PROFIBUS Positioner
Type 3785
PA device profile version 2.0

Fig. 1 · Type 3785 PROFIBUS Positioner

Mounting and Operating Instructions

EB 8382-1 EN

Firmware version R 1.4x/K 1.6x

Edition July 2004

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- *The device is to be assembled, started up or operated only by trained and experienced personnel familiar with the product.*
  According to these mounting and operating instructions, trained personnel is referred to as individuals who are able to judge the work they are assigned to and recognize possible dangers due to their specialized training, their knowledge and experience as well as their knowledge of the applicable standards.
- *Explosion-protected versions of this device are to be operated only by personnel who have undergone special training or instructions, or who are authorized to work on explosion-protected devices in hazardous areas.*
- *Any hazards that could be caused in the positioner by the process medium, the operating pressure, the signal pressure or by moving parts are to be prevented by means of the appropriate measures.*
  If inadmissible motions or forces are produced in the pneumatic actuator as a result of the supply air pressure level, the pressure must be restricted using a suitable supply pressure reducing station.
- *Proper shipping and storage are assumed.*
- ***Note!** Devices with a CE marking fulfil the requirements of the Directives 94/9/EC and 89/336/EEC. The declaration of conformity is available at http://www.samson.de and on request.*

Modifications of the firmware compared to the previous version

Old	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 switched from "linear actuator" to "rotary actuator", the following applies: Initialization method . . . Based on maximum range Transmission code . . . . 590 Nominal angle . . . . . 90° End position for w < . . . 1 % End position for w > . . . 99 % Rot. angle range starts at 0° Rot. angle range ends at 90°
	When the actuator type is switched from "rotary actuator" to "linear actuator", the following applies: **Attachment . . . . . Integral . . . . . NAMUR** Initialization method . . . Based on nominal range . Based on nom. range Mounting position: arrow Towards actuator . . . . Away from actuator Transmission code . . . . D1 . . . . . – 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 switched from "maximum range" to "nominal range", the following applies: End position for w < 1% End position for w > 125 % When the initialization method is switched 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 time is now limited to 75 s.
Initialization	During initialization, the minimum control pulses are determined for 20 % to 80 % of the manipulated variable range and saved in the EEPROM.
Proportional-action coefficients KP_Y1 and KP_Y2	The coefficients are adapted to the selected actuator type and the measured transit times.

Control R 1.41	R 1.42
	Correction when zero calibration was triggered by communication.
Communication K 1.34	K 1.41
	Firmware adaptation for new hardware version Hardware version device index **.01**
Communication 1.41	K 1.51
	Bit 7 of the CHECKBACK parameter indicates the current status of control loop monitoring. In contrast to bit 13, bit 7 is automatically reset when control loop monitoring detects no further errors. The function of bit 13 remains unchanged. Messages issued by bit 7 are only supported with firmware version R 1.41 and higher. The "warm start" message indicated by bit 11 of the DIAGNOSIS parameter is automatically reset after 10 s. In Local Override mode, bit 2 of the CHECKBACK parameter is activated.
Communication 1.51	K 1.60
	A bad set point status no longer causes the positioner to move the valve to fail-safe position in any case. Rather, the positioner's behavior is determined by the FSAVE_TYPE parameter. Using the serial interface, the positioner can be configured and operated with SAMSON's **TROVIS-VIEW** Configuration and Operator Interface software.

Positioner	
Travel Direct attachment Type 3277 Acc. to IEC 60534-6 (NAMUR)	Adjustable 5 mm to 30 mm 5 mm to 255 mm or 30° to 120° for rotary actuators
Bus connection	Fieldbus interface according to IEC 61158-2 Field unit according to FISCO (**F**ieldbus **I**ntrinsically **S**afe **Co**ncept)
Permissible operating voltage	9 to 32 V DC; the specifications in the EC type examination certificate additionally apply to explosion-protected devices. Voltage supplied over bus cable
Static destruction limit	35 V
Max. operating current	10 mA
Current in case of fault	0 mA
Auxiliary energy	Supply pressure of 1.4 to 6 bar (20 to 90 psi) Air quality according to ISO 8573-1:2001, i.e. max. particle size and density: Class 4; oil content: Class 3; pressure dew point: Class 3 or at least 10 K above lowest ambient temperature to be expected
Signal pressure (output)	0 bar up to supply air pressure
Adjustable characteristic	Linear, equal percentage, reverse equal percentage, user-defined Deviation from characteristic ≤ 1 %
Dead band	Adjustable from 0.1 to 10.0 %, default 0.5 % (based on rated travel/angle)
Resolution	< 0.05 % (internal measurement)
Desired transit time	Up to 75 s, separately adjustable for exhaust and supply air
Direction of action	Reversible, adjusted using software
Air consumption	Independent of supply air < 90 l_n/h
Air supply	Actuator pressurized 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 °C to 80 °C, the specifications in the EC type examination certificate additionally apply to explosion-protected devices
Influences	Temperature: ≤ 0.15 %/10 K, auxiliary energy: none Vibration: none up to 250 Hz and 4 g
Explosion protection	II 2 G EEx ia IIC T6 acc. to ATEX, see EC type examination certificate
Degree of protection	IP 65 using the included filter check valve
Electromagnetic compatibility	Requirements acc. to EN 61000-6-2, EN 61000-6-3 and NE 21 met
Binary input	Internal power supply 5 V DC, R_i = 100 kΩ for alarm function, e.g. connection of pressure switch

Forced venting Input K_v coefficient	To be activated using switch inside the positioner 6 to 24 V DC, static destruction limit 45 V R_i approx. 6 kΩ at 24 V DC (depending on voltage) Switching point for "1" signal at ≥ 3 V, switching point for "0" signal only at 0 V 0.17
Communication	Data transmission acc. to PROFIBUS-PA, Profile Class B, version 2.0 acc. to DIN EN 50170 and DIN 19245, Part 4 (version 3.0 also available)
Local interface	SAMSON SSP interface for configuration and start-up
Bus address	Adjustable using software or microswitch, default upon delivery: 126
Accessories	
Inductive limit switches	Two Type SJ2SN proximity switches For connection to switching amplifier according to EN 60947-5-6
Materials	
Housing	Die-cast aluminum, chromated 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 acc. to ATEX			**1**						
	With Ex ia CSA/FM			**3**						
	Ex II 3 G Ex nA II T6 acc. to ATEX			**8**						
Accessories	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 ¼-18							**1**		
	ISO 228/1-G ¼							**2**		
Electrical 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. It is used to assign the valve stem position (controlled variable) to the control signal (reference variable). It compares the digital output signal to the travel of the control valve and generates a corresponding pressure signal as the output variable. As a result, the positioner requires auxiliary supply air with a pressure of 1.4 to 6 bar. The necessary electrical power is supplied by the bus of the PROFIBUS-PA segment based on IEC 61158-2 standard transmission technology.

The positioner consists of an inductive, contactless travel pick-off system and an electrically controlled valve block comprising two on/off valves and an electronic unit. This unit contains two microcontrollers for processing the control algorithm and managing PROFIBUS communication.
If 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, the other the supply air.

The supply air valve (3) controls the connection between the supply air (7, supply air pressure 1.4 to 6 bar) and the actuator (pressurizing). The exhaust air valve (4) controls the air exhausted from the actuator to the atmosphere (venting). The on/off valves can either have the switching states ("permanently open", "permanently closed" or generate single pulses of changing widths). The two valves cause the plug stem to move to a position corresponding to the reference variable. If there is no system deviation, both the supply air valve and the exhaust air valve are closed.

By default, the positioner is equipped with a binary input for floating contacts, which additionally signals the switching state of a further field device via PROFIBUS.
Activating the write protection switch, which is located next to the bus address in the hinged lid, prevents the positioner settings from being overwritten by PROFIBUS communication.

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

1.1 Optional accessories

As a supplement to the standard positioner version, the positioner can be equipped with limit switches. Two proximity switches can be used to indicate the valve's end positions in safety-related circuits.

1.2 Communication

The positioner is completely controlled by digital signal transmission according to the PROFIBUS-PA Profile Class B based on

DIN EN 50170 and DIN 19245, Part 4. Data is transmitted as bit-synchronous current modulation at a transmission rate of 31.25 kbit/s over twisted-pair cables according to IEC 61158-2. Positioners are generally set up using a PC. 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 using an initialization routine. During initialization, zero is automatically adjusted and the preset span is checked.

The positioner is delivered with a standard configuration for a control valve with a rated travel of 15 mm designed for integral positioner attachment.

Customized configuration to adapt the positioner to other actuators can only be carried out using communication.

Configuration

The positioner is configured and operated on the PC over the SSP interface (13) using TROVIS-VIEW. Alternatively, it can be configured and operated via a segment coupler, e.g. using the COMMUWIN II user interface (by Endress + Hauser) or the SIMATIC PDM user interface (by SIEMENS).
During configuration, parameters such as control characteristic, direction of action, travel limitation, travel range, transit time and alarms, can be entered.

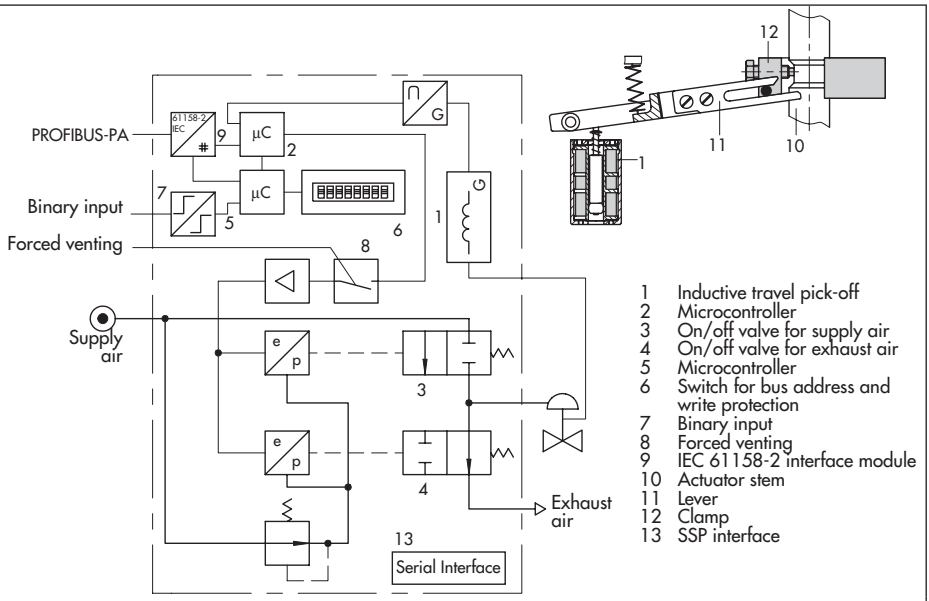


Fig. 2 · Functional diagram

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 cast yokes or rod-type yokes. In combination with an intermediate piece, the positioner can also be attached as a rotary positioner to rotary actuators.

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

Note!
For fast control valves with small travels (transit time < 0.6 s), replace the filter in the signal pressure output with a screw-in restriction, if necessary, to improve the control properties. See also sections 2.1, 2.2 and 2.3.

Important!
The positioner does not have its own vent plug so that the air is exhausted to the atmosphere through vent 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 vent plug included in the accessories with this filter check valve. This is necessary to achieve degree of protection IP 65 by preventing dirt and moisture from entering the device.

2.1 Direct attachment to Type 3277 Actuator

For 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 (120 cm² actuator) from the top, the positioner must be attached to the left side of the actuator.
The **arrow** on the black housing cover (Fig. 11) points **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 actuator, i.e. with the arrow pointing away from the diaphragm chamber.

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

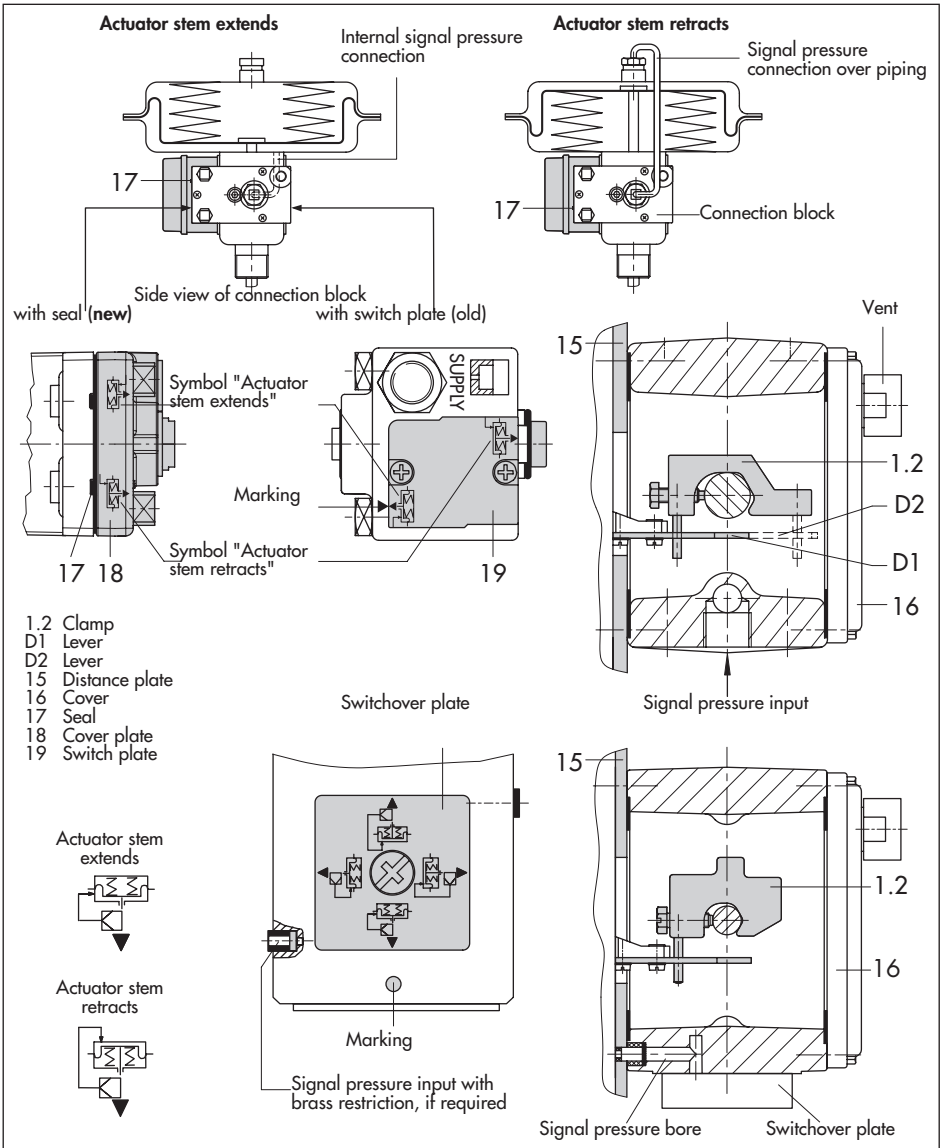


Fig. 3 · Attachment and signal pressure connection for Types 3277 (top) and 3277-5 with 120 cm² (bottom)

240, 350 and 700 cm² actuators

6. Check whether the tongue of the seal (17) is properly aligned at the side of the connection block with the actuator symbol "Actuator stem extends" or "Actuator stem retracts" to match the actuator version used. If it does not match, remove the three fastening screws and the cover plate (18), turn the seal (17) by 180° and reinsert it.
   When the **old** connection block is used, turn the switch plate (19) to align the arrow with the actuator symbol.
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 line.

