuator so that the valve is set to 50 % of its travel. This will ensure the exact alignment of the lever (18) and the bracket (28).

Control valve with cast yoke

1. Use countersunk screw to attach the plate (20) to the coupling which connects the plug and actuator stems. With 2100 cm² and 2800 cm² actuators, use additional mounting bracket (32).
2. Remove rubber plug from the adapter housing and fasten the housing to the NAMUR rib using hexagon head screw.

Control valve with rod-type yoke

1. Screw plate (20) to the follower clamp of the plug stem.
2. Screw studs (29) into the adapter housing.
3. Place the housing with the plate (30) on either the right or the left side of the valve rod and screw the housing tight using nuts (31). Be sure to align the housing in such a way that the lever to be mounted subsequently is in a horizontal position.
4. Move the clamp (21) to surround the pin (19). Screw pin into the center row of bores in the plate (20) and lock it such that it will be located above the correct lever marking (1 to 2) for the assigned travel (see Table 5).



18 Lever N1, N2
19 Pin
20 Plate
21 Clamp
22 Clamping plate
23 Screw
24 Pointer
25 Shaft
26 Lever of positioner
27a Transmission pin
27b Counter nut
28 Bracket
29 Studs
30 Plate
31 Nuts
32 Mounting bracket

Fig. 4 · Attachment according to IEC 60534-6 (NAMUR)

Intermediate values must be calculated.

5. Measure the distance between the center of the shaft (25) and the center of the pin (19). You will be prompted for this value later during the configuration of the positioner.

2.2.2 Presetting the valve travel

1. Adjust the shaft (25) in the adapter housing so that the black pointer (24) is aligned with the cast marking on the adapter housing.
2. Screw clamping plate (22) tight in this position using a screw (23).
3. Screw in the pin (27) at the positioner lever (26) on the side of the insert nuts and secure it with a hex nut on the opposite side. Note the mounting position A or B respectively according to Table 5 and Fig. 5.
4. Put the positioner to the adapter housing such that the pin (27) lies properly within the arms of the bracket (28). To do so, insert a 2.5 mm Allen key or a screwdriver from the front into the bore located below the oblong hole on the cover plate, and push the positioner lever in the required position.
5. Screw the positioner to the adapter housing.
6. Relieve the actuator from the signal pressure.

Table 4 NAMUR attachment	Valve		Travel [mm]	With lever	Order no.
NAMUR mounting kit, see Fig. 4 for parts	Valve with cast yoke		7.5 to 60	N1 (125 mm)	1400-6787
			30 to 120	N2 (212 mm)	1400-6789
	Valve with rod-type yoke, rod diameter [mm]	20 to 25		N1	1400-6436
		20 to 25		N2	1400-6437
		25 to 30		N1	1400-6438
		25 to 30		N2	1400-6439
		30 to 35		N1	1400-6440
		30 to 35		N2	1400-6441
Attachment to Fisher and Masoneilan linear actuators (both mounting kits are required for one actuator)					1400-6771 and 1400-6787
Accessories					Order no.
Pressure gauge mounting block			G ¼		1400-7458
			¼ NPT		1400-7459
Pressure gauge kit			Stainless steel/Brass		1400-6957
			Stainless steel/Stainless steel		1400-6958
Signal pressure throttles (screw-in and brass throttles)					1400-6964
Filter check valve, replacing the exhaust plugs and increasing the degree of protection to IP 65 (one valve is included in the scope of delivery)					1790-7408

Table 5 NAMUR attachment										
Lever [mm]*	7.5	15	15	30	30	60	30	60	60	120
Pin on marking*	1	2	1	2	1	2	1	2	1	2
Corresponding distance between pin/rotation point of lever [mm]	42			84	42	84	84	168	84	168
With lever	N1 (125 mm long)						N2 (212 mm long)			
Transmission pin (27a) on position	A		A		B		A		B	

* Intermediate values need to be calculated

2.3 Attachment to rotary actuators

Refer to Table 6 on page 23 for required accessories.

The positioner can also be attached to rotary actuators according to VDI/VDE 3845 by using the mounting parts and accessories in Table 6. In this arrangement, the actuator's rotary motion is converted via the cam disk on the actuator shaft and the follower roll of the positioner lever into a linear motion required by the positioner's inductive displacement sensor system.
Each cam disk is suitable for two curves: for angles of rotation from 0 to 90° and for 0 to 120°.
For double-acting, springless rotary actuators, it is necessary that a reversing amplifier be attached to the connected side of the positioner (see section 2.3.4).

If the positioner is attached to SAMSON Type 3278 Rotary Actuator, the air exhausted from the positioner is transferred to the inside of the actuator and the chamber behind the diaphragm. No additional tubing is required. If the positioner is attached to actuators by other manufacturers (NAMUR), the air is applied to the chamber behind the diaphragm through a tube assembly with tee, connected between actuator and intermediate piece.

Note! *For faster control valves with a transit time <0.6 sec., replace the filter in the signal pressure output (output 38) with a screw-in throttle (see Accessories table), if necessary.*

2.3.1 Mounting the cam follower roll lever

1. Place lever with the attached roll (35) on the transmission lever (37) and secure it with the enclosed screws (38) and washers.

2.3.2 Mounting the intermediate piece

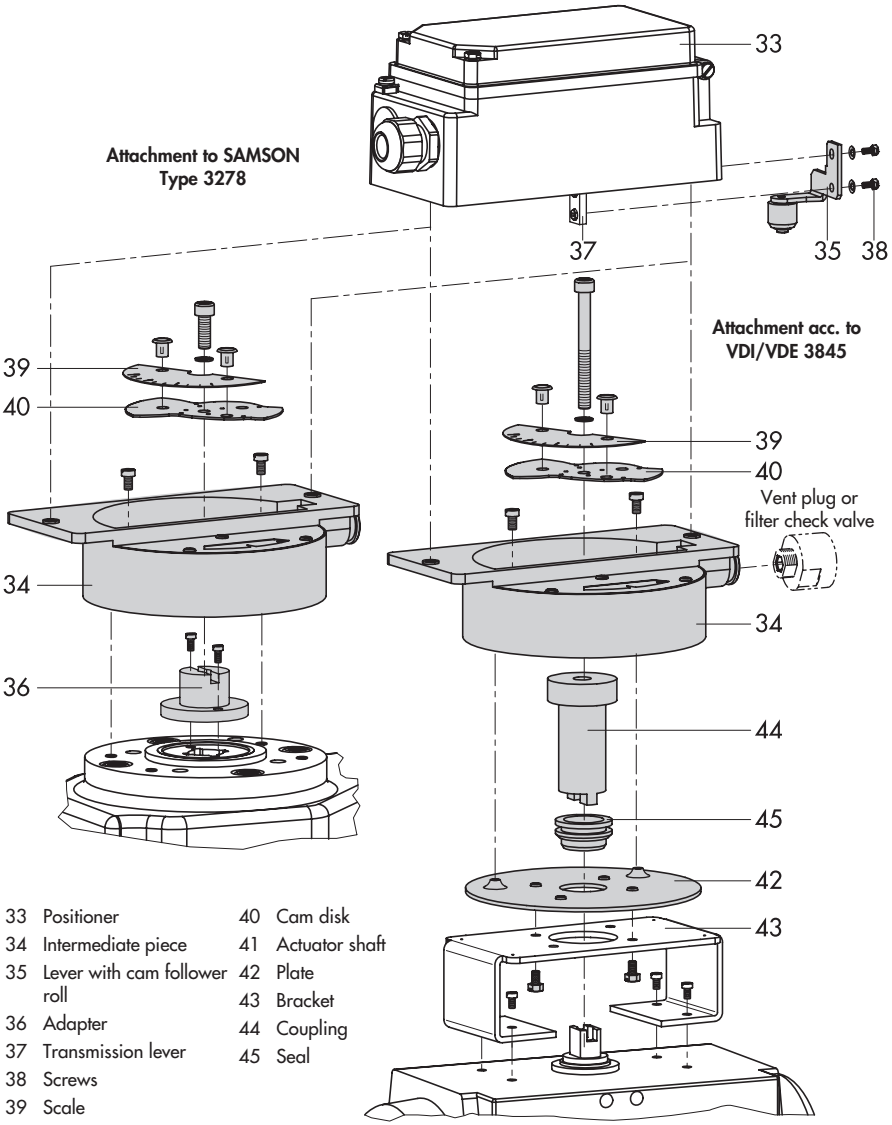
SAMSON Type 3278 Actuator:

11. Screw adapter (36) to the free end of the rotary actuator shaft using two screws.
2. Position intermediate piece (34) on the actuator case and secure it with two screws. Align the positioner's intermediate piece so that the air connections of the positioner face towards the diaphragm case side.

Actuators by other manufacturers:

1. Position complete intermediate piece (34, 42, 44 and 45) on the bracket (fixing level 1, VDI/VDE 3845) delivered with the actuator and fasten with screws.
2. Align cam disk (40) and scale (39) as described in section 2.3.3. Fasten with screws.

With springless actuators, a reversing amplifier (45) must be screwed to the side of the positioner case. See section 2.3.4 for more details.



33 Positioner
34 Intermediate piece
35 Lever with cam follower roll
36 Adapter
37 Transmission lever
38 Screws
39 Scale
40 Cam disk
41 Actuator shaft
42 Plate
43 Bracket
44 Coupling
45 Seal

Fig. 5 · Attachment to rotary actuators

2.3.3 Aligning and mounting the cam disk

In rotary actuators with spring-return mechanism, the built-in actuator springs determine the fail-safe position and the direction of rotation of the control valve. In double-acting, springless rotary actuators, the direction of rotation depends on both the actuator and the valve model used. Any adjustments are only permitted when the valve has been closed.

The positioner's operating direction, i.e. whether the valve shall either open or close when the reference variable increases, has to be software adjusted via communication (increasing/increasing or increasing/decreasing).

1. Position the cam disk with the scale on the adapter (36) or the coupling (34), and fasten the screw loosely.

The cam disk carries two cam sections. The starting point of each section is marked by a small bore.

Note!
With the valve closed, the starting point (bore hole) of the respective characteristic is to be aligned so that the center of rotation of the cam disk, the 0° position on the scale and the arrow mark on the plate are in one line. The starting point for the closing position must not be below the 0° position!

In actuators with fail-safe position "Valve open" (OPEN), the actuator must therefore be loaded with the max. signal pressure prior to aligning the cam disk. In springless actuators, the supply air must be connected.

2. In aligning the cam disk, the double-sided scaled disk must be installed in such a way that the value on the scale corresponds to the control valve's direction of rotation. Only then secure the cam disk with the fastening screws.

Securing the aligned cam disk

If you want to additionally secure the cam disk to prevent it from being turned, proceed as follows:
Four bore holes are located centrically around the center bore on the cam disk. Select a suitable one of the four holes to secure the cam disk. Through this hole, drill a hole in the adapter (36) or coupling (44), and insert a 2 mm dowel pin.

3. Place the positioner on the intermediate piece (34) so that the lever (35) contacts the cam disk with its cam follower roll. To do so, insert a 2.5 mm hexagon socket key or a screwdriver from the front into the bore hole, which can be seen below an oblong hole on the cover plate, and bring the positioner lever to the required position.
4. Screw positioner to the intermediate piece.

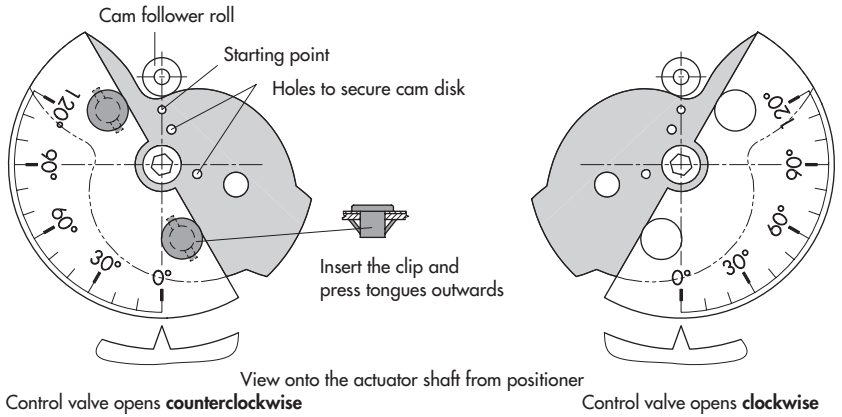


Fig. 6 · Aligning the cam disk

Table 6 Rotary actuators Complete mounting parts, but without cam disk						
SAMSON Type 3278 [cm²]			Acc. to VDI/VDE 3845	Attachment to Masoneilan actuator		
	160	320		Camflex I DN 25...100	Camflex I 125...250	Camflex II
Order no.	1400-7103	1400-7104	1400-8815	1400-7118	1400-7119	1400-7120
Piping kit 8x1 st. steel						
G	1400-6670	1400-6672				
NPT	1400-6669	1400-6671				

Accessories	Order no.
Cam disk (0050-0089) with accessories, angle of rotation 0 to 90° and 0 to 120°	1400-6959
Cam disk (0050-0089) specially for Vetec, adjustable per software from 0 to 75°	1400-6960
Cam disk (0050-0090) specially for Camflex, adjustable per software from 0 to 50°	1400-6961
Reversing amplifier for double-acting actuators without springs	G: 1079-1118 NPT: 1079-1119
Pressure gauge mounting block	G ¼: 1400-7458 ¼ NPT: 1400-7459
Pressure gauge kit	Stainless steel/brass:1400-6957 Stainless steel/Stainless steel:1400-6958
Signal pressure throttles (screw-in and brass throttles)	1400-6964
Filter check valve, replacing the exhaust plugs and increasing the degree of protection to IP 65 (one valve is included in the scope of delivery)	1790-7408

2.3.4 Reversing amplifier for double-acting actuators

For use with double-acting actuators, the positioner must be fitted with a reversing amplifier. The reversing amplifier is listed as an accessory in Table 6 on page 23.

