

HART Positioner Type 3780

SAMSON



Fig. 1 · Type 3780

Mounting and operating instructions

EB 8380-1 EN

Firmware R 2.22/K 2.23

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WARNING



- ▶ *Assembly, commissioning and operation of the device may only be performed by trained and experienced personnel familiar with this product.*

According to these mounting and operating instructions, trained personnel is referred to persons who are able to judge the work they are assigned to and recognize possible dangers due to their specialized training, their knowledge and experience as well as their knowledge of the relevant standards.

- ▶ *Explosion-proof versions of this device may only be operated by personnel who have undergone special training or instructions or who are authorized to work on explosion-proof devices in hazardous areas. See chapter 6 for more details.*
- ▶ *Any hazards which could be caused by the process medium, the signal pressure and moving parts of the control valve are to be prevented by means of appropriate measures.*
If inadmissible motions or forces are produced in the actuator as a result of the level of the supply air pressure, this must be restricted by means of a suitable pressure reducing station.
- ▶ *Proper shipping and appropriate storage are assumed*

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

Modifications of positioner firmware in comparison to previous version	
Former	New
	For more details on the listed parameters, please also refer to the list of parameters in chapter 8.
Positioner R 1.41	R 2.01
Parameters: Operating direction	Direction of action The reference variable (w) is not assigned to the output signal pressure (y) anymore, but to the travel/angle of rotation (x). >> increasing/increasing, valve opens with increasing reference variable. <> increasing/decreasing, valve closes with increasing reference variable.
Minimum transit time filling/venting	Minimum transit time open/closed The measured time is not referenced to filling/venting the actuator, but to the opening and closing the valve.
Required transit time filling/venting	Required transit time open/closed The actuating time is not referenced to filling/venting the actuator, but to the opening and closing the valve.
Cycle time factor K_IS	Omitted
Initialization	For version R2.02 and upwards, an alarm message is generated for deviations larger than 10% when the type of initialization is maximum range. It is for the user to decide if he wants to tolerate the deviation.
Tolerated overshoot	If overshoot and dead band are exceeded by the negative deviation value, the pulse is adapted.
Text field	Free space for storing information text in the field device.

Former	New
Positioner 2.02	R 2.11
Parameters: Minimum pulse filling/venting	The minimum pulses for filling and venting are determined for the travel ranges 0 to 20 %, 20 to 80 % and 80 to 100 %. The minimum pulses are no longer determined during initialization.
Proportional-action coefficient KP_Y1 and KP_Y2 Gain factor KD	These factors are adapted to the actuator type selected and to the transit times measured.
Initialization	"Air leakage of pneumatic system" is displayed as alarm message, but does not cause abortion of initialization anymore. Upon initialization in the "nominal range", the positioner assumes only 100 % travel (no overtravel). "Wrong selection of rated travel/angle of rotation or transmission" is displayed as alarm message, but does not cause abortion of initialization anymore.
Positioner 2.11	R 2.21
Type of actuator	Change over type of actuator from "linear actuator" to "rotary actuator" Initialization typeBased on maximum range Transmission codeS90 Nominal angle.....90° End position when w <1 % End position when w >99 % Rotational angle range start ..0° Rotational angle range end ...90° Change over type of actuator from "rotary actuator" to "linear actuator" Attachment Integral Acc. to NAMUR Initialization typeBased on nominal rangeBased on nominal range Mounting positionArrow towards actuatorArrow away from actuator Transmission codeD1- Pin position.....-A Rated travel15 mm15 mm End position when w <1 %1 % End position when w >125 %125 % Travel range start.....0 mm0 mm Travel range end15 mm15 mm Length of lever.....-42 mm

End position when w </>	<p>Changing the type of initialization from "maximum range" to "nominal range" causes: End position at < 1 % End position at > 125 %</p> <p>Changing the type of initialization from "nominal range" to "maximum range" causes: End position at < 1 % End position at > 99 %</p>
Extended valve diagnostics	Supports TROVIS-EXPERT from version 1.0 and upwards
Required transit time open/closed	The adjustment range for the required transit times has been limited to 75 s. Safe functioning can only be guaranteed up to this limit value.
Initialization	During initialization, the minimum control pulses for the range 20 % to 80 % of the range of the manipulated variable are determined and saved in the EEPROM.
Proportional-action coefficient KP_Y1 and KP_Y2	These factors are adapted to the type of actuator chosen and the transit times measured.
Positioner 2.21	R 2.22
	<p>Correction in "manual" operating mode and direction of action</p> <p>Correction in zero calibration started via communication</p>
Communication K 1.00	K 2.01
Characteristic type	<p>Free space for entering information on the description of the user-defined characteristic saved in the device. Can be stored in the field device.</p> <p>For version K 2.02 upwards, when selecting [equal percentage] or [equal percentage reverse], the description text in parameter characteristic type of the device is automatically set to the selection made.</p>
Communication K 2.02	K 2.11
	Supports all functions of R 2.11
Type of initialization	For K 2.11 and upwards, the default value is "maximum range"
End position when w >	For K 2.11 and upwards, the default value is 99 %

Former	New
Communication K 2.13	K 2.21
	Supports all functions of R 2.21 as well as TROVIS-EXPERT from version 1.0 and upwards
Communication K 2.21	K 2.22
	Supports all functions of R 2.21 as well as TROVIS-VIEW from version 2.0 and upwards

New for model index **3780-x...x. 01** and upwards: **Write protection switch**

If this option is activated using the switch, the positioner settings cannot be written over by HART communication. See chapter 4.1 for more details on the write protection switch.

Model index **3780-x...x. 03** and upwards are suitable for the extended valve diagnosis using the TROVIS-EXPERT software.

Positioner versions

Model		3780 -	X	X	X	X	X
Explosion protection	Without	0					
	Ex II 2 G EEx iA IIC T6 as per ATEX	1					
	CSA/FM	3					
	Ex II 3 G EEx nA II T6 as per ATEX	8					
Additional accessories	Limit switches	Without	0				
		2 inductive	2				
		2 software	3				
	Forced venting	Without		0			
		With		1			
	Position transmitter	Without			0		
		4...20 mA			1		
Pneumatic connections	NPT 1/4-18						1
	ISO 228/1-G 1/4						2

Positioner	
Rated travel, adjustable	Direct attachm. 5 to 30mm Attachment acc. to IEC 60534-6 (NAMUR), 5 to 255 mm or 30 to 120° C
Reference variable	Two-wire connection, signal range 4 to 20 mA, span 4 to 16 mA Min. current = 3.6 mA, load ≤10.8 V (corresponding to 540 Ω at 20 mA), static destruction limit 500 mA
Supply	Supply air from 1.4 to 6 bar (20 to 90 psi)
Signal pressure (output)	0 bar to pressure of supply air
Characteristic, adjustable	Linear, equal percentage, reverse equal percentage, user-programmable Deviation from characteristic ≤1 %
Dead band	Adjustable from 0.1 to 10 %, default 0.5 %
Resolution	≤0.05 %
Transit time to travel	Up to 75 s, separately adjustable for exhaust and supply air
Moving direction	Reversible, adjustment via software
Air consumption	Independent of supply air <90 l _n /h
Air delivery	Actuator filled: for Δp = 6 bar 9.3 m _n ³ /h, for Δp = 1.4 bar 3.5 m _n ³ /h Actuator vented: for Δp = 6 bar 15.5 m _n ³ /h, for Δp = 1.4 bar 5.8 m _n ³ /h
Perm. ambient temperature	– 20 to 80 °C, with metal cable gland – 40 to 80 °C Devices with position transmitter only – 20 to 80 °C For explosion-proof devices, see type examination certificate in appendix
Effects	Temperature: ≤0.15 %/10 K, supply: none, vibrations: none up to 250 Hz and 4 g
Explosion protection	EEx ia IIC T6, see type examination certificate
Degree of protection	IP 65 by using the filter check valve included
Electromagnetic compatibility	Requirements acc. to EN 50081/50082 as well as NAMUR Recommendation 21 have been met
Electrical connections	1 cable gland M20x1.5, black plastic; other threaded hole M20x1.5 available
Fault message output	For connection to switching amplifier acc. to EN 60947-4-6, static destruction limit 16 V
Forced venting (model index .03 and upwards)	Activated/deactivated by a switch inside case Input: 6...24 V DC, R _i approx. 6 kΩ, at 24 V DC (depending on voltage), switching point for "1" signal at ≥ 3 V, signal "0" only at 0 V, K _v value 0.17; static destruction limit 45 V

Communication	
Hardware requirements	SAMSON's TROVIS-VIEW Operator Interface (see Data Sheet T 6661 EN) or handheld communicator, e.g. Type 275 by Rosemount Integration of other operator interfaces, e.g. DTM, are available
Data transmission	HART Field Communication Protocol Impedance in HART frequency range: receive: 350 to 450 Ω ; send: approx. 115 Ω
Accessory equipment	
Inductive limit switches	Two Type SJ 2 SN Prox. Switches for connection to switching amplifier acc. to EN 60947-5-6
Software limit switches	Two configurable limit values for connection to switching amplifier acc. to EN 60947-5-6 Switching hysteresis 1%, static destruction limit 16 V
Analog position transmitter	Two-wire transmitter, output 4 to 20 mA Supply: terminal voltage 12 to 35 V DC, static destruction limit 40 V Direction of action reversible, characteristic linear, operating range: -10 % to +114 % D.C. current signal ripple content: 0.6 % at 28 Hz/IEC 381 T1 Resolution ≤ 0.05 % HF influence <2 % with $f = 50$ to 80 Mhz Influence aux. supply: none; temperature influence: same as positioner
Materials (WN numbers according to DIN)	
Case	Die-cast aluminum, chromed and plastic-coated External parts: stainless steel WN 1.4571 and WN 1.4301
Weight	Approx. 1.3 kg

1. Design and principle of operation

The positioner essentially consists of an inductive, non-contact displacement sensor system and an electrically controlled valve block comprising the 2/2-way on-off valves and an electronic unit. This unit contains two microcontrollers for processing the control algorithm and managing the communication.

Whenever a deviation between the actual valve travel (actual value) and the reference variable (set point) occurs, the microcontroller produces binary pulse-pause modulated signals to control the two 2/2-way on-off valves, each of which is assigned an amplifier. One of these valves controls the exhaust air, and the other one controls the supply air.

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

As a standard feature, the positioner is equipped with a fault message output (binary output according to EN 60947-5-6) used to signalize a fault to the control room.

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

Forced venting function

The positioner is controlled via a 6 to 24 V signal, causing the signal pressure to be applied to the actuator. If this voltage signal decreases, the signal pressure is shut off and the actuator is vented. The springs contained in the actuator move the valve to its fail-safe position.

The forced venting function is installed in all positioners from model index .03 and upwards. The function can be activated or deactivated by a switch. See chapter 4.2 (page 34) for more details.

1.1 Options

As a supplement to the standard positioner version, there are several additional options to extend the positioner functions.

Limit switches

To signalize the valves' end positions in fail-safe circuits, either two software limit switches or two proximity switches can be used.

Position transmitter

The position transmitter is an intrinsically safe 2-wire transmitter controlled by the microcontroller of the positioner. It serves to assign the valve position with the 4 to 20 mA output signal. The position transmitter signalizes both end positions, "valve closed" or "valve fully open", as well as all intermediate positions. Since the valve positions are signalized to the positioner independently of the input signal (minimum current must be observed), the position transmitter is a suitable option for checking the current valve position.

