PROFIBUS Positioner
Type 3785
PA device profile version 2.0

Fig. 1 · Type 3785

Mounting and operating instructions

EB 8382-1 EN

Firmware R 1.42/K 1.60

Edition January 2003

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- *The device may only be assembled, started up, and operated by experienced personnel familiar with this product.*
  In these mounting and operating instructions, the term experienced personnel *refers to individuals who are able to evaluate the responsibilities assigned to them as well as recognize potential hazards due to their specialized training, knowledge, and experience as well as their special knowledge of the relevant standards.*
- *Explosion-proof versions of this device may only be operated by personnel who have undergone special training or instructions, or who are authorized to work on explosion-proof devices in hazardous areas. See also chapter 6.*
- *Any hazards which could be caused by the process medium, operating pressure, signal pressure as well as any moving parts of the control valve, must be prevented by means of appropriate measures.*
  Should inadmissible motions or forces be produced in the pneumatic actuator as a result of the level associated with the supply air pressure, these must be restricted by means of a suitable pressure reducing station.
- *Proper shipping and appropriate storage of the device are assumed.*

- ***Note:** Devices with the CE mark meet the requirements specified in the Directive 94/9/EC and the Directive 89/336/EEC.*
  The Declaration of Conformity can be viewed and downloaded on the Internet at www.samson.de.

Modifications of positioner firmware in comparison to previous version

Obsolete	New
Control R 1.23	R 1.31
	Firmware adaptation for a 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 ..... related to maximum range Transmission code ..... S90 Nominal angle ..... 90° End position for w < ..... 1 % End position for w > ..... 99 % Rotational angle range begins at . 0° Rotational angle range ends at .... 90°
	When the actuator type is set from "rotary actuator" to "linear actuator", the following applies: **Attachment ..... integrated ..... acc. to NAMUR** Initialization method ..... related to nom. range... related to nominal range Mounting position ..... arrow toward actuator . arrow away from actuator Transmission code ..... D1 ..... - Transmission pin position ..... - ..... A Rated travel ..... 15 mm ..... 15 mm End position for w < ..... 1 % ..... 1 % End 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
Initialization method	When the initialization method is set from "maximum range" to "nominal range", the following applies: end position for w < 1 % end position for w > 125 % When the initialization method is set from "nominal range" to "maximum range", the following applies: end position for w < 1 % end 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 are determined for the range 20 % to 80 % of the range of the manipulated variable and are stored in the EEPROM.

Proportional-action coefficients KP_Y1 and KP_Y2	These coefficients are adapted to the selected actuator type and to the measured transit times.
Control R 1.41	R 1.42
	Correction in the zero point calibration started over communication.
Communication K 1.34	K 1.41
	Firmware adaptation for a 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 CHECKBACK parameter. In contrast to bit 13, bit 7 is automatically reset when no further errors are detected by means of control loop monitoring. The function of bit 13 remains unchanged. Messages are only indicated by bit 7 if Control Firmware R 1.41 or higher is used. The message "warmstart" indicated by bit 11 of the DIAGNOSIS parameter is automatically reset after 10 s. When the "local override" operating mode is activated, bit 2 of the CHECK_BACK parameter is set.
Communication K 1.51	K 1.60
	The set point status BAD generally does not cause anymore the positioner to go to the fail-safe position, instead this behavior is determined by the FSAVE_TYPE parameter. The positioner can be set and operated using the SAMSON's **TROVIS-VIEW** Configuration and Operator Interface over the serial interface.

Positioner	
Rated travel Direct attachment Type 3277 Attachment acc. to IEC 605347-6 (NAMUR)	Adjustable 7.5 to 30mm 7.5 to 120 mm or 30° to 120° for rotary actuators
Bus connection	Fieldbus interface according to IEC 61158-2 Field device according to FISCO (**F**ieldbus **i**ntrinsically **s**afe **co**ncept)
Permissible operating voltage	9 to 32 V DC[1)], power supply via the bus cable
Static destruction	35 V
Max. operating current	10 mA
Current in case of fault	0 mA
Auxiliary power	Supply air from 1.4 to 6 bar (20 to 90 psi); air quality acc. to ISO 8573-1: Max. size and density of particles: Class 2; oil quantity: Class 3, the pressure dew point must be 10 °C below the lowest ambient temperature to be expected.
Signal pressure (output)	0 bar to pressure of supply air
Adjustable characteristic	Linear, equal percentage, reverse equal percentage, user programmable Deviation from characteristic ≤1 %
Dead band (based on rated travel/angle)	Adjustable from 0.1 to 10.0 % , default 0.5 %
Resolution	<0.05 % (internal measurement)
Transit time	Up to 240 s, separately adjustable for exhaust and supply air
Moving direction	Reversible, adjustment via software
Air consumption	Independent of supply air <90l_n/h
Air supply	Actuator filled: for Δp = 6 bar 9.3 m_n^3/h, for Δp = 1.4 bar 3.5 m_n^3/h Actuator vented: for Δp = 6 bar 15.5 m_n^3/h, for Δp = 1.4 bar 5.8 m_n^3/h
Permissible ambient temperature	–40 to 80 °C ; the specifications in the EC-type examination certificate additionally apply for explosion-protected devices
Effects	Temperature: ≤0.15 %/10 K, auxiliary power: none, Vibrations: none up to 250 Hz and 4 g
Explosion protection	II 2 G EEx ia IIC T6 according to ATEX, see EC- type examination certificate
Degree of protection	IP 65 by using the filter check valve included
Electromagnetic compatibility	Requirements acc. to EN 50081/50082 are met
Binary input	Internal power supply 5 V DC, R_i = 100 kΩ for signaling function, e.g. connection of a pressure switch
Forced venting, activated over switch inside the positioner	Input: 6 to 24 V DC, static destruction limit 45 V, R_i approx. 6 kΩ at 24 VDC (voltage dependent, switching point 1 - signal at ≤ 3 V, 0 signal only at 0 V, Kv value 0.17

Communication	Data transmission according to PROFIBUS-PA, Profile Class B Version 2.0 acc. to EN 50170 and DIN 19245 Part 4 (Version 3.0 is also available)
Local interface	SAMSON SSP interface for configuration and start-up
Bus address	Adjustable over the software or microswitch; delivered status 126
Accessory equipment	
Inductive limit switches	Two Type SJ 2 SN Proximity Switches for connection to a switching amplifier according to EN 60947-5-6
Materials	
Case	Die-cast aluminum, chromized and plastic-coated
External parts	Stainless steel 1.4571 and 1.4301
Weight	Approx. 1.3 kg

Positioner versions

Type			3785 -	X	X	X	X	X	3	X
Explosion protection	Without			**0**						
	Ex II 2 G Ex ia IIC T6 as per ATEX			**1**						
	mit Ex ia CSA/FM			**3**						
	Ex II 3 G Ex nA II T6 as per ATEX			**8**						
Additional equipment	Limit switches	Without			**0**					
		2 inductive			**2**					**2**
	Forced venting	Without				**0**				
		With				**1**				**2**
PA device profile	Version 2.0						**0**			
	Version 3.0						**1**			
Pneumatic connections	NPT 1/4- 18							**1**		
	ISO 228/1- G1/4							**2**		
Electric connections	Cable gland M 20 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 designed for attachment to pneumatic control valves and is used to ensure a correspondence between the valve stem position (controlled variable) and the control signal (reference variable). It compares the digital output signal to the travel of the control valve, and delivers a corresponding pressure signal as the output variable. For this purpose, auxiliary supply air is required, with a pressure of 1.4 to 6 bar. Auxiliary energy is supplied via bus-powered PROFIBUS-PA segment based on IEC 61158-2 standard transmission technology.
The positioner essentially consists of an inductive, non-contact displacement sensor system and an electrically controlled valve block comprising the two on-off valves and an electronic unit. This unit contains two microcontrollers for processing the control algorithm and managing the PROFIBUS communication. Whenever a deviation between the actual valve travel (actual value) and the reference variable (set point) occurs, the microcontroller produces binary pulse-pause modulated signals to control the two on-off valves, each of which is assigned a downstream amplifier. One of these valves controls the exhaust air, and the other one controls the supply air.

The supply air valve (3) switches the supply air (7, supply air pressure 1.4 to 6 bar) to the actuator (filling). The exhaust air valve (4) controls the air exhausted from the actuator to the atmosphere (venting). These on-off valves can either have the switching states - permanently open, permanently closed - or generate single pulses of changing widths. With the two valves being controlled, the plug stem moves to a position corresponding to the reference variable. If there is no system deviation, both the supply air and the exhaust air valve are closed.

As a standard feature, the positioner is equipped with a binary input for floating contacts which additionally signals the switching state of another field device via PROFIBUS.

Activating the write protection switch located in the hinged cover prevents the positioner settings from being overwritten by PROFIBUS communication.

Positioner with forced venting function:
The positioner is controlled via a 6 to 24 V signal, causing the signal pressure to be applied to the actuator. If this voltage signal decreases, the signal pressure is shut off and the actuator is vented. The springs contained in the actuator move the valve to its fail-safe position. The forced venting is installed in all positioners and can be activated/deactivated as required over a switch. See chapter 4.3 for more details.

1.1 Option

As a supplement to the standard positioner version, the positioner can also be retrofitted with limit switches. Two proximity switches can be used to indicate the valves' end positions in fails-safe circuits.

1.2 Communication

The positioner is completely controlled via digital signal transmission according to the PROFIBUS-PA Profile Class B based on EN 50170 and DIN 19245 Part 4.
Data is transmitted as bit synchronous current modulation at a transmission rate of

31.25 kbit/s via twisted-pair cables according to IEC 61158-2.
Positioners are generally adjusted by a personal computer. One or more positioners are connected to the PC's PROFIBUS segment via segment coupler.
After mechanically resetting the positioner to zero, it can be automatically started up via initialization procedure. During this initialization procedure, zero is automatically adjusted, and the preset span is checked.

The positioner is supplied with a standard configuration for a control valve with a rated travel of 15 mm and designed for integral positioner attachment. An individual configuration to adapt the positioner to other actuators can only be carried out by means of communication.

Configuration

The positioner is configured and operated at the PC over the SSP interface (13) using TROVIS-VIEW. Alternatively, it can be configured via a segment coupler, for example, by the COMMUWIN II user interface (by Endress + Hauser) or SIMATIC PDM user interface (by SIEMENS).

You can enter parameters during configuration such as control characteristic, direction of action, travel limitation, travel range, transit time and alarms.

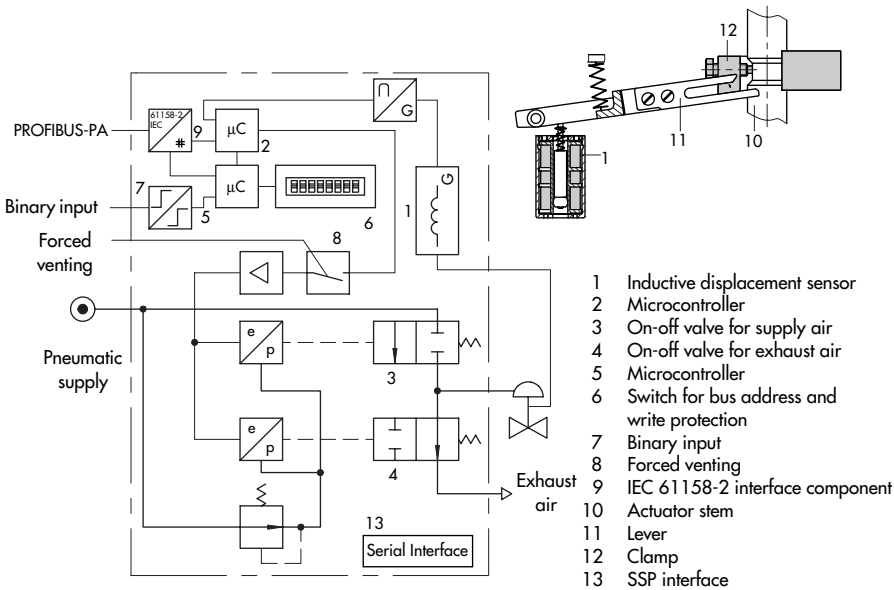

Fig. 2 · Functional diagram

2. Attaching the positioner

The positioner can be attached either directly to a SAMSON Type 3277 Actuator, or according to NAMUR (IEC 60534-6), to control valves with casted yokes or rod-type yokes.
In combination with an intermediate piece, the device can also be attached as rotary positioner to rotary actuators.

Since the standard positioner unit is delivered without accessories, refer to the required mounting parts and their order numbers in the corresponding tables.

NOTE:
The positioner does not have its own venting plug, so that the air is exhausted to the atmosphere through the venting plugs located on the accessories (see also Figs. 3, 5 and 6).
*A **filter check valve** for the exhaust air is included with each positioner (underneath the transparent cover on the back of the positioner.*
Replace the standard venting plug included in the accessories with this filter check valve. This is necessary to achieve the IP 65 degree of protection by preventing dirt and moisture from entering the device.

2.1 Direct attachment to Type 3277 Actuator

For the selection of the required mounting parts, refer to tables 1, 2 and 3 on page 13.