The output signal pressure of the positioner is supplied at output A1 of the reversing amplifier. An opposing pressure, which equals the required supply pressure when added to the pressure at A1, is applied at output A2. The rule A1 + A2 = Z applies.

Mounting

Note!
Remove the sealing plug (1.5) prior to mounting the reversing amplifier. The rubber seal (1.4) must remain installed.

1. Screw the special nuts (1.3) from the accessories of the reversing amplifier into the threaded connections of the positioner.
2. Insert the gasket (1.2) into the recess of the reversing amplifier and push both the hollowed special screws (1.1) into the connecting boreholes A1 and Z.
3. Place the reversing amplifier onto the positioner and screw tight using both special screws (1.1).
4. Use a screwdriver (8 mm wide) to screw the filter (1.6) included in the scope of delivery into the connecting boreholes A1 and Z.
5. Replace venting plug on the reversing amplifier with the enclosed filter check valve.

Signal pressure connections

A1: Output A1 leading to the signal pressure connection at the actuator which opens the valve when the pressure increases

A2: Output A2 leading to the signal pressure connection at the actuator which closes the valve when the pressure increases

- Enter the actuator as "Double-acting without spring return mechanism" in the user interface under Start-up > Actuator type.

2.4 Fail-safe action of the actuator

Note!
If the fail-safe position of the actuator is changed subsequently by modifying the actuator springs from "Actuator stem extends" to "Actuator stem retracts", the mechanical zero point must be readjusted and the positioner must be initialized again.

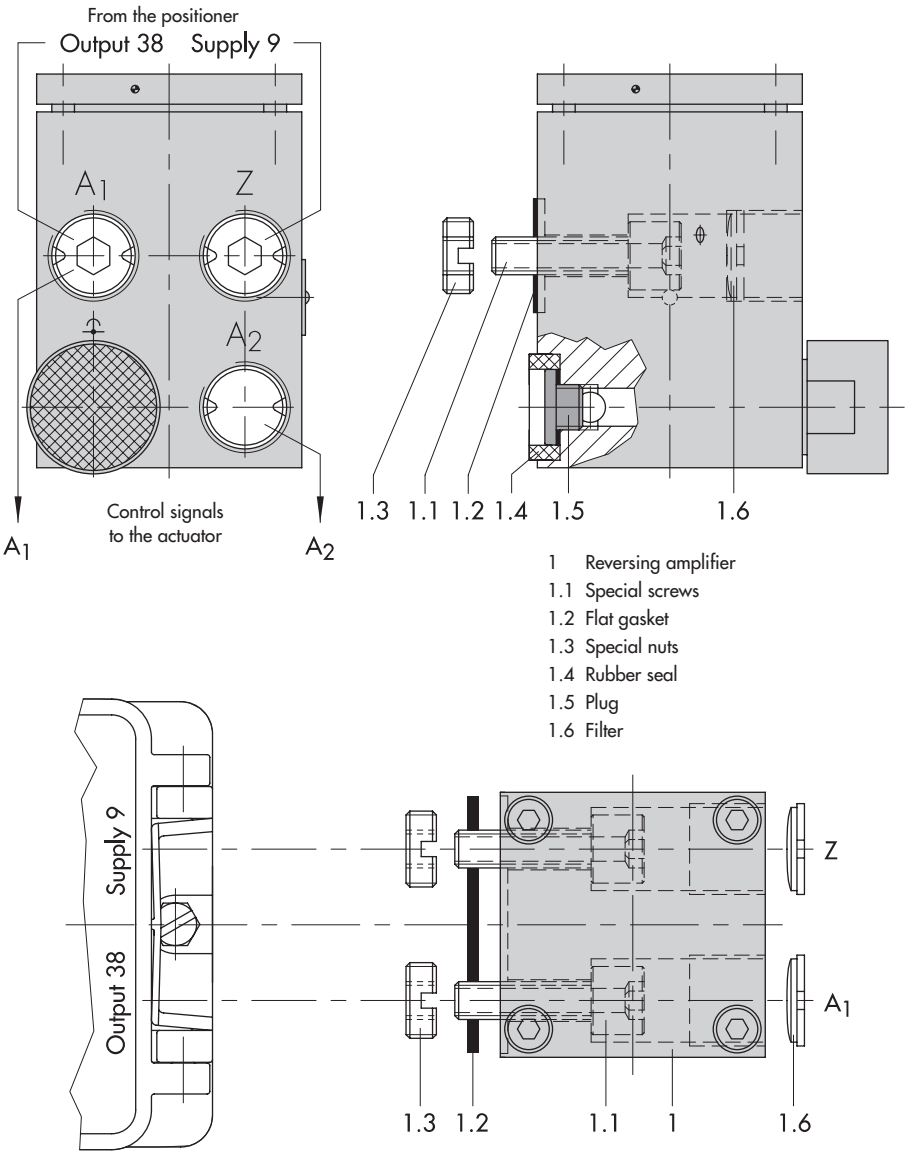


Fig. 7 · Attaching a reversing amplifier

3 Connections

3.1 Pneumatic connections

The air connections are either ¼ NPT or G ¼ tapped holes. The customary fittings for metal and copper tubes or plastic hoses can be used.

Note!
The supply air must be dry and free of oil and dust. The maintenance instructions for upstream pressure reducing stations must be adhered to. Carefully purge all air tubes and hoses before connecting them.

If the positioner is attached directly to the Type 3277 Actuator, the connection of the positioner output pressure to the actuator is fixed. For NAMUR attachment, the signal pressure can be applied to either the upper or lower diaphragm chamber of the actuator, depending on the actuator's fail-safe action (either "Actuator stem retracts" or "stem extends").

Exhaust air:
The exhaust air connection of the positioner is located on the mounting kit. For direct attachment of the positioner, a vent plug is located at the plastic cover of the actuator. For NAMUR attachment, the vent plug is to be found at the adapter housing, and for attachment to rotary actuators, it is either located at the intermediate piece or the reversing amplifier.
To guarantee degree of protection IP 65, the vent plug must be replaced with the filter check valve included with the device. Also see section 2 on page 12.

3.1.1 Pressure gauge

To monitor the operation of the positioner, it is recommended to connect pressure gauges for supply air and signal pressure indication to the positioner. These parts are listed as accessories in Tables 3, 4 or 6.

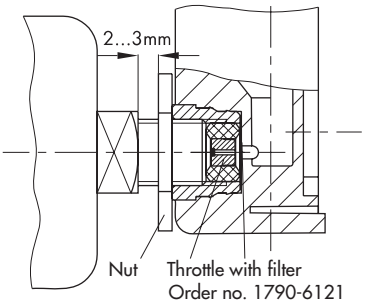


Fig. 8 · Mounting the pressure gauge

3.1.2 Supply air pressure

The required supply pressure depends on the bench range and the operating direction (fail-safe action) of the actuator. The bench range is indicated on the nameplate as spring range or signal pressure range.

Actuator stem extends:

Required supply pressure =
Upper bench range value + 0.2 bar,
at least 1.4 bar.

Actuator stem retracts:

The required supply pressure for tight-closing valves is estimated on the basis of the maximum signal pressure pst_{max}:

$$pst_{max} = F + \frac{d^2 \cdot \pi \cdot \Delta p}{4 \cdot A} \text{ [bar]}$$

d = Seat diameter [cm]
Δp = Differential pressure across the valve [bar]
A = Actuator area [cm^2]
F = Upper bench range value of the actuator [bar]

If there are no specifications, calculate as follows:

Required supply pressure =
Upper bench range value + 1 bar.

3.2 Electrical connections

For electrical installation, you are required to observe the relevant regulations and accident prevention regulations that apply in the country of use. In Germany, these are the VDE regulations and the accident prevention regulations of the employers' liability insurance association.
The following standards apply for assembly and installation in hazardous areas: EN 60079-14: 2003 (VDE 0165 Part 1/8.98) "Electrical apparatus for explosive gas atmospheres" and EN 50281-1-2: 1999 (VDE 0165 Part 2/11.99) "Electrical apparatus for use in the presence of combustible dust".
For the interconnection of intrinsically safe electrical equipment, the permissible maximum values specified in the EC type examination certificate apply (U_i or U_o; I_i or I_o; P_i or P_o; C_i or C_o, and L_i or L_o).
The following applies for equipment with type of protection EEx nA (non-sparking apparatus) according to the standard EN 50021 (1999): Connecting, interrupting, or switching circuits while energized is only allowed during installation, maintenance or repair work.
The following applies for equipment connected to energy-limited circuits with type of protection EEx nL (energy-limited apparatus) according to the standard EN 50021 (1999): This type of equipment may be switched under normal operating conditions.

Caution!
The terminal assignment specified in the certificate must be adhered to. Reversing the assignment of the electrical terminals may cause the explosion protection to become ineffective!
Do not tamper with enameled screws inside or on the housing

Note on the selection of cables and wires:
To install intrinsically safe circuits, observe section 12 of the standard EN 60079-14: 2003 (VDE 0165 Part 1). To run multi-core cables or lines with more than one intrinsically safe circuit, section 12.2.2.7 of this standard applies.
An additional cable gland can be installed when connecting the device over two separate cables. Cable entries left unused must be sealed with blanking plugs. Devices used at ambient temperatures down to –40 °C must have metal cable entries.

For terminal assignment, refer to Fig. 9 or the designations on the cover plate inside the positioner housing.

Cable entries

The cable entry with M20 x 1.5 cable gland, 6 to 12 mm clamping range.
There is a second M20 x 1.5 threaded bore in the housing that can be used for additional connection, when required.
The screw terminals are designed for wire cross-sections of 0.2 to 2.5 mm². Tighten by at least 0.5 Nm.

Bus line

The shielded PROFIBUS connecting cable must be routed over the EMC-proof brass cable gland (standard) of the positioner to the terminals. The shield, which is placed over the clamping insert, is connected over a large area to the gland and housing.

1. To connect the bus line, loosen the coupling nut and the clamping insert from the positioner and remove the dust cap.
2. Slide the coupling nut and clamping insert over the connecting cable.
3. Strip the shield off the bus line to the required connecting length and cut the wire shield off up to a length of approx. 13 mm. If necessary, cut off any cable core filling as well.
4. Disentangle the braided shield and pull it over the clamping insert.
5. Press the clamping insert into the connecting screw gland and screw tight the coupling nut until the connecting cable is clamped tightly.
6. Route the two-wire bus line to the screw terminals marked "EN 61158-2", whereby no polarity has to be observed.

In exceptional cases, when the plant may not allow such a connection, feed the cable shield through the cable gland and connect it to be capacitive over the terminal "S". However, make sure that no conducting connection occurs from the shield to the cable gland or housing.

For further information, refer to PROFIBUS-PA User + Installation Guideline (PNO document 2.092).

At the binary input, a passive floating contact can be used. The positioner signals the circuit status via the bus protocol.

Note! *The connection of limit switches, binary input and forced venting function requires an additional cable gland which must replace the cap fitted on the housing.*

Accessories: Cable gland M20 x 1.5, nickel-plated brass, order no. 8808-0143

3.2.1 Forced venting

For positioners with forced venting function, a voltage of 6 to 24 V DC must be applied to the relevant terminals.

The forced venting function can be activated or deactivated over an internal switch. See section 4.3 for details.

Caution!
If no voltage is connected or when the voltage signal is interrupted, the positioner vents the actuator and does not respond to the reference variable.

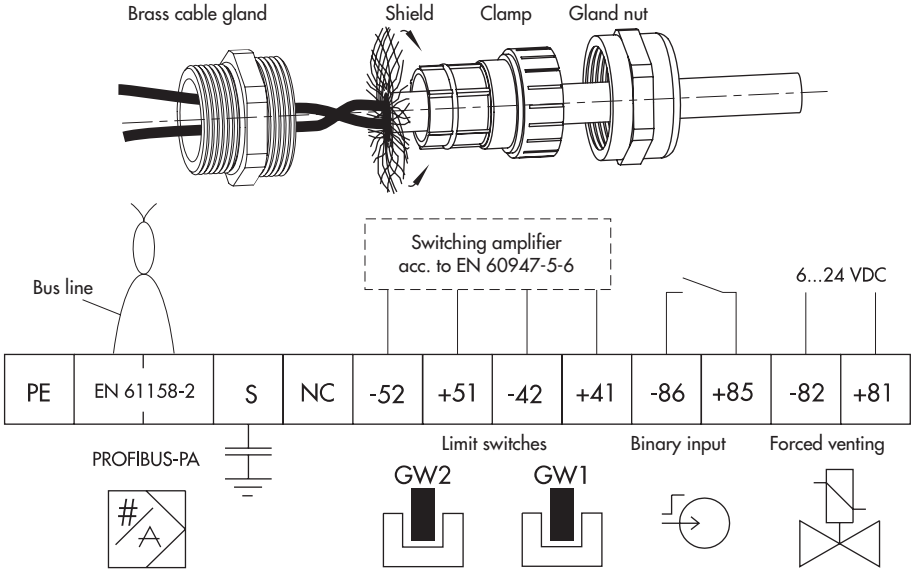


Fig. 9 · Electrical connections (terminal assignment acc. to DIN 45140)

3.2.2 Limit switches

For operation of the limit switches, switching amplifiers have to be connected in the output circuit. Their function is to control the limit values of the control circuit according to NAMUR, thus ensuring operational reliability of the positioner. If the positioner is installed in hazardous areas, the relevant regulations must be observed.

3.2.3 Establishing communication (bus address)

Communication between positioner, programmable logic controller or automated system, or between PC/workstation and the positioner(s), is established via segment coupler (see Fig. 10) in accordance with the PROFIBUS guidelines.