120 cm² actuator

For Type 3277-5 Actuators with 120 cm², the signal pressure is transmitted to the diaphragm chamber over the switchover plate (see Fig. 3, bottom).
For a rated travel of 7.5 mm, a brass restriction (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

6. Remove 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 accessories kit.
7. Mount 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 switchover plate with the corresponding symbol for attachment on the left. Screw the plate to the actuator yoke.

Important!
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 over the required connecting plate (see Table 2). The switchover plate is no longer required.

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

Filling the spring chamber with air

If the Type 3277 Actuator's spring chamber must be pressurized with the air exhausted from the positioner, the spring chamber (version "Actuator stem extends") can be connected to the connection block using a tube (Table 3). To do so, remove the plug on the connection block.

With the Type 3277-5, version "Actuator stem retracts", the spring chamber is constantly pressurized with the air exhausted from the positioner through an internal bore.

Table 1 Required lever with associated clamp and distance plate		Actuator size cm²	Mounting kit Order no.
D1 (33 mm in length with clamp, 17 mm in height)		120 (G ¼) 120 (¼ NPT)	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 120 cm² actuator	Actuator 3277-5xxxxxx.**00** (old)		1400-6819
Switchover plate **new**	Actuators with index **.01** or higher (new)		1400-6822
Connecting plate for additional attachment of, e.g. a solenoid valve	3277-5xxxxxxxx.**00** (old)	G ⅛ ⅛ NPT	1400-6820 1400-6821
Connecting plate **new**	Actuators with index **.01** or higher (new)		1400-6823
Note! Only new switchover plates and connecting plates can be used with the new actuators (modification index **.01**). Old and new plates are not interchangeable.			
Connection block required for actuator sizes 250, 350 and 700 cm² (including seals and fastening screw)		G ¼ ¼ NPT	1400-8811 1400-8812
Table 3	Actuator size cm²	Material	Order no.
Required tubes including fittings For version "Actuator stem retracts" or when pressurizing the upper diaphragm chamber	240	Steel	1400-6444
	240	Stainless steel	1400-6445
	350	Steel	1400-6446
	350	Stainless steel	1400-6447
	700	Steel	1400-6448
	700	Stainless steel	1400-6449
Accessories			Order no.
Pressure gauge mounting kit for supply air and signal pressure		St. steel/brass St. steel/St. steel	1400-6957 1400-6958
Signal pressure restrictions (screw-in and brass restriction)			1400-6964
Filter check valve, replaces vent plug and increases degree of protection to IP 65 (one included with every positioner delivered)			1790-7408

2.2 Attachment according to IEC 60534-6

For 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, an adapter housing is required. The valve travel is transmitted over the lever (18) and shaft (25) to the bracket (28) of the adapter housing and then to the pin (27) located on the positioner lever.
To attach the positioner, the mounting parts listed in Table 4 are required. Which lever is to be used depends on the rated valve travel. The positioner must be attached to the adapter housing so that the arrow on the black housing cover points 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 must point towards the diaphragm actuator.

If the adapter housing cannot be mounted between the actuator and the valve (e.g. non-SAMSON actuators), make sure the arrow on the housing cover points towards the control valve.

Note!
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 restriction (see Accessories table), if necessary.

2.2.1 Mounting sequence

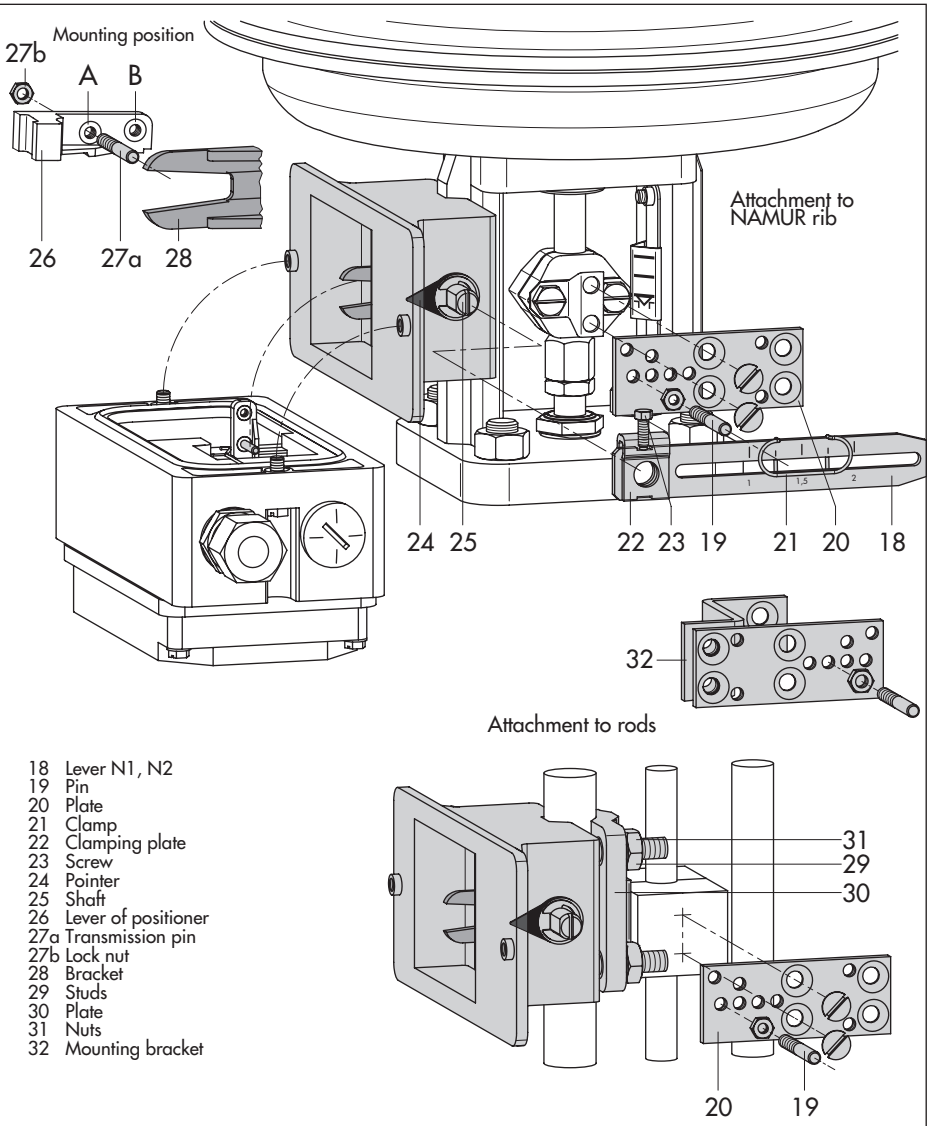
Important!
Before mounting the parts, apply a signal pressure to the actuator so that the valve is set to 50 % of its travel. It is only in this position that the lever (18) and bracket (28) can be aligned exactly.

Control valve with cast yoke

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

Control valve with rod-type yoke

1. Screw plate (20) to the follower clamp of the plug stem.
2. Screw studs (29) into the adapter housing.
3. Place housing with the plate (30) on either the right or left side of the valve rod and screw the housing tight using nuts (31). Align the height of the housing so that the lever (18) to be mounted subsequently is horizontal.
4. Move clamp (21) to surround the pin (19). Screw pin in the center row of bores in the plate (20) and lock it so that it will be located above the correct lever marking (1 to 2) for the assigned travel (see Table 5).
   Intermediate values must be interpolated.



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

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

5. Measure distance between the center of the shaft (25) and the center of the pin (19). This value must later be entered when configuring the positioner.

2.2.2 Presetting the valve travel

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

Table 4 Attachment IEC 60534-6	Control valve		Travel [mm]	With lever	Order no.
NAMUR mounting kit Parts, see Fig. 4	Valve with cast yoke		7.5 to 60	N1 (125 mm)	1400-6787
			30 to 120	N2 (212 mm)	1400-6789
	Valve with rod-type yoke, rod diameter [mm]	20 to 25		N1	1400-6436
		20 to 25		N2	1400-6437
		25 to 30		N1	1400-6438
		25 to 30		N2	1400-6439
		30 to 35		N1	1400-6440
		30 to 35		N2	1400-6441
Attachment to linear Fisher and Masoneilan actuators (one each of both mounting kits is needed per actuator)					1400-6771 and 1400-6787
Accessories					Order no.
Pressure gauge mounting block				G ¼ ¼ NPT	1400-7106 1400-7107
Pressure gauge mounting kit (output and supply) Order with every pressure gauge kit: 2 restrictions (1790-6121)				St. st./Brass St. st./St. st.	1402-0938 1402-0939
Signal pressure restrictions (screw-in and brass restrictions)					1400-6964
Filter check valve, replaces vent plug and increases degree of protection to IP 65 (one included with every positioner delivered)					1790-7408

Table 5 Attachment acc. to IEC 60534-6										
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 to lever fulcrum	42		42	84	42	84	84	168	84	168
With lever	N1 (125 mm long)						N2 (212 mm long)			
Transmission pin (27) on position	A		A		B		A		B	

* Deviating travel values (intermediate values) are to be interpolated accordingly

2.3 Attachment to rotary actuators

For 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 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 travel pick-off system.
Each cam disk is suitable for two curves: for angles of rotation from 0° to 90° (for all angles smaller than 90°) and for 0° to 120° (for all angles of 90° and larger).
For double-acting, springless rotary actuators, it is necessary to connect a reversing amplifier to the connection side of the positioner (see section 2.3.4).
If the positioner is attached to a SAMSON Type 3278 Rotary Actuator, the positioner's exhaust air is routed to the inside of the actuator and the chamber behind the diaphragm. No additional tubing is required.
If the positioner is attached to non-SAMSON actuators (NAMUR), the air is applied to the chamber behind the diaphragm through a tube assembly and a tee, connected between the actuator and the exhaust connection of the intermediate piece.

Note!
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 restriction (see Accessories table), if necessary.

2.3.1 Mounting the cam follower roll lever

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

2.3.2 Mounting the intermediate piece

SAMSON Type 3278 Actuator

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

Non-SAMSON actuators

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

With springless actuators, the reversing amplifier (45) must be screwed to the side of the positioner housing. Refer to section 2.3.4 for details.

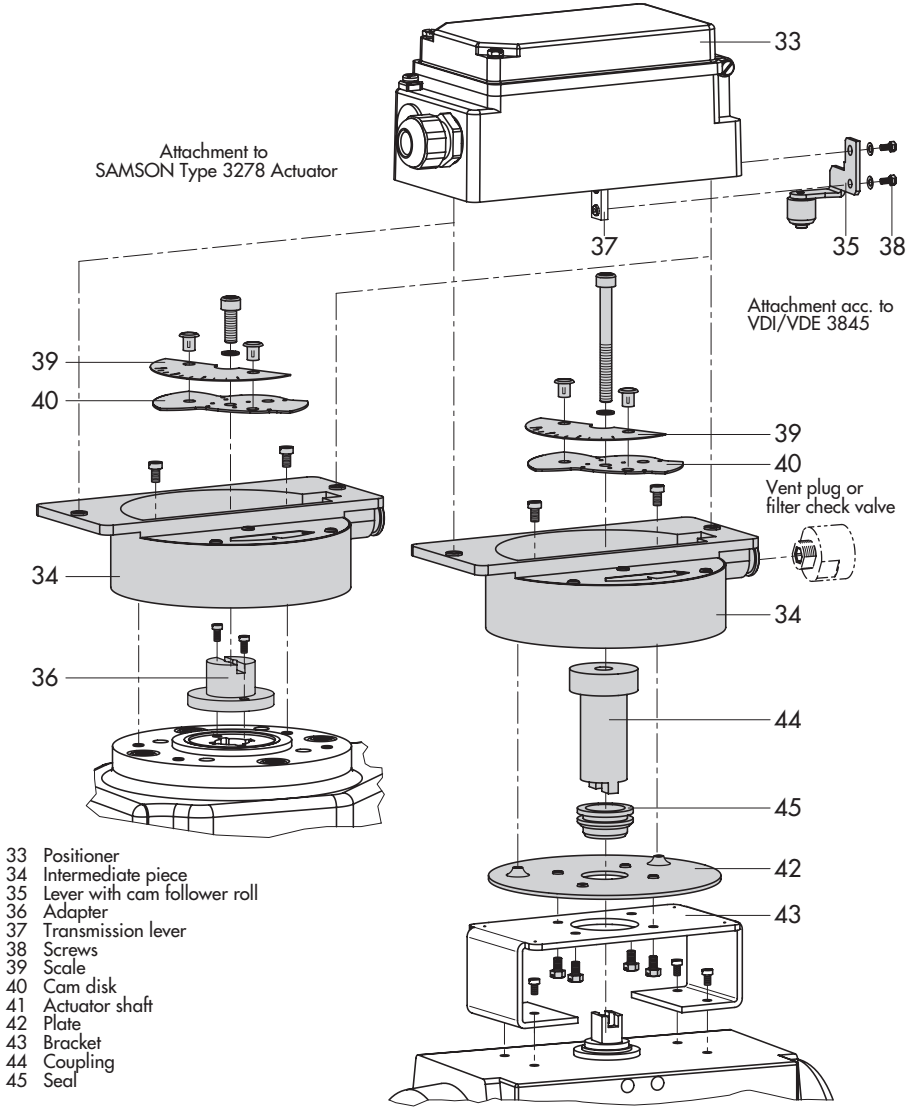


Fig. 5 · Attachment to rotary actuators

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 (clockwise, counterclockwise).
With double-acting, springless rotary actuators, the direction of rotation depends on both the actuator and the valve model used.
Close the valve before making any adjustments.