When looking at the signal pressure connection or the switchover plate respectively (actuator 120 cm^2) from the top, the positioner must be attached to the left side of the actuator.
The **arrow** on the black case cover (Fig. 11) should then point **towards** the **diaphragm chamber.**
Exception: Control valves in which the plug 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, i.e. 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 the associated lever D1 or D2 (for 700 cm^2 actuator) to the transmission lever of the positioner.
3. Fasten distance plate (15) with seal towards the actuator yoke.
4. Place positioner on the plate so that the lever D1 or D2, will slide centrically over the pin of the clamp (1.2). Then screw to distance plate (15).
5. Mount cover (16).

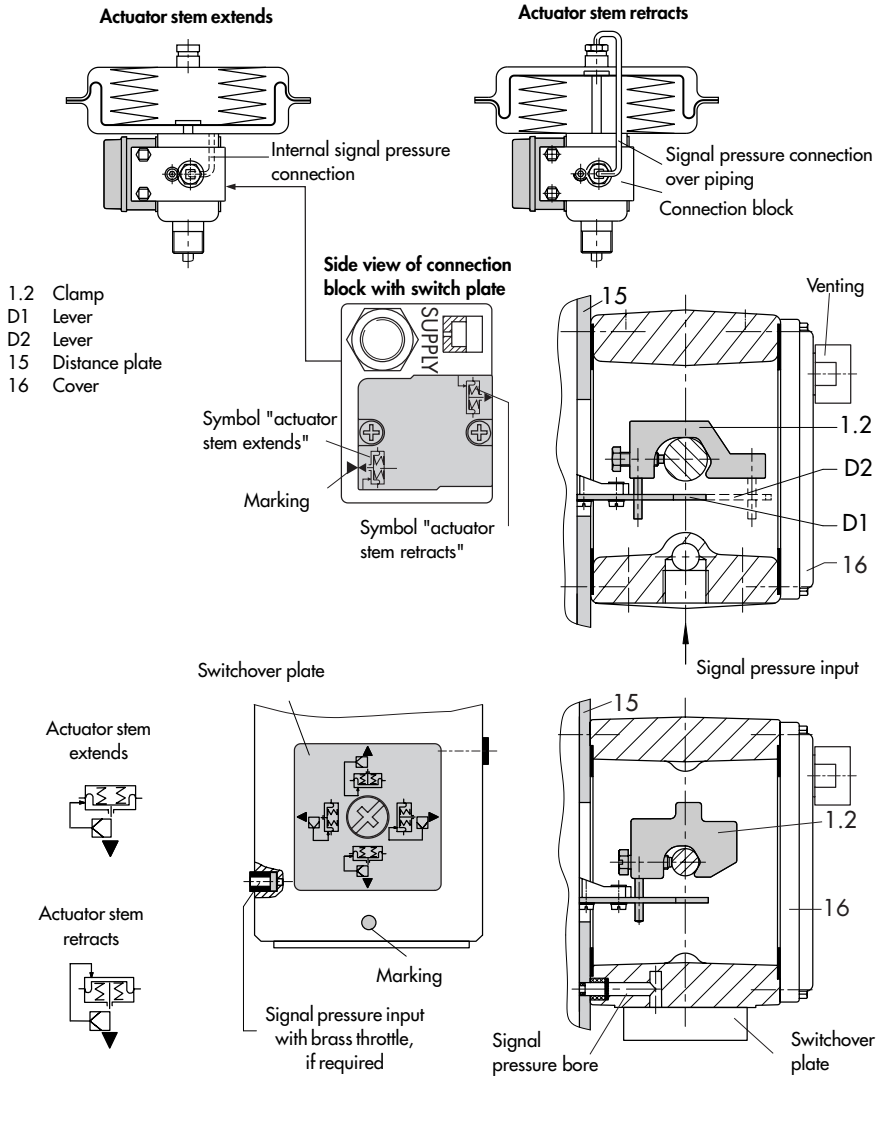

Fig. 3 · Attachment and signal pressure connection for Type 3277 (top) and 3277-5 Actuators with 120 cm² (bottom)

240, 350 and 700 cm² Actuators

6. Align the lateral switch plate at the connection block (Fig. 3) with the proper arrow symbol on the block. This means, the actuator symbol for "actuator stem extends" or "actuator stem retracts" must match the respective actuator version used. If not, remove the two fastening screws and the switch plate, turn the switch plate by 180° and reattach.
7. Place connection block with the associated sealing rings against the positioner and the actuator yoke and screw it tight, using the fastening screw.
   For actuators with fail-safe position "actuator stem retracts", additionally mount the prefabricated signal pressure tube between connection block and actuator.

120 cm² actuator

For Type 3277-5 Actuators with 120 cm², the signal pressure is transmitted to the diaphragm chamber via the switchover plate (see Fig. 3, bottom).

NOTE:
For a rated travel of 7.5 mm, a brass throttle (see Accessories table on page 13) 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.

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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 left, 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** (applicable for all actuators)*
For faster control valves with a transit time < 0.6 s, 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.

Filling the spring chamber with air

If the Type 3277 Actuator's spring chamber 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). For this, you need to remove the vent plug on the connecting block.

With the 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 Required lever with associated clamp and distance plate		Actuator size cm^2	Mounting kit Order no.
D1 (33 mm in length with clamp 17 mm in height)		120 (G1/4) 120 (NPT 1/4)	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 cm^2	Actuator 3277-5xxxxxx. **00** (old)		1400-6819
Switchover plate **new**	Actuators with Index. **01** or higher (new)		1400-6822
Connecting plate for additional attachment e.g. of a solenoid valve	3277-5xxxxxxxx. **00** (old)	G 1/8 NPT 1/8	1400-6820 1400-6821
Connecting plate **new**	Actuators with Index. **01** or higher (new)		1400-6823
NOTE: New switchover plates and connecting plates can only be used with the new actuators (Index 01). Old and new plates are not interchangeable.			
Connection block required for actuator sizes 240, 350 and 700 cm^2 (including seals and fastening screw)		G thread	1400-6955
		NPT thread	1400-6956
Table 3	Actuator size cm^2	Material	Order no.
Required tubes incl. fittings	240	Steel	1400-6444
	240	Stainless steel	1400-6445
for actuator: "Actuator stem retracts" or for filling the upper diaphragm chamber	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 for supply air and signal pressure		St. steel/Brass St. steel/St. steel	1400-6957 1400-6958
Signal pressure throttles (screw-in type and brass throttle)			1400-6964
Filter check valve, replaces exhaust air plug and increases the degree of protection to IP 65 (one included with the delivered positioner)			1790-7408

2.2 Attachment acc. to IEC 60534-6

For the selection of the required mounting parts, refer to Tables 4 and 5 on page 17.

For positioner attachment according to NAMUR as shown in Fig. 4, you require an adapter housing. 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, you require the mounting parts listed in Table 4. Which lever is to be used depends on the rated valve travel.
The positioner is attached, however, the **arrow** on the black case cover has to point **away** from the **diaphragm actuator** towards the valve.
Exception: Control valves in which the plug 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 of other manufacturers), the **arrow** on the case cover must point towards the control valve.

2.2.1 Mounting sequence

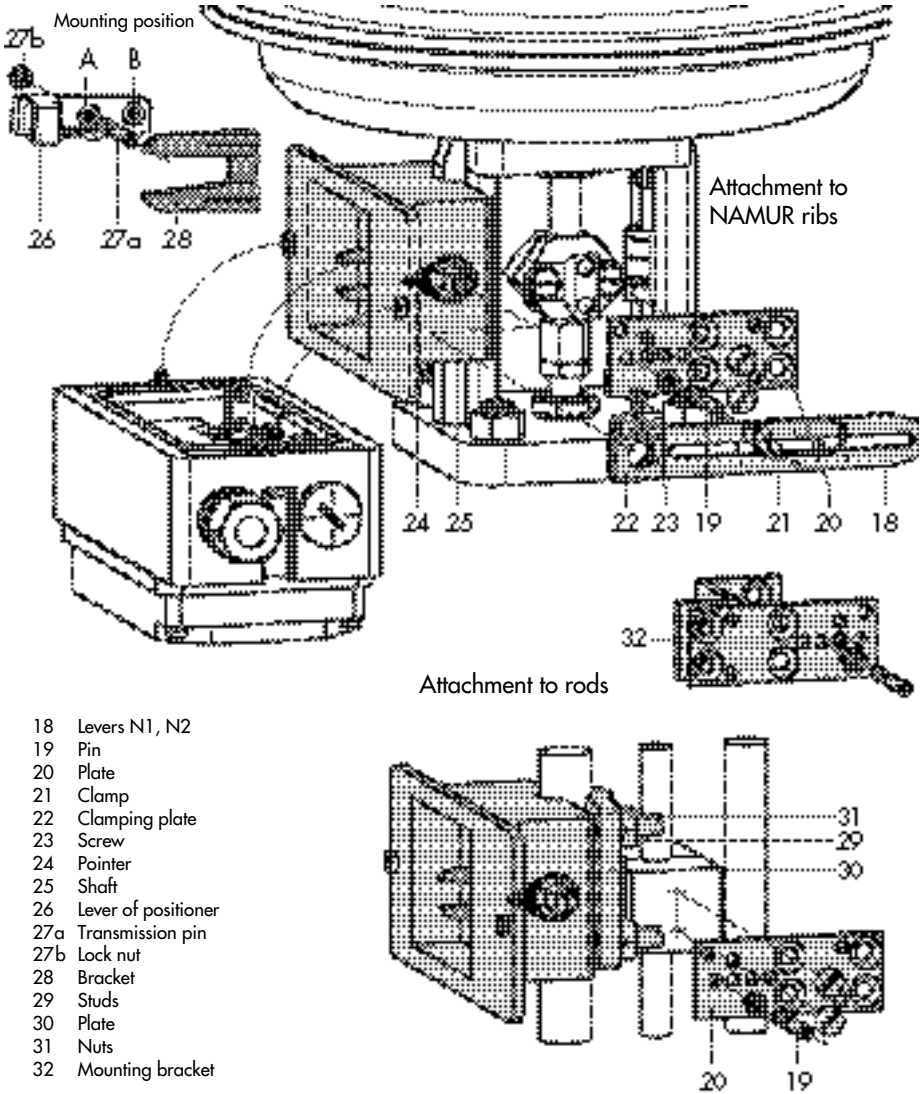
NOTE:
Before you mount the parts, apply a signal pressure to the actuator so that the valve is set to 50 % of its travel. This will ensure the exact alignment of the lever (18) and the bracket (28).

Control valve with casted yoke

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

Control valve with rod-type yoke

1. Screw plate (20) to the follower clamp of the plug stem.
2. Screw the studs (29) into the adapter housing.
3. Place the housing with the plate (30) on either the right or left side of the valve rod and screw the housing tight by using nuts (31). Be sure to align the housing in such a manner that the lever to be mounted subsequently is horizontal.
4. Move the clamp (21) to surround the pin (19). Screw pin in 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.
   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 subsequently during the configuration of the positioner.



18 Levers 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 Lock nut
28 Bracket
29 Studs
30 Plate
31 Nuts
32 Mounting bracket

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

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 casted 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	Control valve		Travel in mm	With lever	Order no.
NAMUR mounting kit	Valve with casted yoke		7.5 to 60	N1 (125mm)	1400-6787
			30 to 120	N2 (212 mm)	1400-6789
Parts, see Fig. 4	Valve with rod-type yoke with rod diameter in 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 (one each of both mounting kits is needed per one actuator)					1400-6771 and 1400-6787
Accessories					Order no.
Pressure gauge mounting block				G 1/4 NPT 1/4	1400-7106 1400-7107
Pressure gauge set				St. st./Brass St. st./St. st.	1400-6957 1400-6958
Signal pressure throttles (screw-in type and brass throttle)					1400-6964
Filter check valve, replaces exhaust air plug and increases the degree of protection to IP 65 (one included with the delivered positioner)					1790-7408

Table 5 NAMUR attachment										
Travel in mm *)	7.5	15	15	30	30	60	30	60	60	120
Pin on marking *)	1		1	2	1	2	1	2	1	2
Corresp. distance pin/lever fulcrum	42		42	84	42	84	84	168	84	168
With lever	N1 (125 mm in length)						N2 (212 mm in length)			
Transmission pin (27) on position	A		A		B		A		B	

*) Deviating travel values (intermediate values) must be calculated accordingly.

2.3 Attachment to rotary actuators

For the selection of the required mounting parts, refer to table 6 on page 21.

The positioner can also be attached to rotary actuators in accordance with VDI/VDE 3845 by using the mounting parts and accessories listed 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 to 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 chapter 2.3.4.

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

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:

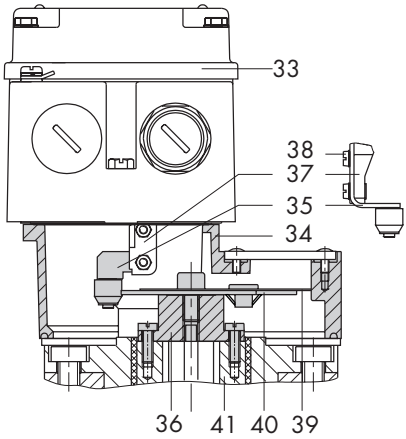
1. Screw adapter (36) to the free end of the rotary actuator shaft, using two screws.
2. Position intermediate piece (34) on the actuator case and secure, using two screws. Align intermediate piece of the positioner so that the air connections of the positioner face towards the diaphragm case side.