If the positioner is used in hazardous areas, explosion-protected versions of PROFIBUS-PA segment couplers must be used. A maximum of 32 positioners can be operated in parallel via segment coupler in one PROFIBUS-PA segment. In hazardous areas, the number of positioners that can be connected is reduced.
Each positioner connected to a segment must be assigned a unique bus address between 0 and 125. Seven micro switches located on the inside of the positioner's hinged cover serve to enter the bus address as binary information. The address is set up with one switch directly as per numbers 1, 2, 4 etc. or by adding up several switch positions. The positioner is delivered with the address set to 126 (default).

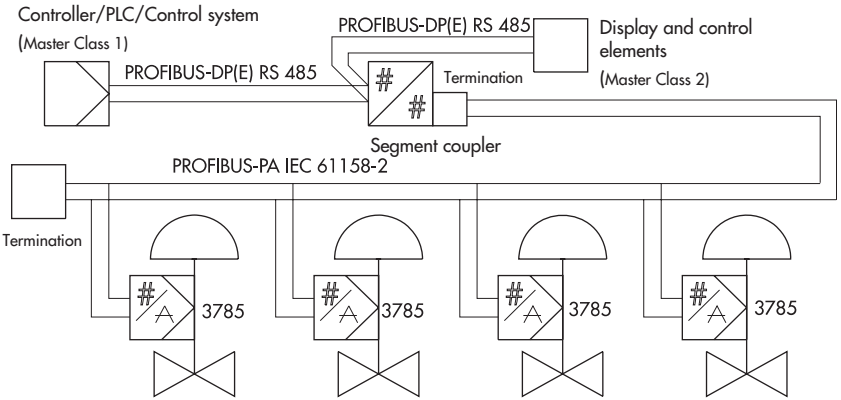
Note!
A new bus address is not accepted, unless you perform a new start-up of the device.

As long as the address is set to 126 via the microswitch, the final bus address can also be adjusted via the software using a Class 2 Master.
Never connect two positioners set to bus address 126 to the same PROFIBUS segment.

Note!
Addressing via microswitch is given priority over a software-adjusted bus address.

3.2.4 Local interface (SSP)

The local interface is located on the inside of the positioner cover. It is connected to the PC over the serial interface adapter (order no. 1400-7700).The interface can be used to start-up the positioner with the TROVIS-VIEW software.
It is no longer necessary to connect the device to a PROFIBUS DP/PA segment. Just the power supply needs to be connected over the bus terminals of the positioner (any DC voltage power supply unit between 9 and 32 Volt).
The TROVIS-VIEW software and the database module 3785 are required in version 2.02.The positioner can also be accessed over the SSP interface when it is connected to a bus segment. Cyclic and acyclic data exchange are not affected. The value written last is always valid for the device parameters.



↑ 10.1 Connection of Type 3785 Positioners

↓ 10.2 Connection of Type 3785-1 Positioners in hazardous area

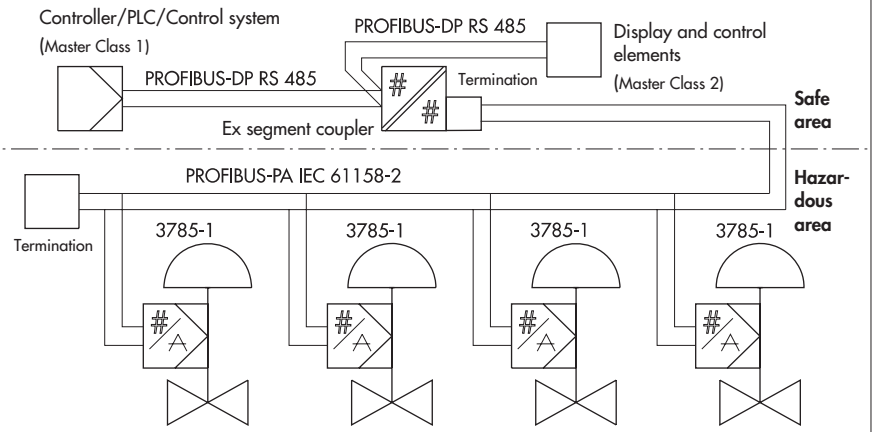


Fig. 10 · PROFIBUS connection

4 Operation

Warning!
Before putting the positioner into operation, carefully move the valve to its final position by covering the hole (manual operation) on the cover plate (Fig. 11). Check whether the lever mechanism functions properly. If the maximum angle of rotation is exceeded by selecting the wrong lever mechanism or by sizing the mechanism improperly, the positioner may be destroyed.

4.1 LED controls

Two LEDs located inside the cover help monitor the positioner, indicating the positioner's status during maintenance procedures, operation and in the event of defects.
The colors generally indicate the following:

Red Start-up or error,
control operation impossible

Green No error recognized,
control operation or fail-safe action
(e.g. if not initialized)

Red + Green Error recognized,
control operation possible

For details, refer to the table below!

Explanation	LED
Positioner start-up	Red LED lights up
No error: Device on the bus, cold start performed, initialization required Initialization or zero point calibration in progress Device initialized, no valid set point Device initialized, valid set point, control operation	Green LED, generally Green LED blinks slowly Green LED blinks quickly Green LED blinks 3x quickly followed by a long pause Green LED lights up
Error in control operation: Zero point error Control loop error	Red and green LEDs Red and green LEDs blink slowly Red and green LEDs blink quickly
Error causing the first initialization to be interrupted: (positioner does not proceed to standard operation) Zero point error Error in the mechanics/pneumatics Control loop error	Red LED, generally Red LED blinks slowly Red LED lights up Red LED blinks quickly
Error causing control operation to be exited: Positioner has recognized an internal error	Red LED blinks 3x quickly followed by a long pause

4.2 Write protection

A microswitch marked "write protection" is located to the right of the seven bus address selector switches inside the hinged cover. When activated (position **ON**), the positioner settings are write protected, so that they cannot be overwritten by the PROFIBUS communication protocol. If you want to change the settings via communication, set the switch to position **OFF**.

4.3 Activating/deactivating the forced venting function

For model index .0**3** and higher:

1. Unscrew the four screws from the cover inside the hinged lid and remove the cover.
2. Unscrew the central screw on the board and push the board to one side.
3. Set switch to desired position:
   1 ENABLED > Function activated
   2 DISABLED > Function deactivated

4.4 Default settings

All variables are set to their default values. Initialization applying the maximum range allows for a universal start-up.

Note!
Manual operation and activated final position functions can cause the actuator to be filled with the maximum supply pressure.
Should this lead to impermissible forces occurring, the supply pressure must be restricted by a suitable reducing station.

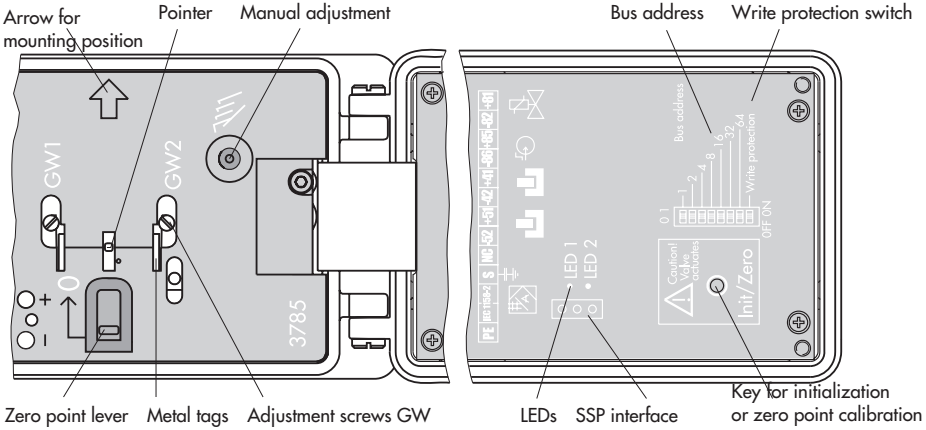


Fig. 11 · Inside view of the cover

4.4.1 Adjusting mechanical zero

Note!
Zero must be adjusted with the valve closed (for three-way valves with the actuator stem extended).

- Firmly push the zero point lever, which is located in the cover plate of the positioner, once in the direction indicated by the arrow as far as it will go. The yellow pointer will then be on the white marking line.

For control valves with starting position OPEN, e.g. an actuator employing fail-safe action "Actuator stem retracts", it is first necessary to supply the positioner with auxiliary air. As soon as the manual operation function is activated, the signal pressure builds up and the valve moves to closed position. Now, the zero point lever can be operated.

4.4.2 Initialization

After the electric reference variable and the auxiliary supply pressure have been connected to the positioner, the initialization routine can be started. In this process, the positioner adapts itself optimally to the friction conditions and signal pressure requirements of the control valve.

Caution!
The initialization routine takes several minutes. During that time, the valve changes its position. Therefore, never initialize the positioner during a running process, but only during the start-up cycle when the shut-off valves in the plant are closed, or when the control valve with the positioner has been removed from the plant and is used on a test stand.

- Enter valve and actuator data under "Start-up" in the operating software.
- "Type of initialization" to "Rated range"; select "Maximum range" only for three-way valves.
- Start initialization.

A successful initialization is indicated in the operating software and over the LEDs (see section 4.1).

- Carry out the configuration suitable for the valve type.

The following setting is recommended:

- **Fail-safe position "Actuator stem extends":**
  Operating direction: increasing/increasing (>>), the globe valve opens with increasing reference variable.
  Final position at a reference variable less than 1% (tight closing), final position at a reference variable larger than 125 % (function deactivated).
- **Fail-safe position "Actuator stem retracts":**
  Operating direction: increasing/decreasing (<>), the globe valve closes with increasing reference variable.

Final position at a reference variable less than –2.5% (function deactivated), final position at a reference variable larger than 99 % (tight closing).
- Set delay time to at least 30 seconds.
- Enter tag identification.
- If necessary, additional configuration, e.g. special characteristics for rotary valves.

If there is no communication set up on the valve, initialization directly at the valve is also possible.

- Connect the positioner, which is not mounted on a valve, to a power supply and initialize the positioner as described in section 4.4.2. If communication is not possible, the default settings must be used.
- Mount positioner and adjust mechanical zero as described in section 4.4.1.

Start initialization by pressing the **Init/Zero** key on the case cover of the positioner using a suitable tool.

The initialization is completed when the positioner takes on the position predetermined by the reference variable.

Note!
After the positioner has been initialized successfully for the first time, pressing the ***Init/Zero*** *key only starts a zero calibration.*

After this, a new initialization routine can only be started when the communication is connected.

A completed initialization can be canceled via the communication with the command "Reset to default values". After this, the Init/Zero key can be pressed to start a complete initialization.

Electric zero calibration

If, during the valve's operation, mechanical zero has shifted, an electric zero calibration can be carried out. To do this, press the **Init/Zero** key located on the inside of the cover (Fig. 11).

Caution!
The control valve moves to its final position.

- Firmly push the zero point lever, which is located in the cover plate of the positioner, once in the direction indicated by the arrow as far as it will go. The yellow pointer will then be on the white marking line.
- Press the key again to start electric calibration.

After the key has been pressed for the second time, it is locked for approximately one minute!

Electric calibration is completed when the positioner takes on the position predetermined by the reference variable.

4.5 Adjusting the inductive limit switches

The positioner version with inductive limit switches has two adjustable tags which are mounted on the shaft of the positioner lever and operate the associated proximity switches.

For operation of the inductive limit switches, the corresponding switching amplifiers have to be connected to the output circuit (see section 3.2.2).
If the tag is in the inductive field of the switch, the switch assumes a high resistance. If the tag is outside the field, the switch assumes a low resistance.
Normally, the limit switches are adjusted such that they will provide a signal in both of the valve's final positions. These switches, however, can also be adjusted to signal intermediate valve positions.
The desired switching function, i.e. whether the output relay shall be picked up or released when the tag has entered the field, must be selected at the switching amplifier, if required.

Adjusting the switching point:

The limit switches are marked GW1 and GW2 on the inside of the case cover. Yellow tags and the associated adjustment screws (Fig. 11) are located below these markings. Each switching position can optionally be signaled either when the tag has entered the field, or when it has left the field.

- Move the valve to the switching position and adjust the tag of the required limit switch GW1 or GW2 by turning the related adjustment screw until the switching point is reached. This is indicated by the LED at the transistor relay.

In so doing, one edge of the yellow tag will be aligned with the white, horizontal line on the case cover. This indicates the side from which the tag enters the inductive field of the proximity switch.

To ensure safe switching under any ambient conditions, the switching point is to be adjusted to a value of approx. 5 % before the mechanical stop (OPEN - CLOSED).

5 Maintenance

The positioner is maintenance free. The pneumatic connection 9/Supply contains a filter with a mesh size of 100 µm. If necessary, the filter can be unscrewed and cleaned.

If applicable, observe the maintenance instructions for upstream pressure reducing stations for supply air.

6 Servicing explosion-protected devices

If a part of the positioner on which the explosion protection is based needs to be serviced, the positioner must not be put back into operation until an expert has inspected the device according to explosion protection requirements, has issued a certificate stating this or given the device a mark of conformity.

Inspection by an expert is not required if the manufacturer performs a routine check on the device prior to putting it back into operation. The passing of the routine check must be documented by attaching a mark of conformity to the device.

Explosion-protected components may only be replaced by original, checked components from the manufacturer.

Devices that have already been used outside of hazardous areas and are intended for use in hazardous areas in future must comply with the safety demands placed on repaired devices. Prior to operation, they must be tested according to the specifications stipulated for "Repairing explosion-protected devices".

7 How to implement the PROFIBUS Master Class 1

7.1 Device Database Files (GSD)

The device database files are provided as text files: SAMS0688.GSD for profile 3.0 or SAMS3785.GSD for profile 2.0. The files are available from SAMSON AG under product no. 1400-7417 on a 1.44 MB disc (3½"). Alternatively, they can be downloaded from the following sites: http://www.samson.de or http://www.profibus.com.