The positioner's direction of action, i.e. whether the valve opens or closes when the reference variable increases, has to be software-adjusted using communication (increasing/increasing or increasing/decreasing).

1. Position cam disk with 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.

Important!
With the valve closed, the starting point (bore hole) of the respective curve 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 0° position!

In actuators with fail-safe position "Control valve open" (OPEN), pressurize the actuator with the max. signal pressure before aligning the cam disk.
In springless actuators, connect the supply air.

2. On aligning the cam disk, the double-sided scale disk must be clipped on so that the value on the scale corresponds to the control valve's direction of rotation. Tightly secure the cam disk with the fastening screws now.

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 hole 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 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 Allen wrench or screwdriver from the front into the bore located below the oblong hole on the cover plate and push the positioner lever to the required position.
4. Screw positioner to the intermediate piece.

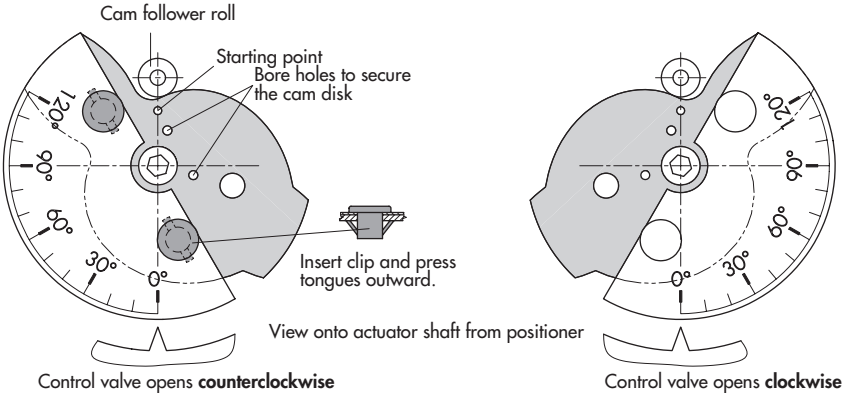


Fig. 6 · Aligning the cam disk

Table 6 Rotary actuators (complete mounting parts, but without cam disk)					
Attachment acc. to VDI/VDE 3845, level 1	SAMSON Type 3278 Actuator		Attachment to Masoneilan actuators		
	160 cm² actuator	320 cm² actuator	Camflex I DN 25 to 100	Camflex I DN 125 to 250	Camflex II
	Order no.				
1400-8815	1400-7103	1400-7104	1400-7118	1400-7119	1400-7120
	Piping kit, 8 x 1 stainless steel				
	G: 1400-6670	G: 1400-6672			
	NPT: 1400-6669	NPT: 1400-6671			

Accessories	Order no.	
Reversing amplifier for springless double-acting actuators	G: 1079-1118	NPT: 1079-1119
Cam disk (0050-0089) with accessories, angle of rotation 0° to 90° and 0° to 120°		1400-6959
Cam disk (0050-0089) esp. for VETEC, adjustable by software from 0° to 75°		1400-6960
Cam disk (0050-0090) esp. for Camflex, adjustable by software from 0° to 50°		1400-6961
Pressure gauge mounting block	G ¼: 1400-7106	¼ NPT: 1400-7107
Pressure gauge set	Stainl. steel/Br: 1400-6957	St. steel/st. steel: 1400-6958
Signal pressure restrictions (screw-in and brass restrictions)	1400-6964	
Filter check valve, replaces vent plug and increases degree of protection to IP 65 (one included with every positioner delivered)	1790-7408	

2.3.4 Reversing amplifiers 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 Table 6 on page 21.

The signal pressure of the positioner is supplied at output A1 of the reversing amplifier. An opposing pressure, which equals the required supply pressure when added to the pressure at A_1, is applied at output A_2. The rule $A_1 + A_2 = Z$ applies.

Mounting

1. Screw special nuts (1.3) from the accessories of the reversing amplifier into the threaded connections of the positioner.
2. Remove sealing plug (1.5) from the reversing amplifier. The rubber seal (1.4) must remain installed.
3. Insert gasket (1.2) into recess of the reversing amplifier and push both hollow special screws (1.1) into the connection bores A1 and Z.
4. Place reversing amplifier onto the positioner and screw tight using both special screws (1.1).
5. Replace vent plug in the reversing amplifier with the included filter check valve.

Signal pressure connections

A_1: Connect output A_1 to the signal pressure connection at the actuator that opens the valve when the pressure increases.

A_2: Connect output A_2 to the signal pressure connection at the actuator that closes the valve when the pressure increases.

- Set up 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

Important!
If the fail-safe position of the actuator is changed subsequently by modifying the actuator springs from "Actuator stem extends" to "Actuator stem retracts", readjust mechanical zero and re-initialize the positioner.

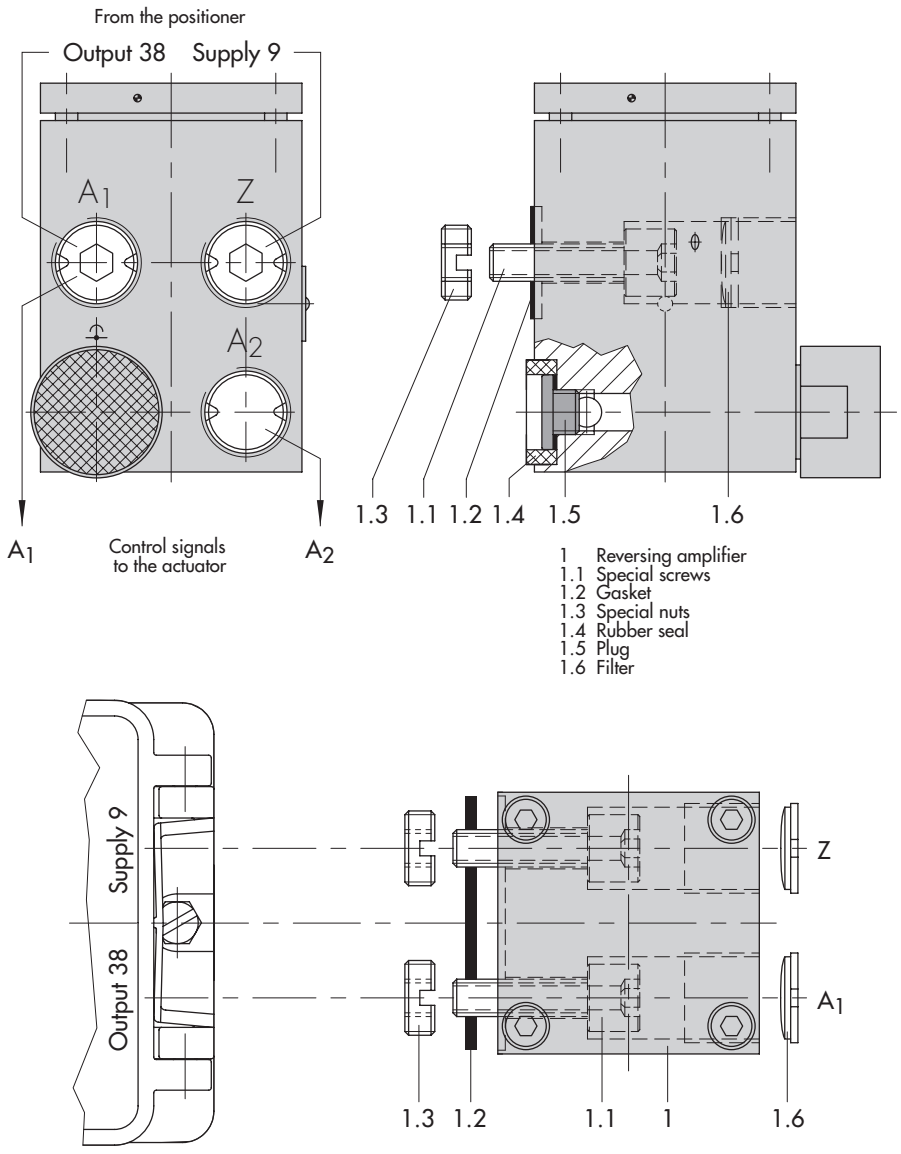


Fig. 7 · Mounting a reversing amplifier

3 Connections

3.1 Pneumatic connections

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

Important!
The supply air must be dry and free of oil and dust. The maintenance instructions for upstream pressure reducing stations must be observed. 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 signal pressure to the actuator is fixed. For NAMUR attachment, the signal pressure can be applied to either the upper or lower diaphragm chamber of the actuator, depending on the actuator's fail-safe action (either "Actuator stem retracts" or "stem extends").

Exhaust air: The exhaust air connection of the positioner is located on the mounting kit. For direct attachment, a vent plug is located on the plastic cover of the actuator. For NAMUR attachment, the vent plug can be found at the adapter housing. For attachment to rotary actuators, it is either located either on the intermediate piece or the reversing amplifier.
To guarantee degree of protection IP 65, the vent plug must be replaced with the filter check valve included with the positioner. Refer to section 2 on page 10 (Important!) for details.

3.1.1 Pressure gauges

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

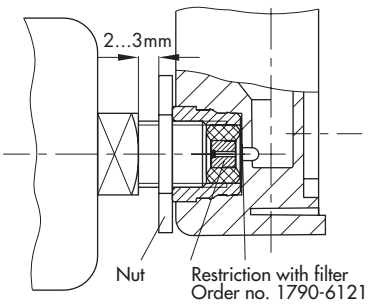


Fig. 8 · Mounting pressure gauges

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 a spring range or 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 $p_{st\ max}$:

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

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

If there are no specifications, calculate as follows:
Required supply air pressure = upper bench range value + 1 bar

3.2 Electrical connections

For electrical installation, you are required to observe the relevant electrotechnical regulations and the accident prevention regulations that apply in the country of use. In Germany, these are the VDE regulations and the accident prevention regulations of the employers' liability insurance.
The following regulations apply for installation in hazardous areas:
EN 60079-14:2003; VDE 0165 Part 1:1998 "Electrical apparatus for explosive gas atmospheres", and
EN 50281-1-2: VDE 0165 Part 2:1999 "Electrical apparatus for use in the presence of combustible dust".
For intrinsically safe electrical equipment approved in accordance with Directive 79/196/EEC, the data specified in the certificate of conformity apply for the connection of intrinsically safe circuits. For intrinsically safe electrical equipment approved in accordance with Directive 94/9/EC, the data specified in the EC type examination certificate apply for the connection of intrinsically safe circuits.
***Caution!** The terminal assignment specified in the certificate must be observed! Switching the assignment of the electrical terminals may cause the explosion protection to become ineffective! Do not loosen enameled screws in or on the housing.*

Note on the selection of cables and wires
To run several intrinsically safe circuits in one multi-core cable, observe section 12 of EN 60079-14; VDE 0165:1998.
Note especially that, for commonly used insulating materials such as polyethylene, the radial thickness of the conductor insulation must be at least 0.2 mm. The diameter of a single wire of 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. When two separate cables are used for connection, an additional cable gland can be installed.
Cable entries left unused must be sealed with plugs.
Positioners used in ambient temperatures down to –40 °C must be fitted with metal cable entries.

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

Cable entries

Cable entry with M20x1.5 cable gland, 7 to 12 mm clamping range.

There is a second M20x1.5 cable gland in the housing that can be used for additional connection, if required.

The screw terminals are designed for wire cross-sections of 0.2 to 2.5 mm² (tightening torque at least 0.5 Nm).

Bus line

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

1. To connect the bus line, remove coupling nut and clamping insert from the positioner. Also remove the dust cap.
2. Slide coupling nut and clamping insert over the connecting cable.
3. Strip insulation off the end of the bus line to the required connecting length. Cut off the wire shield up to a length of approx. 13 mm. If necessary, cut off any filling cable cores as well.
4. Disentangle the braided shield and pull it over the clamping insert.
5. Press clamping insert into connecting screw gland. Tighten coupling nut until the connecting cable is clamped tightly.
6. Route two-wire bus line to the screw terminals marked "IEC 1158-2"; when doing so, no polarity has to be observed.

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

Refer to PROFIBUS-PA User and Installation Guideline (PROFIBUS User Organization document 2.091) for further information.

At the binary input, a passive floating contact can be used. The positioner signals the circuit's state using the bus protocol.

Important!
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: *M20 x 1.5 cable gland, 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 associated terminals.

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

Note!
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.