Actuators of other manufacturers:

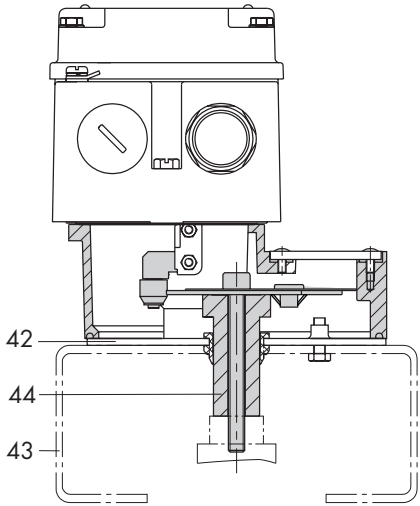
1. Position complete intermediate piece (34, 42 and 44) on fixing level 1 of the bracket (VDI/VDE 3845) delivered with the actuator and fasten with screws.
2. Align cam disk (40) and scale according to chapter 2.3.3 and fasten with screws.

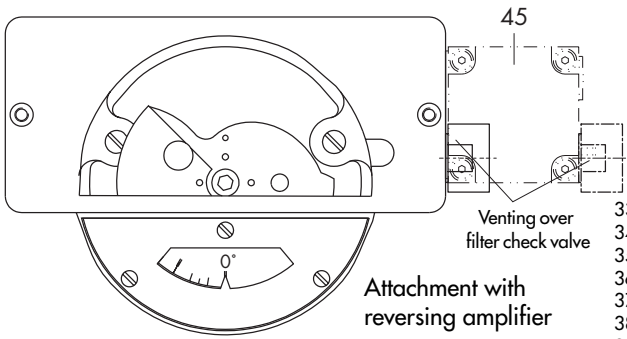
With springless actuators, the reversing amplifier (45) must be screwed to the side of the positioner case. See chapter 2.3.4 for more details.

Attachment to SAMSON Type 3278



Attachment according to VDI/VDE 3845 (NAMUR)





Attachment with reversing amplifier

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 (turned 90°)
44 Coupling
45 Reversing amplifier

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.
With 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 direction of action, i.e. whether the valve shall either open or close when the reference variable increases, has to be software adjusted via the 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 at first.

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 aligned.
The starting point for the closing position must not be below the 0° position!

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

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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. Attach the positioner to 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 in the required position.
4. Screw positioner to the intermediate piece.

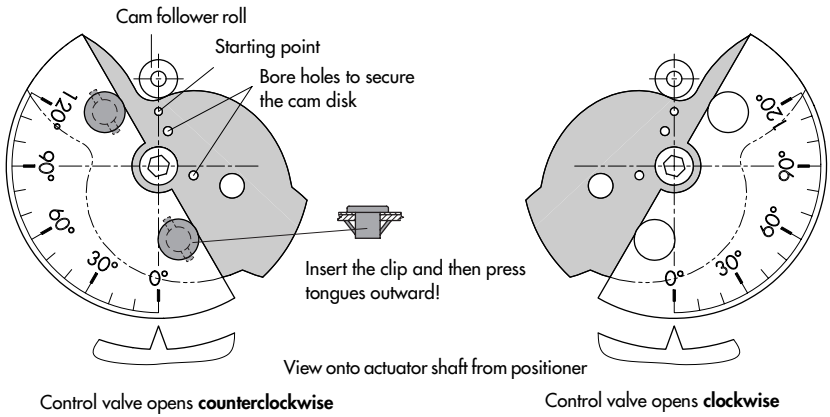


Fig. 6 · Aligning the cam disk

Table 6 Rotary actuators (Complete mounting parts, but without cam disks)

SAMSON Type 3278 Actuator			Attachmt. acc. to VDI/VDE 3845	Attachment to Masoneilan actuator		
	Actuator 160 cm^2	Actuator 320 cm2		Camflex I DN 25 ...100	Camflex I DN 125...250	Camflex II
	Order no.					
	1400-7103	1400-7104	1400-7105	1400-7118	1400-7119	1400-7120
Piping kit 8 x 1 stainl. steel						
G	1400-6670	1400-6672				
NPT	1400-6669	1400-6671				

Accessories	Order no.	
Reversing amplifier for double-acting actuators without springs	G thread: 1079-1118	NPT: 1079-1119
Cam disk with accessories, angle of rotation 0 to 90° and 0 to 120°	1400-6959	
Pressure gauge mounting block	G 1/4: 1400-7106	NPT 1/4: 1400-7107
Pressure gauge set	St. steel/Brass: 1400-6957	St. steel/St. steel: 1400-6958
Signal pressure throttles (screw-in type and brass throttle)	1400-6964	
Filter check valve, replaces exhaust air plug and increases the degree of protection to IP 65 (one included with the delivered positioner)	1790-7408	

2.3.4 Reversing amplifier for double-acting actuators

For the use with double-acting actuators, the positioner must be fitted with a reversing amplifier.
The reversing amplifier is listed as an accessory in the Table 6 on page 21.

The output signal pressure of the positioner is supplied at the output A_1 of the reversing amplifier. An opposing pressure, which equals the required supply pressure when added to the pressure at A_1, is applied at output A_2. The rule $A_1 + A_2 = Z$ applies.

Mounting

1. Screw the special nuts (1.3) from the accessories of the reversing amplifier into the threaded connections of the positioner.
2. Remove the sealing plug (1.5) from the reversing amplifier. The rubber seal (1.4) must remain installed.
3. 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.
4. Place the reversing amplifier onto the positioner and screw tight using both the special screws (1.1).
5. Replace the venting plug in the reversing amplifier with the filter check valve included.

Signal pressure connections

A_1 : Output A_1 leading to the signal pressure connection at the actuator which opens the valve when the pressure increases

A_2 : Output A_2 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 position 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 must be readjusted and the positioner must be re-initialized.

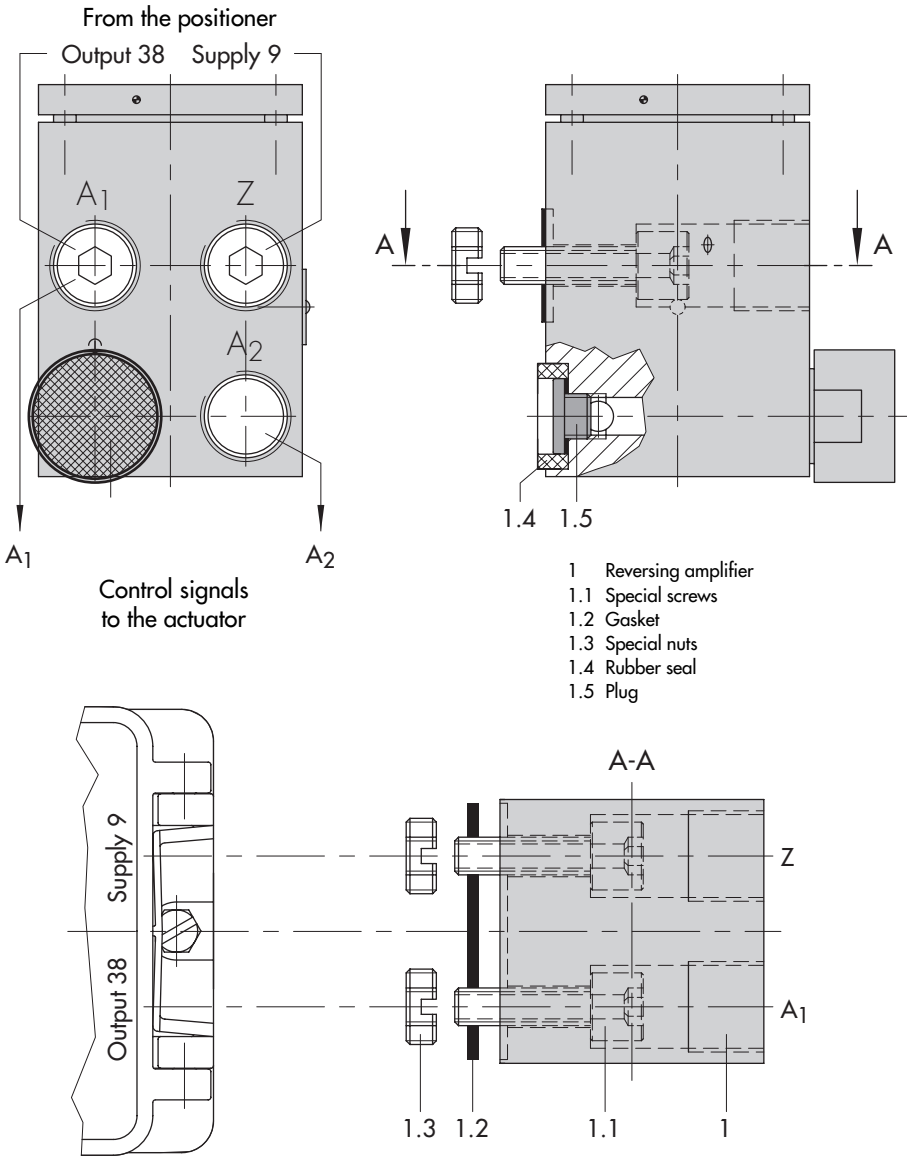


Fig. 7 · Mounting a reversing amplifier

3. Connections

3.1 Pneumatic connections

The air connections are either NPT 1/4 or G 1/4 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 from 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 at 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 can 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 the IP 65 degree of protection, the vent plug must be replaced with the filter check valve included with the device. See also chapter 2 on page 10.

3.1.1 Pressure gauge

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

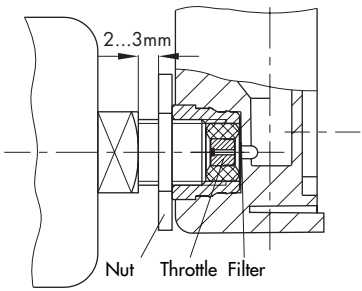


Fig. 8 · Mounting the pressure gauge

3.1.2 Supply air pressure

The required supply air 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 as signal pressure range.

Actuator stem extends:

required supply air pressure =
upper bench range value + 0.2 bar,
at least 1.4 bar.

Actuator stem retracts:
The required supply air pressure for tight-closing valves is estimated on the basis of the maximum signal pressure $p_{st\ max}$:

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

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 air pressure = upper bench range value + 1 bar

3.2 Electrical connections

As far as the electrical installation of the device is concerned, the relevant national regulations governing the installation of electrical equipment and the national accident prevention regulations of the country of destination must be adhered to.
In Germany, these are the VDE regulations and accident prevention regulations of the employer's liability insurance.
For installation in hazardous areas, the following standards apply: EN 60079-14: 1997; VDE 0165 Part 1/8.98 "Electrical apparatus for explosive gas areas" and EN 50281-1-2: VDE 0165 Part 2/11.99 "Electrical apparatus for use in the presence of combustible dust".
For intrinsically safe electrical apparatus that are certified according to the Directive 79/196/EEC, the data specified in the certificate of conformity apply for connection of intrinsically safe circuits.
For intrinsically safe electrical apparatus that are certified according to the Directive 94/9/EC, the data specified in the EC-type examination certificate apply for connection of intrinsically safe circuits.
***Note:** It is absolutely necessary to keep to the terminal plan specified in the certificate. Reversal of the electrical connections may cause the explosion protection to be ineffective! Do not tamper with any painted screws inside or on the case.*

Note on the selection of cables and wires:
To run several intrinsically safe circuits in a multicore cable, note section 12 of EN 60079-14; VDE 0165/8.98.
In particular, the radial thickness of commonly used materials, e.g. polyethylene, for the conductor insulation must be minimum 0.2 mm.
The diameter of a single wire in a flexible conductor must not be smaller than 0.1 mm.
The conductor ends must be protected against unlaying, e.g. by using wire end ferrules. If the positioner is connected via 2 separate cables, an additional cable gland can be mounted.
Wire entries left unused must be sealed with caps.
Positioners used in ambient temperatures down to –40 °C must be fitted with metal cable entries.

For the terminal assignment, refer to Fig. 9 or to the cover plate inside the case cover.

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 insulation off the end of 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 that 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 chapter 4.3 for more details.