The device database files enable the standardized implementation of the SAMSON Type 3785 Positioner in the programming and configuration environment of a Master Class 1 as PROFIBUS slave unit (example: SIEMENS Simatic Step 7, HWConfig). Via the GSD, the Master Class 1 is informed about the basic possibilities of cyclic data exchange with the slave unit, in this case, the Type 3785 Positioner.

7.2 Data exchange

According to the PROFIBUS PA device profile for electropneumatic actuators, a total of 7 different cyclic parameter combinations is available for the exchange of data. One of these seven possible combinations must be selected via the programming and configuration environment of the Master Class 1.The terms "output" and "input" refer to the control system/Master Class 1.

Variant 1:
Module = “SP“ 0xA4 or 0x82, 0x84, 0x82, 0x82

Output value (Output)

Byte 0	1	2	3	4
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5
SP, Value (Floating Point, IEEE)				Status

Variant 2:
Module = "RCAS_OUT, RCAS_IN" 0xB4 or 0xC2, 0x84, 0x84, 0x82, 0x8C

Input value (Input)

Byte 0	1	2	3	4	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	
RCAS_OUT, Value (Floating Point, IEEE)				Status	

Output value (Output)

Byte 0	1	2	3	4	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	
RCAS_IN, Value (Floating Point, IEEE)				Status	

Variant 3:
Module = "READBACK + POS_D, SP" 0x96, 0xA4, or 0xC2, 0x84, 0x86, 0x82, 0xA3

Input value (Input)

Byte 0	1	2	3	4	5	6	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	Octet 1	Octet 2	
READBACK, Value (Floating Point, IEEE)				Status	POS_D Value	POS_D Status	

Output value (Output)

Byte 0	1	2	3	4	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	
SP, Value (Floating Point, IEEE)				Status	

Variant 4:
Module = "CHECKBACK, SP" 0x92, 0xA4, or 0xC2, 0x84, 0x82, 0x82, 0x92

Input value (Input)

Byte 0	1	2	
Octet 1	Octet 2	Octet 3	
CHECK_ BACK[0]	CHECK_ BACK[1]	CHECK_ BACK[2]	

Output value (Output)

Byte 0	1	2	3	4	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	
SP, Value (Floating Point, IEEE)				Status	

Variant 5:
Module = "READBACK + POS_D + CHECKBACK, SP" 0x99, 0xA4, or 0xC2, 0x84, 0x89, 0x82, 0xB3

Input value (Input)

Byte 0	1	2	3	4	5	6	7	8	9
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	Octet 1	Octet 2	Octet 1	Octet 2	Octet 3
READBACK, Value (Floating Point, IEEE)				Status	POS_D Value	POS_D Status	CHECK_ BACK[0]	CHECK_ BACK[1]	CHECK_ BACK[2]

Output value (Output)

Byte 0	1	2	3	4	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	
SP, Value (Floating Point, IEEE)				Status	

Variant 6:
Module = "RCAS_OUT + CHECKBACK, RCAS_IN" 0x97, 0xA4, or 0xC2, 0x84, 0x87, 0x82, 0x9C

Input value (Input)

Byte 0	1	2	3	4	5	6	7	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	Octet 1	Octet 2	Octet 3	
RCAS_OUT, Value (Floating Point, IEEE)				Status	CHECK_ BACK[0]	CHECK_ BACK[1]	CHECK_ BACK[2]	

Output value (Output)

Byte 0	1	2	3	4	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	
RCAS_IN, Value (Floating Point, IEEE)				Status	

Variant 7:
Module = "READBACK+ RCAS_OUT+ POS_D+ CHECKBACK, SP+ RCAS_IN"
0x9E, 0xA9, or 0xC2, 0x89, 0x8E, 0x82, 0xBF

Input value (Input)

Byte 0	1	2	3	4	5	6	7	8	9
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5
READBACK, Value (Floating Point, IEEE)				Status	RCAS_OUT, Value (Floating Point, IEEE)				Status

Byte 10	11	12	13	14	
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 1 Fraction	Octet 2 Fraction	Octet 3	
POS_D Value	POS_D Status	CHECK_ BACK[0]	CHECK_ BACK[1]	CHECK_ BACK[2]	

Output value (Output)

Byte 0	1	2	3	4	5	6	7	8	9
Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5	Octet 1 Sign, Exponent	Octet 2 Exponent, Fraction	Octet 3 Fraction	Octet 4 Fraction	Octet 5
SP, Value (Floating Point, IEEE)				Status	RCAS_IN, Value (Floating Point, IEEE)				Status

7.3 Parameter description

SP – Set point with status: Reference variable w in "Auto" operating mode

In automatic mode ("Auto"), the reference variable w of the positioner is preset via SP. SP consists of a floating point value (4 byte) and the associated status (1 byte). Value and status must be transmitted together (data consistency = 5 byte). If the status of the reference variable is "bad" (value < 64 decimal), the positioner remains in the fail-safe position determined by the actuator.

RCAS_IN/RCAS_OUT: Reference variable w in "RCAS" operating mode

In operating mode REMOTE CASCADE "RCAS", the reference variable is preset via RCAS_IN/RCAS_OUT. RCAS_IN/RCAS_OUT each consist of a floating point value (4 byte) and the associated status (1 byte). Value and status must be transmitted together (data consistency = 5 byte). If the status of the reference variable is "bad" (value < 64 decimal), the positioner remains in the fail-safe position determined by the actuator.

Note! The RCAS operating mode is implemented in version K1.60 and higher.

READBACK – Current position with status: Controlled variable x

The position feedback is transmitted via the READBACK parameter and consists of a floating point value (4 byte) and the associated status (1 byte).

POS_D – Discrete valve position feedback with status: Final position indication

The final valve position is indicated via the POS_D parameter and consists of one message value (1 byte) and the associated status (1 byte).

The message value is encoded as follows:

0 = not initialized
1 = closed (x < 0.5 %)
2 = open (x > 99.5 %)
3 = intermediate position

CHECKBACK – Device status: Detailed device information, bit-wise encoded

Each bit can be hidden by the Class 2 master for cyclic communication. This allows a specific selection to be made from the existing messages.

Bit no.	Name	Description	Byte
0	CB_FAIL_SAFE	Fail safe position (MODE = out of service) set when FSAFE is active	0
1	CB_REQ_LOC_OP	Request for local operation	
2	CB_LOCAL_OP	Device in local mode, initialization or zero calibration running	
3	CB_OVERRIDE	Emergency operation / forced venting active	
4, 5, 6	Not assigned		
7	CB_TRAV_TIME	Status of movement monitoring (is reset automatically)	
8, 9	Not assigned		1
10	CB_UPDATE_EVT	Set when static data are changed	
11	CB_SIMULATE	Simulation mode, i.e. values are not derived from the process	
12	CB_DISTURBANCE	Error, see DIAGNOSIS parameter for cause	
13	CB_CONTR_ERR	Internal control loop error (must be confirmed via Class 2 Master). Indicated by LED, reset automatically as soon as control loop monitoring can no longer detect any error.	
14	CB_CONTR_INACT	Positioner inactive (MODE = out of service)	
15	CB_SELFTEST	Device in self-test mode (MODE = out of service)	
16	CB_TOT_VALVE_TRAV	Limit value for total valve travel exceeded	2
17	CB_BINARY_INPUT	Status of binary input	
18...23	Not assigned		

Device diagnosis messages "Slave Diagnostic Information"

Each bit can be hidden by the Class 2 master for cyclic communication. This allows a specific selection to be made from the existing messages.

In addition to the standard diagnosis messages, the positioner can provide other messages as "Ext_Diag_Data". These are also bit-wise encoded and correspond to the PROFIBUS PA profile parameter "Diagnosis"

Bit no.	Name	Description
0	DIA_HW_ELECTR	Hardware error electronics
1	DIA_HW_MECH	Hardware error mechanics
4	DIA_MEM_CHKSUM	Memory checksum error
5	DIA_MEASUREMENT	Measurement error
6	DIA_NOT_INIT	Device not initialized (auto-initialization not performed)
7	DIA_INIT_ERR	Auto-initialization error
8	DIA_ZERO_ERR	Zero point error (final position)
10	DIA_CONF_INVAL	Incorrect configuration, invalid bus address 127 assigned
11	DIA_WARMSTART	Restart (warm start) completed; for definition of warm start see Profile A
12	DIA_COLDSTART	New start (cold start) completed; for definition of cold start see Profile A
13	DIA_MAINTAINANCE	Maintenance required
14	DIA_CHARACT	Invalid characteristic
31	EXTENSION_AVAILABLE	More information available

7.4 Codes

7.4.1 Measured value status

The following status codes are used by the Type 3785 Positioner:

Bad: Valid value

Substatus	Condition	Value (decimal)
configuration Error	Error in device configuration, value cannot be measured	4
device Failure	Device error: memory, electronics	12
sensor Failure	Error in travel measurement, limit bits indicate that measured value limits were exceeded *)	16/17/18/19
no Communication (last usable value)	Internal communication error, no last usable value available	20
no Communication (no usable value)	Internal communication error, no last usable value available	24
out of Service	Transducer block in operating mode OUT OF SERVICE (e.g. device not initialized)	28

*) Limit bits:

The two least significant bits of the measured value status are used to indicate that the measured value was exceeded.

Bit 0 = Low limited – Limit value not reached.

Bit 1 = High limited – Limit value exceeded.

Bit 0 and 1 = Constant (high and low limited) – Value is blocked.

Uncertain Valid value, but not derived from process

Substatus	Condition	Value
non-specific	Initialization or zero calibration running	64
initial value	Initial value during start-up (temporary)	76

Good (Non-Cascade) Valid value

Substatus	Condition	Value
ok	Everything is ok, no further status available	128
maintenance required	Transit time monitoring active or zero point error active or total valve travel exceeded	164

7.4.2 Set point status

Good (Non-Cascade)

Substatus	Condition	Value
ok	Everything is ok	128 (80)
Good_INITIATE_FAIL_SAFE	The defined fail-safe action of the positioner is activated	160 (A0)

Good (Cascade)

Substatus	Condition	Value
Good_CAS_Init_Acknowledge	This status is required if you wish to switch to RCAS mode	196 (C4)

7.5 Operating modes

Operating modes of the AO (Analog Output)

- Out of Service (OS)
- Local Override (LO)
- Manual (Man)
- Automatic (Auto)
- Remote Cascade (RCAS)

Out of Service (OS)

The AO algorithm of the component is not executed. The control valve is moved to fail-safe position.

Local Override (LO) and Manual (Man)

In these operating modes, the positioner follows the acyclic set point entered via the parameter OUT (correction value) according to the scale and unit (mm or degrees) entered via OUT_SCALE (travel/angle of rotation range). With the characteristic deactivated, this value corresponds to the actual valve position in mm or degrees. The parameter INCREASE_CLOSE (operating direction), however, is not processed. Communication monitoring parameters (FSAFE_TIME, _TYPE, _VALUE) are also not processed.

Automatic (Auto)

In this operating mode, the positioner follows the cyclic or acyclic set point entered via the parameter SP (w) according to the scale and unit entered via PV_SCALE (reference variable range).

Remote Cascade (RCAS)

In this operating mode, the positioner follows the cyclic set point entered via the parameter RCAS_IN (w_rcas) according to the scale and unit entered via PV_SCALE (reference variable range).

Operating modes of the Transducer Block

Out of Service (OS)

In this operating mode, the correction value received from the AO Function Block is not used. The control valve is moved to the fail-safe position determined via ACT_FAIL_ACTION. The positioner also switches to operating mode OS when the forced venting function has been activated.

Automatic (Auto)

In this operating mode, the correction value received from the AO Function Block is used to calculate a position value. The valve is positioned accordingly.

7.5.1 Start-up (warm start)

The response of the positioner to a warm start is determined by the parameter FSAFE_TYPE (fail-safe action).

If FSAFE_TYPE is set to "adjust to fail-safe value", the positioner switches to automatic operating mode and adjusts to the value determined by the parameter FSAFE_VALUE.

If FSAFE_TYPE is set to "adjust to last set point value" or "fail-safe position determined by spring action", the device remains in fail-safe position. As soon as a valid set point SP is transmitted to the positioner, the operating mode changes to automatic.

If the status of the transmitted set point is "bad" or the positioner has not been successfully initialized, it remains in fail-safe position (out of service).

7.5.2 Monitoring function FSAVE_TIME, FSAVE_TYPE, FSAVE_VALUE

The action determined by the parameter FSAFE_TYPE (fail-safe action) is triggered by the following events:

- Start-up (warm start) of the positioner.
- Elapsing of the DP watchdog through interruption of the cyclic communication with a Master Class 1 (not applicable when communication is terminated properly).
- In Automatic or Remote Cascade operating mode, when the status of the reference variable SP or RCAS_IN valid in this operating mode is set to "Initiate Fail Safe". In this case, the action determined by FSAFE_TYPE (fail-safe action) is triggered before the fail-safe time has elapsed.
- Receipt of a DP "Global Control" service for which the clear bit is set.
- Setting the status of the reference variable valid in current operating mode to "bad".