1.2 Communication

For communication, the positioner is equipped with an interface for the HART protocol (Highway Addressable Remote Transducer). Data transmission is accomplished by superimposing an FSK signal (FSK = Frequency Shift Keying) over the existing 4 to 20 mA signal lines for the reference variable.

You can configure and operate the positioner either via HART-compatible, hand-held communicator or via PC, using an FSK modem and an RS 232 interface.

After mechanically resetting the positioner to zero, it can be automatically started up via initialization procedure. During this initialization procedure, zero is automatically adjusted, and the preset span is checked.

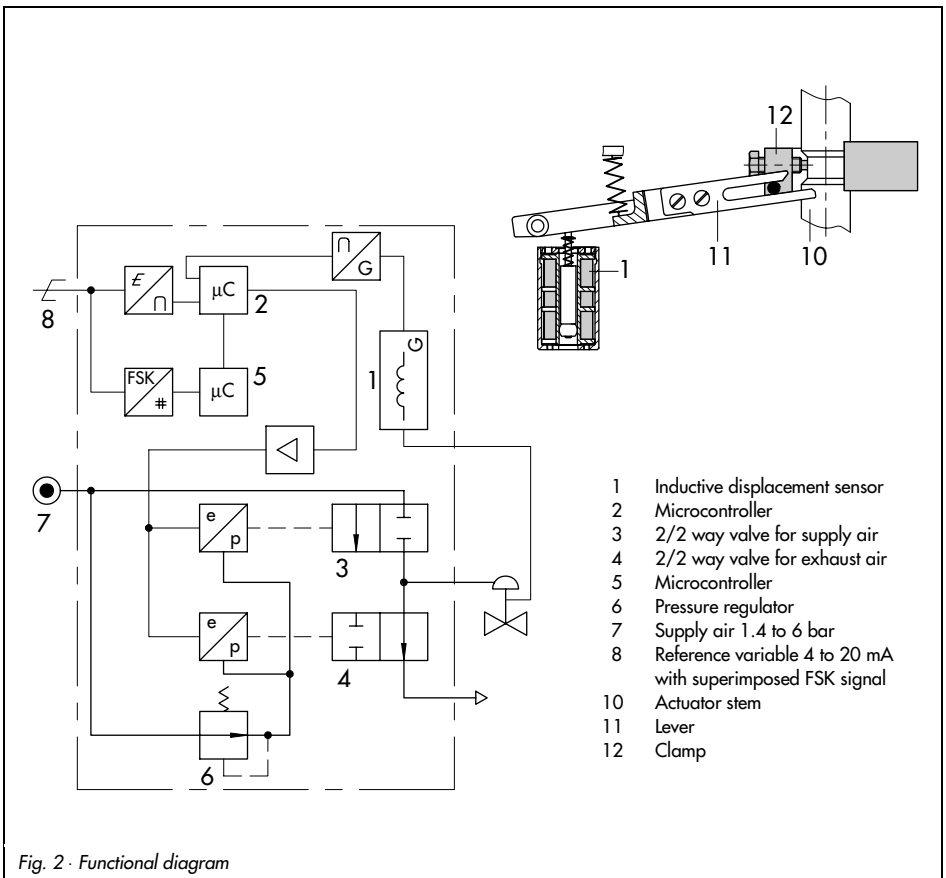


Fig. 2 · Functional diagram

The positioner is supplied with a standard configuration applying to a valve with 15 mm rated travel, which is designed for integrated positioner attachment.

An individual configuration needed to adapt the positioner to deviating actuators can only be carried out by means of a communicator or a PC with a connected FSK modem, using the HART protocol.

You can enter the following parameters: control characteristic, direction of action, limitation of travel, travel range, transit time to travel and fault messages.

Operating software

- ▶ TROVIS-VIEW
for devices with firmware K 2.11 or higher, Data Sheet T 6661 EN
- ▶ IBIS
(DOS-based, no longer runs on Windows 2000/ME/XP/NT),
see EB 8380-2 EN for more details
- ▶ DMT 1.2 and PACTware
- ▶ Integration
e.g. Fisher AMS, Siemens PDM, etc.

Handheld communicator
DD-based handheld communicators,
e.g. Fisher-Rosemount HART Communicator.

2. Attachment to the control valve

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 device can also be attached as rotary positioner to rotary actuators.

For quick-acting control valves with a small travel volume (transit time travel <0.6 s) it might be necessary to replace the filter installed in the output pressure bore (Output 36) with a screw-in throttle (see list of accessories on page 17) to obtain good control properties.

Since the standard positioner unit is delivered without accessories, the required mounting parts and their order numbers have to be derived from the tables.

CAUTION

The positioner does not have a venting plug. Instead the air is exhausted via venting plugs on the mounting parts (see also Fig. 3, 5 and 7).

A filter check valve for the exhaust air is supplied with every positioner (located underneath a transparent cover at the back of the positioner). Use this filter check valve in place of the standard venting plug included in the accessories. The IP 65 degree of protection to prevent dirt and moisture entering the device is only achieved when this filter check valve is used.

2.1 Direct attachment to Type 3277 Actuator

For the selection of the required mounting parts, refer to Tables 1, 2 and 3 (page 17).

When looking at the signal pressure connection or the switchover plate (Fig. 3) from the top, the positioner must be attached to the left side of the actuator. The **arrow** on the black case cover (Fig. 12) should then point **towards the diaphragm chamber**.

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

1. First screw the clamp (1.2) to the actuator stem. Make sure the fastening screw is located in the groove of the actuator stem.
2. Screw the associated lever D1 or D2 to the transmission lever of the positioner.
3. Fasten distance plate (15) with seal towards the actuator yoke.
4. Place positioner on the plate (15) so that the lever D1 or D2 will slide centrally over the pin of the clamp (1.2). Then screw on to distance plate (15).
5. Attach cover (16).

Actuator with 240 to 700 cm²

6. The rear switch plate at the connection block (Fig. 3) is to be aligned with the proper arrow symbol on the block. This means, the adjusted symbol for "actuator stem extends" or "actuator stem re-

tracts" has to correspond to the respective actuator version used. If not, remove the two fastening screws and the switch plate, turn the switch plate by 180° and reinstall it.

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 action "actuator stem retracts", additionally install the ready-made signal pressure pipe between the connection block and the actuator.

Actuator with 120 cm²

With Type 3277-5 Actuator with 120 cm² the signal pressure is transmitted via the switchover plate to the diaphragm chamber.

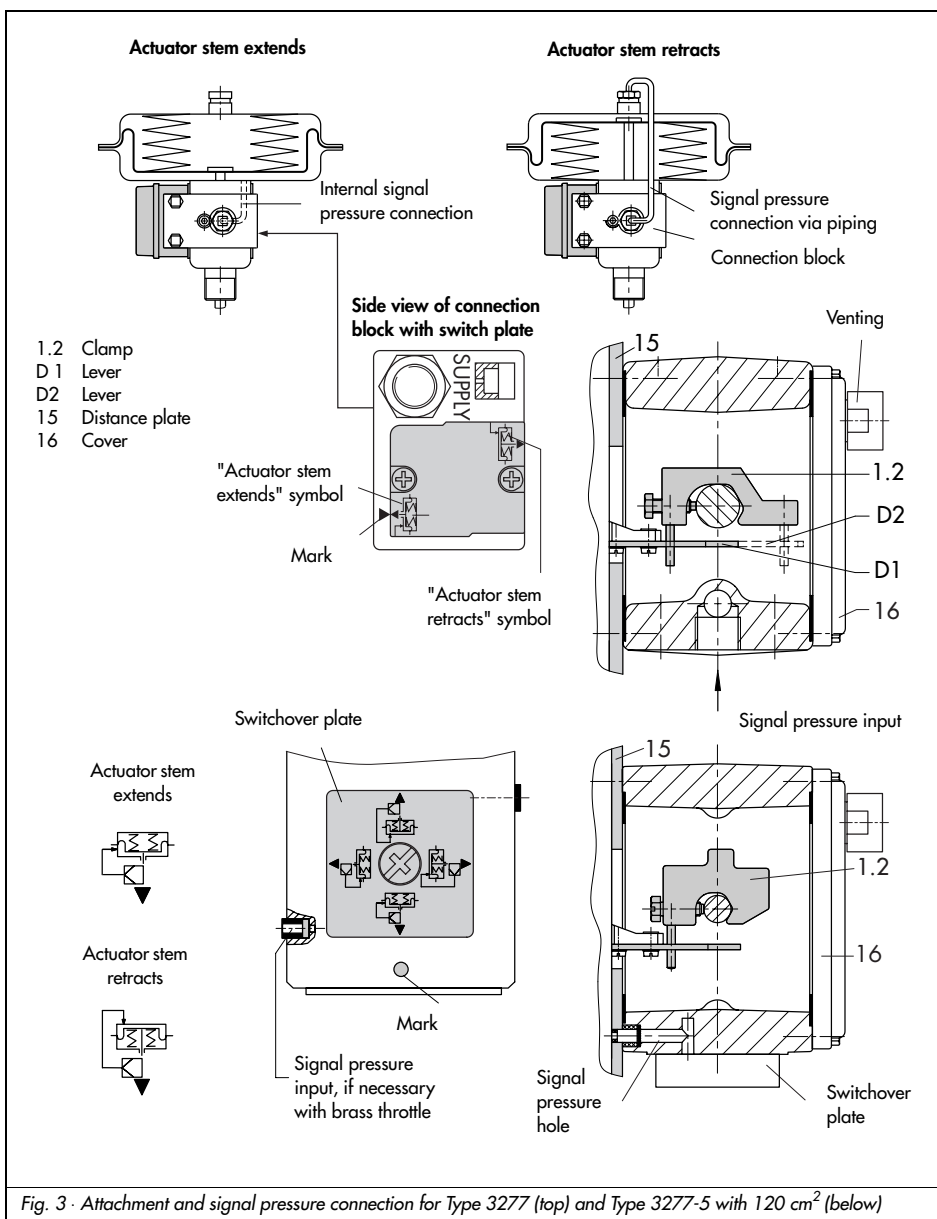
NOTE

For a rated travel of 7.5 mm, a brass throttle (see list of accessories on page 17) has to be pressed into the seal located in the signal pressure input on the actuator yoke.

With 15 mm rated travel, this is only required when the supply air pressure is higher than 4 bar.

Additionally, the filter in the signal pressure output (Output 36) must be removed and replaced with a screw-in throttle (see accessories table) in fast control valves (transit time <0.6 s) to achieve better control characteristics.

6. Remove the vent plug on the back of the positioner and close the side-located signal pressure output (36) with the plug from the accessory kit.



7. Mount the positioner so that the hole in the distance plate (15) matches the seal located in the hole of the actuator yoke.
8. Align the switchover plate with the corresponding symbol for left attachment according to the marking and screw tight onto the actuator yoke.

NOTE

If, with the 120 cm² actuator in addition to the positioner, a solenoid valve or a similar device is attached to the actuator, do not remove the rear M3 screw. In this case, the signal pressure has to be fed from the signal pressure output to the actuator via the required connecting plate (see Table 2). The switchover plate is not used.

Filling the spring chamber with air

If the spring chamber of the Type 3277 Actuator must be filled with the air exhausted from the positioner, the spring chamber (version "Actuator stem extends") can be connected to the connection block by means of a tube (see Table 3). To proceed, remove the venting plug in the connection block.

In Type 3277-5 when "Actuator stem retracts" the exhausted air from the positioner is constantly applied to the spring chamber through an internal hole.