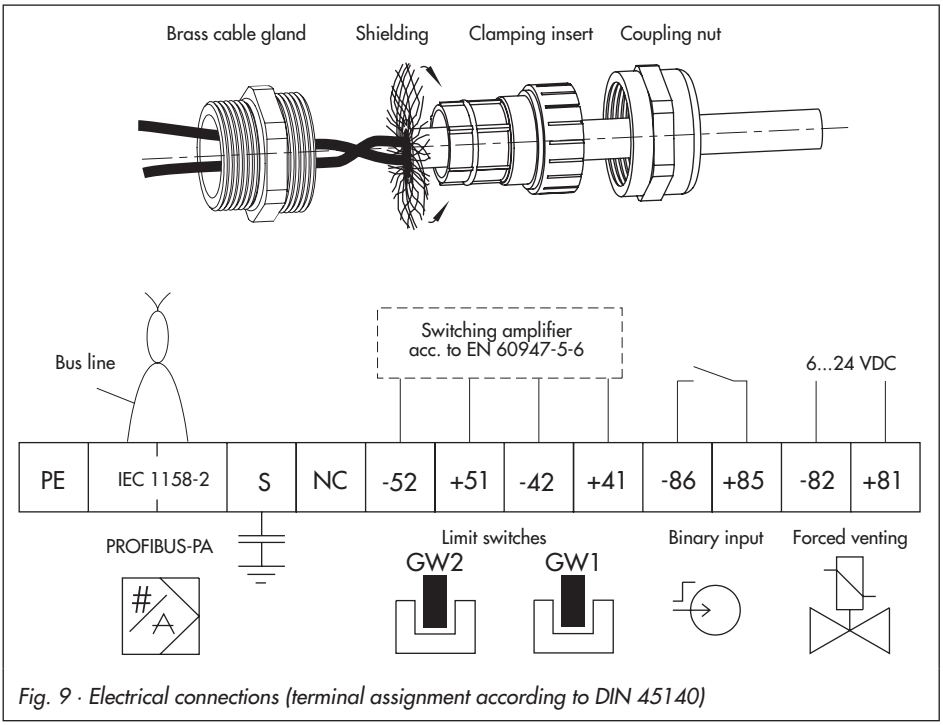


Fig. 9 · Electrical connections (terminal assignment according to DIN 45140)

3.2.2 Limit switches

Switching amplifiers have to be connected in the output circuit to operate limit switches. To ensure operational safety of the positioner, these switching amplifiers must comply with the limits of the control circuit according to NAMUR. Observe the relevant regulations if the positioner is installed in hazardous areas.

3.2.3 Establishing communication (bus address)

Communication between positioner, programmable logic controller or automation system, i.e. between PC or workstation and the positioner(s), is established using a segment coupler (see Fig. 10) in accordance with the PROFIBUS guidelines.
If the positioner is used in hazardous areas, exlosion-protected PROFIBUS-PA segment couplers must be used.
A maximum of 32 positioners can be operated in parallel on a segment coupler in one PROFIBUS-PA segment. In hazardous areas, fewer positioners can be connected.
Each positioner in a segment must be assigned a unique bus address between 0 and 125. Seven microswitches located on the inside of the positioner's hinged lid serve to enter the bus address either directly by switch numbers 1, 2, 4 etc. or by adding up several switch positions. The positioner is delivered with the default address set to 126. Make absolutely sure that the switches are adjusted all the way to either 1 or 0, not set to an intermediate position.

Note!
Start the positioner up again for a new bus address to be adopted.

3.2.4 Local interface (SSP)

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

It is no longer necessary to connect the device to a PROFIBUS DP/PA segment. Only the power supply needs to be connected over the bus terminals of the positioner (any DC voltage supply unit between 9 and 32 V).

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

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

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

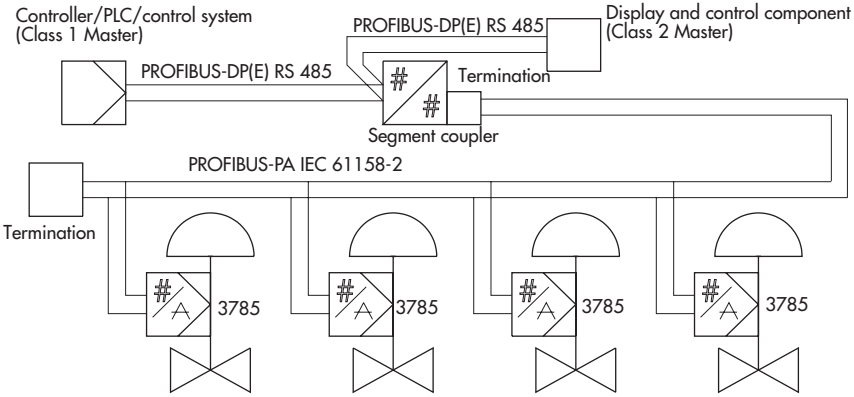


Fig. 10.1 · Connection of Type 3785 Positioners

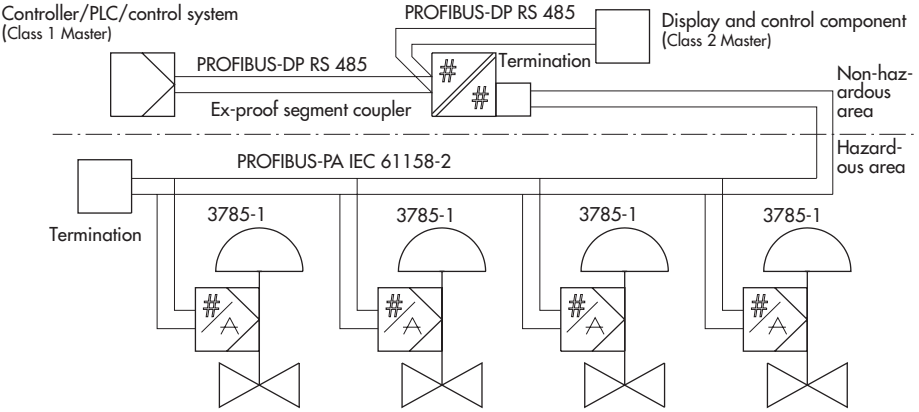


Fig. 10.2 · Connection of Type 3785-1 Positioners in hazardous areas

Fig. 10 · PROFIBUS connection

4 Operation

Warning!
Before putting 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 start-up, operation and in the event of defects.

The colors 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
Positioner start-up	Red ON
No errors Positioner connected to bus, cold start performed, initialization required When initializing or adjusting zero Positioner initialized, no valid set point Positioner initialized, valid set point, control operation	Green, generally Green blinks slowly Green blinks quickly Green blinks 3 times quickly + long pause Green ON
Errors during control operation Zero point error Control loop error	Red and green Red and green blink slowly Red and green blink quickly
Errors causing the first initialization to be canceled (positioner does not start standard operation) Zero point error Error in mechanics/pneumatics section Control loop error	Red, generally Red blinks slowly Red ON Red blinks quickly
Errors causing the positioner to stop control operation Positioner recognized an 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 forced venting

For model index **.03** and higher:

1. Remove four screws from the cover inside the hinged lid and remove the cover.
2. Remove screw in the middle of the printed circuit board and turn the PCB to one side.
3. Set switch to desired position:
   1 ENABLED > function activated
   2 DISABLED > function deactivated

4.4 Default settings

All parameters are set to their default values. Refer to section 8 for descriptions of the parameters.

Caution!
Manual operation and activated end position function can cause the actuator to be pressurized with the maximum supply pressure. If this causes inadmissible forces, restrict the supply pressure using a suitable pressure reducing station.

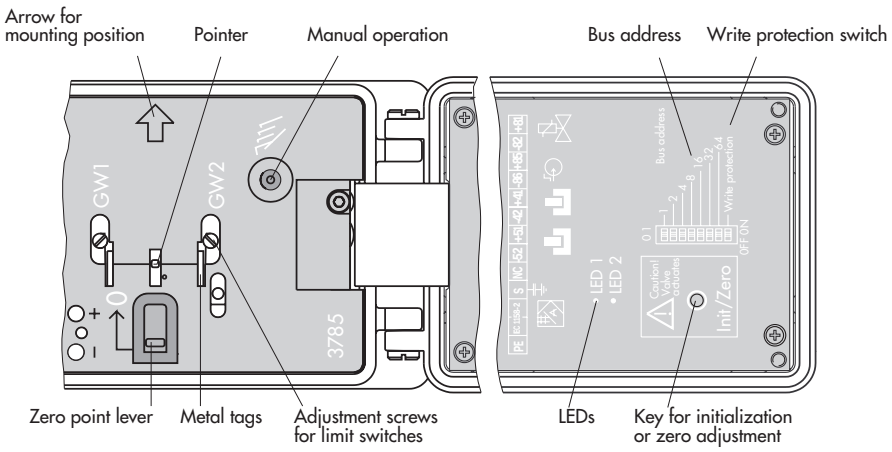


Fig. 11 · Inside view of the cover plate

4.4.1 Adjusting mechanical zero

Important!
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 on 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.

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

4.4.2 Initialization

After the electric reference variable and the supply air have been connected to the positioner, the initialization process can be started. During initialization, the positioner is optimally adapted to the friction conditions and signal pressure demands of the control valve.

Warning!
The initialization process takes several minutes. During that time, the valve changes its position. Therefore, never initialize the positioner during a running process; only perform initialization 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 bench.

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

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

- Carry out the configuration suitable for the valve type.

The following settings are recommended:

- **Fail-safe position "Actuator stem extends":**
  Direction of action: increasing/increasing (>>), a globe valve opens with increasing reference variable
  End position at a reference variable below 1 % (tight closing)
  End position at a reference variable above 125 % (function deactivated).
- **Fail-safe position "Actuator stem retracts":**
  Direction of action: increasing/decreasing (<>), a globe valve closes with increasing reference variable
  End position at a reference variable below –2.5 % (function deactivated)
  End position at a reference variable above 99 % (tight closing).

- Set delay time to at least 30 s.
- Enter tag identification.
- If necessary, configure the positioner further, e.g. special characteristics for rotary valves.

If **no communication can be established on the valve**, the positioner can also be initialized directly on the device itself.

- Connect positioners that are not mounted on a valve to a power supply and initialize the positioner as described in section 4.4.2.
  If communication cannot be established, the default settings must be used.
- Mount positioner and adjust mechanical zero as described in section 4.4.1.
- Start initialization by pressing the **Init/Zero** key on the positioner's hinged lid using a suitable tool.

Initialization is completed when the positioner moves to the position predetermined by the reference variable.

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

After a successful initialization, the positioner can be re-initialized when communication is established.

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

Electric zero calibration

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

Caution!
The control valve moves to its end position.

- Firmly push the zero point lever, which is located on 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.
- Press key again to start electric calibration.

After the key has been pressed for the second time, it is locked for approximately one minute.
Electric calibration is completed when the positioner moves to the position predetermined by the reference variable.

4.5 Adjusting the inductive limit switches

The positioner version with inductive limit switches has two adjustable metal tags that are mounted on the shaft of the positioner lever and operate the associated proximity switches.
Connect appropriate switching amplifiers to the output circuit to operate the inductive limit switches (see section 3.2.2).

If the tag is inside the inductive field of the proximity switch, the switch assumes a high resistance. If the tag is outside the field, the switch assumes a low resistance.

Normally, the limit switches are adjusted such that they will provide a signal in both 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 is to be pulled in or dropped out 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 housing cover. Yellow tags and the associated adjustment screws (Fig. 11) are located below these markings.

Each switching position can optionally be signaled when the tag has entered or left the field.

- Move the valve to the switching position and adjust the tag of the desired 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.

When doing so, one edge of the yellow tag is aligned with the white, horizontal line on the housing cover. This indicates the side from which the tag enters the inductive field of the proximity switch.

To ensure safe switching under all ambient conditions, the switching point is to be adjusted to a value 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. Remove and clean the filter, if required.

Observe the maintenance instructions for upstream pressure reducing stations for supply air, if applicable.

6 Servicing explosion-protected devices

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

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

7 How to implement a Class 1 PROFIBUS Master

7.1 Device database files (GSD)

The device data are provided as a text file (SAMS3785.GSD). It is available from SAMSON AG under order no. 1400-7417 on a 3½" 1.44 MB floppy disk or on the Internet at http://www.samson.de or http: //www.profibus.com.
The device database file permit the standardized implementation of the SAMSON Type 3785 PROFIBUS Positioner as a PROFIBUS slave unit in the programming and configuration environment of a Class 1 master (example: SIEMENS Simatic Step 7, HWConfig). Using the device database file, the Class 1 master 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 seven cyclic parameter combinations is available for the exchange of data. One of the combinations is to be selected in the programming and configuration environment of the Class 1 master.
The terms "Output" and "Input" refer to the control system/Class 1 master.

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	
RCAS_IN, 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_IN, 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 by 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 < 64 dec.), 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 REMOTE CASCADE (RCAS) operating mode by RCAS_IN/RCAS_OUT. RCAS_IN/RCAS_OUT both consist 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 < 64 dec.), the positioner remains in the fail-safe position determined by the actuator.