Mode Auto

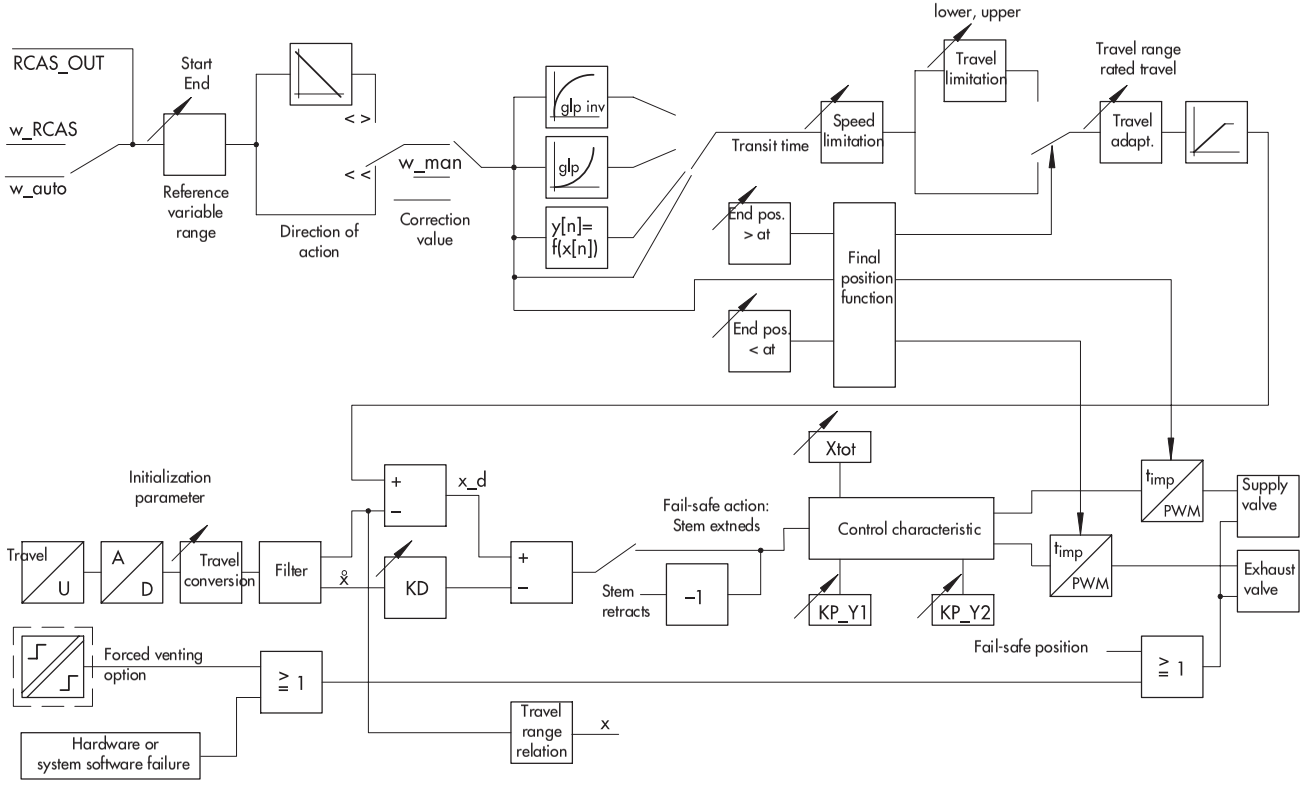
If the status of the reference variable (SP) is bad, the action determined via FSAFE_TYPE is executed after the fail-safe time (FSAFE_TIME) has elapsed.

Mode RCAS

In RCAS mode, the positioner switches to automatic mode after the fail-safe time (FSAFE_TIME) has elapsed, unless the status of the reference variable RCAS_IN is "good-cascade".

Once the positioner has switched to automatic mode, the rules stated under "Auto mode" apply, i.e. fail-safe action is activated depending on the reference variable (SP). The positioner switches to automatic mode before the fail-safe time has elapsed if the status of the reference variable RCAS_IN is "good_cas_initiate_fail_fsave".

Configuration block diagram



8 List of parameters

The detailed overview below lists the parameters by their fields of application.

The list of parameters following the overview is in alphabetical order and describes all parameters of the positioner which can be displayed or modified via PROFIBUS communication, e.g. on a PC.

Manufacturer-specific parameters of the SAMSON Type 3785 PROFIBUS PA Positioner are marked with (M).

8.1 Summary of parameters

Device identification

Loop/tag identification	TAG_DESC
Firmware version communication/control	SW_REVISION
Hardware version electronics/mechanics	HW_REVISION
Positioner manufacturer	DEVICE_MAN_ID
Valve manufacturer	VALVE_MAN
Actuator manufacturer	ACTUATOR_MAN
Type number positioner	DEVICE_ID
Serial number positioner	DEVICE_SER_NUM
Serial number of associated actuator	ACTUATOR_SER_NUM
Serial number of associated valve	VALVE_SER_NUM
Type of protection	DEVICE_CERTIFICATION
Description	DESCRIPTOR
Message	DEVICE_MESSAGE
Date of installation	DEVICE_INSTALL_DATE
Identification forced venting	IDENT_FORCED_VENTING (M)
Binary input	IDENT_BINARY_INPUT (M)
Identification limit switches	IDENT_LIMIT_SWITCHES (M)
Product number positioner	DEVICE_PRODUCT_NUM (M)
Text fields	TEXT_INPUT_1 ... TEXT_INPUT 3 (M)
Date last maintenance	VALVE_MAINT_DATE
Date last calibration	DEVICE_CALIB_DATE
Date last configuration	DEVICE_CONFIG_DATE

Additional component serial number	ADD_GEAR_SER_NUM
Additional component manufacturer	ADD_GEAR_MAN
Additional component identification	ADD_GEAR_ID
Additional component installation date	ADD_GEAR_INST_DATETAG_DESC

Start-up

Security locking	SECURITY_LOCKING
Cold start	FACTORY_RESET
Warm start	DEVICE_RESET_CMD
Actuator type	ACTUATOR_TYPE
Valve type	VALVE_TYPE
Fail-safe position	ACTUATOR_ACTION
Attachment	ATTACHMENT (M)
Actuator version	ACTUATOR_VERSION (M)
Mounting position	MOUNTING_POSITION (M)
Transit time - minimum OPEN	ACT_STROKE_TIME_INC
Transit time - minimum CLOSED	ACT_STROKE_TIME_DEC
Calibration command	SELF_CALIB_CMD
Calibration status	SLF_CALIB_STATUS
Transmission code	TRANSM_CODE (M)
Transmission length	TRANSM_LENGTH (M)
Transmission pin position	TRANSM_PIN_POS (M)
Initialization method	INIT_METHOD (M)
Selection identification number	IDENT_NUMBER_SELECTOR
Assignment AO - Transducer Block	OUT_CHANNEL
Assignment Transducer - AO Block	IN_CHANNEL
Write protection software	WRITE_LOCKING
Cold start, warm start, resetting bus address	FACTORY_RESET

Device settings

Configuration

Write protection	HW_WRITE_PROTECTION
Reference variable range	PV_SCALE
Fail-safe value reference variable	FSAFE_VALUE
Fail-safe action	FSAFE_TYPE
Fail-safe time	FSAFE_TIME
Travel/angle of rotation range	OUT_SCALE
Operating direction	INCREASE_CLOSE
Local operation enabled	LOCAL_OP_ENA
Rated travel/nominal angle	RATED_TRAVEL
Travel/angle limit, lower	TRAVEL_LIMIT_LOW
Travel/angle limit, upper	TRAVEL_LIMIT_UP
Transit time – required CLOSED	TRAVEL_RATE_DEC
Transit time – required OPEN	TRAVEL_RATE_INC
Final position when ref. variable below limit value	SETP_CUTOFF_DEC
Final position when ref. variable above limit value	SETP_CUTOFF_INC
Characteristic selection	LIN_TYPE
Characteristic type	CHARACT_TYPE

Positioner parameters

Proportional-action coefficient KP_Y1	SERVO_GAIN_1
Proportional-action coefficient KP_Y2	SERVO_GAIN_2
Derivative-action coefficient KD	SERVO_RATE_1
Dead band Xtot	DEADBAND
Proportional-action coefficient KP_Y2	KP_Y2
Tolerated overshoot	TOL_OVERSHOOT (M)

Operation

Operating mode, required/valid	MODE_BLK/TARGET-MODE
Controlled variable x	READBACK
Reference variable w	SP
Reference variable w_rcas	RCAS_IN/RCAS_OUT

Valve position feedback, discrete	POS_D
Set point deviation e	SETP_DEVIATION
Correction value	OUT
Transducer state	TRANSDUCER_STATE (M)
Correction value transducer block	POSITIONING_VALUE
Controlled variable transducer block	FEEDBACK_VALUE
Availability checkback	CHECK_BACK_OPT

Diagnosis

Diagnosis	DIAGNOSIS
Diagnosis extension	DIAGNOSIS_EXTENSION
Availability diagnosis	DIAGNOSIS_OPT
Simulation	SIMULATE
Device status	CHECK_BACK
Total valve travel	TOTAL_VALVE_TRAVEL
Total valve travel limit value	TOT_VALVE_TRAV_LIM
Delay time	DELAY_TIME (M)
Tolerance band	TOLERANCE_BAND (M)
Calibration alarm message	SELF_CALIB_WARNING (M)
State binary input	BINARY_INPUT (M)
Travel/angle of rotation, max. permissible	MAX_HUB (M)

8.2 Parameters

Actuator manufacturer ACTUATOR_MAN	Clearly identifies the manufacturer of the actuator. Length: 16 characters
Actuator type ACTUATOR_TYPE States: Default:	Identifies the actuator design. Read-only parameter, determined by the actuator. 0 = Electropneumatic 1 = Electric 2 = Electrohydraulic 3 = Other 0
Actuator version ACTUATOR_VERSION (M) States: Default:	Actuator version with/without spring return mechanism. 0 = Single-acting with spring return mechanism 1 = Double-acting without spring return mechanism 0
Additional component identification ADD_GEAR_ID	Manufacturer-specific details for identification of the additional components
Additional component installation date ADD_GEAR_INST_DATE	Installation date of additional components
Additional component manufacturer ADD_GEAR_MAN	Manufacturer of additional components
Additional component serial number ADD_GEAR_SER_NUM	Serial number of additional components
Assignment of controlled variable IN_CHANNEL	Assignment between the output of the transducer block and the input of the AO block. On adjusting the default values, the FEEDBACK_VALUE parameter of the transducer block is assigned to the READBACK parameter of the analog output block.
Assignment of positioning value OUT_CHANNEL	Assignment between the output of the analog output block and the input of the transducer block. On adjusting the default values, the OUT parameter of the AO block is assigned to the POSITIONING_VALUE parameter of the Transducer Block.

Attachment ATTACHMENT (M) States: Default:	Defines the attachment of the positioner to the control valve with linear actuators. For rotary actuators, only attachment according to VDI/VDE 3845 (NAMUR) is possible. For more details on attachments, also see sections 2.1 and 2.2. 0 = Integral > attachment in combination with a SAMSON Type 3277 Actuator 1 = NAMUR > attachment according to IEC 60534-6 (NAMUR) 0
Availability checkback CHECK_BACK_OPT States: Default:	Defined the availability of the status bit in CHECK_BACK 0 = Not available 1 = Available 1
Availability diagnosis DIAGNOSIS_OPT States: Default:	Defined the availability of the status bit in DIAGNOSIS 0 = Not available 1 = Available 1
Binary input IDENT_BINARY_INPUT States: Default:	Describes whether and how the binary switch option is evaluated. 0 = Not evaluated 1 = Actively open 2 = Actively closed 0
Binary input state BINARY_INPUT (M) States: Default:	Switching state of the binary switch 0 = Not active 1 = Active 254 = Not evaluated 0
Calibration alarm message SELF_CALIB_WARNING (M) States: Default:	Additional alarm messages of the initiated calibration procedure. 0 = Undetermined 13 = Wrong selection of rated travel or transmission 15 = Air leakage in pneumatic system (during initialization) 254 = Successful 255 = No valid data at the application 0

Calibration command SELF_CALIB_CMD States:	Command to start manufacturer-specific calibration procedures in the field device. 0 = No test, standard control operation 1 = Zero calibration 2 = Initialization 7 = Reset total valve travel 10 = Reset "Control loop fault" 255 = Abort process in action
Calibration status SELF_CALIB_STATUS States:	Manufacturer-specific status of the calibration procedure started with SELF_CALIB_CMD. 0 = Undetermined 2 = Aborted 4 = Error in mechanics /pneumatics 11 = Timeout 17 = Initialization status: determination of mechanical stops 19 = Initialization status: determination of minimum transit times 20 = Initialization aborted due to activated forced venting function 30 = Zero error 254 = Successful
Characteristic selection LIN_TYPE States: Default:	Characteristic selection to assign reference variable to valve travel/angle range. 0 = Linear 1 = Equal percentage 2 = Equal percentage reverse 3 = User-defined (supported in a future firmware version) 4 = SAMSON butterfly control valve, linear 5 = SAMSON butterfly control valve, equal percentage 6 = VETEC rotary plug valve, linear 7 = VETEC rotary plug valve, equal percentage 0
Characteristic type CHARACT_TYPE	Text field (32 characters) to enter a description of the adjusted characteristic.
Cold start FACTORY_RESET	Command for reset to default values. 1 Cold start - resetting application values and device identification 2506 Warm start 2712 Reset the bus address to 126 32768 Reset the device identification 32769 Cold start – resetting application values
Controlled variable x READBACK	Current position with status Controlled variable in unit PV_SCALE