Table 1		Actuator size cm ²	Mounting kit Order no.
Required lever with associated clamp and distance plate			
D1 (33 mm in length with clamp 17 mm in height)		120 (G1/4) 120 (NPT 1/4)	1400-6790 1400-6791
D1 (33 mm in length with clamp 17 mm in height)		240 and 350	1400-6370
D2 (44 mm in length with clamp 13 mm in height)		700	1400-6371
Table 2			Order no.
Switchover plate for actuator 120 cm ²	Actuator 3277-5xxxxxx. 00 (old)		1400-6819
Switchover plate new	Actuators with Index. 01 or higher (new)		1400-6822
Connecting plate for additional attachment e.g. of a solenoid valve	3277-5xxxxxxx. 00 (old)	G 1/8	1400-6820
		NPT 1/8	1400-6821
Connecting plate new	Actuators with Index. 01 or higher (new)		1400-6823
NOTE: New switchover plates and connecting plates can only be used with the new actuators (Index 01). Old and new plates are not interchangeable.			
Connection block required for actuator sizes 240, 350 and 700 cm ² (including seals and fastening screw)		G thread	1400-6955
		NPT thread	1400-6956
Table 3	Actuator size cm ²	Material	Order no.
Required tubes incl. fittings for actuator: "actuator stem retracts" or for filling 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			
Pressure gauge mounting kit for supply air and signal pressure		St.S/Brass: 1400-6957	St.S/St.S: 1400-6958
Signal pressure throttles (screw-in type and brass throttle)			1400-6964
Filter check valve, replaces venting plug and increases the degree of protection to IP 65 (one included with the delivered positioner)			1790-7408

2.2 Attachment according to IEC 60534-6 (NAMUR)

For the selection of the required mounting parts, refer to Tables 4 and 5 (page 21).

The positioner is attached using an adapter housing as shown in Fig. 4. The valve travel is transmitted via the lever (18) and the shaft (25) to the bracket (28) of the adapter housing and then to the pin (27a) located at the positioner lever.

To attach the positioner, the mounting parts listed in Table 4 are required. Which lever is to be used depends on the rated valve travel.

Once the positioner is attached, however, the **arrow** on the black case cover has to point downwards **away** from the **diaphragm actuator**. (**Exception:** Control valves in which the plug closes the seat area when the actuator stem retracts. In this case, the arrow has to point **towards** the diaphragm actuator).

2.2.1 Mounting sequence

NOTE

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

Control valve with cast yoke

1. Use countersunk screws to screw the plate (20) to the coupling which connects the plug and actuator stem. With 2,100 and 2,800 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 the housing with the plate (30) on either the right or left side of the valve rod and screw the housing tight by using nuts (31). While doing so, make sure that lever (18) to be mounted subsequently is horizontal (when the valve is at midtravel).
4. Screw the pin in a hole in the center row of holes in the plate (20) and lock it such that it will be located above the correct lever marking (1 to 2) for the assigned travel, see Table 5. Intermediate values must be calculated. Beforehand, move the clamp (21) to surround the pin.
5. Measure the distance between the center of the shaft (25) and the center of the pin (19). You will be prompted for this value subsequently during the configuration of the positioner.

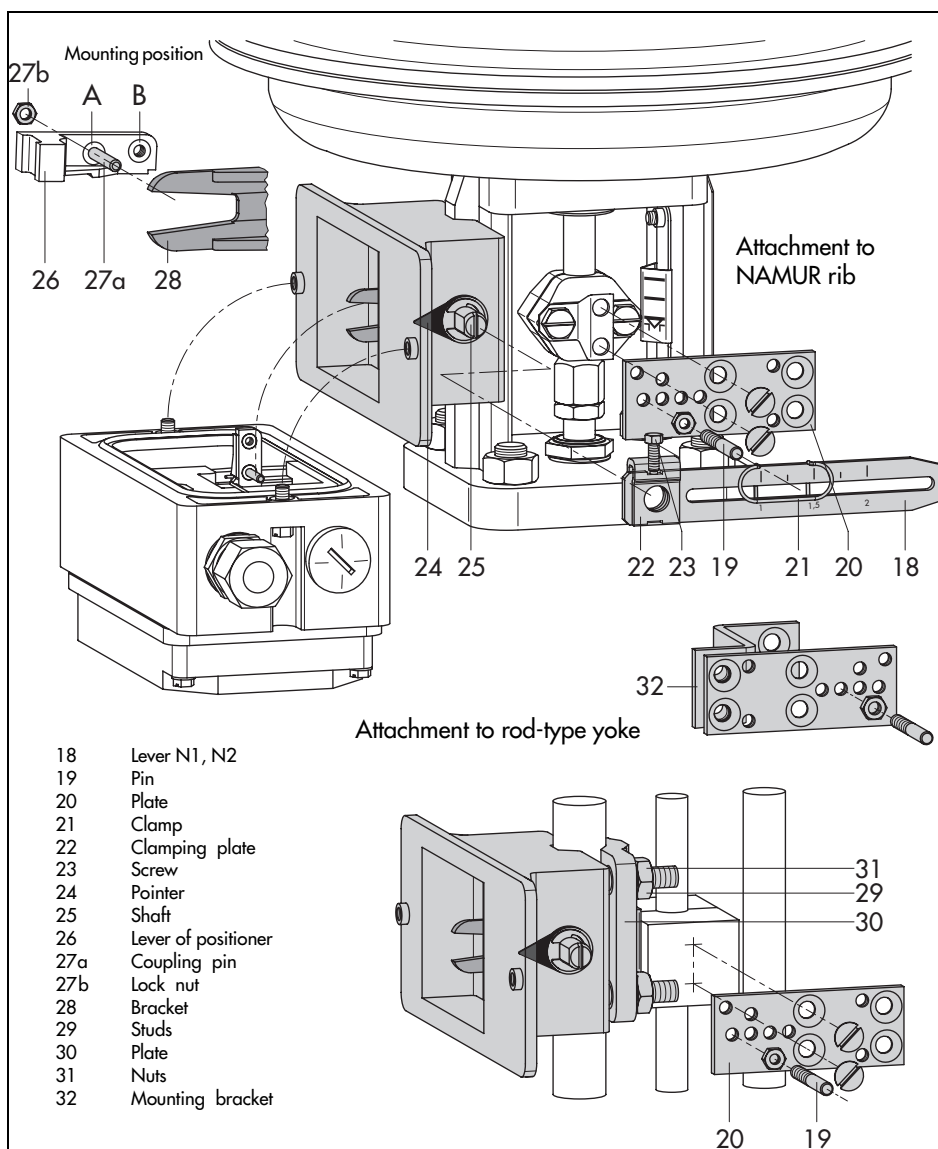


Fig. 4 · Attachment according to IEC 60534-6 (NAMUR)

2.2.2 Presetting the valve travel

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

Table 4	NAMUR attachment		Control valve		Travel in mm	With lever	Order no.
NAMUR mounting kit			Valve with cast yoke		7.5 to 60	N1 (125 mm)	1400-6787
					30 to 120	N2 (212 mm)	1400-6789
Parts illustrated in Fig.4			Valve with rod-type yoke with rod diameter in mm	20 to 25		N1	1400-6436
				20 to 25		N2	1400-6437
				25 to 30		N1	1400-6438
				25 to 30		N2	1400-6439
				30 to 35		N1	1400-6440
				30 to 35		N2	1400-6441
Attachment to Fisher and Masoneilan linear actuators (one each of both mounting kits is needed per one actuator)							1400-6771 and 1400-6787
Accessories							Order no.
Pressure gauge mounting block						G 1/4 NPT 1/4	1400-7106 1400-7107
Pressure gauge set						St. st./Brass St. st./St. st.	1400-6957 1400-6958
Signal pressure throttles (screw-in type and brass throttle)							1400-6964
Filter check valve, replaces venting plug and increases the degree of protection to IP 65 (one included with the delivered positioner)							1790-7408

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

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

2.3 Attachment to rotary actuators

For the selection of the required mounting parts, refer to Table 6 (page 25).

The positioner can also be attached to rotary actuators in accordance with VDI/VDE 3845 by using the mounting parts and accessories listed in Table 6. In this arrangement, the actuator's rotary motion is converted via the cam disk on the actuator shaft and the feeler roll of the positioner lever to a linear motion required by the positioner's inductive displacement sensor system.

Each cam disk is suitable for two characteristics, i.e. for the ranges of angle of rotation from 0 to 90° and 0 to 120°.

For double-acting, springless rotary actuators, it is necessary that a reversing amplifier be attached to the positioner on the side of the connection. See chapter 2.3.4 for more details.

If the positioner is attached to a SAMSON Type 3278 Rotary Actuator, the air exhausted from the positioner is admitted to the inside of the actuator and the chamber behind the diaphragm. No additional piping is required.

If the positioner is attached to actuators of other manufacturers (NAMUR) the air is applied to the chamber behind the diaphragm through a tube assembly and a tee, connected between actuator and intermediate piece.

1. Place lever with the attached roll (35) on the side of 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 intermediate piece (34) on the actuator case and fasten with two screws. Align intermediate piece of the positioner so that the air connections of the positioner will face towards the diaphragm case side.

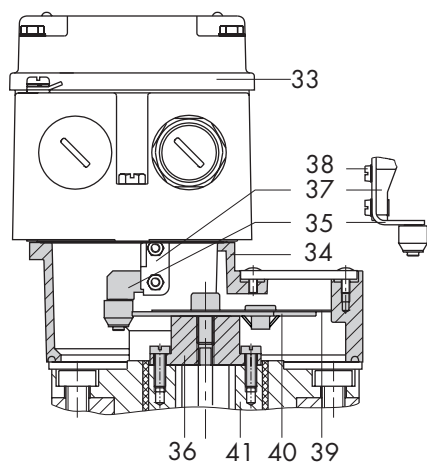
Actuators according to VDI/VDE 3845

1. Place the complete intermediate piece (32, 42 and 44) onto the mounting bracket (fixing level 1 VDI/VDE 3845) and screw tight.
2. Align the cam disk (40) and scale as described in chapter 2.3.3 and fasten tight.

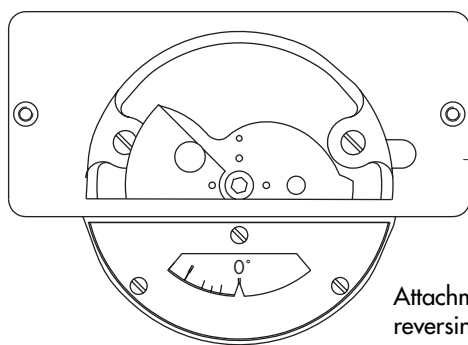
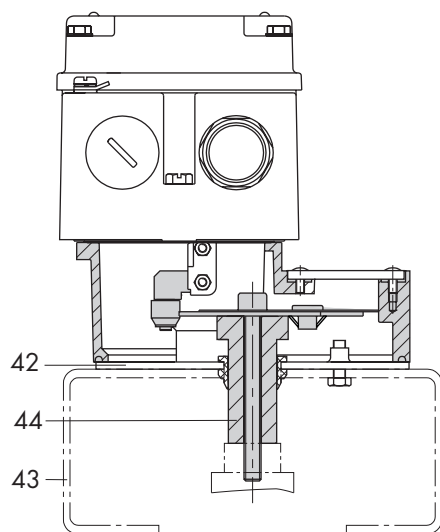
With springless actuators, the reversing amplifier (45) must be screwed to the side of the positioner case. See chapter 2.3.4 for more details.