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

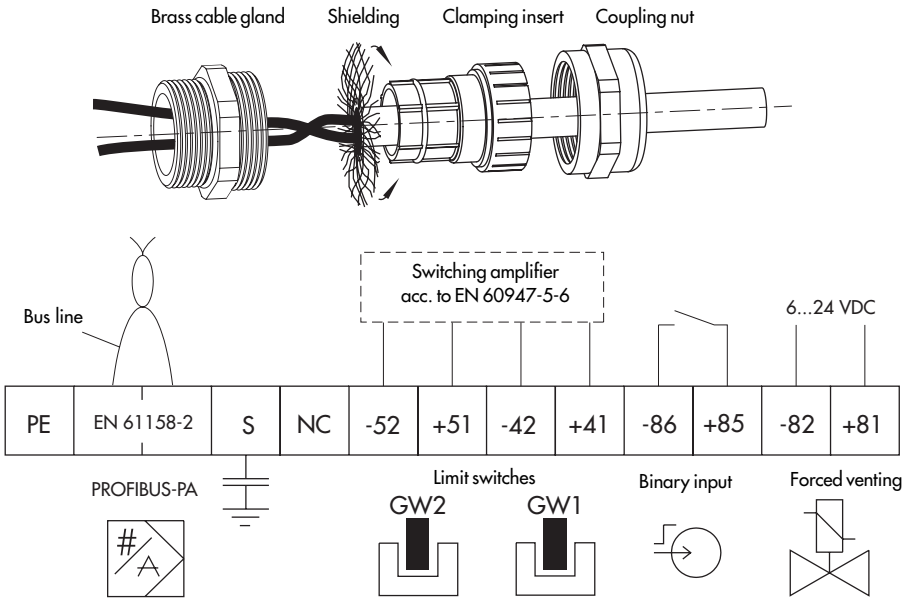


Fig. 9 · Electrical connections (terminal assignment according to DIN 45140)

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, i.e. between PC or 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, ex-proof versions of PROFIBUS-PA segment couplers must be used.
A maximum of 32 positioners can be operated in parallel via segment coupler in parallel in one PROFIBUS-PA segment. In hazardous areas, the number of positioners that can be connected is reduced.
For each positioner connected via segment, an individual, non-repetitive bus address from 0 to 125 must be assigned. Seven microswitches located on the inside of the positioner hinged cover serve to enter the bus address as binary information. The address is made 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.
Make absolutely sure that the switches are not set to center position, but all the way to 0 or 1.

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

3.2.4 Local interface (SSP)

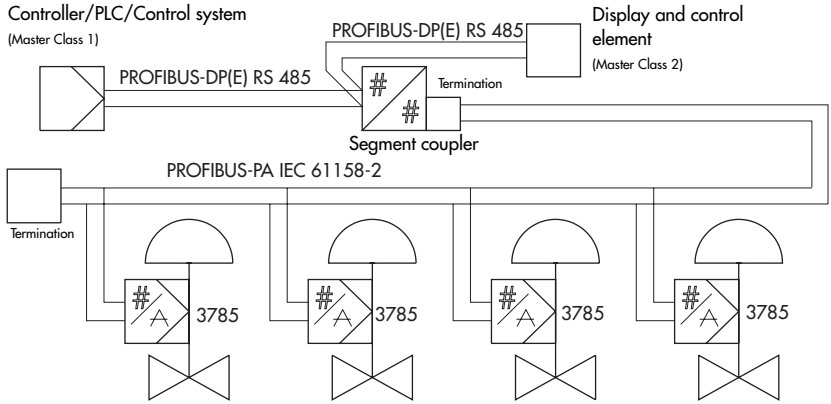
The local interface is located on the inside of the positioner hinged cover. It is connected to a PC over the serial interface adapter (order no. 1400-7700).
The positioner can be started up over the interface using the TROVIS-VIEW software.

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).

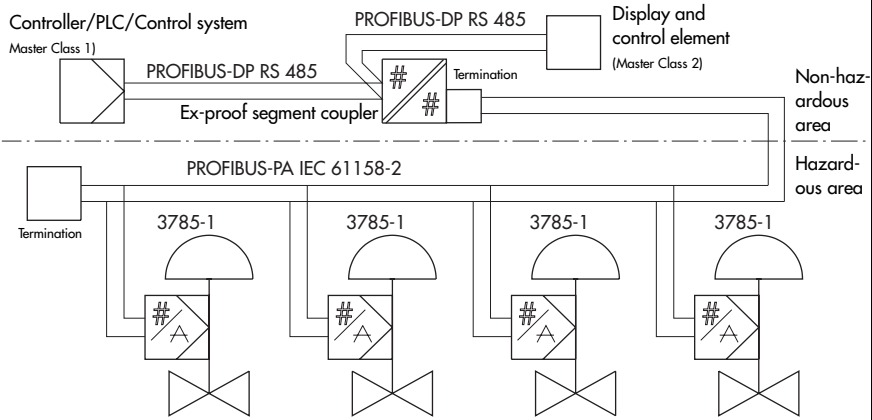
The TROVIS-VIEW software and the device module 3785 in the 2.02 version are required.

The positioner can also be accessed over the SSP interface when it is connected to a bus segment.

Cyclic and acylic data exchange are not affected. The value written last is always valid for the device parameters.



10.1 Connection ofType 3785 Positioners



10.2 Connection ofType 3785-1 Positioners in hazardous areas

Fig. 10 · PROFIBUS connection

4. Operation

WARNING
Before you take the positioner into operation, carefully move the control valve to its end position by covering the hole (manually) 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 sizing the lever mechanism incorrectly, the positioner may be destroyed.

4.1 LED controls

Two LEDs located inside the cover serve to 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, no control operation possible

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

Red + Green error recognized, control operation possible

For details, refer to the table below.

Description	LED
Device start-up:	Red lights up
No fault: Device on the bus, coldstart executed, initialization required Initialization or zero adjustment in operation Device is initialized, no valid set point Device is initialized, valid set point, operation	Green, generally Green blinks slowly Green blinks quickly Green blinks 3 times quickly + long pause Green lights up
Error in the control operation: Zero point error Control loop error	Red and green Red and green blink slowly Red and green blink quickly
Errors leading to the abortion of the first initialization (device does not move to standard operation) Zero point error Error in the mechanics/pneumatics section Control loop error	Red, generally Red blinks slowly Red lights up Red blinks quickly
Errors causing the control operation to be exited Device recognized internal error	Red blinks 3 times quickly + 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 it is 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 Activate/deactivate 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 setting

All parameters are set to default values. See chapter 8 on description of parameters.

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 reducing station.

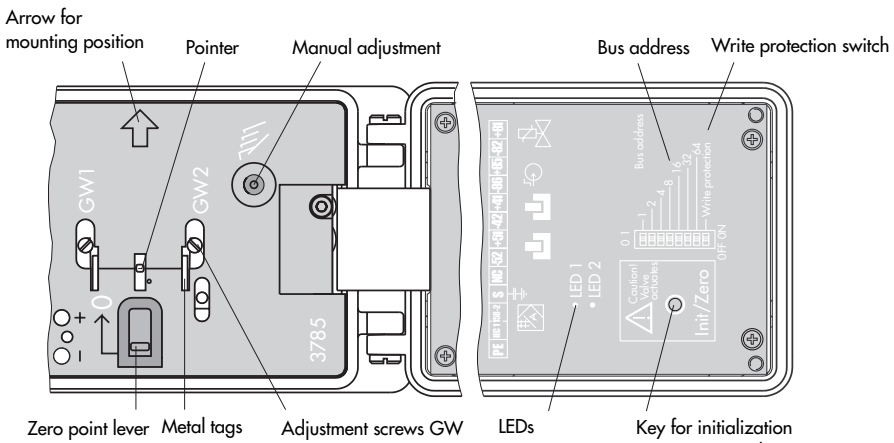


Fig. 11 · Inside view of cover plate

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 the 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 the closed position. Subsequently, 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 process 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 process 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 data on valve and actuator under "Start-up" in the operating software.
- Set "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 chapter 4.1).

- Carry out the configuration suitable for the valve type.

The following setting is recommended:

- **Fail-safe position "Actuator stem extends":**
  Direction of action: 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":**
  Direction of action: 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 30 s at the minimum.
- Enter tag identification.
- If necessary, other 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 positioners that are not mounted on a valve to a power supply and initialize the positioner as described in chapter 4.4.2.
  If communication is not possible, the default setting must be used.
- Mount positioner and set the mechanical zero as described in chapter 4.4.1.
- Start initialization by pressing the **Init/Zero** key on the positioner hinged cover 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 subsequently only starts a zero calibration.*

A new initialization routine can only be started after this when communication is connected.

A completed initialization can be cancelled 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, the 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 press the zero lever, located on the cover plate of the positioner, in the direction indicated by the arrow as far as it will go once. The yellow pointer will then be aligned with the white line.
- Press the key again to start the electric calibration.

After the key is pressed twice, it is locked for approximately one minute!
The electric calibration has been 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 that 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 chapter 3.2.2).
If the tag is in the inductive field of the switch, the switch assumes a high resistance. If the tag is out of the field, the switch assumes a low resistance.
Normally, the limit switches are adjusted such that they will provide a signal in both end positions of the valve. 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, has to be determined 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 signalled 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 in alignment 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 should be adjusted to a value of approx. 5% before the mechanical stop (OPEN - CLOSED).

5. Maintenance

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

Also refer to the maintenance instructions for upstream pressure reducing stations for supply air, if applicable.

6. Servicing ex-proof versions

In the event that a positioner's part on which the explosion protection is based must be serviced, the positioner must not be taken into operation again, unless an expert has inspected the device according to the explosion protection requirements, has issued a certificate stating this, or equipped the device with his mark of conformity.

Inspection by an expert does not have to be carried out, if the manufacturer performs a routine check test on the device prior to taking it into operation again, and the success of the routine check test is documented by attaching a mark of conformity to the device.

7. How to implement the PROFIBUS Master Class 1

7.1 Device Database Files (GSD)

The device database files are provided as a text file SAMS3785.GSD. They are available at SAMSON AG under **Product no. 1400-7417** on a 1.44 MB disk 3 1/2". Or you can download the files via Internet 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 PROFIBUS Positioner as a PROFIBUS slave unit in the programming and configuration environment of a Master Class 1 (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. Via the programming and configuration environment of the Master Class 1, you must select one of the above mentioned seven combinations.
The terms output and input are based on the control system /Master Class 1.

Variant 1: Module = "SP" 0xA4

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

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

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

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

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

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 1	
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	
SP, Value (Floating Point, IEEE)				Status	

Variant 7:
Module = " READBACK+ RCAS_OUT+ POS_D+ CHECKBACK, SP+ RCAS_IN " 0x9E, 0xA9

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	Octet 2	Octet 1	Octet 2	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_OUT, Value (Floating Point, IEEE)				Status

7.3 Parameter description

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

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

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

The reference variable w of the positioner is preset in the REMOTE CASCADE "RCAS" operating mode via RCAS_IN/RCAS_OUT. RCAS_IN/RCAS_OUT both are made up of one floating point value (4 bytes) and the associated status (1 byte).
Value and status must be transferred together (data consistency = 5 bytes). If the status of the reference variable is "bad" (value < 64dec.), 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 bytes) 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

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

Bit no.	Name	Description	Byte
0	CB_FAIL_SAFE	Fail-safe position (MODE = out of service)	0
1	CB_REQ_LOC_OP	Request for local operation	
2	CB_LOCAL_OP	Device in local mode	
3	CB_OVERRIDE	Emergency operation / Forced venting active	
4, 5, 6	Not used		
7	CB_TRAV_TIME	Status of movement monitoring (is reset automatically)	0

8, 9	Not used		1
10	CB_UPDATE_EVT	This message is issued when device 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 positioner control loop error (must be confirmed via Class 2 Master). Indicated by LED, automatically reset provided the control loop monitoring can no longer determine any error.	
14	CB_CONTR_INACT	Positioner is inactive (MODE = out of service)	
15	CB_SELFTEST	Device is in selftest mode (MODE = out of service)	
16	CB_TOT_VALVE_TRAV	Limit value of total valve travel exceeded	2
17...23	Not used		

Device diagnosis messages "Slave Diagnostic Information"

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

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 executed)
7	DIA_INIT_ERR	Auto initialization error
8	DIA_ZERO_ERR	Zero point error (final position)
10	DIA_CONF_INVAL	Configuration incorrect
11	DIA_WARMSTART	Warmstart (restart) completed, for definition of warmstart, see Profile A
12	DIA_COLDSTART	Coldstart (new start) completed, for definition of coldstart, see Profile A
13	DIA_MAINTAINANCE	Maintenance required
14	DIA_CHARACT	Characteristic invalid
31	EXTENSION_AVAILABLE	More information available

7.4 Status code of the measured value

The following status codes (decimal values) are used by the Type 3785 Positioner:

BAD:

0 = non-specific – value bad without more details.

4 = Configuration Error – device settings not consistent.

12 = Device Failure - device error.

16/17/18/19 = Sensor Failure – error in determining the measuring value (limits exceeded). Limit bits indicate that the measured value limits were exceeded.

20 = No Communication, with last usable value – (internal) transmission error, device operates with the last usable value.

24 = No Communication, with no usable value - (internal) transmission error, device does not have an usable value.

28 = Out of Service – no valid value since the block is out of service.

Uncertain:

64 = Non-specific – value uncertain without more details.

68 = Last Usable Value – value uncertain, device operates with the last usable value.

76 = Initial Value – starting value (default).

Good (non-cascade):

128 = O.K. - value is o.k.

160 = Initiate Fail Safe(IFS) – if the reference variable has this status and is not transferred in a period longer than the FSAVE_TIME, the action configured in FSAVE_TYPE is executed.