Controlled variable of Transducer Block FEEDBACK_VALUE	Indicates current valve position in unit OUT_SCALE
Date last calibration DEVICE_CALIB_DATE	Indicates the date of the last calibration of the field device.
Date last configuration DEVICE_CONFIG_DATE	Indicates the date of the last configuration of the field device.
Date of installation DEVICE_INSTALL_DATE	Indicates the date on which the field device was installed.
Date last maintenance DEVICE_MAINT_DATE	Indicates the date of the last maintenance of the field device.
Dead band XtotDEAD_BAND Default:	Dead band of the control characteristic in the range of 0.1 to 10.0 % of the rated travel/nominal angle. 0.5 %
Delay time DELAY_TIME (M) Default:	Reset criterion for monitoring the active control loop. When the entered delay time DELAY_TIME is exceeded and the system deviation is not within the limits of the entered tolerance band TOLERANCE_BAND, a control loop error is reported. Range 0 to 240 seconds The delay time is determined from the minimum transit time during initialization and can be adapted. 10 s
Derivative-action coefficient KD SERVO_RATE_1 Range: Default:	Gain factor of the derivative element. We recommend increments of 0.02 when adapting the value. Higher increments cause an increased deceleration before reaching the reference variable 0.0 to 1.00 0.12
Description DESCRIPTOR	Available space to enter text describing the application, stored in the field device Length: 32 characters
Device identification DEVICE_ID	Field device identification
Device status CHECK_BACK Message type: States:	Detailed device information, bit-wise encoded which enables several simultaneous messages, also see section 9. A: Dynamic messages; they are automatically reset when they are read R: Static messages; they are retained as long as the event is present in the field device. 0 = No message 1 = Status message active

Diagnosis DIAGNOSIS Message type: States:	Detailed device information, bit-wise encoded which enables several simultaneous messages, also see section 9. D A: Dynamic messages; they are automatically reset when they are read. R: Static messages; they are retained as long as the event is present in the field device. 0: No message 1: Diagnosis message active
Diagnosis extension DIAGNOSIS_EXTENSION Message type: States:	Further manufacturer-specific detailed device information, bit-wise encoded which enables several simultaneous messages, also see section 9.1. A: Dynamic messages; they are automatically reset when they are read. R: Static messages; they are retained as long as the event is present in the field device. 0: No message 1: Diagnosis message active
Discrete valve position feedback POS_D States:	Discrete valve position feedback with status 0 = Not initialized 1 = Closed (x < 0.5 %) 2 = Opened (x > 99.5 %) 3 = Intermediate position
Fail-safe action FSAVE_TYPE States: Default:	Defines reaction when communication failure or device start-up is recognized. 0 = Move valve to fail-safe value 1 = Move valve to/save last valid set point 2 = Move to fail-safe position determined by spring action 2
Fail-safe action of the actuator ACTUATOR_ACTION States:	Fail-safe position of the actuator in the event of air/power failure or start-up. Read-only value, automatically determined during initialization. 0 = Not initialized 1 = Opening towards the 100 % position 2 = Closing towards the 0 % position 3 = None/saving (position is retained)
Fail-safe time FSAVE_TIME Range: Default:	If the DP watchdog detects a communication failure, the fail-safe action is triggered after the fail-safe time has elapsed. 0 to 3600 seconds 10 s
Fail-safe value reference variable FSAVE_VALUE Default:	Substitute value for set point (reference variable w or w_rcas) when communication failure is recognized. 0

Final position when reference variable is above the limit value SETP_CUTOFF_INC Default:	If the reference variable exceeds the entered limit, the valve moves towards the end position corresponding to 100 % of the reference variable. Hysteresis 1%. When the value is 125 %, the function is deactivated. 99 % Caution! Since the actuator will automatically be filled with air or vented when this function is executed, the control valve moves to its absolute final positions. Restrictions specified in the functions "travel range" or "travel limit" do not apply here. This function must be deactivated if unacceptably high positioning forces result from the complete filling/venting action.
Final position when reference variable is below the limit value SETP_CUTOFF_DEC Default:	If the reference variable falls below the entered limit, the valve moves towards the end position corresponding to 0 % of the reference variable. Hysteresis 1%. When the value is –2.5 %, the function is deactivated. 1 % Caution! Since the actuator will automatically be filled with air or vented when this function is executed, the control valve moves to its absolute final positions. Restrictions specified in the functions "travel range" or "travel limit" do not apply here. This function must be deactivated if unacceptably high positioning forces result from the complete filling/venting action.
Firmware version SW_REVISION	Firmware version communication/control
Hardware version HW_REVISION	Hardware version electronics/mechanics
Identification forced venting IDENT_FORCED_VENTING (M) States:	Indicates whether the optional forced venting function has been installed. Read-only parameter (automatically set by the device) 0 = Not installed 1 = Installed
Identification limit switches IDENT_LIMIT_SWITCHES (M) States: Default:	Indicates whether the optional inductive limit switch function has been installed (no automatic identification). 0 = Not installed 1 = Installed 0

Initialization method INIT_METHOD (M) States: Default:	Method of initialization related to the nominal or maximum range. For initialization in the nominal range, only the range of the manipulated variable entered under rated travel/nominal angle is considered (e.g. globe valve with mechanical stop on one side). When the maximum range is initialized, the maximum permissible range of the manipulated variable is used (e.g. three-way valve with mechanical stop on both sides). 0 = Initialization related to maximum range 1 = Initialization related to nominal range 0
Identification number selection IDENT_NUMBER_SELEKTOR States: Default:	 0 = Profile-specific identification number 1 = Manufacturer-specific identification number 1
Local operation enabled LOCAL_OP_EN States: Default:	Enables local operation (zero/initialization button). In case of communication failure of more than 30 seconds, local operation is enabled. 0 = Disabled 1 = Enabled 1
Message DEVICE_MESSAGE	Available space to enter text in the field device Length: 32 characters
Mounting position MOUNTING_POSITION (M) (linear actuator) States: Default:	An arrow located on the cover plate of the positioner indicates how to attach the positioner to the actuator. For direct attachment, the arrow must point towards the actuator. For attachment according to NAMUR, the arrow must point away from the actuator. 0 = Arrow pointing away from the actuator 1 = Arrow pointing towards the actuator 1
Operating direction INCREASE_CLOSE (M) States: Default:	Determines the assignment of reference variable to travel/angle of rotation. 0 = Increasing/increasing, valve opens when the reference variable increases (in three-way valves: actuator stem retracts) 1 = Increasing/decreasing, valve closes when the reference variable increases (in three-way valves: actuator stem extends) 0

Operating mode, target **Operating mode, current** MODE_BLK/ TARGET_MODE	Positioner operating mode Firmware Version K 1.20 and lower: OS, AUTO Firmware Version K 1.30 and higher: OS, LO, MAN, AUTO Positioner operating modes: **Automatic (AUTO):** In this operating mode, the positioner follows the cyclic or acyclic set point entered via the parameter SP (w) according to the scale and unit entered via PV_SCALE (reference variable range). **Manual (MAN):** In this operating mode, the positioner also follows the set point entered via the parameter SP (w) according to the scale and unit entered via PV_SCALE (reference variable range). The parameter INCREASE_CLOSE (operating direction), however, is not processed. Communication monitoring parameters (FSAFE_TIME, _TYPE, _VALUE) are also not processed. **Local override (LO):** In this operating mode, the positioner follows the acyclic set point entered via the parameter OUT (correction value) according to the scale and unit (mm or degrees) entered via OUT_SCALE (travel/angle of rotation range). With the characteristic deactivated, this value corresponds to the actual valve position in mm or degrees. The parameter INCREASE_CLOSE (operating direction), however, is not processed. Communication monitoring parameters (FSAFE_TIME, _TYPE, _VALUE) are also not processed. **Out of service (OS):** Fail-safe operating mode. The valve is automatically moved to fail-safe position. **Remote cascade (RCAS):** In this operating mode, the positioner follows the cyclic set point entered via the parameter RCAS_IN (w_rcas) according to the scale and unit entered via PV_SCALE (reference variable range). Operating mode during start-up (warm start) The response of the positioner to a warm start is determined by the parameter FSAFE_TYPE (fail-safe action). If FSAFE_TYPE is set to "adjust to fail-safe value", the positioner switches to automatic operating mode and adjusts to the value determined by the parameter FSAFE_VALUE. If FSAFE_TYPE is set to "adjust to last set point value" or "fail-safe position determined by spring action", the device remains in fail-safe position. As soon as a valid set point SP is transmitted to the positioner, the operating mode changes to automatic. If the status of the transmitted set point is "bad" (value < 64) or the positioner has not been successfully initialized, it remains in fail-safe position (out of service).

	The action determined by the parameter FSAFE_TYPE (fail-safe action) is triggered by the following events: • Start-up (warm start) of the positioner • Elapsing of the DP watchdog through interruption of the cyclic communication with a Master Class 1 (not applicable when communication is terminated properly). • In Automatic or Remote Cascade operating mode, when the status of the reference variable SP or RCAS_IN valid in this operating mode is set to "Initiate Fail Safe". Receipt of a DP- "Global Control" service, for which the clear bit is set (for version K 1.30 and higher). By setting the status of the reference variable used in the valid operating mode to "bad", the actuator always moves to the fail-safe position determined by the spring action (for version K 1.30 and higher).
Operating state TRANDUCER_STATE (M) States:	Current state of control loop. 0 = See current operating mode 1 = Forced venting active 2 = Lower travel limitation active 3 = Upper travel limitation active 4 = Final position at < active 5 = Final position at > active
Positioner manufacturer DEVICE_MAN_ID	Clearly identifies the manufacturer of the field device. Read-only.
Positioning value OUT	The positioning value in [mm] or [degrees] calculated from the set point by the function block. In the Local Override (LO) mode, this value can be predetermined.
Positioning value of the Transducer Block POSITIONING_VALUE	Current positioning value of the Transducer Block in the unit OUT_SCALE
Product number DEVICE_PRODUCT_NUM (M)	Manufacturer's product number of the positioner.
Proportional-action coefficient KP_Y1 SERVO_GAIN_1	Proportional-action coefficient for supply air. When writing, the value is written to KP_1 (supply air) and KP_Y2 (exhaust air).

Proportional-action coefficient KP_Y2 SERVO_GAIN_2 Default:	Proportional-action coefficient for exhaust air. When writing, the value is written to KP_Y2 (exhaust air). KP_Y1 (supply air) remains unchanged. We recommend to adjust the value in increments of 0.1 when adjusting the value in the range from 0.01 to 10.0. If the value is increased, the set point will be reached faster. Range 0.01 to 10.0 1.2 **Note!** When the positioner is initialized for the first time, the proportional-action coefficients KP_Y1 and KP_Y2 are determined. The initialization values listed in the table below might have to be adapted to the modified operating conditions in order to achieve optimum control behavior.

Type of actuator	Rated travel/ angle	Transit time				KD	KP_Y1 Supply	KP_Y2 Exhaust
		Min	Fail-safe action	OPEN	CLOSED			
Rotary actuator		–	–	> 0.7 s	> 0.7 s	0.12	0.5	0.5
			Closing	> 0.7 s	< 0.7 s		0.5	0.1
			Closing	< 0.7 s	> 0.7 s		0.1	0.5
			–	< 0.7 s	< 0.7 s		0.1	0.1
			Opening	> 0.7 s	< 0.7 s		0.1	0.5
			Opening	< 0.7 s	> 0.7 s		0.5	0.1
Linear actuator	≥ 60 mm	< 10 s	–				0.5	0.5
		≥ 10 s	–				3.0	4.0
	< 60 mm	< 10 s	–	> 0.7 s	> 0.7 s		0.5	1.2
			Stem extends	> 0.7 s	< 0.7 s		0.5	0.8
			Stem extends	< 0.7 s	> 0.7 s		0.3	1.2
			–	< 0.7 s	< 0.7 s		0.3	0.8
			Stem retracts	> 0.7 s	< 0.7 s		0.3	1.2
			Stem retracts	< 0.7 s	> 0.7 s		0.5	0.8
		≥ 10 s	–				3.0	4.0

Rated travel RATED_TRAVEL Default:	Rated travel [mm] or nominal angle [degree] of the valve. Nominal operating range 5.0 to 255 mm or 0.0 to 120.0 degrees. 15 mm
Reference variable range PV_SCALE Default:	Scale and unit of the reference variable w/w_rcas (SP or RCAS_IN) 0 to 100 %

Reference variable w SP	Set point with status Reference variable w in "AUTO" operating mode Also see reference variable range.
Reference variable w_rcas RCAS_IN/RCAS_OUT	Set point with status Reference variable w in "RCAS" operating mode Also see reference variable range.
Security locking SECURITY_LOCKING Default:	Storage place for a password to be used by the host, serves to check access rights (format: 16-bit unsigned integer). 0 x 2457
Serial no. actuator ACTUATOR_SER_NUM	Serial number of the actuator on which the positioner is mounted. Length: 16 characters
Serial no. positioner DEVICE_SER_NUM	Serial number of the positioner. Uniquely identifies the field device in combination with the manufacturer's name and device type number.
Serial no. valve VALVE_SER_NUM	Serial number of the valve on which the positioner is mounted. Length: 16 characters
Set point deviation e SETP_DEVIATION	System deviation in %
Simulation SIMULATE	Option to preset a value for the current READBACK position, including status, for simulation.
Tag identification TAG_DESC	Tag identification number of the device Length: 32 characters
Text fields TEXT_INPUT_1... (M) TEXT_INPUT_3	Available space for entering text Length: 32 characters
Tolerance band TOLERANCE_BAND (M) Range: Default:	Reset criterion for monitoring the active control loop. Input of the system deviation permissible for the monitoring of the active control loop. Also see DELAY_TIME. 0.1 to 10.0 % 5 %
Tolerated overshoot TOL_OVERSHOOT (M) Range: Default:	If the set point deviation e exceeds the overshoot, the pulse adaptation reduces the minimum pulses in the operating direction which has caused the overshoot. If the set point deviation e exceeds the dead band Xtot, but remains within the overshoot range, the pulse adaptation only reduces the minimum pulses in both operating directions after two complete amplitudes within the overshoot range. 0.01 to 10.00 % of the rated travel/nominal angle. 0.5 %