2.3.1 Mounting the cam follower roll lever

Attachment to SAMSON Type 3278



Attachment acc. to VDI/VDE 3845 (NAMUR)



Attachment to reversing amplifier

- 45
- Venting
- 33 Positioner
 - 34 Intermediate piece
 - 35 Lever w. cam follower roll
 - 36 Adapter
 - 37 Transmission lever
 - 38 Screws
 - 39 Scale
 - 40 Cam disk
 - 41 Actuator shaft
 - 42 Plate
 - 43 Bracket (turned 90°)
 - 44 Coupling
 - 45 Reversing amplifier

Fig. 5 · Attachment to rotary actuators

2.3.3 Aligning and mounting of 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 (either counterclockwise or clockwise).

With double acting, springless rotary actuators, the direction of rotation depends on both the actuator and the valve model used. Any adjustments are only permitted when the valve has been closed.

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

1. Position the cam disk with the scale on the adapter (36) or the coupling (44) and fasten the screw loosely at first.

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

NOTE

With the valve closed, the starting point (bore hole) of the respective characteristic is to be aligned so that the center of rotation of the cam disk, the 0° position on the scale, and the arrow mark on the disk are aligned.

The starting point when the valve is closed should not under any circumstances be below the 0° position!

With actuators with fail-safe position "Valve OPEN", the maximum signal pressure must be applied to the actuator before aligning the cam disk.

With springless actuators, the supply air must be connected.

2. In aligning the cam disk, clip on the double-sided scaled disk in such a way that the valve on the scale will correspond to the direction of rotation of the control valve. Only then, secure the cam disk with the fastening screws.

Securing the aligned cam disk

If the cam disk should be additionally secured to prevent it from being turned, proceed as follows:

Choose one of the four bore holes located centrally around the center bore on the cam disk which is suitable to secure the cam disk.

Drill a hole in the adapter (36) or coupling (44) through the selected hole so that a 2 mm dowel pin can be inserted in this hole.

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

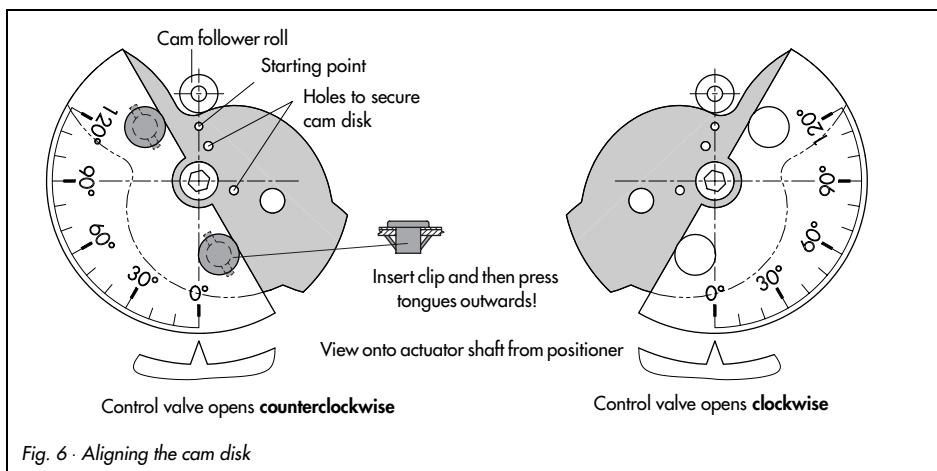


Table 6		Rotary actuators		(Complete mounting parts, but without cam disks)		
SAMSON Type 3278 Actuator			Attachmt. acc. to VDI/VDE 3845	Attachment to Masoneilan actuator		
	Actuator 160 cm ²	Actuator 320 cm ²		Camflex I DN 25 ...100	Camflex I DN 125...250	Camflex II
	Order no.					
	1400-7103	1400-7104	1400-7105	1400-7118	1400-7119	1400-7120
Piping kit 8 x 1 stainl. steel						
G	1400-6670	1400-6672				
NPT	1400-6669	1400-6671				
Accessories				Order no.		
Reversing amplifier for double-acting, springless actuators				G thread: NPT: 1079-1118 1079-1119		
Cam disk with accessories, angle of rotation 0 to 90° and 0 to 120°				1400-6959		
Pressure gauge mounting block				G 1/4: NPT 1/4: 1400-7106 1400-7107		
Pressure gauge set				St. steel/Br.: 1400-6957		St. steel/St. steel: 1400-6958
Signal pressure throttles (screw-in type and brass throttle)				1400-6964		
Filter check valve, replaces venting plug and increases the degree of protection to IP 65 (one included with the delivered positioner)				1790-7408		

2.3.4 Reversing amplifier for double-acting actuators

For the use with double-acting actuators, the positioner must be fitted with a reversing amplifier.

The reversing amplifier is listed as an accessory in the Table 6 on page 25.

The output signal pressure of the positioner is supplied at the output A₁ of the reversing amplifier. An opposing pressure, which equals the required supply pressure when added to the pressure at A₁, is applied at output A₂. The rule $A_1 + A_2 = Z$ applies.

Mounting

NOTE

Prior to attaching the reversing amplifier, remove the sealing plug (1.5). The rubber seal (1.4) must remain installed.

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

Signal pressure connections

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

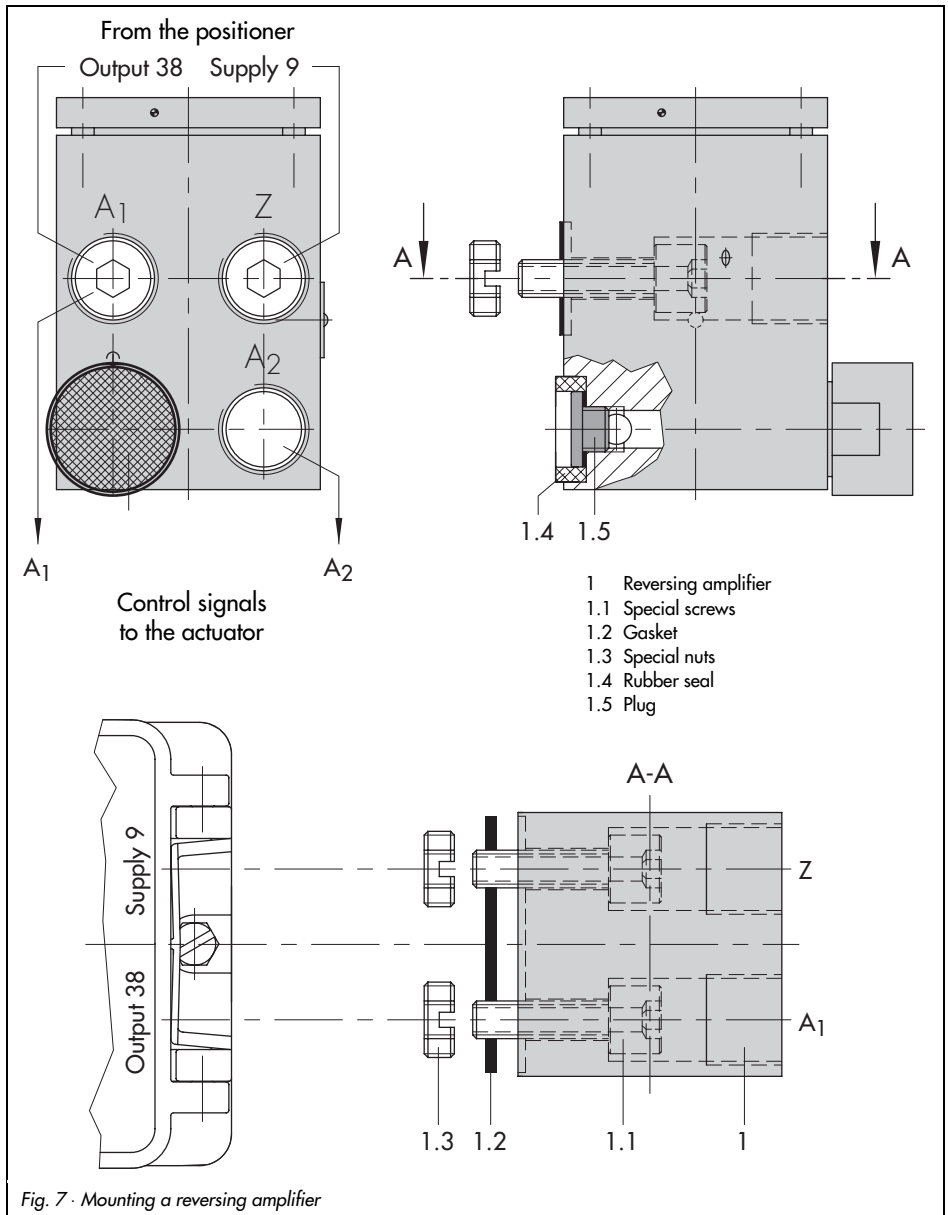
A₂ : Output A₂ leading to the signal pressure connection at the actuator which closes the valve when the pressure increases

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

2.4 Fail-safe action of the actuator

NOTE

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



3. Connections

3.1 Pneumatic connections

The air connections are either NPT 1/4 or G 1/4 tapped holes. The customary fittings for metal and copper tubes or plastic hoses can be used.

NOTE

The supply air has to be dry and free from oil and dust. The maintenance instructions for upstream pressure reducing stations must be observed. Carefully blow through all air tubes and hoses before connecting them.

If the positioner is attached directly to the Type 3277 Actuator, the connection of the positioner's output pressure to the actuator is fixed. For Namur attachment, the signal pressure can be applied to either the upper or lower diaphragm chamber of the actuator, depending on the actuator's fail-safe position.

Exhaust air: The exhaust air connection of the positioner is located in the mounting kit. If the positioner is attached directly, a vent plug is located in the plastic cover of the actuator. For Namur attachment, it is in the adapter housing and for attachment to rotary actuators, it will either be located in the intermediate piece or in the reversing amplifier.

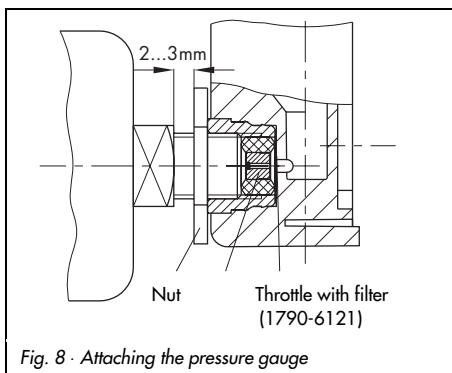


Fig. 8 · Attaching the pressure gauge

3.1.1 Pressure gauge

To monitor the positioner operation, we recommend connecting a pressure gauge for supply air and signal pressure. These parts are listed as accessories in Table 3, 4 or 6.

3.1.2 Supply air pressure

The required supply air pressure depends on the bench range and the actuator's fail-safe action. The bench range is registered on the nameplate either as 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:

for tight-closing valves, the signal pressure $p_{st\ max}$ is roughly estimated as follows:

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

d = Seat diameter [cm]

Δp = Differential pressure $p_1 - p_2$ [bar]

A = Actuator area [cm²]

F = Upper bench range value of the actuator [bar]

If there are no specifications, calculate as follows:

required supply air pressure =
upper bench range value + 1 bar

3.2 Electrical connections



As far as the electrical installation of the device is concerned, the relevant national regulations governing the installation of electrical equipment and the national accident prevention regulations of the country of destination must be adhered to.

In Germany, these are the VDE regulations and accident prevention regulations of the employer's liability insurance.

For installation in hazardous areas, the following standards apply: EN 60079-14: 1997; VDE 0165 Part 1/8.98 "Electrical apparatus for explosive gas areas" and EN 50281-1-2: VDE 0165 Part 2/11.99 "Electrical apparatus for use in the presence of combustible dust".