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

READBACK – Current position with status: Controlled variable x

Position feedback is provided by 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: End position indication

The final valve position is indicated by the POS_D parameter and consists of one message value (1 byte) and the associated status (1 byte). The message value is encoded as follows:

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

CHECK_BACK – Device status: Detailed device information, 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 travel monitoring (reset automatically)	0
8, 9	Not used		1
10	CB_UPDATE_EVT	Indicates change to static device data	

11	CB_SIMULATE	Simulation mode, i.e. value are not derived from the process	1
12	CB_DISTURBANCE	Error, refer to DIAGNOSIS parameter for cause	
13	CB_CONTR_ERR	Error in internal positioner control loop (to be confirmed by Class 2 master), indicated by LED, reset automatically when control loop monitoring no longer detects any errors	
14	CB_CONTR_INACT	Positioner inactive (mode = Out of Service)	
15	CB_SELFTEST	Positioner in self-test mode (mode = Out of Service)	
16	CB_TOT_VALVE_TRAV	Limit for total valve travel exceeded	2
17 to 23	Not used		

Diagnostic messages of the positioner (slave diagnostic information)

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

Bit no.	Name	Description
0	DIA_HW_ELETR	Hardware error, electronics
1	DIA_HW_MECH	Hardware error, mechanics
4	DIA_MEM_CHKSUM	Checksum error, memory
5	DIA_MEASUREMENT	Measurement error
6	DIA_NOT_INIT	Positioner not initialized (no auto-initialization performed)
7	DIA_INIT_ERR	Auto-initialization error
8	DIA_ZERO_ERR	Zero point error (end position)
10	DIA_CONF_INVAL	Invalid configuration
11	DIA_WARMSTART	Restart (warm start) completed, refer to Profile A for definition of warm start
12	DIA_COLDSTART	New start (cold start) completed, refer to Profile A for definition of cold start
13	DIA_MAINTENANCE	Maintenance required
14	DIA_CHARACT	Invalid characteristic
31	EXTENSION_AVAILABLE	Further information available

7.4 Coding of measured value status

Measured value status

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

Bad	Value is valid	
Substatus	Condition	Decimal value
Configuration error	Error in device configuration, value cannot be determined	4
Device failure	Device error: memory, electronics	12
Sensor failure	Error in travel measurement, limit bits indicate which measured value limits were exceeded*	16/17/18/19
No communication (last usable value)	Internal communication error, device operates with last usable value	20
No communication (no usable value)	Internal communication error, no usable error available	24
Out of service	Transducer block in Out of Service mode (e.g. device not initialized)	28

* **Limit bits:**

The two lowest bits of the measuring value status indicate that the limits for the measuring value have been exceeded.

Bit 0 = Low limited – lower limit value not reached
Bit 1 = High limited – upper limit value exceeded
Bit 0 and 1 = Constant (high and low limited) – value is blocked

Uncertain	Value is valid, but not derived from the process	
Substatus	Condition	Value
Non-specific	Initialization or zero calibration running	64
Initial value	Initial value during device start-up (temporary)	76

Good (non-cascade) Value is valid

Substatus	Condition	Value
OK	Everything OK, no other status available	128
Maintenance required	Transit time monitoring active, zero point error active or total valve travel exceeded	164

Set point status

Good (non-cascade)

Substatus	Condition	Value
OK	Everything OK	128 (80)
Good_INITIATE_FAIL_SAFE	Positioner's defined fail-safe action activated	160 (AO)

Good (cascade)

Substatus	Condition	Value
Good_CAS_Init_Acknowledge	Status required for transition to RCAS mode	196 (C4)

7.5 Operating modes

Possible operating modes

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

- 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) mode

In this operating mode, the positioner follows the set point that is cyclically or acyclically preset by the SP (w) parameter according to the scale and unit preset by PV_SCALE (reference variable range).

Local Override (LO) or Manual (Man) mode

In these operating modes, the positioner follows the acyclic set point preset by the OUT parameter (correction value) according to the scale and unit (mm or degrees) entered as OUT_SCALE (travel/angle of rotation range). With the characteristic deactivated, this value corresponds to the actual valve position in mm or degrees.
The INCREASE_CLOSE parameter (direction of action), however, is not processed. Neither are the communication monitoring parameters (FSAFE_TIME, _TYPE, _VALUE) processed.

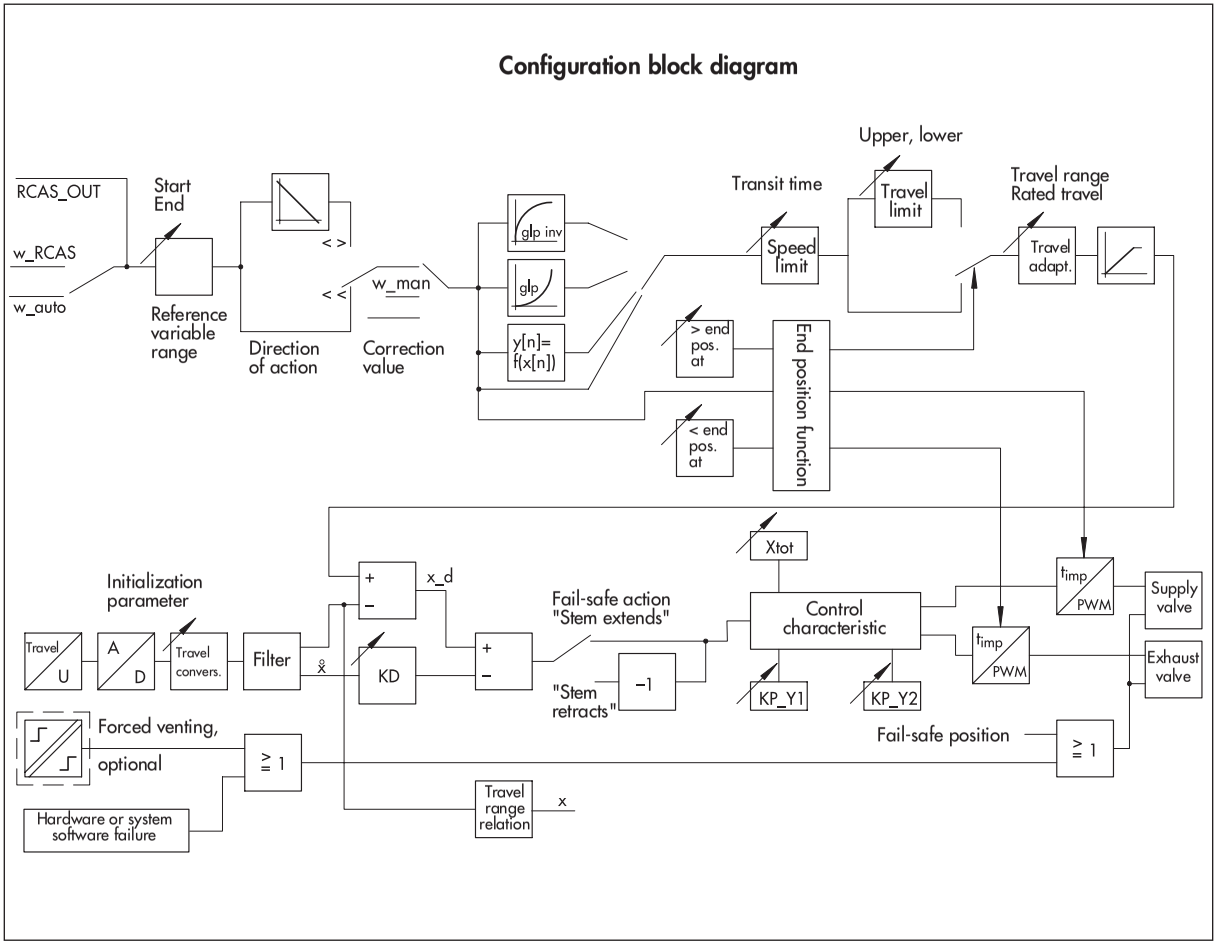
Remote cascade (Rcas) mode

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

Out of Service (OS) mode

In this operating mode, the valve is automatically moved to its fail-safe position.

Configuration block diagram



Start-up (warm start)

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

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

If FSAFE_TYPE is set to "control to last set point" 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) up to firmware version K1.51. With version 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 (warm start)
- Elapsing of DP-Watchdog through interruption of the cyclic communication with a Class 1 master (not applicable when communication is terminated properly).
- Elapsing of FSAFE_TIME in Automatic or Remote Cascade operating modes, when the status of the reference variable valid in this operating mode (SP or RCAS_IN) 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 K1.30)

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 versions K1.30 to K1.51). In version K1.6 and higher, the behavior for a bad set point status is determined by the FSAFE_TYPE parameter.

8 List of parameters

Below is an overview of parameters ordered 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 using PROFIBUS communication, e.g. on a PC.
Manufacturer-specific parameters of the SAMSON Type 3785 PROFIBUS-PA Positioner are marked with (M).

Parameter overview

Device identification

Tag identification	TAG_DESC
Firmware version, communication/control	SW_REVISION
Hardware version, electronics/mechanics	HW_REVISION
Manufacturer, positioner	DEVICE_MAN_ID
Manufacturer, valve	VALVE_MAN
Manufacturer, actuator	ACTUATOR_MAN
Type number, positioner	DEVICE_ID
Serial number, positioner	DEVICE_SER_NUM
Serial number of corresponding actuator	ACTUATOR_SER_NUM
Serial number of corresponding valve	VALVE_SER_NUM
Type of protection	DEVICE_CERTIFICATION
Description	DESCRIPTOR
Message	DEVICE_MESSAGE
Date of installation	DEVICE_INSTALL_DATE
Identification, forced venting	IDENT_FORCED_VENTING (M)
Binary input	IDENT_BINARY_INPUT (M)
Identification, limit switches	IDENT_LIMIT_SWITCHES (M)
Product number, positioner	DEVICE_PRODUCT_NUM (M)
Text fields	TEXT_INPUT_1…TEXT_INPUT_3 (M)
Date of last maintenance	VALVE_MAINT_DATE
Date of last calibration	DEVICE_CALIB_DATE
Date of last configuration	DEVICE_CONFIG_DATE

Start-up

Security locking	SECURITY_LOCKING
Cold start	FACTORY_RESET
Warm start	DEVICE_RESET_CMD
Actuator type	ACTUATOR_TYPE
Valve type	VALVE_TYPE
Fail-safe position	ACTUATOR_ACTION
Attachment	ATTACHMENT (M)
Actuator version	ACTUATOR_VERSION (M)
Mounting position	MOUNTING_POSITION (M)
Transit time, minimum OPEN	ACT_STROKE_TIME_INC
Transit time, minimum CLOSED	ACT_STROKE_TIME_DEC
Calibration, command	SELF_CALIB_CMD
Calibration, status	SLF_CALIB_STATUS
Transmission, code	TRANSM_CODE (M)
Transmission, length	TRANSM_LENGTH (M)
Transmission, pin position	TRANSM_PIN_POS (M)
Initialization method	INIT_METHOD (M)

Device settings
Configuration

Write protection	WRITE_PROTECTION_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 enabled	LOCAL _OP_ENA
Rated travel/nominal angle	RATED_TRAVEL
Travel/angle limit, lower	TRAVEL_LIMIT_LOW
Travel/angle limit, upper	TRAVEL_LIMIT_UP
Transit time, desired CLOSED	TRAVEL_RATE_DEC
Transit time, desired OPEN	TRAVEL_RATE_INC

End pos. when reference variable is below limit value	SETP_CUTOFF_DEC
End pos. when reference variable is above limit value	SETP_CUTOFF_INC
Selection of characteristic	CHARACT
Type of characteristic	CHARACT_TYPE
Control parameters	
Proportional-action coefficient KP_Y1	SERVO_GAIN
Derivative-action coefficient KD	SERVO_RATE
Deadband Xtot	DEADBAND
Proportional-action coefficient KP_Y2	KP_Y2
Tolerated overshoot	TOL_OVERSHOOT (M)
Operation	
Operating mode, desired/current	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)
Diagnostics	
Diagnostics	DIAGNOSIS
Diagnostics extension	DIAGNOSIS_EXTENSION
Simulation	SIMULATE
Device status	CHECK_BACK
Total valve travel, absolute	TOTAL_VALVE_TRAVEL
Total valve travel, limit	TOT_VALVE_TRAV_LIM
Delay time	DELAY_TIME (M)
Tolerance band	TOLERANCE_BAND (M)
Calibration, alarm message	SELF_CALIB_WARNING (M)
Binary input, status	BINARY_INPUT (M)
Travel/angle of rotation, max. permissible	MAX_HUB (M)

List of parameters

Actuator type ACTUATOR_TYPE States: Default:	Identifies the actuator design Read-only parameter, determined by actuator 0 = Electropneumatic 1 = Electric 2 = Electrohydraulic 3 = Other 0
Actuator version ACTUATOR_VERSION (M) States: Default:	Specifies the actuator version with/without spring return mechanism 0 = Single-acting with spring return mechanism 1 = Double-acting without spring return mechanism 0
Attachment ATTACHMENT (M) States: Default:	Defines positioner attachment to control valves with linear actuators. For rotary actuators, only attachment according to VDI/VDE 3845 (NAMUR) is possible. For details, refer to sections 2.1 and 2.2. 0 = Integral – attachment with SAMSON Type 3277 Linear Actuator 1 = NAMUR – attachment acc. to IEC 60534-6 (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
Binary input, status BINARY_INPUT (M) States: Default:	Indicates state of the binary switch 0 = Deactivated 1 = Activated 254 = Not evaluated 0
Calibration, alarm message SELF_CALIB_WARNING (M) States: Default:	Indicates additional alarm messages of started calibration procedure 0 = Not determined 13 = Improper selection of rated travel or transmission 15 = Air leakage of pneumatic system (during initialization) 254 = Successful 255 = No valid data in application 0
Calibration, command SELF_CALIB_CMD States:	Starts manufacturer-specific 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 error 255 = Cancel current action