Total valve travel TOTAL_VALVE_TRAVEL	Total valve travel, sum of nominal duty cycles (double up-and-down travels) Maximum value: 16 500000
Total valve travel limit value TOTAL_VALVE_TRAVEL_LIM Default:	Total valve travel limit value. Range 0 to 16 500 000 1 000 000
Transit time - minimum OPEN ACT_STROKE_TIME_INC **Transit time - minimum CLOSED** ACT_STROKE_TIME_DEC	The minimum transit time OPEN (towards the 100 % position) is the actual time in seconds required by the system comprising positioner, actuator and valve to pass through the rated travel/nominal angle in direction of the valve to be opened (measured during start-up). The minimum transit time CLOSED (towards the 0 % position) is the actual time in seconds required by the system comprising positioner, actuator and valve to pass through the rated travel/nominal angle in direction of the valve to be closed (measured during start-up). Read-only values
Transit time - required OPEN TRAVEL_RATE_INC Default: **Transit time required CLOSED** TRAVEL_RATE_DEC Default:	The required transit time OPEN is the adjustable minimum time in seconds required by the valve to pass through the range of the manipulated variable in direction of the 100 % position. Range 0 to 75 seconds 0 The required transit time CLOSED is the adjustable minimum time in seconds required by the valve to pass through the range of the manipulated variable towards the 0 % position. Range 0 to 75 seconds 0
Transmission code TRANSM_CODE (M) States: Default:	For linear actuator with integrally attached positioner: Determination of the geometrical dimensions of the travel pick-off with integrated positioner attachment. 1 = D1, lever 64 mm 2 = D2, lever 106 mm For rotary actuator: Maximum opening angle of the selected cam disk segment installed. 3 = S90, 90 degrees segment 4 = S120, 120 degrees segment 1
Transmission length TRANSM_LENGTH (M) Range: Default:	Only for linear actuator with positioner attached according to NAMUR. Lever length, distance between travel pick-off and fulcrum of the pick-up lever. 0.0 to 1023.0 mm 42.0 mm

Transmission pin position TRANSM_PIN_POS (M) States: Default:	Only for linear actuator with positioner attached according to NAMUR. Pin position on the positioner lever, see marking on the positioner lever. 0 = A 1 = B 0
Travel/angle limit lower TRAVEL_LIMIT_LOW Default:	Lower limitation of valve travel/angle of rotation to the entered value. Range –20.0 to 99.9 %. The characteristic is not adapted. 0.0 %
Travel/angle limit upper TRAVEL_LIMIT_UP Default:	Upper limitation of valve travel/angle of rotation to the entered value. Range 0.0 to 120.0 %. The characteristic is not adapted. 100.0 %
Travel range/range of rotation OUT_SCALE Default:	Lower and upper adjustment value of the effective working range in [mm] or [degree]. For a non-linear characteristic, the characteristic is adapted to the reduced travel. For initialization in the maximum range, the travel range/range of rotation is always related to the rated travel/nominal angle entered. When selecting the operating range, make sure that it is not smaller than ¼ of the rated travel/angle. Range: 0.0 to 255.9 mm/ 0.0 to 120.0 degrees Beginning: 0 End: 15 mm/90.0 degrees
Travel/angle of rotation, maximum permissible MAX_HUB (M)	Maximum travel/angle of rotation determined during initialization in per cent of the entered rated travel/nominal angle. Note! If the initialization is successful with regard to the nominal range, the maximum permissible travel/angle of rotation is not determined.
Type of protection DEVICE_CERTIFICATION	Describes the type of protection of the positioner
Write protection HW_WRITE_PROTECTION States:	witching state of the write protection switch in the device. When this option is activated, the device data can only be read, but they cannot be overwritten. Write protection can only be activated by using the switch in the device. 0 = Not write protected 1 = Write protected
Valve manufacturer VALVE_MAN	Clearly identifies the manufacturer of the valve. Length: 16 characters

Valve type VALVE_TYPE States: Default:	Describes the valve type. 0 = Control valve with linear motion of the control element 1 = Control valve with rotary motion of the control element, part turn, rotary motion 0
Warm start DEVICE_RESET_CMD States: Default:	Command to reset the device (warm start). 0 = No action 1 = Reset the device (warm start) 0
Write protection software WRITE_LOCKING States:	 0 = Any acyclic writing access except for WRITE_LOCKING is blocked 2457 = Writing access not active

9 Messages and diagnosis

The Type 3785 PROFIBUS PA Positioner provides the best possibilities for diagnosis during the initialization process. In automatic mode, detailed tests are carried out to check and evaluate the attachment situation and the positioner's reaction, taking into account the preset or entered data. When performing routine tests or in case of unclear diagnosis/error messages during operation, reinitialize the system to enable a better assessment of the controlled system.

9.1 Diagnosis messages

Bit no.	Name	Description **R** = Static messages which remain valid while the error is present in the field device	
0	DIA_HW_ELECTR	**Hardware error electronics** Set when a defect in the electronics module is detected during the cyclic check. Repair required	R
1	DIA_HW_MECH	**Hardware error mechanics** Set when a defect in the mechanics module is detected during the cyclic check. Repair required.	R
4	DIA_MEM_CHKSUM	**Memory checksum error** Set when the cyclic check detects that a memory cell has been modified without verification. Static message, remains valid while the error is detected in the field device. 8,	R
5	DIA_MEASUREMENT	**Measurement error** The internal A/D converter is not working properly within its specified time frame, or the measured values exceed the physical measuring range limits of the A/D converter. In case a reset (warm start) is not successful, repair is required.	R
7	DIA_NOT_INIT_ERROR	**Auto-initialization error** Initialization was not successful. For detailed error messages, see section 9.3. Initialization messages	R
8	DIA_ZERO_ERR	**Zero point error (final position)** Set when the value determined during initialization or zero adjustment is changed by more than ± 5 %. Possible sources of error: worn-out plug/seat or foreign body between seat and plug.	R

10	DIA_CONF_INVAL	**Incorrect configuration – invalid bus address** Set when the address switch is adjusted to the invalid address 127. Device starts with default address 126.	R
11	DIA_WARMSTART	**Reset (warm start) completed** Displayed when the device was reset via warm start. This reset is triggered following an electric power failure or by "DEVICE_RESET_CMD = 1". Automatic reset when the message is read.	R
12	DIA_COLDSTART	**New start (cold start) completed** Displayed when the device was reset via cold start and started up with the default values for the control loop. This reset is triggered by "FACTORY_RESET = 2". The device must be reinitialized. Automatic reset when the message is read.	R
13	DIA_MAINTENANCE	**Maintenance required** The current value for the total valve travel exceeds the entered or preset limit value. If this limit value is preset to a value slightly lower than the one determined for a reference valve, the positioner automatically signals that the valve needs to be maintained to avoid a possible failure. Reset is triggered by command "SELF_CALIB_CMD = 7" (resetting of total valve travel).	R
14	DIA_CHARACT	**Invalid characteristic** Set when an error was detected while transferring the characteristic to the device, or when the input values for a user-defined characteristic were not entered in ascending order, or when an inclination value >16 was entered for the user-defined characteristic.	R
15	IDENT_NUMBER_VIOLATION	**Invalid identification number** Selected identification number has not been interpreted by the device. Set when the identification number entered via IDENT_NUMBER_SELECTOR and the number in the device differ. The identification number is interpreted after the cyclic connection was terminated, or after a cold start.	R
16...30	Not assigned		
31	EXTENSION_AVAILABLE	**Further information available** Set when diagnosis extension messages have been generated.	R

9.2 CHECK_BACK messages

Bit no.	Name	Description **R** = Static message, remains valid while the error is present in the field device **A** = Dynamic message, automatically reset when read	
0	CB_FAIL_SAVE	**Fail-safe position** The fail-safe position was activated by the device, either by selecting operating mode "OUT OF SERVICE", by activating the forced venting function, or by a communication failure. The device switches to "OUT OF SERVICE" mode.	R
1	CB_REQ_LOC_OP	**Request for local operation** Set when local operation was requested, but not enabled (LOCAL_OP_ENA = 0).	A
2	CB_LOC_OP	**Local operation**	R
3	CB_OVERRIDE	**Emergency operation/forced venting active** Forced venting was activated, i.e. the signal applied to terminals +81 and –82 is smaller than 3 V. The control valve moves to fail-safe position regardless of the control loop. Automatically reset when a 6 to 24 V DC signal is applied to terminals +81 and –82.	R
6	Unassigned		
7	CB_TRAV_TIME	**Status of travel monitoring** Set when permissible transit time was exceeded.	A
10	CB_UPDATE_EVT	**Change of static data** Set when device data are changed. Enables monitoring of (unintentional/unauthorized) changes of the initially adjusted values.	A
11	CB_SIMULATE	**Simulation mode**, i.e. values are not derived from the process. Set when the device is in simulation mode. In this case, the controlled variable x is predetermined.	R

13	CB_CONTR_ERR	**Internal control loop error** Displayed when the positioner is unable to control the adjusted range of tolerance for error messages within the preset delay time. Possible sources of error: > Oscillation caused by actuator operated too rapidly (small travel volume) > Remedy: Reduce supply air pressure as described in section 3.1.2 or install a signal pressure throttle. > Supply air failure/insufficient supply air > Filter is clogged > Solenoid valves are oiled > Actuator diaphragm is ruptured > Actuator springs are broken > Control valve is blocked > Considerable increase in friction at the control valve Message is indicated by bit 7 and bit 13 of the CHECK_BACK parameter (see table on pages 42/43). Status of bit 7 is reset automatically. Bit 13 is reset via "SELF_CALIB_CMD = 10" (resetting 'control loop error')	R
14	CB_CONTR_INACT	**Positioner inactive** (MODE = OUT OF SERVICE) Set when the device is in operating mode "OUT OF SERVICE".	R
15	CB_SELFTEST	**Device in self-test mode (MODE = OUT OF SERVICE)** Set when the device performs the initialization routine or when calibrating electrical zero.	
16	CB_TOT_VALVE_TRAV	**Limit value for total valve travel exceeded** The current value for the total valve travel exceeds the entered or preset limit value. If this limit value is preset to a value slightly lower than the one determined for a reference valve, the positioner automatically signals that the valve needs to be maintained to avoid a possible failure. Reset is triggered by command "SELF_CALIB_CMD = 7" (resetting of total valve travel).	R
17	CB_ADD_INPUT	Status of binary input terminals 85/86	A
18...23	Unassigned		

9.3 Initialization messages

Description
Not defined The device has not been initialized or a cold start was performed. Automatically reset after confirmation.
Aborted The initialization routine was canceled by the user. Automatically reset after confirmation. If the device has already been successfully initialized and no cold start was performed, the device returns to control operation.
Error in mechanics/pneumatics The initialization routine detects no or a constant change of the value measured for travel/angle. Initialization is aborted. Possible sources of error: > Supply pressure too low/not stable > Air capacity too low > Improper mechanical attachment > Lever not properly linked For NAMUR attachment: > Lever not properly attached to the shaft of the adapter housing > Connecting cable between logic and displacement sensor board disconnected
Timeout The initialization routine cannot move the valve to the final position within 240 seconds. Initialization is aborted. Possible sources of error: > Large difference between static and sliding friction at the valve (oscillation) is generated as an individual message > Supply pressure unstable > Air capacity too low
Incorrect selection of rated travel or transmission The determined maximum travel, given as per-cent value of the rated travel/nominal angle, is smaller than the selected rated travel/nominal angle. Warning, initialization is not aborted. Possible sources of error: > Incorrect mechanical attachment > Incorrect transmission entered For NAMUR attachment: > Wrong pin position entered > Valve is blocked > Supply air pressure is too low. The supply air pressure should be at least 0.4 bar above the upper spring range (see section 3.1.2).

Air leakage in pneumatic system

The actuator must stall for a few seconds when the duty cycle is being determined initially. This time is used to check the pneumatic system for leaks. If the control valve moves more than 9.3 % from its resting position in 7 seconds, the relevant message is issued and additionally, an initialization warning is indicated. Warning, initialization is not aborted.

Possible sources of error:
> Actuator untight
> Signal pressure connection untight

Initialization status: determining the mechanical stops

When determining the mechanical stops, the initialization routine recognizes the spring action and zero by completely venting and filling the actuator. In addition, the routine checks whether the positioner can move through 100 % rated travel/nominal angle.

Initialization status: determining the minimum transit times

Transit time determination measures the time required by the valve to pass through the rated travel/nominal angle from 0 % to 100 % and vice versa.

Zero point error

The determined zero point exceeds the permissible tolerance limit of max. ±5 % around the internal absolute value for the detection of measured values. Initialization is aborted.

To eliminate this error, adjust mechanical zero as described in section 4.4.1.

The yellow pointer of the displacement sensor must then be approximately aligned with the white marking on the cover plate.