Limit bits:

The two bits of the measuring value status with the least significant bit are used to indicate that the limit values have been exceeded.

Bit 0 = Low limited – lower limit value exceeded.

Bit 1 = High limited – upper limit value exceeded.

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

7.5 Operating modes

Possible operating modes

The following operating modes are defined in Profile AO (Analog Output):

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

The Type 3785 Positioner supports the following operating modes:
up to firmware version K 1.20: OS, AUTO
firmware version K 1.30 and higher: OS, LO, MAN, AUTO

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).

Local Override (LO) or 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 (direction of action), however, is not processed. Communication monitoring parameters (FSAFE_TIME, _TYPE, _VALUE) are also not processed.

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).

Out of service (OS):

Fail-safe operating mode. The valve is automatically moved to fail-safe position.

Operating mode during start-up (warmstart)

The response of the positioner to the warmstart 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.

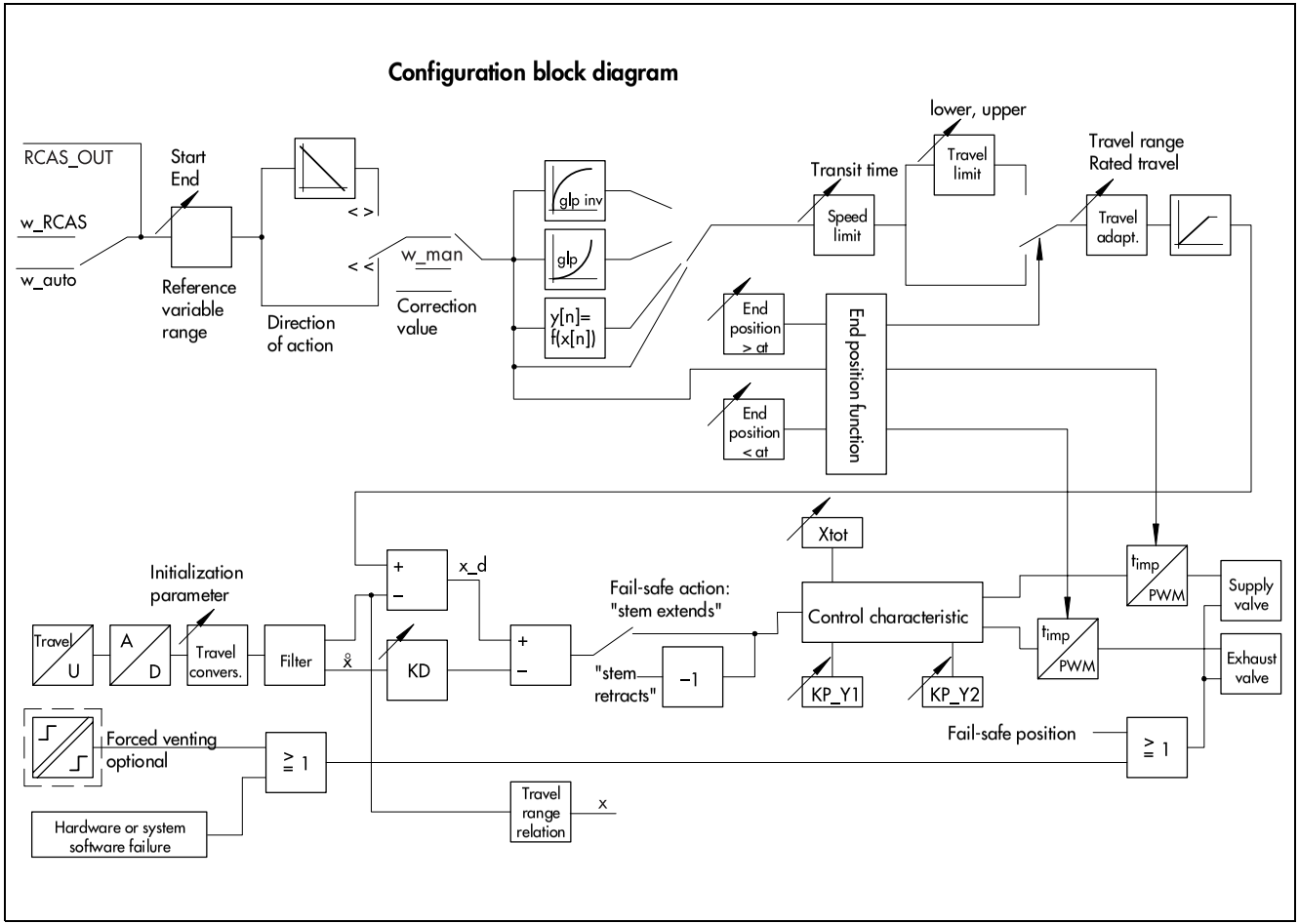
If the status of the transmitted set point is "bad" or the positioner has not been successfully initialized, it remains in fail-safe position (out of service) in K1.51 version. In K1.6 and higher, the behavior for a BAD set point status is determined by the FSAFE_TYPE parameter.

Monitoring parameters FSAFE_TIME, FSAFE_TYPE, FSAFE _VALUE

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

- Start-up of the positioner (warmstart)
- Elapsing of the DP watchdog through interruption of the cyclic communication with a Master Class 1 (not applicable, when communication is terminated properly).
- Elapsing of FSAFE_TIME 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 (not yet applicable for version K 1.30).

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 firmware version K 1.30 to K1.51). In version K1.6 and higher, the behavior for a BAD set point status is determined by the FSAFE_TYPE parameter.


Configuration block diagram
RCAS_OUT
w_RCAS
w_auto
Start
End
Reference variable range
< >
< <
Direction of action
w_man
Correction value
glp inv
glp
y[n]= f(x[n])
Transit time
Speed limit
lower, upper
Travel limit
Travel range
Rated travel
Travel adapt.
End position > at
End position < at
End position function
Xtot
Initialization parameter
Travel U
A D
Travel convers.
Filter
x̂
+ −
x_d
KD
+ −
Fail-safe action: "stem extends"
"stem retracts"
−1
Control characteristic
KP_Y1
KP_Y2
timp PWM
timp PWM
Supply valve
Exhaust valve
Forced venting optional
≥ 1
Hardware or system software failure
Travel range relation
x
Fail-safe position
≥ 1

8. List of parameters

The summary below lists the parameters by their fields of application.
The list of parameters following the overview is in alphabetical order and describes all positioner parameters that can be displayed or modified via PROFIBUS communication, e.g. on a PC.
Manufacturer-specific parameters of the SAMSON Type 3785 PROFIBUS-PA Positioner have been marked with (M).

Parameter overview:

Device identification

Loop/tag identification	TAG_DESC
Firmware version communication/control	SW_REVISION
Hardware version electronics/mechanics	HW_REVISION
Positioner manufacturer	DEVICEMAN_ID
Valve manufacturer	VALVE_MAN
Actuator manufacturer	ACTUATOR_MAN
Type number positioner	DEVICE_ID
Serial number positioner	DEVICE_SER_NUM
Serial number of the corresponding actuator	ACTUATOR_SER_NUM
Serial number of the corresponding valve	VALVE_SER_NUM
Type of protection	DEVICE_CERTIFICATION
Description	DESCRIPTOR
Message	DEVICE_MESSAGE
Date 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

Start-up

Security locking	SECURITY_LOCKING
Coldstart	FACTORY_RESET
Warmstart	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)

Device setting

Configuration

Write protection	WRITE_PROTECT_SWITCH (M)
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
Direction of action	INCREASE_CLOSE
Local operation enable	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

End position when reference variable is below limit value	SETP_CUTOFF_DEC
End position when reference variable is above limit value	SETP_CUTOFF_INC
Characteristic selection	CHARACT
Characteristic type	CHARACT_TYPE

Parameters

Proportional-action coefficient KP_Y1	SERVO_GAIN
Derivative-action coefficient KD	SERVO_RATE
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)

Diagnosis

Diagnosis	DIAGNOSIS
Diagnosis extension	DIAGNOSIS_EXTENSION
Simulation	SIMULATE
Device status	CHECK_BACK
Valve travel, total	TOTAL_VALVE_TRAVEL
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)

List of 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. 0 = Single-acting with spring return 1 = Double-acting without spring return 0
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, see also Chapters 2.1 and 2.2. 0 = Integral — attachment in combination with a SAMSON Type 3277 Linear Actuator 1 = NAMUR — attachment according to DIN/IEC 534 (NAMUR) 0
Binary input IDENT_BINARY_INPUT (M) States: Default:	Describes whether and how the binary switch option is evaluated 0 = not evaluated 1 = actively open 2 = actively closed 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 SLF_CALIB_STATUS States:	Manufacturer-specific status of the calibration procedure started with SELF_CALIB_CMD. 0 = Undetermined 2 = Aborted 4 = Defective 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 option 30 = Zero error 254 = Successful
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 of pneumatic system (during initialization) 254 = Successful 255 = No valid data at the application 0
Characteristic selection CHARACT States: Default:	Characteristic selection for the creation of assignments between the reference variable and valve travel/angle range. 0 = Linear 1 = Equal percentage 2 = Equal percentage reverse 3 = Customized (supported by 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) for a description of the adjusted characteristic.
Coldstart FACTORY_RESET States: Default:	Command for reset to default values. 0 = No action 1 = Reset application to default values. All device data are reset to default values. The positioner moves to fail-safe position and must be reinitialized. Only the device identification parameters are retained. 2 = Reset device identification to default values. All device identification parameters are reset. Application parameters are retained. 0
Controlled variable x READBACK	Current position with status Controlled variable x in % related to the travel/angle of rotation range
Correction value OUT	Correction value calculated by the function block from the set point in [mm] or [degree]. This value can be entered in the "local override"(LO) operating mode.
Date last calibration DEVICE_CALIB_DATE	Indicates the last calibration date of the field device.
Date last configuration DEVICE_CONFIG_DATE	Indicates the last configuration date of the field device.

Date last maintenance VALVE_MAINT_DATE	Indicates the last maintenance date of the field device.
Date of installation DEVICE_INSTALL_DATE	Indicates the date on which the field device was installed.
Dead band Xtot DEAD_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. 0 to 240 s. The delay time is determined from the min. transit time during initialization and can be adapted. 10 s
Derivative-action coefficient KD SERVO_RATE 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 for entering texts on the description of the application, stored in the field device. Length: 32 characters
Device reset DEVICE_RESET_CMD States Default:	Command to reset the device 0 = No action 1 = Reset the device 0
Device status CHECK_BACK Message type: States:	Detailed device information, coded bit-wise encoded which enables several simultaneous messages, see also Chapter 9. A: Dynamic messages; they are automatically reset by readout. R: Static mess.; they are retained, as long as the event is imminent in the field device 0 = No message 1 = Message active
Diagnosis DIAGNOSIS Message type: States:	Detailed device information, coded bit-wise encoded which enables several simultaneous messages, see also Chapter 9. A: Dynamic messages; they are automatically reset by readout. R: Static messages; they are retained, as long as the event is imminent in the field device. 0: No message 1: Message active

Diagnosis extension DIAGNOSIS_EXTENSION Message type: States:	Additional manufacturer-specific detailed device information, coded bit-wise encoded which enables several simultaneous messages, see also Chapter 9. A: Dynamic messages; they are automatically reset by readout. R: Static messages; they are retained, as long as the event is imminent in the field device. 0: No message 1: Message active
End position when reference variable is above the limit value SETP_CUTOFF_INC Default:	If the reference variable exceeds the entered limit, the valve moves in 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 in its absolute end positions. Constraints specified in the function "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.
End 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 in 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 in its absolute end positions. Constraints specified in the function "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.
Fail-safe action FSAFE_TYPE States: Default:	Defines reaction when communication failure or device start-up is recognized. 0 = Adjust to fail-safe value 1 = Adjust to/save last valid set point 2 = Move to fail-safe position determined by spring action 1
Fail-safe position 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 the initialization process 0 = Not initialized 1 = Opening in direction of the 100 % position 2 = Closing in direction of the 0 % position 3 = None/saving (position is retained)
Fail-safe time FSAFE_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 3600s 10 s

Fail-safe value reference variable FSAFE_VALUE Default:	Substitute value for set point (reference variable w or w_rcas) when communication failure is recognized. 0
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
Local operation enable LOCAL_OP_EN States: Default:	Enables local operation (zero/initialization button) option. In case of communication failure of more than 30 sec, local operation is enabled. 0 = Disabled 1 = Enabled 1
Message DEVICE_MESSAGE	Available space for entering texts 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 toward the actuator, and for attachment according to NAMUR, the arrow must point away from the actuator. 0 = Arrow pointing away from the actuator 1 = Arrow pointing toward the actuator 1

Operating mode, required/valid MODE_BLK/TARGET-MODE	Positioner operating mode. Up to Firmware Version K 1.20: 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 (direction of action), 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 (direction of action), 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 in 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 (warmstart)** The response of the positioner to the warmstart 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 caused by the following events: Start-up of the positioner (warmstart). Elapsing of the DP-watchdog through interruption of the cyclic communication with a Master Class 1 (not applicable, when communication is terminated properly). Elapsing of FSAFE_TIME 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 (not yet applicable for version K 1.30). 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).
Positioner manufacturer DEVICE_MAN_ID	Clearly identifies the manufacturer of the field device. Read-only.
Product number positioner DEVICE_PRODUCT_NUM (M)	Manufacturer's product number of the positioner.
Proportional-action coefficient KP_Y1 SERVO_GAIN **Proportional-action coefficient KP_Y2** Default:	Proportional-action coefficient for supply air. In writing, the value is written to KP_1 (supply air) and KP_Y2 (exhaust air). Proportional-action coefficient exhaust air. In 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 attained 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 on the following page might have to be adapted to the modified operating conditions in order to achieve optimum control behavior.