For intrinsically safe electrical apparatus that are certified according to the Directive 79/196/EEC, the data specified in the certificate of conformity apply for connection of intrinsically safe circuits.

For intrinsically safe electrical apparatus that are certified according to the Directive 94/9/EC, the data specified in the EC-type examination certificate apply for connection of intrinsically safe circuits.

Note: *It is absolutely necessary to keep to the terminal plan specified in the certificate. Reversal of the electrical connections may cause the explosion protection to be ineffective!*

Note on the selection of cables and wires:

To run several intrinsically safe circuits in a multi-core cable, read paragraph 12 of EN 60039-14; VDE 0165/8.98.

For generally used insulating materials, for example polyethylene, the radial thickness of the conductor insulation has to be at least 0.2 mm. The diameter of a single wire in a flexible conductor shall not be smaller than 0.1 mm.

The conductor ends are to be protected against unlaying, e.g. by using wire end ferrules. If the positioner is connected via two separate cables, an additional cable gland can be mounted.

Wire entries left unused must be sealed with caps.

The wires for the reference variable are to be connected to the terminals 11 and 12 located in the case as shown in Fig. 9. Make sure to connect the appropriate poles. The voltage applied must not exceed 15 V.

Caution! If the poles are connected incorrectly, just 1.4 V is sufficient to reach the static destruction limit of 500 mA.

The + and – socket contacts allow a communication to be connected locally.

In general, it is not necessary to connect the positioner to a bonding conductor (0).

Should there be the need, however, this conductor can be connected either to the inside or outside of the case. For plants in hazardous areas, see paragraph 5.3.3 of VDE standard 0165.

Depending on the supplied version, the positioner is equipped with either inductive limit switches, software limit switches and/or forced venting function. All electric circuits are electrically isolated.

In versions with position transmitter, the built-in transmitter is operated in a two-wire circuit. With regard to the resistance of the supply lead, the voltage at the position transmitter terminals must not be lower than

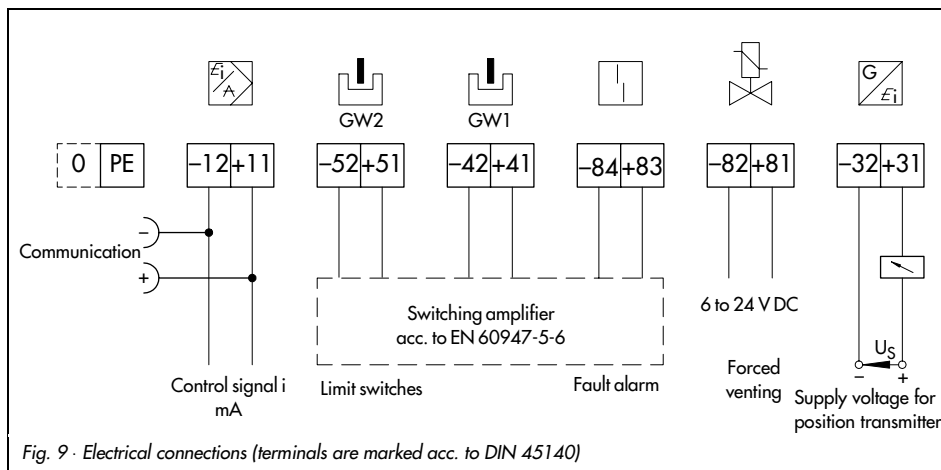


Fig. 9: Electrical connections (terminals are marked acc. to DIN 45140)

12 V and not higher than 35 V DC.
Terminal assignment is shown in Fig. 9 and is indicated on the cover plate inside the case cover.

Accessories:

Model index 3780-x...x. 01

Cable gland PG 13.5:

Black Order no. 1400-6781

Blue Order no. 1400-6782

Adapter PG 13.5 on 1/2" NPT:

Metallic Order no. 1400-7109

Blue finish Order no. 1400-7110

Model index 3780-x...x. 02 and upwards

Cable gland M20 x 1.5:

Black plastic Order no. 1400-6985

Blue plastic Order no. 1400-6986

Adapter M20 x 1.5 on 1/2" NPT:

Aluminum powder-coated
Order no. 0310-2149

3.2.1 Switching amplifiers

For operation of the limit switches and the fault alarm output, switching amplifiers complying to EN 60947-5-6 have to be connected in the output circuit.

If the positioner is to be installed in hazardous areas, the relevant regulations are to be observed.

3.2.2 Establishing communication

Communication between PC and positioner via FSK modem or communicator, if necessary, using an isolating amplifier is based on the HART protocol. (Type FXA 191 FSK modem, order no. 8812-0024).

If the supply voltage of the controller or control station becomes too low because it has been reduced by the load in the circuit, an isolating amplifier is to be connected between controller and positioner (interfacing same as for positioner connected in hazardous areas, see Figs. 10 and 11).

If the positioner is used in hazardous areas, an explosion-proof isolating amplifier is to be used. Connection of an FSK bus always requires interfacing of isolating amplifiers.

By means of the HART protocol, all control room and field devices connected in the loop are accessible through their address via point-to-point, standard bus (Multidrop) or FSK bus communication.

Point-to-point:

The bus address/polling address must always be set to zero (0).

Standard bus (Multidrop):

In the standard bus (Multidrop) mode, the positioner follows the analog current signal (reference variable) as for point-to-point communication. This operating mode is, for example, suitable for split-range operation of positioners (series connection). The bus address/polling address has to be within a range of 1 to 15.

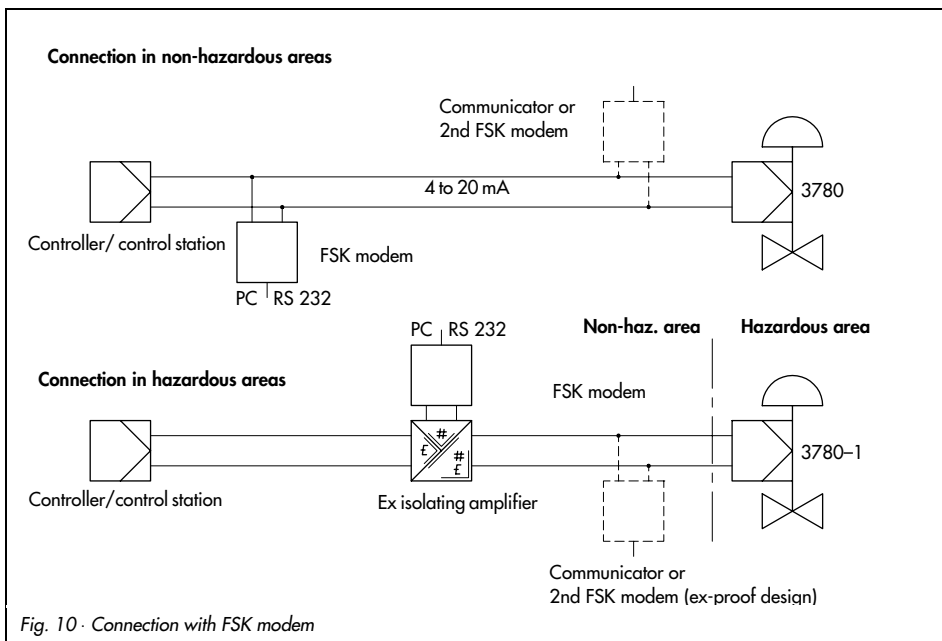


Fig. 10 · Connection with FSK modem

Note:

Communication faults may occur when the process controller/control station output is not HART-compatible. For adaptation, the HART box, order no. 1170-1349, can be installed between output and communication interface. At the HART box a voltage of 1 V is released ($\geq 50 \Omega$ at 20 mA).

Alternatively, a $250\text{-}\Omega$ resistor can be connected in series and a $22\text{-}\mu\text{F}$ capacitor can be connected in parallel to the analog output. Note that in this case, the controller output load will increase.

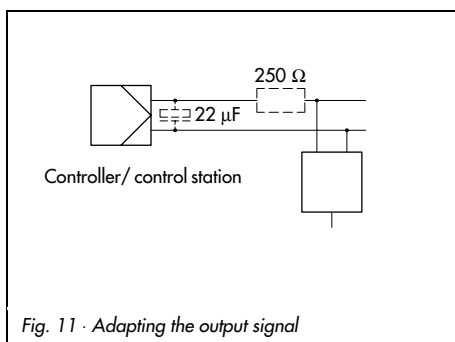


Fig. 11 · Adapting the output signal

4. Operation



CAUTION

Before taking the positioner into operation, carefully move the control valve to its end position by covering the hole (manual adjustment) on the cover plate (Fig. 12). Check whether the lever mechanism functions properly.

If the wrong lever is used or the lever mechanism does not function properly, the valve will exceed the maximum permissible angle of rotation, which can destroy the positioner.

4.1 Write protection

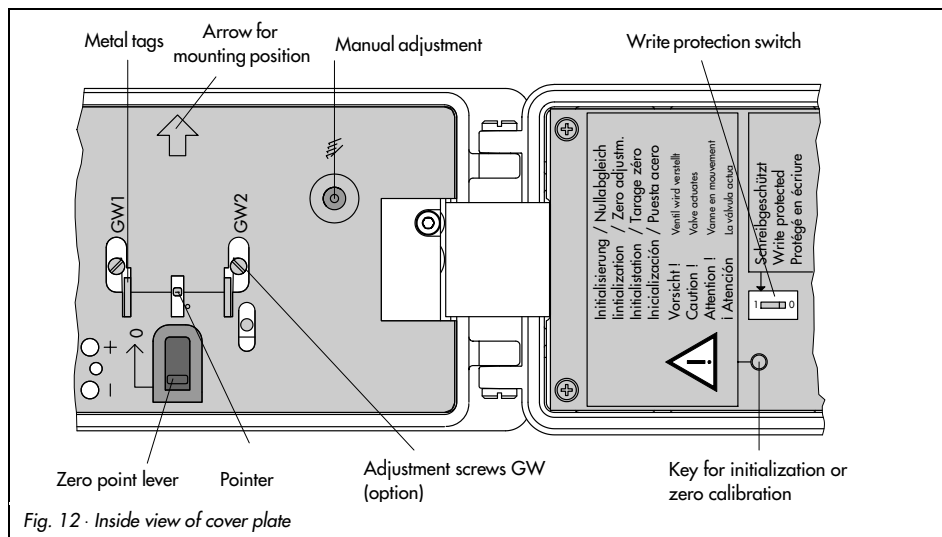
A sliding switch is located inside the hinged cover.

When it is activated (position 1), the positioner settings are write-protected so that they cannot be overwritten by the HART protocol. If you want to change the settings via communication, set the switch to 0 position.

4.2 Activate/deactivate forced venting function

Model index .03 and upwards

1. Remove cover inside the positioner's lid by unscrewing the four screws.
2. Loosen the screw in the center of the board and swivel out the board.
3. Set switch to desired position
 - 1 ENABLED > Function activated
 - 2 DISABLED > Function deactivated.



4.3 Default setting

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



NOTE

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

4.3.1 Adjusting mechanical zero point

NOTE

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

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

For control valves with the starting position OPEN, e.g. an actuator employing fail-safe action "actuator stem retracts", it is first necessary to supply the positioner with auxiliary air.

If the manual operation function is activated then, the signal pressure builds up and the valve moves to the closed position. Subsequently, the zero point lever can be operated.

4.3.2 Initialization

After the electric reference variable and the auxiliary supply pressure have been connected to the positioner, the initialization process can be started. In this process, the positioner adapts itself optimally to the mechanical conditions (friction) and signal pressure requirements of the control valve. See list of parameters on page 48 for required changes of the proportional-action coefficient KP_Y1 and KP_Y2.