Calibration, status SELF_CALIB_STATUS States:	Indicates manufacturer-specific status of calibration procedure started with SELF_CALIB_CMD 0 = Not determined 2 = Canceled 4 = Error in mechanics/pneumatics 11 = Timeout 17 = Initialization status: determining mechanical stops 19 = Initialization status: determining minimum transit times 20 = Initialization canceled by activating forced venting 30 = Zero point error 254 = Successful
Characteristic selection CHARACT States: Default:	Selects characteristic to assign the reference variable to the valve travel/angle range 0 = Linear 1 = Equal percentage 2 = Reverse equal percentage 3 = User-defined (will be supported in future firmware version) 4 = SAMSON butterfly valves: linear 5 = SAMSON butterfly valves: equal percentage 6 = VETEC rotary plug valves: linear 7 = VETEC rotary plug valves: equal percentage 0
Characteristic type CHARACT_TYPE	Text field to describe the adjusted characteristic Length: 32 characters
Cold start FACTORY_RESET States: Default:	Resets the positioner to its default values 0 = No action 1 = Resets application to default values. All positioner data are reset to their default values. Positioner moves to fail-safe position and must be re-initialized. Only device identification parameters are retained. 2 = Resets device identification parameters to their default values. Application parameters are retained. 0
Controlled variable x READBACK	Indicates current valve position with status Controlled variable x in % of travel/angle of rotation range
Correction value OUT	Calculated by the function block from the set point in [mm] or [degree]. Value can be preset in Local Override mode
Date of installation DEVICE_INSTALL_DATE	Indicates when the field device was installed
Date of last calibration DEVICE_CALIB_DATE	Indicates when the field device was last calibrated
Date of last configuration DEVICE_CONFIG_DATE	Indicates when the field device was last configured

Date of last maintenance VALVE_MAINT_DATE	Indicates when the last maintenance was performed on the field device
Dead band Xtot DEAD_BAND Default:	Indicates dead band of the control characteristic between 0.1 and 10.0 % of the rated travel/nominal angle 0.5 %
Delay time DELAY_TIME (M) Range: Default:	Specifies reset criterion for active control loop monitoring. If the entered delay time is exceeded and the system deviation is outside the limits of the entered tolerance band, a control loop error is issued. 0 to 240 s Determined during initialization from min. transit time; can be adapted 10 s
Derivative-action coefficient KD SERVO_RATE Range: Default:	Specifies gain factor of derivative element. We recommend incrementing the value in steps of 0.02. Incrementing the value causes an increased deceleration before the reference variable is reached. 0.0 to 1.00 0.12
Description DESCRIPTOR	Text field to describe the application, saved in field device Length: 32 characters
Device status CHECK_BACK Message type: States:	Provides detailed, bitwise-encoded device information, which permits several simultaneous messages; see also section 9 A: Dynamic messages, automatically reset when read R: Static messages, retained as long as event exists in the field device 0 = No message 1 = Device status message active
Diagnostic extension DIAGNOSIS_EXTENSION Message type: States:	Provides additional, detailed manufacturer-specific device information; bitwise-encoded, which allows for several simultaneous messages; see also section 9 A: Dynamic messages, automatically reset when read R: Static messages, remain active while error persists in field unit 0: No message 1: Diagnostic message active
Diagnostics DIAGNOSIS Message type: States:	Provides detailed, bitwise-encoded device information, which permits several simultaneous messages; see also section 9 A: Dynamic messages, automatically reset when read R: Static messages, remain active while error persists in field unit 0 = No message 1 = Diagnostic message active

Direction of action INCREASE_CLOSE (M) States: Default:	Determines the assignment of reference variable to travel/angle 0 = Increasing/increasing, valve opens when reference variable increases (for rotary plug valves, the actuator stem retracts) 1 = Increasing/decreasing, valve closes when reference variable increases (for rotary plug valves, the actuator stem extends) 0
End position when reference variable is above limit value SETP_CUTOFF_INC Default:	If the reference variable exceeds the entered limit, the valve moves towards its end position that corresponds to 100 % of the reference variable; hysteresis: 1 % Function is deactivated when the value is 125 % 1 % **Caution!** Since the actuator is fully pressurized or vented when this function is active, the valve moves to its absolute end positions. Restrictions specified by the "travel range" or "travel limit" functions do not apply. Deactivate the function if excessive positioning forces are created by fully pressurizing or venting the actuator.
End position when reference variable is below limit value SETP_CUTOFF_DEC Default:	If the reference variable exceeds the entered limit, the valve moves towards its end position that corresponds to 0 % of the reference variable; hysteresis: 1 % Function is deactivated when the value is –2.5 % 99 % **Caution!** Since the actuator is fully pressurized or vented when this function is active, the valve moves to its absolute end positions. Restrictions specified by the "travel range" or "travel limit" functions do not apply. Deactivate the function if excessive positioning forces are created by fully pressurizing or venting the actuator.
Fail-safe action FSAFE_TYPE States: Default:	Defines response when communication failure or device start-up is detected 0 = Control to fail-safe value 1 = Control to/save last valid set point 2 = Move to fail-safe position determined by spring action 1
Fail-safe position ACTUATOR_ACTION States:	Indicates actuator's fail-safe position upon air/power supply failure or device start-up; read-only value; automatically detected during initialization 0 = Not initialized 1 = Opening in direction of 100 % position 2 = Closing in direction of 0 % position 3 = None/saving (position is retained)
Fail-safe time FSAFE_TIME Range: Default:	When DP-Watchdog detects a communication failure, fail-safe action is triggered after the fail-safe time has elapsed. 0 to 3600 s 10 s

Fail-safe value, reference var. FSAFE_VALUE Default:	Functions as replacement value for set point (reference variable w or w_cas) when communication failure was detected 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 is 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 optional inductive limit switch function is installed; not detected automatically 0 = Not installed 1 = Installed 0
Initialization method INIT_METHOD (M) States: Default:	Specifies Initialization method based on nominal or maximum range. For initialization in nominal range, only the manipulated variable range entered under rated travel/nominal angle is considered (e.g. globe valve with mechanical stop on one side). For initialization in maximum range, the max. possible manipulated variable range is used (e.g. three-way valve with mechanical stops on both sides). 0 = Initialization based on maximum range 1 = Initialization based on nominal range 0
Local operation enabled LOCAL_OP_ENA States: Default:	Unlocks local operation (zero/initialization button). Local operation is enabled when communication fails for longer than 30 s. 0 = Disabled 1 = Enabled 1
Manufacturer, actuator ACTUATOR_MAN	Clearly identifies the manufacturer of the actuator Length: 16 characters
Manufacturer, positioner DEVICE_MAN_ID	Clearly identifies the manufacturer of the field device Read-only parameter
Manufacturer, valve VALVE_MAN	Clearly identifies the manufacturer of the valve Length: 16 characters
Message DEVICE_MESSAGE	Text field to enter any desired text, saved in the field device Length: 32 characters

Mounting position MOUNTING_POSITION (M) (linear actuator) States: Default:	An arrow on the positioner's cover plate indicates how to attach the positioner to the actuator. For direct attachment, the arrow must point towards the actuator. For NAMUR attachment, the arrow must point away from the actuator. 0 = Arrow points away from actuator 1 = Arrow points towards actuator 1
Operating mode, current **Operating mode, desired** MODE_BLK / TARGET_MODE	Positioner operating modes for firmware versions: K 1.20 and earlier: OS, AUTO K 1.30 and higher: OS; LO, MAN, AUTO **Operating modes of the positioner:** **Automatic (AUTO):** In AUTO mode, the positioner follows the set point defined by the SP (w) parameter, which is preset cyclically or acyclically, according to the scale and unit determined by PV_SCALE (reference variable range). **Manual (MAN):** In MAN mode, the positioner also follows the set point defined by the SP (w) parameter, which is preset cyclically or acyclically, according to the scale and unit determined by PV_SCALE (reference variable range). The INCREASE_CLOSE (direction of action) parameter, however, is not processed; neither are the communication monitoring parameters (FSAFE_TIME, _TYPE, _VALUE). **Local Override (LO):** In LO mode, the positioner follows the set point defined by the OUT parameter (correction value), which is refreshed acyclically, according to the scale and unit (mm or degree) preset by OUT_SCALE (travel/angle of rotation range). With the characteristic deactivated, this value corresponds to the actual valve position in mm or degrees. The INCREASE_CLOSE parameter (direction of action), however, is not processed; neither are the communication monitoring parameters (FSAFE_TIME, _TYPE, _VALUE). **Out of Service (OS):** In this mode, the valve is automatically moved to fail-safe position. **Remote Cascade (RCas):** In RCas mode, the positioner follows the set point defined by the RCAS_IN (w_rcas) parameter, which is refreshed cyclically, according to the scale and unit preset by PV_SCALE (reference variable range). **Operating mode during start-up (warm start)** The positioner's response to a warm start is determined by the FSAFE_TYPE parameter (fail-safe action). If FSAFE_TYPE is set to "control to fail-safe value", the positioner switches to automatic operating mode and controls to the value preset by FSAFE_VALUE. If FSAFE_TYPE is set to "control to last set point" or "fail-safe position determined by spring action", the positioner remains in fail-safe position. The positioner switches to automatic operating mode as soon as a valid set point SP is transmitted to the device. If the status of the transmitted set point is "bad" or if the positioner has not been successfully initialized, the positioner remains in fail-safe position (Out of Service).

Operating mode, current **Operating mode, desired** MODE_BLK / TARGET_MODE (continued)	The action determined by the FSAFE_TYPE parameter (fail-safe action) is triggered by the following events: – Start-up of the positioner (warm start) – Elapsing of DP watchdog by interrupting the cyclic communication with a Class 1 master (not applicable when communication is properly terminated) – Elapsing of FSAFE_TIME (fail-safe time) in automatic or remote cascade operating mode when the status of the reference variable valid in this operating mode, SP or RCAS_IN, is set to "Initiate fail-safe" – Receipt of a DP "Global Control" service for which the CLEAR bit is set (not in K 1.30) By setting the reference variables tatus, which is used in the current operating mode, to "bad", the actuator always moves to the fail-safe position determined by the spring action (version K 1.30 and higher).
Product number, positioner DEVICE_PRODUCT_NUM (M)	Indicates the manufacturer's product number of the positioner
Proportional-action coefficient KP_Y1 SERVO_GAIN **Proportional-action coefficient KP_Y2** Range: Default:	Proportional-action coefficient for supply air: When writing, the value is written to KP_Y1 (supply air) and KP_Y2 (exhaust air). Proportional-action coefficient for exhaust air: When writing, the value is written to KP_Y2 (exhaust air). KP_Y1 (supply air) remains unchanged. Between 0.01 to 10.0, we recommend incrementing the value in steps of 0.1. When increasing the value, the set point is reached faster. 0.01 to 10.0 1.2 **Note!** The proportional-action coefficients KP_Y1 and KP_Y2 are determined when the positioner is initialized for the first time. The initialization values listed in the table on page 57 may have to be adapted to the changed operating conditions to achieve optimum control behavior.
Rated travel/nominal angle RATED_TRAVEL Default:	Specifies rated travel [mm] or nominal angle [degree] of the valve Nominal operating range 5 to 255 mm or 0.0° to 120.0° 15 mm
Reference variable range PV_SCALE Default:	Specifies scale and unit of reference variable w/w_cas (SP or RCAS_IN) 0 to 100 %
Reference variable w SP	Specifies the set point with status. Reference variable in AUTO / MANUAL mode. See also "Reference variable range"
Reference variable w_rcas RCAS_IN / RCAS_OUT	Specifies the set point with status. Reference variable in RCAS mode See also Reference variable range

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

Security locking SECURITY_LOCKING Default:	Memory position for a password to be used by the host, serves to check access rights (format: 16 bit unsigned integer) 0x2457
Serial no., actuator ACTUATOR_SER_NUM	Indicates serial number of the actuator associated with the positioner Length: 16 characters
Serial no., positioner DEVICE_SER_NUM	Indicates positioner's serial number. Clearly identifies the field unit together with the manufacturer ID and type number.
Serial no., valve VALVE_SER_NUM	Indicates serial number of the valve associated with the positioner Length: 16 characters
Set point deviation e SETP_DEVIATION	Indicates the system deviation in percent
Simulation SIMULATE	Allows operators to specify a simulation value for the current READBACK position including status
Tag identification TAG_DESC	Indicates tag number of the positioner Length: 32 characters
Text fields TEXT_INPUT_1 to TEXT_INPUT_3 (M)	Text fields to enter any desired text Length: 32 characters

Tolerance band TOLERANCE_BAND (M) Range: Default:	Reset criterion for active control loop monitoring. Enter permissible deviation for control loop monitoring. See also DELAY_TIME parameter. 0.1 to 10.0 % 5 %
Tolerated overshoot TOL_OVERSHOOT (M) Adjustment range: Default:	If the set point deviation e exceeds the tolerated overshoot, pulse adaptation reduces the minimal pulses in operating direction that caused the overshooting. If the set point deviation e exceeds the dead band Xtot, but stays within the tolerated overshooting range, pulse adaptation reduces the minimal pulses in both moving directions after two complete amplitudes with the overshooting range. 0.01 to 10.00 % of rated travel/opening angle 0.5 %
Total valve travel, absolute TOTAL_VALVE_TRAVEL	Specifies absolute total valve travel, i.e. sum of nominal duty cycles (e.g. valve travels from fully open to fully closed position and back) Maximum value: 16,500,000
Total valve travel, limit TOT_VALVE_TRAV_LIM Default:	Specifies limit for the total valve travel. Range: 0 to 16,500,000 1,000,000
Transducer state TRANSDUCER_STATE (M) States:	Indicates current state of control 0 = See current operating mode 1 = Forced venting active 2 = Lower travel limit active 3 = Upper travel limit active 4 = End position at < active 5 = End position at > active
Transit time, desired CLOSED TRAVEL_RATE_DEC Range: Default:	Specifies the adjustable min. time in seconds that the valve needs to move through the manipulated variable range towards 0 % position. 0 to 75 s 0 s
Transit time, desired OPEN TRAVEL_RATE_INC Default:	Specifies the adjustable minimum time in seconds that the valve needs to move through the manipulated variable range towards 100 % position. Range: 0 to 75 s 0 s
Transit time, minimum CLOSED ACT_STROKE_TIME_DEC	The minimum transit time to CLOSE the valve (towards 0 % position) specifies the actual time in seconds that the system (positioner, actuator, valve) needs to move through the rated travel/angle and close the valve. This parameter is measured during start-up. Read-only value
Transit time, minimum OPEN ACT_STROKE_TIME_INC	The minimum transit time to OPEN the valve (towards 100 % position) specifies the actual time in seconds that the system (positioner, actuator, valve) needs to move through the rated travel/angle and open the valve. This parameter is measured during start-up. Read-only value