Type of actuator	Rated travel/ nom. angle	Transit time				KD	KP_Y1 Supply air	KP_Y2 Exhaust air
		min.	Spring action	Open	Closed			
Rotary actuator		-	-	> 0.7 s	> 0.7 s	0.12	0.5	0.5
			Closing	> 0.7 s	< 0.7 s	0.12	0.5	0.1
			Closing	< 0.7 s	> 0.7 s	0.12	0.1	0.5
			-	< 0.7 s	< 0.7 s	0.12	0.1	0.1
			Opening	> 0.7 s	< 0.7 s	0.12	0.1	0.5
			Opening	< 0.7 s	> 0.7 s	0.12	0.5	0.1
Linear actuator	≥ 60 mm	< 10 s	-			0.12	0.5	0.5
		≥ 10 s	-			0.12	3.0	4.0
	< 60 mm	< 10 s	-	> 0.7 s	> 0.7 s	0.12	0.5	1.2
			Extending	> 0.7 s	< 0.7 s	0.12	0.5	0.8
			Extending	< 0.7 s	> 0.7 s	0.12	0.3	1.2
			-	< 0.7 s	< 0.7 s	0.12	0.3	0.8
			Retracting	> 0.7 s	< 0.7 s	0.12	0.3	1.2
			Retracting	< 0.7 s	> 0.7 s	0.12	0.5	0.8
		≥ 10 s	-			0.12	3.0	4.0

Rated travel/nominal angle RATED_TRAVEL Default:	Rated travel [mm] or nominal angle [degree] of the valve. Nominal operating range 0.0 to 255.9 mm or 0.0 to 120.0 degrees. 15 mm
Reference variable range PV_SCALE Default:	Scaling 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 in "AUTO"/"MANUAL" operating mode, see also reference variable range.
Reference variable w_rcas RCAS_IN/RCAS_OUT	Set point with status. Reference variable w in "RCAS" operating mode, see also reference variable range.
Security locking SECURITY_LOCKING Default:	Storage position for a password to use the host, serves to check the access rights (16-bit unsigned integer format). 0x2457
Serial no. actuator ACTUATOR_SER_NUM	Serial number of the positioner's corresponding actuator. 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 the device type number.
Serial no. valve VALVE_SER_NUM	Serial number of the positioner's corresponding valve. Length: 16 characters
Set point deviation e SETP_DEVIATION	System deviation in %
Simulation SIMULATE	Option to indicate a value for the current READBACK position, including status, for simulation.
State binary input BINARY_INPUT (M) States: Default:	Switching state of binary switch. 0 = not active 1 = active 254 = not evaluated 0
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. See also DELAY_TIME. 0.1 to 10.0 % 5 %
Tolerated overshoot TOL_OVERSHOOT (M) Default:	If the set point deviation e exceeds the overshoot, the pulse adaptation reduces the minimum pulses in the moving direction that 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 moving directions after two complete amplitudes within the overshoot range. Adjustment range 0.01 to 10.00 % of the rated travel/nominal angle. 0.5 %
Transducer state TRANSDUCER_STATE (M) States:	Currently valid state of the transducer block. 0 = See valid operating mode 1 = Forced venting active 2 = Lower travel limit active 3 = Upper travel limit active 4 = End position active at < 5 = End position active at >
Transit time minimum OPEN ACT_STROKE_TIME_INC	The min. transit time OPEN (in direction of 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).

Transit time minimum CLOSED ACT_STROKE_TIME_DEC	The min. transit time CLOSED (in direction of 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 CLOSED TRAVEL_RATE_DEC Default:	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 in direction of the 0 % position. Range 0 to 240 s. 0 s
Transit time required OPEN TRAVEL_RATE_INC 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 the100 % position. Range 0 to 240 s. 0 s
Transmission code TRANSM_CODE (M) States: 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-degree segment 4 = S120, 120-degree 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 pivot 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 of 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 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 to the entered value. Range 0.0 to 120.0 %. The characteristic is not adapted. 100.0 %
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 is not determined.

Travel /angle of rotation range 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/angle of rotation range is always related to the rated travel/angle entered. When selecting the operating range, make sure that it is not smaller than 1/4 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
Type no. positioner DEVICE_ID (M)	Type number of the field device.
Type of protection DEVICE_CERTIFICATION	Describes the device's type of protection.
Valve manufacturer VALVE_MAN	Clearly identifies the manufacturer of the valve. Length: 16 characters
Valve position feedback, discrete POS_D States:	Discrete valve position feedback with status 0 = Not initialized 1 = Closed (x < 0.5%) 2 = Open (x > 99.5%) 3 = Intermediate
Valve travel limit value TOT_VALVE_TRAV_LIM Default:	Total valve travel limit value. Range 0 to 16 500 000. 1 000 000
Valve travel, total TOTAL_VALVE_TRAVEL	Total valve travel, sum of nominal duty cycles (double up-and-down travels). Maximum value: 16 500 000
Valve type VALVE_TYPE States: Default:	Describes the valve design. 0 = Control valve with linear motion of the connecting element 1 = Control valve with rotary motion of the connecting element, part turn, rotary motion 0
Write protection WRITE_PROTECT_SWITCH (M) States:	Switching 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. The only way to activate the write protection option is by using the switch installed in the device. 0 = Not write protected 1 = Write protected

9. Messages and diagnosis

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

9.1 Diagnosis messages

Hardware error electronics

This message is issued if a defect is detected in the electronics module during cyclic check. Repair required.

Hardware error mechanics

This message is issued if, during cyclic check, a defect is detected in the mechanics module. Repair required.

Memory checksum error

This message is issued if the cyclic check determines that a memory block has been modified without verification.
Static message, remains active until the event is located in the field device.

Measurement error

The internal A/D converter does not function properly within its specified time frame, or the measured values are not within the physical measuring range limits. In case reset is not successful after a warmstart, repair is required.
Static message, remains active until the event is located in the field device.

Device not initialized

The device has not been initialized, or a coldstart was carried out.
Automatic reset after initialization has been successfully completed.

Auto initialization error

Initialization was not successful. For detailed error messages, see chapter 9.4.
Automatic reset after initialization has been successfully completed.

Zero point error (final pos.)

This message indicates any changes exceeding the value determined during the initialization or zero adjustment by more than ±5 %.
Possible sources of error:
– Worn-out valve plug/seat
– Impurities between valve plug/seat
Automatic reset after zero adjustment has been successfully completed.

Configuration incorrect

Message indicating that incorrect values have been entered.
After downloading data to the positioner, it responds with the message that the downloaded value is not within the permissible range. The previous value is retained.
Reset by acknowledgement.

Warmstart (restart) completed

This message is displayed if the device was RESET via warmstart.
This RESET is carried out following a coldstart after an electrical power failure or by indicating "DEVICE_RESET_CMD = 1".
Automatic reset when the message is read out.

Coldstart (new start) completed

This message is displayed if the device was RESET via coldstart and started up with default values for the control loop.
This RESET is carried out by indicating "FACTORY_RESET = 2".
The device must be reinitialized.
Automatic reset when the message is read out.

Maintenance required

The current value of the total valve travel lies above the limit value entered or preset.
When this limit value is preset slightly below the value determined for a reference valve, the positioner automatically signals that the valve needs to be maintained so that possible failure is prevented.
Reset via command "SELF_CALIB_CMD = 7" (reset total valve travel).

Characteristic invalid

This message is generated if one of the following applies:
- Errors are recognized during transmission of the characteristic to the device.
- For a user-defined characteristic, the input values were not entered in ascending order.
- For the user-defined characteristic an inclination value >16 was entered.

In case a Characteristic invalid error occurs, the characteristic is automatically switched from user-defined to linear after downloading the data to the positioner.
Automatic reset after a correct characteristic has been transmitted.

More information available

This message is issued if diagnosis extension messages have been generated.

9.2 Diagnosis extension messages

Binary input is active

This message is generated if the condition for activating the binary input has been fulfilled.

Invalid start values for min. pulses range 1

The pulse search for the range 0 to 20 % relative to the rated travel/nominal angle has not been completed yet by adaption of the pulse-pause ratio.
Automatic reset after successful adaption for supply and exhaust air pulses.

Invalid start values for min. pulses range 2

The pulse search for the range 20 to 80 % relative to the rated travel/nominal angle has not been completed yet by adaption of the pulse-pause ratio.
Automatic reset after successful adaption for supply and exhaust air pulses.

Invalid start values for min. pulses range 3

The pulse search for the range 80 to 100 % relative to the rated travel/nominal angle has not been completed yet by adaption of the pulse-pause ratio.
Automatic reset after successful adaption for supply and exhaust air pulses.

Error in forced venting option

The option module is not screwed on tight or the coding jumper is not set for missing option forced venting.

9.3 "CHECK-BACK" messages

Fail-safe position (MODE = OUT OF SERVICE)

The fail-safe position was activated by the device and can be caused by selecting operating mode "OUT OF SERVICE", by activating the forced venting option or by communication failure.
The device switches to the "OUT OF SERVICE" mode.

Request for local operation

This message is issued if local operation was required, but not enabled (LOCAL_OP_ENA = 0) .
Automatic reset when the message is read out.

Local operation

Forced venting active

The forced venting option 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.

Automatic reset when a 6 V DC to 24 V DC signal is applied to terminals +81 and –82.

Static data changed

This message is issued after device data have been changed, thus providing a control function for (unintentional/unauthorized) modifications of the originally adjusted values.
Automatic reset when the message is read out.

Simulation mode, i.e. values are not derived from the process

This message is generated when the device is in simulation mode. In this case, the controlled variable x is indicated.

Error - see DIAGNOSIS messages

The device has a defect. A message from the DIAGNOSIS area provides exact localization.

Control loop error

This message is displayed when the positioner fails 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 fast (small travel volume)
  Remedy: Reduce supply air pressure as per chapter 3.1.2 or install a signal pressure throttle.
- Supply air failure/supply air insufficient
- Filter clogged
- Solenoid valves oiled-up
- Actuator diaphragm ruptured
- Actuator springs broken
- Considerable increase of friction at the control valve
- Control valve blocked

The messages are indicated by bit 7 and bit 13 of the CHECKBACK parameter (refer to table on pages 38/39). Bit 7 is automatically reset, whereas bit 13 is reset by means of the "SELF_CALIB_CMD = 10" command (reset 'control loop fault').

Positioner inactive (MODE = out of service)

This message is generated if the positioner is in the "OUT OF SERVICE" mode.

Device in selftest mode (MODE = out of service)

This message is generated if the device is in the initialization phase or adjusting electrical zero.

Limit value of total valve travel exceeded

The current value of the total valve travel lies above the limit value entered or preset.
If this limit value is preset slightly below the value determined for a reference valve, the positioner automatically signals that the valve needs to be maintained so that possible failure is prevented. Reset via "SELF_CALIB_CMD = 7" command (reset total valve travel)

9.4 Initialization messages

Not defined

The device has not been initialized, or a coldstart was carried out.
Automatic reset after confirmation.

Aborted

The initialization routine was aborted by the user.
Automatic reset after acknowledgement.
If the device was already successfully initialized and no coldstart was performed, control operation restarts.

Defective mechanics/pneumatic section

The initialization routine recognizes a constant change or no 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 hung
- For NAMUR attachment: lever not correctly secured to the shaft of the adapter housing
- Connecting cable between logic and displacement sensor board disengaged.

Timeout

The initialization routine cannot move the valve to end position within 240 seconds. Initialization is aborted.
Possible sources of error:

- Large difference between static and sliding friction at the control valve (oscillation)
  is generated as an individual message
- Supply pressure unstable
- Air capacity too low.

Incorrect selection of rated travel or transmission

The maximum determined travel which is read out as per cent value of the rated travel/angle is smaller than the selected rated travel/angle. This message is only generated in initialization mode "related to nominal range"; 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 pressure too low. The supply pressure should be minimum 0.4 bar above the upper spring range value (see chapter 3.1.2).

Air leakage of pneumatic system

The actuator stalls for a few seconds when the duty cycle is being determined initially. This time is used by initialization to check the pneumatic system for leaks. If the control valve moves more than 9.3 % from this resting position within 7 seconds, the relevant message is issued and, additionally, an initialization warning is issued. Warning, initialization is not aborted. Possible sources of error:

– Actuator not tight
– Signal pressure connection not tight.

Initialization status: Determining mechanical stops

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

Initialization status: Determining 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.

Initialization aborted through activation of forced venting option

If the implemented option forced venting is activated, the initialization procedure is aborted. For implemented option forced venting it is required that between 6 V DC and 24 V DC be applied to terminals +81 and –82.