CAUTION

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

- ▶ Enter data on valve and actuator under "Start-up" in the operating software.
- ▶ Set "Type of initialization" to "Rated range", select "Maximum range" only for three-way valves.
- ▶ Start initialization.
- ▶ When the initialization process is completed, perform configuration suitable for the type of valve.

The following setting is recommended:

- ▶ **Fail-safe position "Actuator stem extends" (FA):**
Direction of action: increasing/increasing (>>), the globe valve opens with increasing reference variable
Final position at a reference variable less than 1% (tight closing),
Final position at a reference variable larger than 125% (function deactivated).
- ▶ **Fail-safe position "Actuator stem retracts" (FE):**
Direction of action: increasing/decreasing (<>), the globe valve closes with increasing reference variable
Final position at a reference variable less than -2.5% (function deactivated),
Final position at a reference variable larger than 99% (tight closing).
- ▶ Set delay time to 30 s at the minimum.
- ▶ Enter tag identification.
- ▶ If necessary, other configuration, e.g. special characteristics for rotary valves.

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

- ▶ Connect positioners that are not mounted on a valve to a power supply and initialize the positioner as described in chapter 4.3.2.
If communication is not possible, the default setting must be used.
- ▶ Mount positioner and set the mechanical zero point as described in chapter 4.3.1.
- ▶ Start initialization by pressing the **Init/Zero** key on the positioner hinged cover using a suitable tool.

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

NOTE

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

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

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

Electric zero calibration

If, during the valve's operation, the mechanical zero has shifted, an electric zero calibration can be carried out. To do this, press the Init/Zero key located on the inside of the cover (Fig. 12).



CAUTION

The control valve moves to its final position.

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

After the key is pressed twice, it is locked for approximately one minute!

The electric calibration has been completed when the positioner takes on the position predetermined by the reference variable.

4.4 Adjusting inductive limit switches

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

For operation of the inductive limit switches, the corresponding switching amplifiers have to be connected to the output (see section 3.2.1). If the tag is in the inductive field of the switch, the switch assumes a high resistance. If the tag is out of the field, the switch assumes a low resistance.

Normally, the limit switches are adjusted such that they will provide a signal in both end positions of the valve. These switches, however, can also be adjusted to signalize intermediate valve positions.

The desired switching function, i.e. whether the output relay shall be picked up or released when the tag has entered the field, has to be selected, if necessary, at the switching amplifier.

Adjusting the switching point:

The limit switches are marked GW1 and GW2 on the inside of the case cover. Yellow tags and the associated adjustment screws (Fig. 12) are located below these markings.

Each switching position can optionally be signalized when the tag has entered the field, or when it has left the field.

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

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

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

5. Maintenance

The positioner is maintenance-free.

The pneumatic connection 9/Supply features a sieve with 100 µm mesh size. If required, the filter can be unscrewed and cleaned.

The maintenance instructions for any upstream air pressure reducing stations for supply air must be observed.

6. Servicing explosion-proof versions

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

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

Ex-components may only be replaced by original checked components from the manufacturer.

7. Summary of parameters

The list of parameters describes - in alphabetical order - all parameters of the Type 3780 Positioner that can be transferred via HART communication and displayed or modified on a PC, a handheld communicator, or a similar device.

Device identification

- MSR no./bus identification
- Manufacturer
- Type number controller
- Product number controller
- Serial number controller
- Hardware version electronics/mechanics
- Firmware version communication/control
- HART universal revision, field device revision
- Number of required preambles
- Bus address/polling address
- Message/loop tag identification/numbers
- Description/plant identification
- Date
- Type of protection
- Identification of the options forced venting, contacts, position transmitter
- Ident. number actuator
- Ident. number valve
- Text field, not allocated

Start-up

- Actuator type
- Attachment
- Model
- Mounting position
- Rated travel/nominal angle
- Transmission code/length/pin position
- Initialization related to nominal range /maximum range
- Fail-safe position

- Minimum control pulses
- Minimum transit time on/off
- Initialization cycle

Device settings

Configuration

- Reference variable range
- Final position with reference variable below preset value
- Final position with reference variable above preset value
- Travel range/angle of rotation
- Limitation of travel range / angle of rotation
- Moving direction
- Selection of characteristic
- User-defined characteristic with 11 co-ordinates
- Required transit time on/off
- Limit values for software limit switches GW1/GW2
- GW1/GW2 on when the respective limit value is exceeded/not attained
- Operating direction position transmitter
- Write protection

Parameters

- Dead band X_{tot}
- Proportional-action coefficient KP_Y1/KP_Y2
- Derivative-action coefficient KD
- Tolerated overshoot

Operation

- Operating mode
- Reference variable w_{analog}
- Reference variable w_{manual}
- Reference variable w
- Controlled variable x
- Error e
- State fault message

- State software limit switches GW1/GW2
- Forced venting function

Diagnostics

- Device status (control loop monitoring, zero point monitoring, etc.)
- Total valve travel
- Limit value total valve travel
- Error monitoring tolerance band/lag time
- Fault message in case of communication fault
- Fault message with controller in special function
- Fault message if limit value for total valve travel is exceeded
- Test of fault indication output
- Test of position transmitter
- Test of software limit switches GW1/GW2
- Zero adjustment

8. List of parameters

Actuator id number Range:	Manufacturer's identification (id) number of the actuator and the positioner. 0 to 999 999
Actuator type States: Default (coldstart) value:	---- Linear actuator/rotary actuator Linear actuator
Angle range End Range: Default (coldstart) value:	Upper limit of the effective working range (opening angle). For a non-linear characteristic, the characteristic is adapted to the reduced angle. If initialization is based on "maximum range", the angle range is always related to the entered nominal angle. The working range may not be selected 1 / 4 less than the nominal angle. Maximum value = nominal angle. 0.0 degrees to 120.0 degrees 90.0 degrees
Angle range Start Range: Default (coldstart) value:	Lower limit of the effective working range (opening angle). For a non-linear characteristic, the characteristic is adapted to the reduced angle. If initialization is based on "maximum range", the angle range is always related to the entered nominal angle. The working range may not be selected 1 / 4 less than the nominal angle. 0.0 degrees to 120.0 degrees 0.0 degrees
Attachment States: Default (coldstart) value:	Defines the positioner attachment to the control valve with a linear actuator. For a rotary-motion actuator, only attachment according to VDI / VDE 3845 (NAMUR) is possible. Integral - Type of attachment in combination with a SAMSON Type 3277 Linear Actuator. NAMUR - Type of attachment according to IEC 60534-6 (NAMUR). Integral
Bus address Range: Default (coldstart) value:	Address used by the control station to identify a field device. Changeable by the user: 0 for point-to-point, 1 to 15 for multidrop communication. 0 to 15 0 Non-IBIS devices → polling address
Bus identification	Text for instrument identification in connection with the field device installation. The text may be freely assigned. We recommend to clearly identify the field device. For field bus installation, a bus identification has to be assigned. Length: 8 characters Non-IBIS devices → MSR no.

Characteristic	Creation of assignments between the reference variable and valve travel/angle range. When the equal percentage characteristic is selected, this characteristic is copied in the user-defined characteristic, overwriting the previously entered user-defined characteristic. The control loop is interrupted (for approx. 3 seconds) while the characteristic is internally transmitted.
States:	User defined - characteristic in accordance with enterable coordinates $x[n]$, $y[n]$, preset to butterfly valve equal percentage Linear — linear characteristic Equal percent. — equal percentage characteristic Equal percent. reverse — equal percentage reverse characteristic
Default (coldstart) value:	Linear
Characteristic co-ordinates $x[0]/y[0]$ to $x[10]/y[10]$	Characteristic co-ordinates for user-defined assignment between reference variable and travel/angle range. $x[n]$ = reference size in % of the reference size range. $y[n]$ = travel/angle in % of travel/angle range. The control loop is interrupted until the characteristic transmission is completed (max. 1.5 s).
Range:	0.0 % to 100 %
Default (coldstart) :	For characteristic points: butterfly valve equal percentage.
Date	A date entered according to the European date format [DD.MM.YYYY] can be stored in the field device. The date can be entered as required.
Dead band Xtot	Maximum tolerated deviation between set point value and actual value specified as a percentage of the travel range. A small dead band means a high degree of control accuracy. The smallest possible dead band is determined by the quality of the control valve; high friction and a small actuator volume can otherwise lead to unstable operation.
Range:	0.01 % to 0.00 % of the nominal travel/nominal angle
Default (coldstart) value:	0.5 %
Description	Text stored in the field device. Length: 16 characters. For IBIS → plant identification
Direction of action	Determines the assignment of reference variable to the travel/angle of rotation.
States:	>>, Increasing reference variable opens the valve (for three-way valves: Actuator stem retracts) <<, Increasing reference variable closes the valve (for three-way valves: Actuator stem extends)
Default (coldstart) value:	>>
End position when w: above limit value	If the reference value exceeds the entered limit, the valve moves in the pre-determined end position, corresponding to 100 % of the reference variable. Hysteresis 1 %. When the value is 125 %, the function is deactivated.
Range:	0 % to 125.0 %
Default (coldstart) value:	99 %

List of parameters

	<p>Caution: Since the actuator will automatically be filled (loaded with air) or vented (exhausted) when this function is executed, the control valve moves to its absolute end position. Constraints specified in the function "travel range" or "travel limit" are inapplicable here. This function must be deactivated if unacceptably high positioning forces might result from the complete filling/venting action.</p>
<p>End position when w: below limit value</p> <p>Range: Default (coldstart) value:</p>	<p>If the reference variable falls below the entered limit, the valve moves in the pre-determined end position, corresponding to 0 % of the reference variable. Hysteresis 1 %.</p> <p>When the value is -2.5 %, the function is deactivated.</p> <p>-2.5 % to 100.0 % 1 %</p> <p>Caution: Since the actuator will automatically be filled (loaded with air) or vented (exhausted) when this function is executed, the control valve moves in its absolute end position. Constraints specified in the function "travel range" or "travel limit" are inapplicable here. This function must be deactivated if unacceptably high positioning forces might result from the complete filling/venting action.</p>
Error e	Control system deviation in %
<p>Error monitoring of delay time</p> <p>Range: Default (coldstart) value:</p>	<p>Reset criterion for active control loop monitoring. A control loop fault is reported when an entered delay time is exceeded and the deviation (error) does not lie within the entered tolerance band. The delay time is determined from the minimum transit time during the initialization process when the detected value exceeds the preset value.</p> <p>0 s to 240 s 10 s</p>
<p>Error monitoring of tolerance band</p> <p>Range: Default (coldstart) value:</p>	<p>Reset criterion for active control loop monitoring. Entry of the specified maximum permissible control system deviation (error). See also delay time.</p> <p>0.1 % to 10.0 % of nominal travel/nominal angle 5 %</p>
Error variable x	Error variable in % related to travel/angle range.
<p>Ex-proof type</p> <p>States:</p>	Not installed/Installed
<p>Fail-safe action</p> <p>States:</p> <p>Default (coldstart) value:</p>	<p>Fail-safe action of the actuator in the event of air/power failure. This is determined automatically during the initialization process.</p> <p>Unknown if not yet initialized Actuator stem retracts linear actuator Actuator stem extends linear actuator Opening rotary actuator Closing rotary actuator None double acting Unknown</p>
Fault alarm: Communication failure	Fault of the positioner communication hardware

States: Default (coldstart) value:	No/Yes Yes
Fault alarm: Special function States: Default (coldstart) value:	Fault message for controller in special function (zero calibration, initialization, test functions). No/Yes Yes
Fault alarm: Total valve travel exceeded States: Default (coldstart) value:	Fault alarm whenever the limit value for the total valve travel is exceeded. No/Yes Yes
Field device revision	Revision status of the field device-specific description that the field device conforms to.
Firmware version Communication/Control	Revision status of the communication and control software implemented in the field device.
Forced venting States:	Indicates whether the optional forced venting function has been installed. Not installed/Installed
Hardware version electronics/ mechanics	Revision number of the electronics/mechanics implemented in the field device.
Inductive limit switches States: Default (coldstart) value:	For devices without software limit switches you can enter whether inductive contacts were installed (no automatic identification). Not installed/Installed Not installed
Initialization (special function)	Automatic start-up. Prerequisite: Mechanical zero point adjustment must have been carried out once. Valid initialization data must have been entered.
Initialization alarm States:	Message concerning initialization. Unknown Ok Air leakage of pneumatic system Wrong selection of rated travel or transmission
KD derivative-action coefficient Range: Default (coldstart) value:	Derivative-action coeff. of the differential element. When optimizing the value, increments of 0.02 are recommended. Higher increments cause an increased "deceleration" before reaching the reference variable. 0.0 to 1.00 0.12
Limit switches States:	Indicates which type of limit switch is installed. Not installed Inductive — inductive limit switches attached to the internal travel pick-up. Software — Derived by software from the signal of the displacement pick-up.
Limit switch Software GW1	Limit value alarm referring to travel/angle range, determined by the software from the signal of the travel (displacement) pick-up. (Switching hysteresis 1%).