Transmission code TRANSM_CODE (M) States: States: Default:	**For linear actuators with integrally attached positioner:** determine geometrical dimensions of the travel pick-off with integral attachment 1 = D1, lever length 64 mm 2 = D2, lever length 106 mm **For rotary actuators:** Max. opening angle of selected segment of the installed cam disk 3 = S90, 90° segment 4 = S120, 120° segment 1
Transmission length TRANSM_LENGTH (M) Range: Default:	**Only for linear actuators with positioner attached acc. to NAMUR** Lever length, distance between travel pick-off and fulcrum of pick-off lever 0.0 to 1023.0 mm 42.0 mm
Transmission pin position TRANSM_PIN_POS (M) States: Default:	**Only for linear actuators with positioner attached acc. to NAMUR** Position of pin on positioner lever, see marking on positioner lever 0 = A 1 = B 0
Travel/angle limit, lower TRAVEL_LIMIT_LOW Default:	Allows you to enter the lower limit of the valve travel/angle Range: –20.0 to 99.9 %. The characteristic is not adapted. 0.0 %
Travel/angle limit, upper TRAVEL_LIMIT_UP Default:	Allows you to enter the upper limit of the valve travel/angle Range: 0.0 to 120.0 %. The characteristic is not adapted. 100.0 %
Travel/angle of rotation range OUT_SCALE Range: Default:	Specifies the adjusted upper and lower values of the actual operating range in mm or degrees. For non-linear characteristics, the characteristic is adapted to the reduced travel. If the positioner is initialized based on the maximum range, the travel/angle range is always relative to the entered rated travel/angle. The operating range must not be smaller than ¼ of the rated travel/angle. 0.0 to 255.9 mm / 0.0° to 120.0° Lower limit: 0 Upper limit: 15 mm/90°
Travel/angle of rotation, max. permissible MAX_HUB (M)	Specifies the maximum permissible travel/opening angle determined during initialization in percent of the rated travel/opening angle **Note!** If initialization was successful with regard to the nominal range, the maximum permissible travel/angle is not determined.
Type number, positioner DEVICE_ID	Specifies the type number of the field unit
Type of protection DEVICE_CERTIFICATION	Specifies the field unit's type of protection
Valve position feedback, discrete POS_D States:	Indicates the discrete valve position feedback with status 0 = Not initialized 1 = Closed (x < 0.5 %) 2 = Open (x > 99.5 %) 3 = Intermediate

Valve type VALVE_TYPE States: Default:	Specifies the valve design 0 = Control valve with linear motion of the connecting element 1 = Control valve with rotary or part-turn motion of the element 0
Warm start DEVICE_RESET_CMD States: Default:	Resets the field device (warm start) 0 = No action 1 = Reset the device 0
Write protection WRITE_PROTECT_SWITCH (M) States:	Indicates state of the write-protection switch in the positioner When write protection is activated, device data can only be read, but not overwritten. Write protection can only be activated on the switch in the positioner. 0 = Write enabled 1 = Write protected

9 Messages and diagnostics

The Type 3785 PROFIBUS-PA Positioner provides the best opportunities for diagnostics during the initialization phase. The positioner automatically conducts detailed tests to check the mounting position and valve response as well as to evaluate them based on the entered or preset parameters.
When running routine tests or when unclear diagnostic/error messages occur during operation, we recommend to re-initialize the positioner to better assess the control system.

9.1 Diagnostic messages

Hardware error in electronics

This message is issued when the cyclic check detects a defect in the electronics module. Requires repair.

Hardware error in mechanics

This message is issued when the cyclic check detects a defect in the mechanics module. Requires repair.

Error in data memory

This message is issued when the cyclic check detects that a storage cell was changed without verification. The static message remains active while the error persists in the field unit.

Measurement error

This message indicates that the internal analog/digital converter does not work properly within its time frame or the measured values are outside the physical measuring range limits of the analog/digital converter. Repair is required if resetting the positioner fails after performing a warm start. The static message remains active while the error persists in the field unit.

Device not initialized (no auto-initialization performed)

This message indicates that the device has not been initialized yet or a cold start was performed. The message is automatically reset when initialization has been competed successfully.

Auto-initialization error

This message indicates that initialization could not be completed successfully. Detailed error messages will be issued (see section 9.4). The message is automatically reset when initialization has been competed successfully.

Zero point error (end position)

This message indicates any change that exceeds the value determined during initialization or zero adjustment by more than ±5 %. Possible sources of error:
– Worn-out valve seat or plug
– Foreign particles between seat and plug

The message is automatically reset when zero adjustment has been competed successfully.

Incorrect configuration

This message indicates that incorrect values have been entered. When receiving an incorrect value, the positioner indicates that the received value is outside the permissible range. The previous value remains valid. The message is reset by confirmation.

Restart (warm start) completed

This message indicates that the positioner was reset by performing a warm start. The reset is triggered by a restart after an electrical power failure or by the DEVICE_RESET_CMD = 1 command. The message is automatically reset when it is read.

New start (cold start) completed

This message indicates that the positioner was reset by performing a cold start and that it is started up again with the default control values. The reset is triggered by the FACTORY_RESET = 2 command. The positioner needs to be re-initialized.
The message is automatically reset when it is read.

Maintenance required

This message indicates that the current total valve travel value exceeds the entered or preset limit. If the limit is adjusted slightly below the value determined for a reference valve, the positioner automatically signals that the valve needs to be serviced so that a possible failure is prevented. The message is reset by the SELF_CALIB_CMD = 7 command (reset total valve travel).

Invalid characteristic

This message indicates that:
– An error occurred while the characteristic was transmitted to the positioner, or
– The input values for a user-defined characteristic were not entered in ascending order, or
– The gradient of a user-defined characteristic exceeds 16.

If an Invalid characteristic error occurs, the positioner automatically switches from a user-defined characteristic to a linear characteristic after receiving the values.
The message is automatically reset when a correct characteristic has been received.

Further information available

This message indicates that extended diagnostic messages have been generated.

9.2 Extended diagnostic messages

Binary input active

This message indicates that the condition for activating the binary input has been fulfilled.

Invalid start values for min. pulses in range 1

This message indicates that the pulse search for the 0 to 20 % range of the rated travel/angle by adapting the pulse-pause ration has not been completed yet.
The message is automatically reset after supply and exhaust air pulses have successfully been adapted.

Invalid start values for min. pulses in range 2

This message indicates that the pulse search for the 20 to 80 % range of the rated travel/angle by adapting the pulse-pause ration has not been completed yet.
The message is automatically reset after supply and exhaust air pulses have successfully been adapted.

Invalid start values for min. pulses in range 3

This message indicates that the pulse search for the 80 to 100 % range of the rated travel/angle by adapting the pulse-pause ration has not been completed yet.
The message is automatically reset after supply and exhaust air pulses have successfully been adapted.

Error in optional forced venting function

This message indicates that either the optional module is not screwed on tightly or that the coding jumper is not set when the optional forced venting function is missing.

9.3 CHECKBACK messages

Fail-safe position (mode = Out of Service)

This message indicates that fail-safe position was triggered by the positioner. This can be caused by selecting Out of Service mode, by activating the optional forced venting function or by a communication failure. The positioner switches to Out of Service mode.

Request for Local Operation mode

This message indicates that local operation was requested, but not enabled (LOCAL_OP_ENA = 0). The message is automatically reset when it is read.

Positioner in Local Operation mode

Forced venting active

This message indicates that forced venting was triggered, i.e. the signal at terminals +81 and –82 is smaller than 3 V. The valve is moved to fail-safe position regardless of the control loop. The message is automatically reset when a 6 to 24 V DC signal is applied to terminals +81 and –82.

Static data changed

This message indicates that positioner data have been changed, which allows operators to detect (unintentional/unauthorized) changes of the originally adjusted values.
The message is automatically reset when it is read.

Simulation mode (values not derived from the process)

This message indicates that the positioner is in simulation mode. In this case, the controlled variable x is preset.

Error (refer to section on diagnostic messages for possible causes)

This message indicates that the positioner is defective. Diagnostic messages indicate specific causes.

Control loop error

This message indicates that the positioner fails to control within the adjusted tolerance band for error monitoring within the specified delay time.

Possible sources of error:
– Oscillation caused by the actuator working too fast (small travel volume)
  Remedy: reduce supply pressure (see section 3.1.2) or install signal pressure restriction.
– Supply air failure/insufficient supply air
– Clogged filter
– Oiled-up solenoid valves
– Ruptured actuator diaphragm
– Broken actuator springs
– Considerable increase in friction on the control valve
– Blocked control valve

The message is indicated by bit 7 and bit 13 of the Checkback parameter (see table on pages 38/39). The state of bit 7 is automatically reset; bit 13 is reset by the SELF_CALIB_CMD = 10 command (reset Control Loop Error).

Positioner inactive (mode = Out of Service)

This messages indicates that the positioner is in Out of Service mode.

Positioner in self-test mode (mode = Out of Service)

This message indicates that the positioner is going through the initialization process or electric zero calibration.

Limit for total valve travel exceeded

This message indicates that the current total valve travel value exceeds the entered/preset limit. If the limit is adjusted slightly below the value determined for a reference valve, the positioner automatically signals that the valve needs to be serviced so that a possible failure is prevented.
The message is reset by the SELF_CALIB_CMD = 7 command (reset total valve travel).

9.4 Messages during initialization

Not defined

This message indicates that the positioner has not yet been initialized or that a cold start was performed.
The message is reset by confirmation.

Canceled

This message indicates that the initialization routine was aborted by the user.
The message is reset by confirmation.
If the positioner had already been initialized successfully and no cold start has been triggered, the positioner returns to control operation.

Error in mechanics/pneumatics section

This message indicates that the initialization routine detects no or a constant change of the value measured for the controlled variable travel/angle. Initialization is canceled.

Possible sources of error:
– Insufficient/unstable supply pressure
– Insufficient air capacity
– Improper mechanical attachment
– Pick-off lever improperly mounted
– With NAMUR attachment: lever incorrectly secured to the shaft of the adapter housing
– Connecting cable between logic unit and PCB for travel pick-off removed

Timeout

This message indicates that the valve could not be moved to its end position within max. 240 seconds. Initialization is canceled.

Possible sources of error:
– Large difference between static and sliding friction on the control valve (oscillation) triggers separate message
– Unstable supply pressure
– Insufficient air capacity

Incorrect selection of rated travel or transmission

This message indicates that the maximum travel determined, which is issued in percent of the rated travel/angle, is smaller than the selected rated travel/angle.
Warning! Initialization is not canceled.

Possible sources of error:
– Improper mechanical attachment
– Improper transmission entered
– With NAMUR attachment: wrong pin position selected
– Valve blocked
– Insufficient supply pressure. Adjust the supply pressure to be at least 0.4 bar above the upper spring range value (see section 3.1.2).

Leakage in pneumatic system

When initially determining the minimum control pulse, the actuator must stall for a few seconds. This period of time is used to leak-test the pneumatic system. If the control valve moves from its rest position by more than 9.3 % within seven seconds, the associated message is generated. Additionally, an initialization warning is issued.
Warning! initialization is not canceled.

Possible sources of error:
– Leakage in actuator
– Leakage in signal pressure connection

Initialization state: determining mechanical stops

When determining the mechanical stops, the initialization routine detects the spring action and zero point by completely pressurizing and venting the actuator. In addition, the routine checks whether the positioner can move through 100 % of its rated travel/angle.

Initialization state: determining the minimum transit times

When determining the transit time, the time required by the valve to move through its rated travel/angle from 0 % to 100 % and back is measured.

Initialization canceled by activating the forced venting function

Initialization is canceled if the optional forced venting function is activated. When the optional forced venting function is included, make sure a voltage between 6 and 24 V DC is applied to terminals +81 and –82.

Zero point error

This message indicates that the zero point determined is outside the permissible tolerance of max. ±5 % around the absolute internal value for measurement. Initialization is canceled. To remove the error, adjust mechanical zero (see section 4.4.1). After that, make sure that the yellow position pin of the travel pick-off is roughly aligned with the white line marking zero on the cover plate.