Zero point error

The determined zero point does not lie within the acceptable tolerance limit of max. ±5 % by the internal absolute value for the detection of measured values. Initialization is aborted.
To eliminate this error, mechanical zero must be adjusted (see chapter 4.4.1).
The yellow pointer of the displacement sensor must then be approximately in alignment with the marking on the cover plate.

Proportional band restricted too much

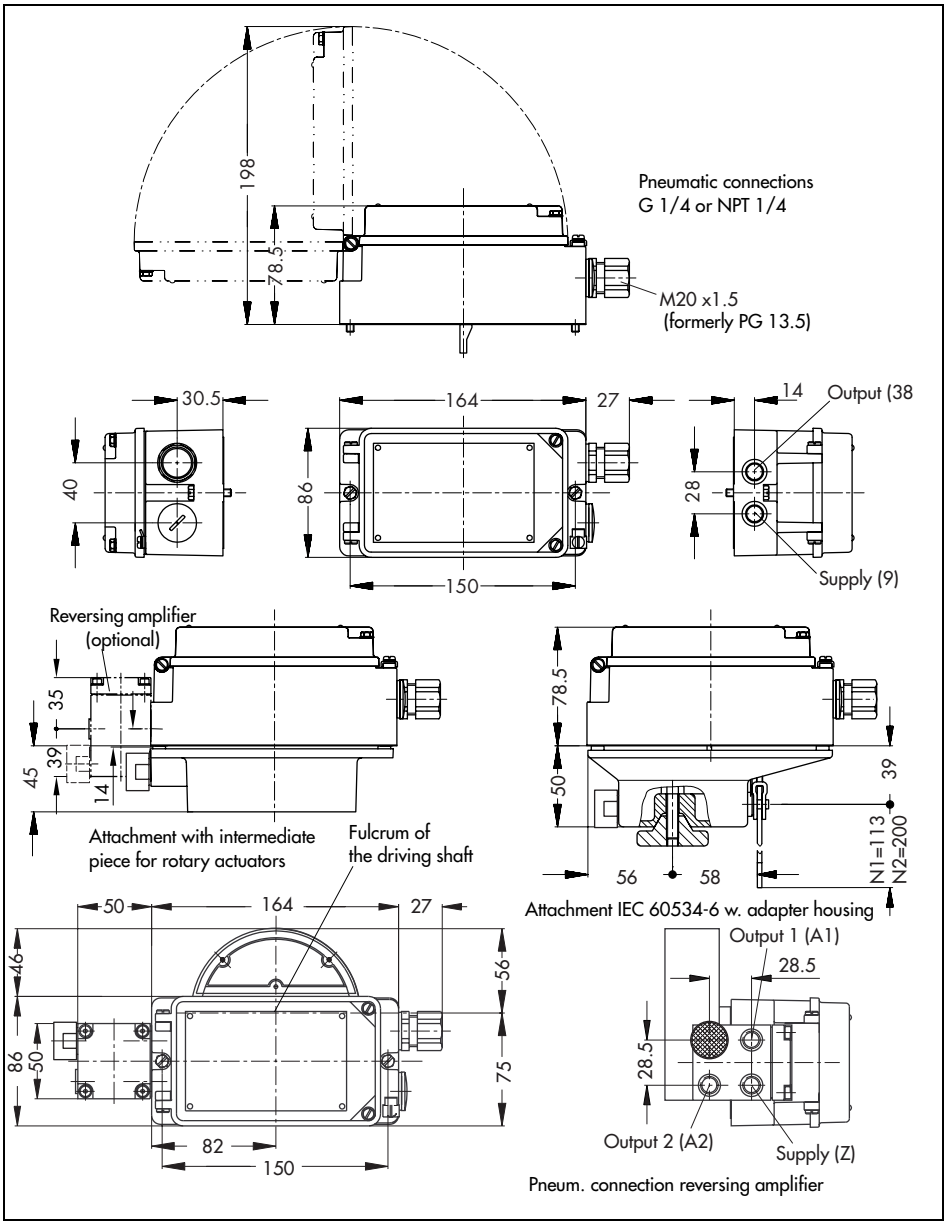
Even the smallest permissible pulses still cause too large changes in travel. Initialization is aborted.
Possible sources of error:

– Supply pressure too high
– Missing signal pressure throttle for actuators with small volumes
– Fault 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.

Dimensional diagram



(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.

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

(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.
Extracts or changes shall require the prior approval of the Physikalisch-Technische Bundesanstalt.

Physikalisch Technische Bundesanstalt - Bundesallee 100 -D - 38116 Braunschweig

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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**
Ui ≤ 20 V	Ui ≤ 24 V
Ii ≤ 220 mA	Ii ≤ 285 mA

The effective internal capacitance is Ci < 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: Ui ≤ 16 V
Ii ≤ 52 mA
Pi ≤ 169 mW

The effective internal capacitance is Ci = 60 nF
The effective internal inductance is Li = 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: Ui ≤ 28 V
I ≤ 115 mA

The effective internal capacitance is Ci < 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: Uo ≤ 5.88 V
Io ≤ 1 mA

The permissible maximum external capacitance is for

Gas classification group IIC Co ≤ 43 µF
Gas classification group IIB Co ≤ 1000 µF

The permissible maximum external inductance is for

Gas classification group IIC Lo ≤ 1 H
Gas classification group IIB Lo ≤ 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.
Extracts or changes shall require the prior approval of the Physikalisch-Technische Bundesanstalt.

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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. 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: Ex **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	Io/Po
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 ≤ 43 µF	C ≤ 1000 µF
Lo ≤ 1 H	Lo ≤ 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 Lo = 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
Ci negligible Li negligible

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

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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.

Ptb09Add-22.doc

Installation Manual for apparatus certified by CSA for use in hazardous loctions.

The **FISCO Concept** allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criteria for interconnection is that the voltage **(U_i)** the current **(Ii)** and the power **(Pi)** which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage **(Uo)** the current **(I_o)** and the power **(Po)** levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance **(Ci)** and inductance **(Li)** of each apparatus (other than the termination) connected to the fieldbus must be less than or equal to **5 nF** and **10 µH** respectively.

In each segment only one active device, normally the associated apparatus, is allowed to provide the necessary energy for the fieldbus system The allowed voltage **Uo** of the associated apparatus is limited to the range of **14V DC** to **24V DC**. All other equipment connected to the bus cable has to be passive, meaning that they are not allowed to provide energy to the system, except to a leakage current of 50 mA for each connected device. Separately powered equipment needs a galvanic isolation to assure that the intrinsically safe fieldbus circuit remains passive.

The cable used to interconnect the devices need to have the parameters in the following range:

Loop resistance R':	15 ... 150 Ohm/km
Inductance per unit length L':	0.4 ... 1 mH/km
Capacitance per unit length C':	80 ... 200 nF/km

C' = C' line/line + 0.5 C' line/screen, if both lines are floating or, C' = C' line/line + C'line/screen, if the screen is connected to one line

Length of spur cable:	< 30 m
Length of trunk cable:	≤ 1 km

At each end of the trunk cable an approved infallible line termination with the following parameters is suitable:

R = 90 ... 100 Ohm	C = 0 ... 2,2 µF

One of the allowed terminations might already be intergrated in the associated apparatus.

The number of passive devices connected to the bus segment is not limited due to I S. reasons. If the above rules are respected, the inductance and capacitance of the cable will not impair the intrinsic safety of the installation.

Notes:

1. Certified associated apparatus must be installed in accordance with manufacturer instructions
2. Certified associated apparatus must meet the following requirements:

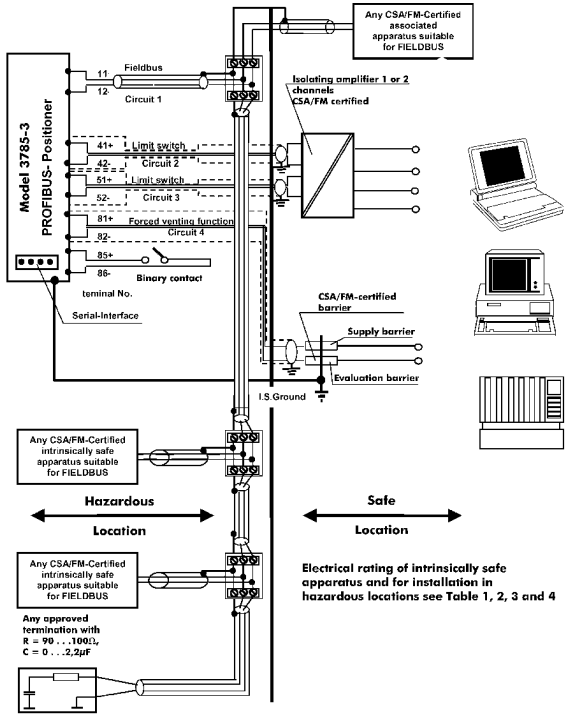
   Uo or Voc or Vt ≤ Ui or Vmax, Io or Isc or Ii or Imax. Po or Pmax ≤ Pi or Pmax
3. The maximum non-hazardous area voltage must not exceed 250 V.
4. The installation must be in accordance with the Canadian Electrical code Part 1.
5. Each set of wires must be provided with grounded shield. The shield must extend asclose to the terminal(s) as possible and it must be grounded shield at I. S. Barrier ground.
6. Caution: Use only supply wires suitable for 5 °C above surrounding.
7. Warning: Substitution of components may impair intrinsic safety. PE = I. S. Ground
8. The polarity for connecting 11 and 12 is of no importance due to an internal rectifier.
9. FISCO concept applies to fieldbus / circuit only.
10. Entity parameters apply to circuit 2, 3 and 4 and further required to meet the following conditions: Co ≥ C_i + Ccable, Lo ≥ Li + Lcable

Intrinsically safe if installed as specified in manufactureres installation manual.

CSA-certified for use in hazardous locations:

Class I, Zone 0 Ex ia IIC T6
Class I, Division 1, Groups A, B, C, D; Class II, Division 1, Groups F + G

Fieldenclosure: Type 4 Enclosure



Electrical rating of intrinsically safe apparatus and for installation in hazardous locations see Table 1, 2, 3 and 4

Installation Manual for apparatus certified by CSA for use in hazardous loctions.

Electrical rating of intrinsically safe apparatus and apparatus for installation in hazardous locations.

Table 1: Maximum values

	Fieldbus ⊘		Limit-switches Induktiv	Forced venting-function	Binary-input	Serial-Interface	
	FISCO					activ	passive
Circuit No.	1		2 and 3	4	5	6	6
Terminal No.	11 / 12		41 / 42 and 51 / 52	81 / 82	85 / 86	plug	
Groups	§	§§	#/#	#/#	#/#	#/#	#/#
U_i or V_{max} [V]	20	24	16	28	V_{0C} 5,88	V_{0C} 5,88	V_{max} 20
I_i or I_{max} [mA]	360	380	25/52	115	I_{SC} 1	I_{SC} 55	I_{max} 60
P_i or P_{max} [W]	1,54	2,58	64/169 [mW]	#/#	7,2 [mW]	298 [mW]	250 [mW]
C_i [nF]	5		60	5,3	[43 µF]	[42 µF]	0
L_i [µH]	10		100	0	[1 H]	[10 mH]	0

⊘ **Notes: Fieldbus: § = Class I Groups: A, B, C, D; IIC. / Class II Groups E, F & G.**
§§= Class IGroups C, D; IIB. / Class II Groups E, F & G.

1. Entity parameters must meet the following requirements:

   U_0 or V_{0C} or $V_i \leq U_i$ or V_{max} , I_0 or I_{0C} or $I_i \leq I_i$ or I_{max} ,P_0 or $P_{max} \leq P_i$ or P_{max}
   $C_a \geq C_i + C_{cable}$ and $L_a \geq L_i + L_{cable}$

2. Install in accordance with the Canadian Electrical Code Part I

3. Cable entry M 20 x1,5 or metalconduit acc. to dwg. No. 1050-0539 or 1050-0540

Table 2: CSA – certified barrier parameters of circuit 4

Barrier	Supply barrier				Evaluation barrier		
	V_{0C}	R_{min}	I_{0C}	P_{max}	V_{0C}	R_{min}	I_{0C}
circuit 4	≤28V	≥300Ω	≤115mA	≤1W	≤28V	#	0mA

The correlation between temperature classification and permissible ambient temperature ranges is shown in the table 3 below:

Table 3:

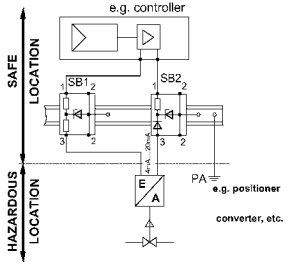
Temperatur class	Permissble ambient temperature range
T6	+60°C
T5	-40°C ≤ T_a ≤+70°C
T4	+80°C

For the Model 3785–32 . . . Positioner the correlation between temperatur classification, permissible ambient temperature ranges and maximum short- circuit current is shown in the table 4 below:

Table 4:

Temperture class	Permissible ambient temperature range	Maximum short-circuit current
T6	- 40°C ... 45°C	52mA
T5	- 40°C ... 60°C	
T4	- 40°C ... 75°C	
T6	- 40°C ... 60°C	25mA
T5	- 40°C ... 80°C	
T4	- 40°C ... 80°C	

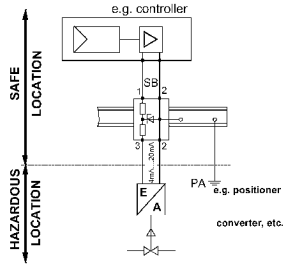
Circuit diagram of a ground- free signal circuit. *(forced venting function circuit 4)*



Ground-free control signal circuit with two barriers

In grounded signal circuits with only one barrier, the return line must be grounded or included in the potential equalization network of the system.