List of parameters

Range: Default (coldstart) value:	0.0 % to 120 % 2.0 %
Limit switch Software GW2 Range: Default (coldstart) value:	Limit value alarm referring to travel/angle range, determined by the software from the signal of the travel (displacement) pick-up. (Switching hysteresis 1%). 0.0 % to 120 % 98 %
Limit switch Software GW1 set when States: Default (coldstart) value:	Defines the contact circuit state as ≤ 1 or ≥ 3 mA ≥ 3 mA values under range for travel/angle, values over range for travel/angle values under range
Limit switch Software GW2 set when States: Default (coldstart) value:	Defines the contact circuit state as ≤ 1 or ≥ 3 mA ≥ 3 mA values under range for travel/angle, values over range for travel/angle values over range
Limit value for total valve travel Range: Default (coldstart) value:	An alarm message is issued as soon as the limit for the total valve travel is exceeded. 0 to 16 500 000 1 000 000
Loop/tag number	Loop/tag number - text that is associated with the field device installation. This text can be used by the user in any way. Each field device is recommended to be assigned a unique loop/tag number. Length: 32 characters For non-IBIS devices → message
Manufacturer	Manufacturer's id code - Clearly identifies the manufacturer of the field device.
Message	Unassigned text stored in the field device. Length: 32 characters. For IBIS devices → loop/tag number.
Minimum control pulses States:	Shortest pulse supplied to the supply air or exhaust air valve. The pulses for the travel ranges 0 to 20 %, 20 to 80 % and 80 to 100 % are determined separately! None no pulses determined yet Exhaust air pulse for exhaust air determined Supply air pulse for supply air determined Valid pulse for exhaust and supply air determined
Minimum transit time (filling/venting)	The minimum transit time, in seconds, for filling or venting air from the actuator during initialization is measured separately for supply and vented air. The transit time is defined as the time required by the system comprising positioner, actuator, and valve to pass through the rated travel / nominal angle.

Mounting position (linear actuator) States: Default (coldstart) value:	An arrow is located on the cover plate of the positioner, which is used for alignment on the actuator. This arrow must either point toward the actuator (direct attachment) or away from the actuator (NAMUR attachment). Exception: Control valves for which the seat is solely closed by a retracting actuator stem. In this case, the arrow must point either away from the actuator (direct attachment) or toward the actuator (NAMUR attachment). For rotary-type (part-turn) actuators, this parameter is omitted. Arrow pointing toward the actuator / Arrow pointing away from the actuator. Integral attachment: Arrow pointing toward the actuator. NAMUR attachment: Arrow pointing away from the actuator.
MSR no.	Text for instrument identification in connection with the installation of the field device. This text can be used by the user in any way. Each field device is recommended to be assigned a unique MSR no. Length: 8 characters. For IBIS devices → bus identification.
Nominal angle Range: Default (coldstart) value:	Nominal working range of the valve. 0.0 degrees to 360.0 degrees 60.0 degrees
Nominal travel Range: Default (coldstart) value:	Nominal working range of the valve. 0.0 mm to 255.9 mm 15.0 mm
Number of (request) preambles	Number of preambles required from the control station requested by the field device.
Operating direction of position transmitter States: Default (coldstart) value:	Determines the operating direction of the optional position transmitter. >>, Increasing controlled variable causes increasing output signal. <>, Increasing controlled variable causes decreasing output signal . >>
Operating mode States: Default (coldstart) value: Default (warmstart) value:	Determines whether the reference variable is specified via the analog current signal (automatic) or via the digital communication (manual). The manual/automatic transfer is smooth. Automatic - The reference variable is specified via the analog current signal. Manual - The reference variable is specified via the digital communication by entering w_manual. Fail-safe - The valve moves in the fail-safe position. Fail-safe position Automatic
Plant identification	Text stored in the field device. Length: 16 characters For non-IBIS devices → description
Polling address	Address used by the control station to identify a field device. Changeable by the user: 0 for point-to-point, 1 to 15 for multidrop communication.

List of parameters

Range: Default (coldstart) value:	0 to 15 0 For IBIS devices → bus address
Positioner type number	Type number of the positioner
Position transmitter States:	Indicates whether the option position transmitter is installed. Not installed/Installed
Product number	Manufacturer's product number of the positioner. Length: 16 characters.
Proportional-action coefficient KP_Y1 / KP_Y2 Range: Default (coldstart) value:	Proportional-action coefficient KP_Y1 for supply air, KP_Y2 for exhaust air. We recommend to adjust the value in increments of 0.1. If the value is increased, the set point will be attained faster. 0.01 to 10.0 1.2 Note: Proportional-action coefficients KP_Y1 / KP_Y2 are determined when the positioner is initialized for the first time. The initialization values listed in the table below may possibly have to be adapted to the changed operating conditions, in order to attain the best control response.

Type of actuator	Nom. travel/angle	Transit time				KD	KP_Y1 Filling	KP_Y2 Venting
		Min.	Effect of spring	Open	Close			
Rotary actuator	–	–	–	> 0.7 s	> 0.7 s	0.12	0.5	0.5
			Closes	> 0.7 s	< 0.7 s	0.12	0.5	0.1
			Closes	< 0.7 s	> 0.7 s	0.12	0.1	0.5
			–	< 0.7 s	< 0.7 s	0.12	0.1	0.1
			Opens	> 0.7 s	< 0.7 s	0.12	0.1	0.5
			Opens	< 0.7 s	> 0.7 s	0.12	0.5	0.1
Linear actuator	≥ 60 mm	< 10 s	–			0.12	0.5	0.5
		≥ 10 s	–			0.12	3.0	4.0
	< 60 mm	< 10 s	–	> 0.7 s	> 0.7 s	0.12	0.5	1.2
			Extends	> 0.7 s	< 0.7 s	0.12	0.5	0.8
			Extends	< 0.7 s	> 0.7 s	0.12	0.3	1.2
			–	< 0.7 s	< 0.7 s	0.12	0.3	0.8
			Retracts	> 0.7 s	< 0.7 s	0.12	0.3	1.2
			Retracts	< 0.7 s	> 0.7 s	0.12	0.5	0.8
			–			0.12	3.0	4.0
	≥ 10 s	–				0.12	3.0	4.0

Pulse adaptation	Adaptation of the minimum pulses in order to optimize the control algorithm for the system comprising positioner, actuator and valve. In normal control mode the parameter should be set to "Automatic". Disable this parameter when tuning the control parameters. For R 1.20 and upwards, the pulse adaptation is internally set to "Automatic".
States:	Disabled Automatic
Default (coldstart) value:	Automatic
Reference variable end	End of the valid input range (corresponding to 100 % w). The minimum span is 4.0 mA.
Range:	4.00 mA to 20.00 mA
Default (coldstart) value:	20.00 mA
Reference variable start	Start of the valid input variable (corresponding to 0 % w). The minimum span is 4.0 mA.
Range:	4.00 mA to 20.00 mA
Default (coldstart) value:	4.00 mA
Reference variable w	Reference variable in % with consideration of reference variable start and reference variable end.
Reference variable w_analog	Current input signal in mA, used as reference variable in "Automatic" mode.
Reference variable w_manual	Reference variable in mA, adjustable in "Manual" mode via communication.
Range:	3.8 mA to 22 mA
Required transit time (filling/venting)	The transit time is defined as the time required by the system comprising positioner, actuator and valve to pass through the complete rated travel/nominal range. The actual transit time is extended to the entered value. If the required transit time is less than the minimum transit time determined during initialization, the minimum transit time shall apply. Separately adjustable for filling and venting.
Range:	0 s to 75 s
Default (coldstart) value:	0 s
Scanning rate	Time between the start of two requests to the positioner (only for IBIS).
Range:	1 to 3600 s
Serial no.	Uniquely identifies the field device combined with the manufacturer name and the device type number.
State of fault alarm	Switching state of fault alarm output.
States:	Off, ≥ 3 mA On, ≤ 1 mA
State of forced venting	If installed, the absence of the input signal forces the control valve to move in the appropriate fail-safe position.
States:	Forced venting off with control signal > 3 V Forced venting on (i.e. actuator vented) with control signal < 3 V

List of parameters

State of software limit switch GW1 / GW2 States:	State of the software limit switch GW1 or GW2. Off, ≤ 1 mA On, ≥ 3 mA
Test of fault alarm (special function)	Functional test of the fault alarm output by activating it three times.
Test of position transmitter (special function)	Test of the optional position transmitter by specifying values in % (only when the software limit switch option is installed).
Test of software limit switch GW1 (special function)	Test of software limit switch GW1 by activating it three times (only when this option is installed).
Test of software limit switch GW2 (special function)	Test of software limit switch GW2 by activating it three times (only when this option is installed).
Text field	Unassigned information text to be stored in the field device 4 lines with 32 characters each
Tolerated overshoot Range: Default (coldstart) value:	If the error signal e exceeds the overshoot, the pulse adaptation reduces the minimum pulses in the moving direction that has caused the overshoot. If the error signal e exceeds the dead band x_{tot} , but remains within the overshoot range, the pulse adaptation only reduces the minimum pulses in both moving directions after two complete oscillations within the overshoot range. 0.01 % to 10.00 % of the nominal travel/nominal angle 0.5 %
Total valve travel	Sum of nominal duty cycles. Maximum value: 16 500 000. The value is indicated in double in up-and-down travels, i.e. corresponds to the travel rate determined during initialization multiplied by 2.
Transmission code (for linear actuator with integral positioner attachment) States: Default (coldstart) value:	Determination of the geometrical code for the travel pick-up when the positioner is integrally attached. D1 for actuators 120, 240 and 350 cm2 / D2 for actuator 700 cm2 D1
Transmission code for rotary actuator States:	Maximum opening (rotational) angle of the selected cam segment. S90, 90 degree segment / S120, 120 degree segment
Transmission code (length) for linear actuator acc. to NAMUR Range: Default (coldstart) value:	Lever length, distance between the travel pick-up and pivot of the pick-up lever. 0.0 mm to 1023.0 mm 42.0 mm