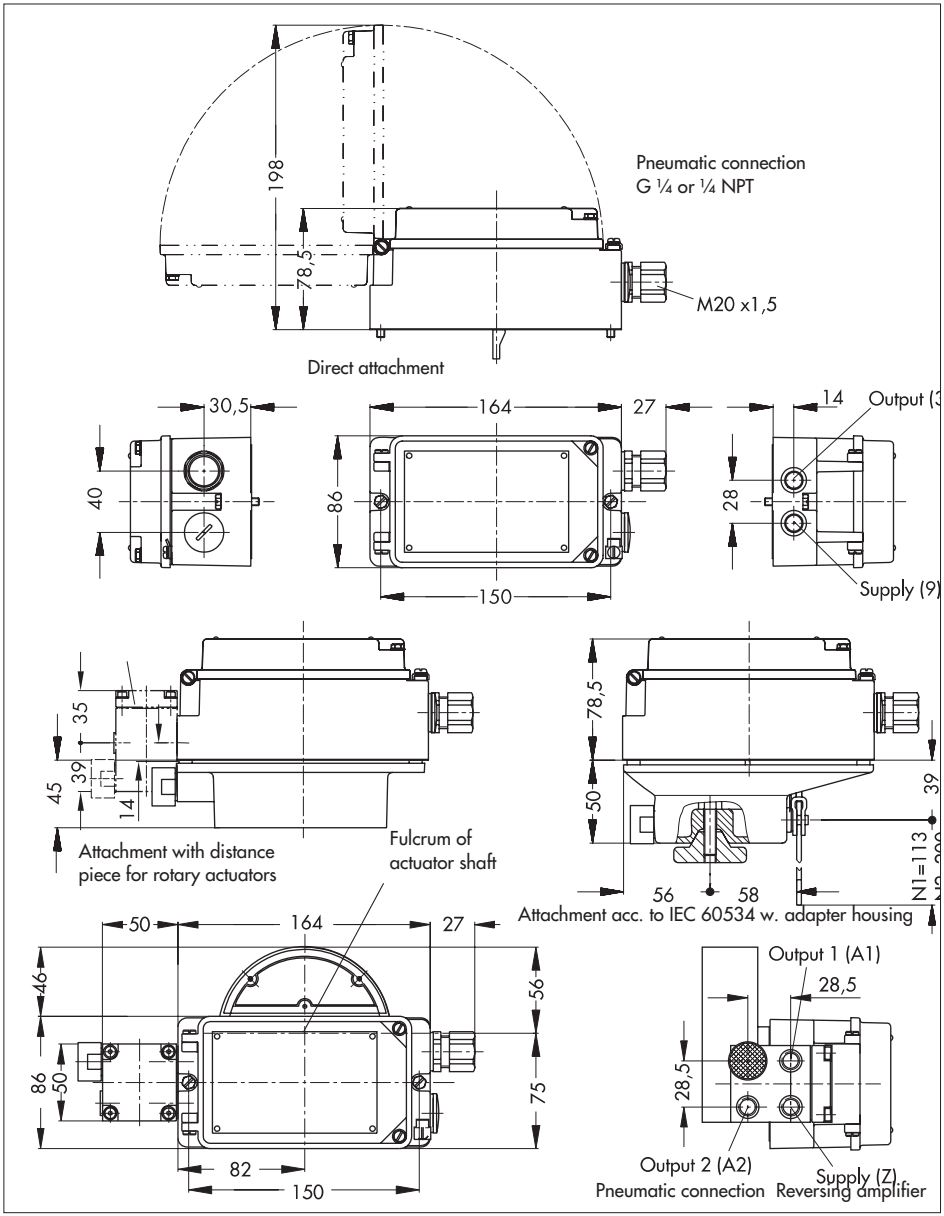
Proportional band restricted too much

Even the smallest permissible pulses still cause too large changes in travel. Initialization is aborted.

Possible sources of error:
> Supply pressure too high – Missing signal pressure throttle for actuators with small volumes
> Error in the mechanics, particularly with attachment according to IEC 60534-6 (NAMUR)
> In case a booster valve has been mounted for large volume actuators, the bypass should be opened further.

Successful

Initialization has been successfully completed without error.


198
78,5
Pneumatic connection
G ¼ or ¼ NPT
M20 x1,5
Direct attachment
30,5
40
164
27
86
150
14
Output (
28
Supply (9)
35
39
45
14
Attachment with distance
piece for rotary actuators
Fulcrum of
actuator shaft
78,5
50
39
56
58
N1=113
Attachment acc. to IEC 60534 w. adapter housing
50
164
27
46
86
50
56
75
82
150
Output 1 (A1)
28,5
28,5
Output 2 (A2)
Pneumatic connection
Supply (Z)
Reversing amplifier

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(1) **EC TYPE EXAMINATION CERTIFICATE**

(2) Equipment and Protective System Intended for Use in Potentially Explosive Atmospheres - Directive 94/9/EC

(3) EC Type Examination Certificate Number

PTB 97 ATEX 2254

(4) Equipment: Profibus Positioner Model 3785-1

(5) Manufacturer: SAMSON AG

(6) Address: Weismüllerstraße 3, D-60314 Frankfurt am Main

(7) This equipment and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) The Physikalisch-Technische Bundesanstalt, notified body number 0102 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March, 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given i Annex II to the Directive.

The examination and test results are recorded in confidential report No. PTB Ex 97-27230.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with

EN 50014: 1997 EN 50020: 1994

(10) If the sign "X" places after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC TYPE EXAMINATION CERTIFICATE relates only to the design and construction of the specified equipment. If applicable, further requirements of this Directive apply to the manufacture and supply of the equipment.

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(12) The marking of the equipment shall include the following:

II 2 G EEx ia IIC T6

Zertifizierungsstelle Explosionsschutz Braunschweig, 10 December 1997
By order

(Signature) (Seal)

Dr.-Ing. U. Johannsmeyer
Oberregierungsrat

EC Type examination Certificates without signature and seal are invalid.
This EC Type Examination Certificate may only be reproduced in its entirety and without any change, schedule included.
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(13) **Schedule to the**

(14) **EC TYPE EXAMINATION CERTIFICATE No. PTB 97 ATEX 2254**

(15) **Description of Equipment**

The PROFIBUS Positioner Model 3785-1 operates as a passive two-pole network and is intended for attachment to pneumatic control valves. The apparatus serves for assigning a valve position (the controlled variable) to an electrical control signal (the reference variable), for this purpose, the control signal provided by a control system is compared with the travel of the positioner, and a pneumatic signal pressure is supplied.

The PROFIBUS Positioner Model 3785-1 essentially consist of an inductive non-contacting displacement transducer system, an electrically driven valve block with two switching valves, and of the electronics circuitry for processing the control algorithms and communication.

The PROFIBUS Positioner Model 3785-1 communicates via PROFIBUS-PA according to the FISCO Model with power being supplied via the two-wire bus line.

The relationship between temperature classification and permissible maximum ambient temperature is shown in the table below:

T6 - 40 °C...+ 60 °C **T5 - 40 °C...+ 70 °C**

Electrical Data

Signal circuit .....Type of protection. Intrinsic safety EEx ia IIC/IIB
(Terminals 11/12) or EEx ib IIC/IIB

Only for connection to a certified intrinsically safe circuit.
Maximum values:

II C	**IIB**
$U_i \leq 20$ V	$U_i \leq 24$ V
$I_i \leq 220$ mA	$I_i \leq 285$ mA

The effective internal capacitance is $C_i < 5$ nF
The effective internal inductance is negligible.

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EC TYPE EXAMINATION CERTIFICATE No. PTB 97 ATEX 2254

Limit switches Type of protection: Intrinsic safety EEx ia IIC/IIB
(Terminals 41/42 or EEx ib IIC / IIB
and 51/52)

Only for connection to a certified intrinsically safe circuit.

Maximum values: $U_i \leq 16$ V
$I_i \leq 52$ mA
$P_i \leq 169$ mW

The effective internal capacitance is $C_i = 60$ nF
The effective internal inductance is $L_i = 100$ nF

Forced venting function Type of protection. Intrinsic safety EEx ia IIC/IIB
(Terminals 81/82) or EEx ib IIC/IIB

Only for connection to a certified intrinsically safe circuit.

Maximum Values: $U_i \leq 28$ V
$I \leq 115$ mA

The effective internal capacitance is $C_i < 5$ nF
The effective internal inductance is negligible.

Binary input Type of protection: Intrinsic safety EEx ia IIC/IIB
(Terminals 85/86) or EEx ib IIC/IIB

Maximum Values: $U_o \leq 5.88$ V
$I_o \leq 1$ mA

The permissible maximum external capacitance is for

Gas classification group IIC $C_o \leq 43\ \mu F$
Gas classification group IIB $C_o \leq 1000\ \mu F$

The permissible maximum external inductance is for

Gas classification group IIC $L_o \leq 1$ H
Gas classification group IIB $L_o \leq 1$ H

EC Type examination Certificates without signature and seal are invalid.
This EC Type Examination Certificate may only be reproduced in its entirety and without any change, schedule included.
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PTB

Schedule to the

EC TYPE EXAMINATION CERTIFICATE No. PTB 97 ATEX 2254

(16) **Report No.: PTB Ex 97-27230**

(17) **Special conditions for safe use**

Inapplicable

(18) **Essential Health and Safety Requirements**

In compliance with standards

Zertifizierungsstelle Explosionsschutz
By order

Braunschweig, 10 December 1997

(Signature) (Seal)

Dr.-Ing. U. Johannsmeyer
Oberregierungsrat

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

ADDENDUM No. 1

**in compliance with Directive 94/9/EC Annex III Clause 6
to the EC Type Examination Certificate PTB 97 ATEX 2254**

Equipment:	Profibus Positioner Model 3785-1
Marking:	**II 2 G EEx ia IIC T6**
Manufacturer:	SAMSON AG
Adress:	Weismüllerstr. 3 D-60314 Frankfurt

Description of the additions and modifications

The Profibus Positioner Model 3785-1 is expanded by the Model 3785-1.....-01 and is permitted to be manufactured in compliance with the certification documents identified in the associated test report. The Profibus Positioner Model 3785-1.....-01 operates at a nominal voltage U_N = 3.3 volt.
The electrical data are changed as follows:

Electrical data

Signal circuit .....Type of protection: Intrinsic Safety
(terminals 11/12) EEx ia IIC / IIB or EEx ib IIC / IIB
only for connection to a certified intrinsically safe circuit.

Maximum values:	**IIC**	**IIB**
	U ≤ 20 V	**U** ≤ 24 V
	Ii ≤ 285 mA	**Ii** ≤ 285 mA

The effective internal capacitance is C_i <5 nF

The effective internal inductance is negligible.

All other specifications remain unchanged.
Test report: PTB Ex 99-29174

Zertifizierungsstelle Explosionsschutz
By order (Seal)

Braunschweig, 23 July 1999

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

ADDENDUM No. 2

in compliance with Directive 94/9/EC Annex III Clause 6 to the EC Type Examination Certificate PTB 97 ATEX 2254

Equipment: Profibus Positioner Model 3785-1

Marking: II 2 G EEx ia IIC T6

Manufacturer: SAMSON AG

Adress: Weismüllerstr. 3
D-60314 Frankfurt

Description of the additions and modifications

In future the Profibus Positioner Model 3785-1 is permitted to be manufactured in compliance with the certification documents identified in the associated test report.

The modifications relate to the internal and external structure. The logic pcb has been modified and a serial interface has been added.

The electrical data have been changed as follows:

Electrical data

Signal circuit
(terminals 11/12)

Type of protection: Intrinsic safety EEx ia IIC/IIB
or EEx ib IIC/IIB
only for connection to a certified intrinsically safe circuit

Maximum values

IIC	**IIB**
$U_i \leq$ 20 V	$U_i \leq$ 24 V
$I_i \leq$ 360 mA	$I_i \leq$ 380 mA
$P_i \leq$ 1,54 W	$P_i \leq$ 2,58 W
C_i negligible	L_i negligible

Limit switches
(terminals 41/42 and 51/52)

Type of protection: Intrinsic safety EEx ia IIC/IIB
EEx ib IIC/IIB
only for connection to a certified intrinsically safe circuit

Maximum values

$U_i \leq$ 16 V
$I \leq$ 52 mA
$P_i \leq$ 169 W
C_i 60 nF L_i 100 nF

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The correlation between temperature classification, permissible ambient temperature range, maximum short-circuit currents and maximum power for analysers is shown in the table below:

Temperature class	**Permissible ambient temperature range**	**I_o/P_o**
T6 **T5** **T4**	45°C -45°C . . . 60°C 75°C	52 mA / 169 mW
T6 **T5** **T4**	60°C -45°C . . . 80°C 80°C	25 mA / 64 mW

Binary input
(terminals 85/86)

Type of protection: Intrinsic safety EEx ia IIC/IIB
or EEx ib IIC/IIB
only for connection to a certified intrinsically safe circuit

Maximum values

U_i = 5.88 V
I_i = 1 mA
P_i = 7.2 mW

IIC	**IIB**
$C \leq$ 43 µF	$C \leq$ 1000 µF
$L_o \leq$ 1 H	$L_o \leq$ 1 H

Serial interface

Type of protection: Intrinsic safety EEx ia IIC/IIB
EEx ib IIC/IIB

Maximum values

U_o = 5.88 V
I_o = 55 mA
P_o = 298 mW
C_o = 42 µF L_o = 10 mH

only for connection to a certified intrinsically safe ciruit

Maximum values

U_i = 20 V
I_i = 60 mA
P_i = 250 mW
C_i negligible L_i negligible

Interconnection shall be in compliance with the rules for interconnecting intrinsically safe circuits.

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Physikalisch-Technische Bundesanstalt
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All the other specification apply without change also to this Addendum No. 2.

Test report: **PTB Ex 01-21488**

Zertifizierungsstelle Explosionsschutz — Braunschweig, 19 February 2002

By order

(Signature)
Dr.-Ing. U. Johannsmeyer (Seal)
Regierungsdirektor

All other specifications remain unchanged.

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

ADDENDUM No. 3

in compliance with Directive 94/9/EC Annex III Clause 6
to the EC Type Examination Certificate PTB 97 ATEX 2254

Equipment: Profibus Positioner Model 3785-1

Marking: **II 2G EEx ia IIC T6**

Manufacturer: SAMSON AG Mess- und Regeltechnik

Adress: Weismüllerstr. 3 D-60314 Frankfurt

Description of the additions and modifications

The Model 3785-1.. PROFIBUS Positioners satisfy the requirements of EN 50281-1-1;1998 relating to electrical apparatus with protection provided by the enclosure.

The positioners are attached to pneumatic control valves or butterfly valves either directly across actuators of the 3277 Series or to conventional actuators via NAMUR adapter plates.

The Model 3785-1.. PROFIBUS Positioners shall be provided in addition with the following marking:

II 2D IP 65 T 80 °C

All the other data apply also to this Addendum No. 3 without change.

Test report: **PTB Ex 03-23394.**

Zertifizierungsstelle Explosionsschutz — Braunschweig, 14 January 2004

By order

(Seal)

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

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