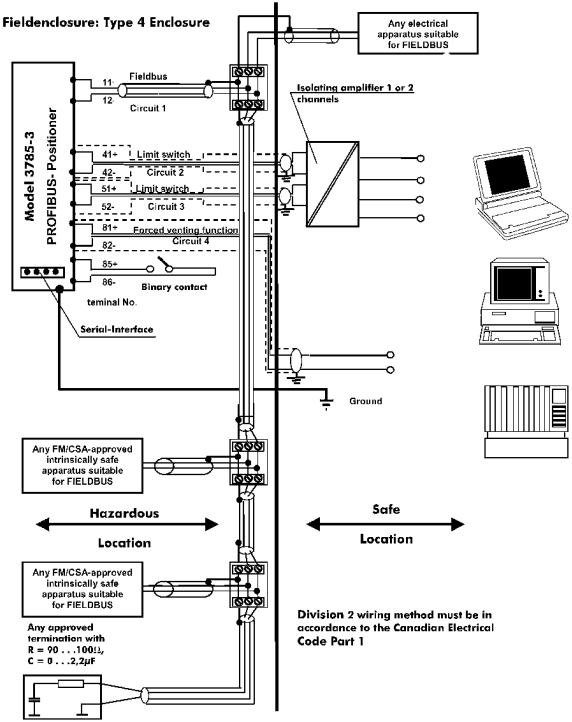
Circuit diagram of a grounded signal circuit *(forced venting function circuit 4)*



Ground signal circuit with one barriers

CSA certified for hazardous locations:
Class I, Zone 2, Ex nA IIC T6
Class I, II, Division 2, Groups A, B, C, D, F + G

Fieldenclosure: Type 4 Enclosure



Installation Manual for apparatus approved by FMRC for use in hzardous loctions.

The **FISCO-Concept** allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criteria for interconnection is that the voltage **(Ui or Vmax)** the current **(Ii or Imax)** and the power **(P! or Pmax)** which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal or greater than the voltage **(Uo or Voc)** the current **(Io or Isc)** and the power **(Po or Pmax)** levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance **(Ci)** and inductance **(Li)** of each apparatus (other than the termination) connected to the fieldbus must be less than or equal to **5 nF** and **10 µH** respectively.

In each segment only one active device, normally the associated apparatus, is allowed to provide the necessary energy for the fieldbus system The allowed voltage **(Uo or Voc)** of the associeted apparatus is limited to the range of **14V DC**. to **24V DC**. All other equipment connected to the bus cable has to be passive, meaning that they are not allowed to provide energy to the system, except to a leakage current of **50 µA** for each connected device. Separately powered equipment needs a galvanic isolation to assure that the intrinsically safe fieldbus circuit remains passive.

The cable used to interconnect the devices need to have the parameters in the following range:

Loop resistance R':	15 ... 150 Ohm/km
Inductance per unit length L':	0.4 ... 1 mH/km
Capacitance per unit length C':	80 .. 200 nF/km

C' = C' line/line + 0,5 C' line/screen, if both lines are floating or, C' = C' line/line + C'line/screen, if the screen is connected to one line

Length of spur cable:	< 30 m
Length of trunk cable:	≤ 1 km

At each end of the trunk cable an approved infallible line termination with the following parameters is suitable:

R = 90 ... 100 Ohm	C = 0 ... 2,2 µF

One of the allowed terminations might already be intergrated in the associated apparatus.

The number of passive devices connected to the bus segment is not limited due to I.S. reasons. If the above rules are respected, the inductance and capacitance of the cable will not impair the intrinsic safety of the installation.

Notes:

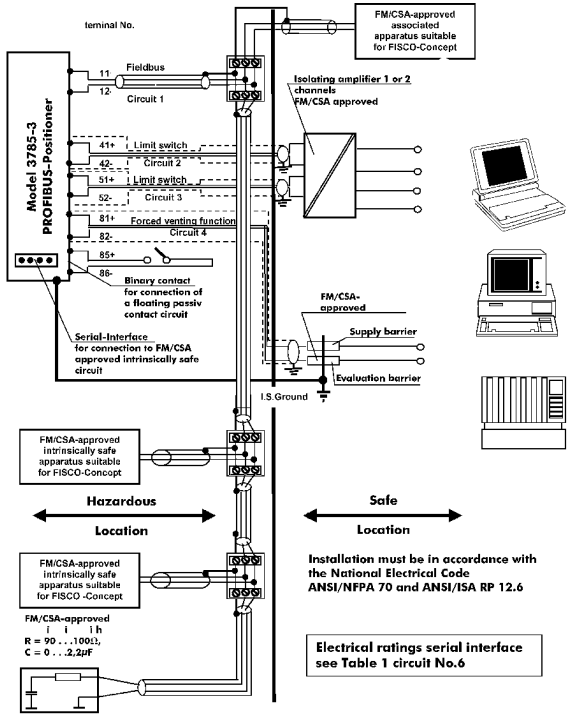
1. FM-Approved associated apparatus must be installed in accordance with manufacturer instructions
2. FM-Approved associated apparatus must meet the following requirements:

   Uo or Voc or Vt ≤ Ui or Vmax, Io or Isc or Ii or Imax, Po or Pmax ≤ Pi or Pmax
3. The maximum non-hazardous area voltage must not exceed 250 V.
4. The installation must be in accordance with the National Electrical Code (ANSI/NFPA 70) and (ANSI/ISA RP 12.6)
5. Each set of wires must be provided with grounded shield. The shield must extend asclose to the terminal(s) as possible and it must be grounded shield at I. S. Barrier ground.
6. Caution: Use only supply wires suitable for 5 °C above surrounding.
7. Warning: Substitution of components may impair intrinsic safety. PE = I. S. Ground
8. The polarity for connecting 11 and 12 is of no importance due to an internal rectifier.
9. **FISCO-Concept** applies to fieldbus / circuit only.
10. Entity parameters apply to circuit 2, 3 and 4 and further required to meet the following conditions: Co ≥ C_i + Ccable, Lo ≥ Li + Lcable

FMRC-approved for use in hazardous locations:

Class I, Zone 0, A Ex ia IIC T6
Class I, II, III, Division 1, Groups A, B, C, D, E, F + G

Field enclosure: NEMA Type 4X



Installation Manual for apparatus approved by FMRC for use in hazardous loctions.

Electrical rating of intrinsically safe apparatus and apparatus for installation in hazardous locations.

Maximum values Table 1:

	Fieldbus ★		Limit-switches Induktiv	Forced venting-function	Binary-input	Serial-Interface	
	FISCO					activ	passive
Circuit No.	1		2 and 3	4	5	6	6
Terminal No.	11 / 12		41 / 42 51 / 52	81 / 82	85 / 86	plug	
Groups see below	**I**	**II**	#/#	#/#	#/#	#/#	#/#
U_i or V_{max}	20V	24V	16V	28V	#/#	#/#	20V
U_o or V_{oc}	#/#				5,88V	5,88V	#/#
I_i or I_{max}	360mA	380mA	25/52mA	115mA	#/#	#/#	60mA
I_o or I_{sc}	#/#				1	55	#/#
P_i or P_{max}	1,54W	2,58W	64/169mW	#/#			250mW
P_o or P_{max}	#/#				7,2mW	298mW	#/#
C_i	5nF		60nF	5,3nF	0nF	#/#	0nF
C_a	#/#				43 µF	42 µF	#/#
L_i	10 µH		100 µH	0µH	0µH	#/#	0µH
L_a	#/#				1 H	10 mH	#/#

★ **Notes: Fieldbus: I = Groups A, B, C, D, E, F & G; IIC, IIB.**
II=Groups C, D, E, F & G; IIB.

1. Entity parameters must meet the following requirements:

   U_o or V_{oc} or $V_t \leq U_i$ or V_{max} , I_o or I_{sc} or $I_t \leq I_i$ or I_{max} , P_o or $P_{max} \leq P_i$ or P_{max}
   $C_a \geq C_i + C_{cable}$ and $L_a \geq L_i + L_{cable}$

2. Installation must be in accordance with the National Electrical Code ANSI/NFPA 70 and ANSI/ISA RP 12.6

3. Cable entry M 20 x1,5 or metalconduit acc. to dwg. No. 1050-0539 or 1050-0540

FMRC – approved barrier parameters of circuit 4

Table 2:

Barrier	Supply barrier				Evaluation barrier		
	V_{oc}	R_{min}	I_{sc}	P_0	V_{oc}	R_{min}	I_{sc}
circuit 4	≤28V	≥392Ω	≤115mA	≤1W	≤28V	#	0mA

The correlation between temperature classification and permissible ambient temperature ranges is shown in the table 3 below:

Table 3:

Temperatur classification	Permissble ambient temperature range
T6	+60°C
T5	-40°C ≤ T_a ≤+70°C
T4	+80°C

For the Model 3785–32 . . . Positioner the correlation between temperatur classification, permissible ambient temperature ranges and maximum short- circuit current is shown in the table 4 below:

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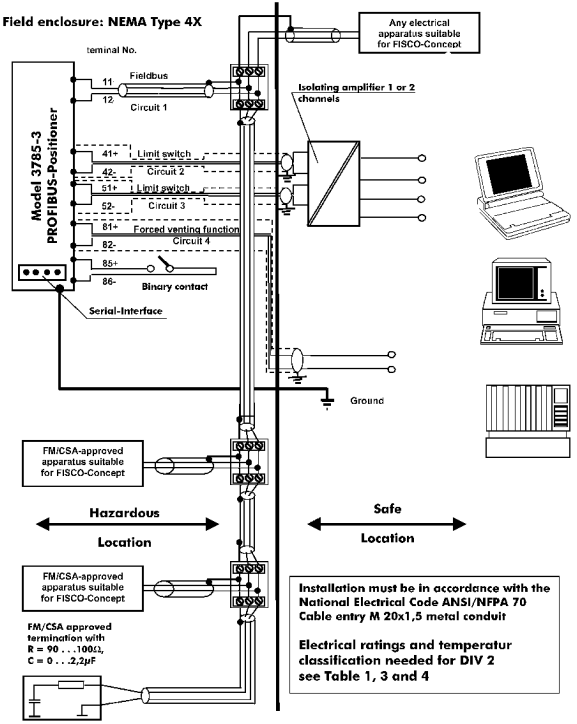
T6	- 40°C ... 60°C	25mA
T5	- 40°C ... 80°C	
T4	- 40°C ... 80°C	

FMRC-approved for hazardous locations:

Class I, Division 2, Groups A, B, C, D. Class II, III, Division 2, Groups, F & G

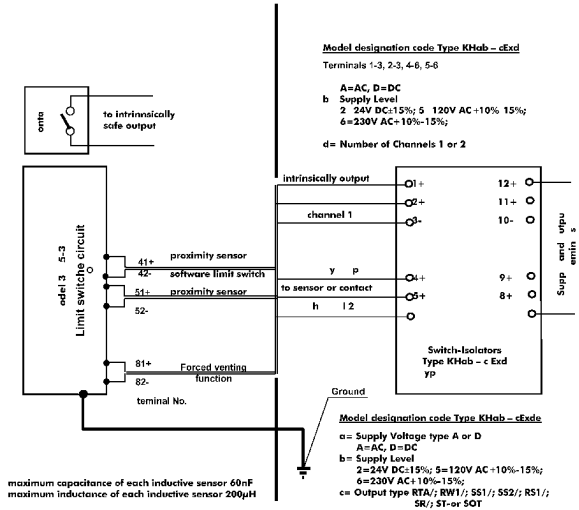
Field enclosure: NEMA Type 4X



Installation must be in accordance with the National Electrical Code ANSI/NFPA 70 Cable entry M 20x1,5 metal conduit

Electrical ratings and temperatur classification needed for DIV 2 see Table 1, 3 and 4

Installation drawing Control Relay Hab – cEx de with proximity sensors typ SJ-b-N



maximum capacitance of each inductive sensor 60nF
maximum inductance of each inductive sensor 200µH

The total series inductance and shunt capacitance of shield wiring must be restricteto the following maximum values

Control Relay Terminal No.	Groups	L [mH]	C [µF]	V_{OC} [V]	I_{SC} [mA]
1 3; 2 3	A + B	84,8	1,27	↑ ↓	↑ ↓
	C E	299	3 82		
	D F G	744	10 2		

SAMSON AG · MESS- UND REGELTECHNIK
Weismüllerstraße 3 · 60314 Frankfurt am Main · Germany
Phone +49 69 4009-0 · Fax +49 69 4009-1507
Internet: http://www.samson.de

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