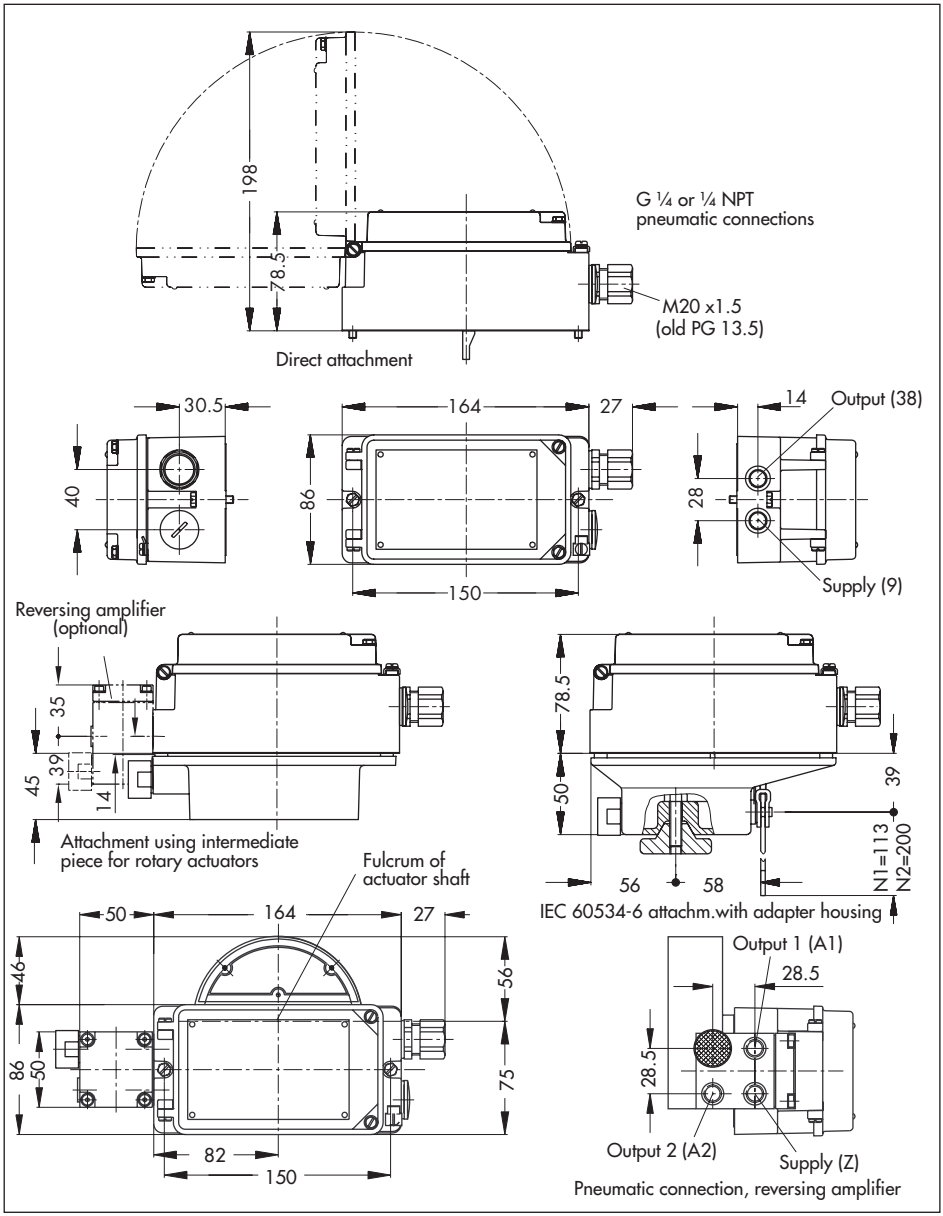
Proportional band excessively restricted

This message indicates that even the smallest permissible pulses cause excessive changes in travel. Initialization is canceled.

Possible sources of error:
– Excessive supply pressure
– Missing signal pressure restriction for small-volume actuators
– Error in mechanics section, particularly with NAMUR attachment (acc. to IEC 60534-6)
– Bypass not opened far enough with booster valve mounted on large-volume actuator

Successful

This message indicates that initialization was completed without any errors.


198
78.5
G ¼ or ¼ NPT
pneumatic connections
M20 x1.5
(old PG 13.5)
Direct attachment
30.5
40
164
27
86
150
14
Output (38)
28
Supply (9)
Reversing amplifier
(optional)
35
39
45
14
Attachment using intermediate
piece for rotary actuators
78.5
50
39
56
58
N1=113
N2=200
IEC 60534-6 attachm.with adapter housing
Fulcrum of
actuator shaft
50
164
27
46
56
86
50
75
82
150
Output 1 (A1)
28.5
28.5
Output 2 (A2)
Supply (Z)
Pneumatic connection, reversing amplifier

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Braunschweig und Berlin

PTB Ex

(1) **EC TYPE EXAMINATION CERTIFICATE**

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

(3) EC Type Examination Certificate Number

PTB 97 ATEX 2254

(4) Equipment: Profibus Positioner Model 3785-1

(5) Manufacturer: SAMSON AG

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

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

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

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

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

EN 50014: 1997 EN 50020: 1994

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

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

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PTB Ex

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

Ex **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.

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(13) **Schedule to the**

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

(15) **Description of Equipment**

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

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

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

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

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

Electrical Data

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

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

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

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

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EC TYPE EXAMINATION CERTIFICATE No. PTB 97 ATEX 2254

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

Only for connection to a certified intrinsically safe circuit.

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

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

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

Only for connection to a certified intrinsically safe circuit.

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

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

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

Maximum Values: $U_e \leq 5.88$ V
$I_e \leq 1$ mA

The permissible maximum external capacitance is for

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

The permissible maximum external inductance is for

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

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

A D D E N D U M No. 1

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

Equipment: Profibus Positioner Model 3785-1

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

Manufacturer: SAMSON AG

Adress: Weismüllerstr. 3
D-60314 Frankfurt

Description of the additions and modifications

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

Electrical data

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

Maximum values:	**IIC**	**IIB**
	$U_i \leq$ 20 V	$U_i \leq$ 24 V
	$I_i \leq$ 285 mA	$I_i \leq$ 285 mA

The effective internal capacitance is C_i <5 nF

The effective internal inductance is negligible.

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

Zertifizierungsstelle Explosionsschutz
By order
(Seal)

Braunschweig, 23 July 1999

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

ADDENDUM No. 2

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

Equipment: Profibus Positioner Model 3785-1

Marking: 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 or 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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PTB

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

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

Binary input (terminals 85/86)
Type of protection: Intrinsic safety EEx ia IIC/IIB or EEx ib IIC/IIB
only for connection to a certified intrinsically safe circuit

Maximum values		
	U_i =5.88 V	
	I_i = 1 mA	
	P_i =7.2 mW	
	IIC	**IIB**
	$C \leq$ 43 µF	$C \leq$ 1000 µF
	$L_o \leq$ 1 H	$L_o \leq$ 1 H

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

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

only for connection to a certified intrinsically safe ciruit

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

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

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Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

All the other specification apply without change also to this Addendum No. 2.

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

Zertifizierungsstelle Explosionsschutz Braunschweig, 19 February 2002

By order

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

All other specifications remain unchanged.

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

ADDENDUM No. 3

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

Equipment: Profibus Positioner Model 3785-1

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

Manufacturer: SAMSON AG Mess- und Regeltechnik

Adress: Weismüllerstr. 3 D-60314 Frankfurt

Description of the additions and modifications

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

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

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

II 2D IP 65 T 80 °C

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

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

Zertifizierungsstelle Explosionsschutz Braunschweig, 14 January 2004

By order

(Seal)

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

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 **(Ui)** 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:

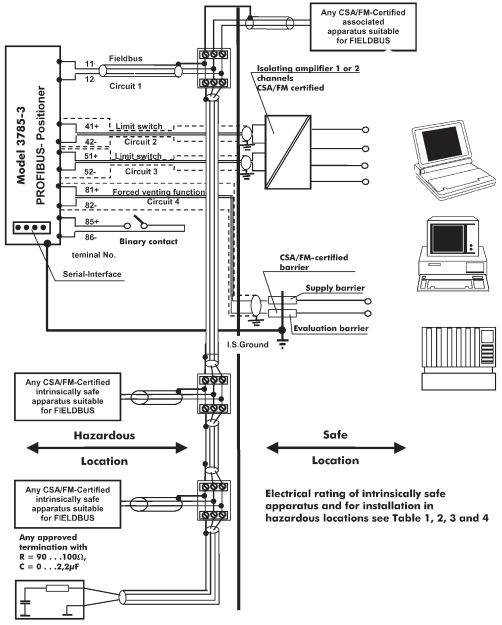
   Uo or Voc or Vt ≤ Ui or Vmax, Io or Isc or Ii or Imax, Po or Pmax ≤ Pi or Pmax
3. The maximum non-hazardous area voltage must not exceed 250 V.
4. The installation must be in accordance with the Canadian Electrical code Part 1.
5. Each set of wires must be provided with grounded shield. The shield must 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 ≥ Cᵢ + 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_{OC} 5,88	V_{OC} 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_{OC} or $V_t \leq U_i$ or V_{max} , I_0 or I_{OC} or $I_t \leq I_i$ 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_{OC}	R_{min}	I_{OC}	P_{max}	V_{OC}	R_{min}	I_{OC}
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:

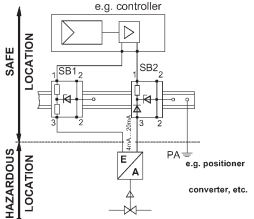
Temperatur class	Permissble ambient temperature range
T6	+60°C
T5	-40°C ≤ T_a ≤+70°C
T4	+80°C

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	

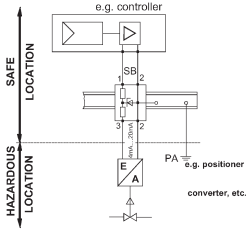
Circuit diagram of a ground- free signal circuit. *(forced venting function circuit 4)*



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.

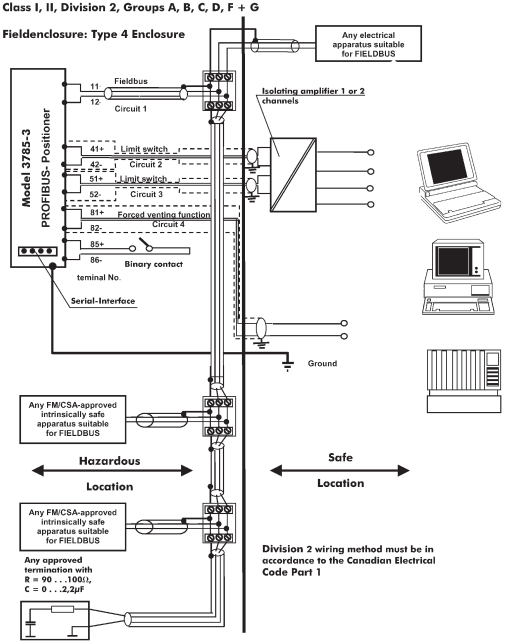
Circuit diagram of a grounded signal circuit *(forced venting function circuit 4)*



Ground signal circuit with one barriers

CSA certified for hazardous locaions:
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 **(Pi 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 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 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:

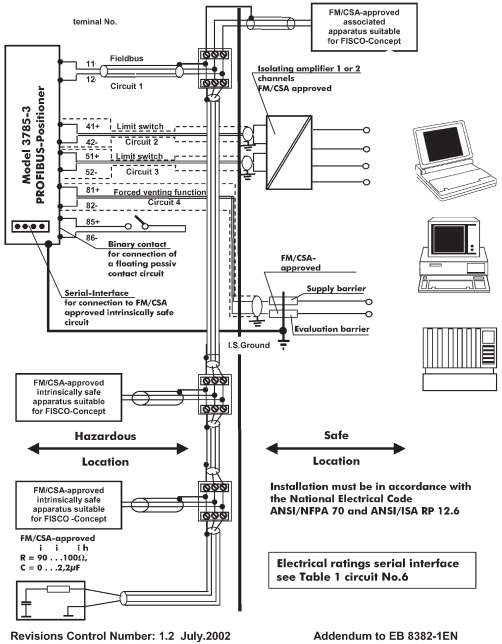
1. FM-Approved associated apparatus must be installed in accordance with manufacturer instructions
2. FM-Approved associated apparatus must meet the following requirements:

   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_0 or V_{OC}	#/#				5,88V	5,88V	#/#
I_i or I_{max}	360mA	380mA	25/52mA	115mA	#/#	#/#	60mA
I_0 or I_{SC}	#/#				1	55	#/#
P_i or P_{max}	1,54W	2,58W	64/169mW	**#/#**			250mW
P_0 or P_{max}	#/#				7,2mW	298mW	#/#
C_i	5nF		60nF	5,3nF	0nF	#/#	0nF
Ca	#/#				43 μF	42 μF	#/#
L_i	10 μH		100 μH	0μH	0μH	#/#	0μH
La	#/#				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_0 or V_{OC} or $V_t \leq U_i$ or V_{max} , I_0 or I_{SC} or $I_t \leq I_i$ or I_{max} , P_0 or $P_{max} \leq P_i$ or P_{max}
   Ca $\geq C_i + C_{cable}$ and La $\geq L_i + L_{cable}$

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_{0C}	R_{min}	I_{SC}	P_0	V_{0C}	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:

Table 4:

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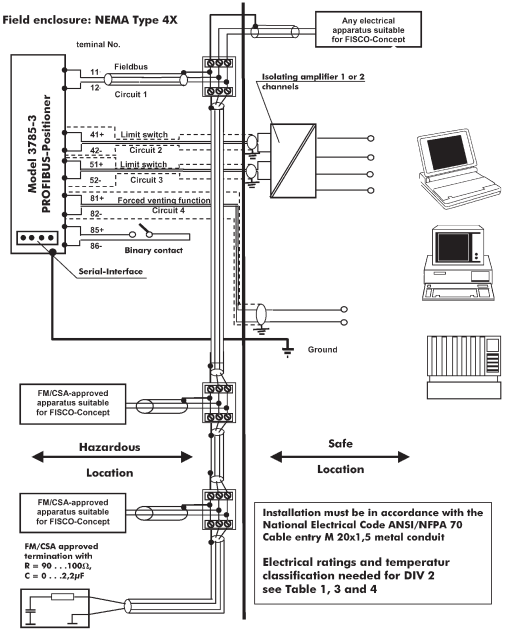
T5	- 40°C ... 60°C	
T4	- 40°C ... 75°C	
T6	- 40°C ... 60°C	25mA
T5	- 40°C ... 80°C	
T4	- 40°C ... 80°C	

FMRC-approved for hazardous locations:

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

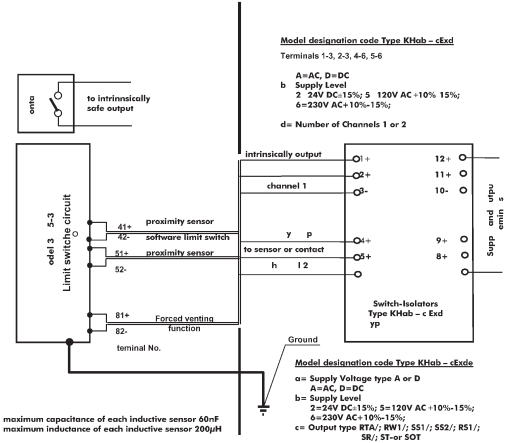
Field enclosure: NEMA Type 4X



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	↓	↓

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