Transmission pin position	Pin position of the positioner lever. See marking on the positioner lever. Only for attachment to linear actuator acc. to NAMUR.
States:	A/B
Default (coldstart) value:	A
Travel/angle limit lower	Lower limitation of valve travel/angle to the entered value. The characteristic is not adapted.
Range:	-20.0 % to 99.9 % of the travel/angle range
Default (coldstart) value:	0.0 %
Travel/angle limit upper	Upper limitation of valve travel/angle to the entered value. The characteristic is not adapted.
Range:	0.0 % to 120.0 % of the travel/angle range
Default (coldstart) value:	100.0 %
Travel range end	Upper limitation of the effective working range (travel). For a non-linear characteristic, the characteristic is adapted to the reduced valve travel. Maximum value = rated travel. If the "maximum range" has been initialized, the travel range is always related to the entered nominal travel. The working range may not be selected 1/4 less than the nominal angle.
Range:	0.0 mm to 255.9 mm
Default (coldstart) value:	15.0 mm
Travel range start	Lower limitation of the effective working range (travel). For a non-linear characteristic, the characteristic is adapted to the reduced travel. If the "maximum range" has been initialized, the travel range is always related to the entered nominal travel. The working range may not be selected 1/4 less than the nominal angle.
Range:	0.0 mm to 255.9 mm
Default (coldstart) value:	0.0 mm
Type of initialization	Type of initialization related to the nominal or maximum range. For initialization in the nominal range, only the range of the manipulated variable is considered (e.g. globe valve with mechanical stop at one side). When the maximum range is initialized, the maximum range is passed (e.g. three-way valve with mechanical stop at both sides).
States:	Nominal range / maximum range
Default (coldstart) value:	Maximum range
Type of characteristic	Unassigned text describing the user-defined characteristic Length: 32 characters
Universal revision	Revision number of the universal device description that the field device conforms to.
Valve id number	Manufacturer identification of the valve delivered with the positioner.
Version	Actuator with/without spring return.
States:	Single acting with spring return / double acting without spring return.
Default (coldstart) value:	Single acting.

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Write protection	When this option is activated, the device data can only be read, but they cannot be overwritten. The only way to activate the write protection is using the switch installed on the device.
States:	Activated/deactivated
Zero calibration (special function)	Zero correction with valid mechanical zero point.

9. Error messages and diagnostics

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During the initialization cycle, the Type 3780 HART Positioner offers the best possibilities for diagnosis. In the automatic mode, detailed tests are carried out in order to check the attachment situation and the positioner's reaction while taking the preset or entered data into account. When routine tests are carried out or in case of unclear error messages during operation the system should be initialized so that the positioner system can be optimally assessed. The IBIS user software differentiates between information/alerts which are displayed on the screen in yellow, and errors which are displayed in red.

9.1 Information/alerts

9.1.1 Device setup modified

Is always set if the device data were modified, thus checking (unintentional/unauthorized) modifications of the originally preset values.

The error message is reset via [Device data → Specialist → Device data → Reset "Device setup modified"].

9.1.2 Insufficient power supply

The parameter is set when the power supply exceeds ≤ 3.6 mA.

It is automatically reset when the current exceeds 3.6 mA again.

9.1.3 Warmstart completed

This message is displayed when the power supply was ≤ 3.2 mA informing about a possible power supply failure. The device is automatically reset after the message has been acknowledged.

9.1.4 Coldstart completed

This message is displayed if the device was reset via [Device data → Specialist → Device → Reset] and restarted with the standard control values.

The device must be re-initialized. Information, such as loop/tag number, bus identification or plant identification remain intact.

The device is automatically reset after acknowledgement.

9.1.5 Choose mode "Manual"

This message is issued when the "Manual" reference variable is modified, but the device is not set for "Manual" operating mode.

This error can not occur under IBIS.

The device is automatically reset after correction.

9.1.6 Parameter not supported

After downloading to the positioner, the positioner intelligence replies that this parameter is unknown. This message can occur with older firmware versions.

The device is automatically reset after acknowledgement.

9.1.7 Limit value of total valve travel exceeded

The current value which is stored after 1024 double strokes and protected against power failure lies above the limit value entered or preset via [Device data → Specialist → Extension → Configuration].

When this limit value is preset slightly below the value determined for a broken-down reference valve, the positioner automatically signals that the valve needs to be maintained so that possible failure is prevented.

Reset via [Diagnostics → Device status].

9.1.8 Zero adjustment aborted

Zero adjustment was aborted by the user.

Automatic reset after acknowledgement.

The previous zero point is maintained if zero adjustment has already been carried out successfully.

Initialization status

9.1.9 Initialization aborted

Initialization was aborted by the user.

If the device has been successfully initialized and no coldstart was triggered, the control operation is restarted.

9.1.10 Not initialized

The device has not been initialized, or a coldstart was carried out.

The device is automatically reset after initialization has been successfully completed.

9.2 Error messages

9.2.1 Communication fault

This message is displayed when the HART communication is interrupted.

Possible sources of error:

- Auxiliary power too low or power failure
- FSK modem not properly connected
- Communication (for example COM1) configured incorrectly [**Options** → **Configure communication**]
- Attempt to set up communication via menu item [**Set up communication** → **Single unit**] while the system is in bus mode

The device is reset after the error has been eliminated.

9.2.2 Control loop error

This message is displayed when the positioner fails to control the adjusted range of tolerance for error messages within the preset delay time. The criteria are adjusted via [**Device data** → **Specialist** → **Extension** → **Configuration**].

Possible sources of error:

- Oscillation caused by actuator being operated too fast (small travel volume).
Remedy: Reduce the supply air pressure as described in chapter 3.1.2 and install a signal pressure throttle (see chap. 2)
- Supply air failure/supply air insufficient
- Filter clogged
- Solenoid valves oiled-up
- Actuator diaphragm torn
- Actuator springs broken
- Considerable increase of friction at the control valve
- Control valve blocked

Reset via [**Diagnostics** → **Device status**].

9.2.3 Zero point erroneous

The zero point monitoring signals any changes exceeding the value determined during the initialization or zero adjustment by $\pm 5\%$.

Possible sources of error:

- Worn-out valve plug/seat

- Impurities between valve plug/seat

The device is reset after the zero adjustment has been carried out effectively.

9.2.4 Zero calibration erroneous, mechanical readjustment necessary

The value determined during electric zero calibration exceeds the permissible tolerance of $\pm 5\%$ by the internal absolute value for the detection of measured values.

The device is reset after electric zero calibration has been successfully completed and after mechanical zero point adjustment.

9.2.5 Measuring mode erroneous

The internal A/D converter does not function properly within its specified time frame, or the measured values are not within the physical measuring range limits. In case reset is not successful after a warmstart, repair work is required.

9.2.6 Reference var. w out of range

The internal A/D conversion results in values which are not within the permissible measuring range.

Possible sources of error:

- Reference variable exceeded (power supply) $>22.5\text{ mA}$

This message is automatically reset when the power supply decreases below 22.5 mA .

9.2.7 Controlled var. x out of range

The internal A/D conversion results in values which are not within the permissible measuring range.

Possible sources of error:

- Improper mechanical attachment
- Incorrect transmission value entered
- For attachment according to NAMUR: incorrect pin position entered
- Overtravel larger than rated travel

This message is automatically reset after the error has been eliminated.

9.2.8 Parameter out of range

Message indicating that incorrect values have been entered.

After downloading data to the positioner, it responds with the message that the downloaded value is not within the permissible range. The previous value is retained.

Acknowledge this message to reset.

Characteristic fault

In case a characteristic fault (chapters 9.2.9 to 9.2.11) occurs, the characteristic is automatically switched from user-defined to linear after downloading data to the positioner.

9.2.9 Erroneous characteristic

This message is generated when errors are recognized during transmission of the characteristic.

It is automatically reset after a correct characteristic has been transmitted.

9.2.10 Erroneous characteristic monotony

This message is generated when you did not enter the input values in ascending order for a user-defined characteristic.

It is automatically reset after a correct characteristic has been transmitted.

9.2.11 Erroneous characteristic inclination

This message is generated when you enter too high an inclination value (>16).

It is automatically reset after a correct characteristic has been transmitted.

9.2.12 Timeout

This message is generated when a specified time frame is exceeded during certain tests.

Acknowledge this message to reset.

9.2.13 Application data invalid

This message is generated in case an internal communication fault or a HART communication fault occurs.

It is reset after the error has been eliminated.

9.2.14 Control data memory erroneous

A memory block in the EEPROM area cannot be written.

Repair required.

9.2.15 Checksum error control data memory

This message is generated when the cyclic check determines that a memory block in the control parameter section has been modified without verification.

The user can reset this message by rewriting one memory block minimum after checking all values.

9.2.16 Communication data memory erroneous

A memory block in the RAM/EEPROM area cannot be written.
Repair required.

9.2.17 Checksum error communication data memory

This message is generated when, during cyclic check, a memory block in the communication parameter area has been modified without verification.
It is automatically reset when the communication parameters are reset to the default values.

9.2.18 Checksum error device information

This message is generated when, during the cyclic check, a memory block in the device information area has been modified without verification.
The user can reset this message by rewriting one memory block minimum after checking all values.

9.3 Error messages during initialization without abortion

Error message without abortion of the initialization procedure.
Error message with abortion of the initialization procedure.
After the error has been eliminated, initialization must be restarted.

9.3.1 Wrong selection of rated travel or transmission

The maximum determined travel which is read out as %-value of the rated travel/angle is smaller than the selected rated travel/angle. This message is only generated in initialization mode "related to nominal range".

Possible sources of error:

- Incorrect mechanical attachment
- Incorrect transmission entered
- For NAMUR attachment: wrong pin position entered
- Valve is blocked

Supply pressure too low. The supply pressure must be higher than the spring range and stable. It should be minimum 0.4 bar above the upper spring range value (refer also to chapter 3.1.2)

9.3.2 Air leakage of pneumatic system

The actuator stalls for a few seconds when the duty cycle is being determined. This time is used by initialization to check the pneumatic system for leaks. If the control valve moves more than 9.3 % from this resting position within 7 seconds, initialization is aborted with this error message.

Possible sources of error:

- Actuator not tight
- Signal pressure connection not tight
-

9.4 Error messages during initialization with abortion

9.4.1 Forced venting check:

Initialization cannot be started if the implemented option forced venting is activated

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

9.4.2 Determining the mechanical end stops

The initialization routine recognizes the spring action and zero during determination of the mechanical end stops by completely venting and exhausting the actuator. In addition, the routine checks whether the positioner can pass 100 % rated travel/angle.

9.4.2.1 Defective mechanics/pneumatic section when determining the mechanical end stops

The initialization routine recognizes a constant change or no change of the value measured for travel/angle.

Possible sources of error:

- Supply pressure too low/not stable
- Air capacity too low
- Improper mechanical attachment
- Lever not properly hung
- For NAMUR attachment: lever not correctly secured to the shaft of the adapter housing
- Connecting cable between logic and displacement sensor board disengaged

9.4.2.2 Zero calibration error

The determined zero point does not lie within the acceptable tolerance limit of max. $\pm 5\%$ by the internal absolute value for the detection of measured values.

To eliminate this error, mechanical zero must be adjusted. The yellow pointer of the displacement sensor must then be approximately in alignment with the marking on the cover plate.

9.4.3 Messages during determination of transit time

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

9.4.3.1 Control loop error

If the system cannot travel through the entire rated travel/angle, the supply air pressure is usually too low.

9.4.4 Messages during determination of minimum pulses

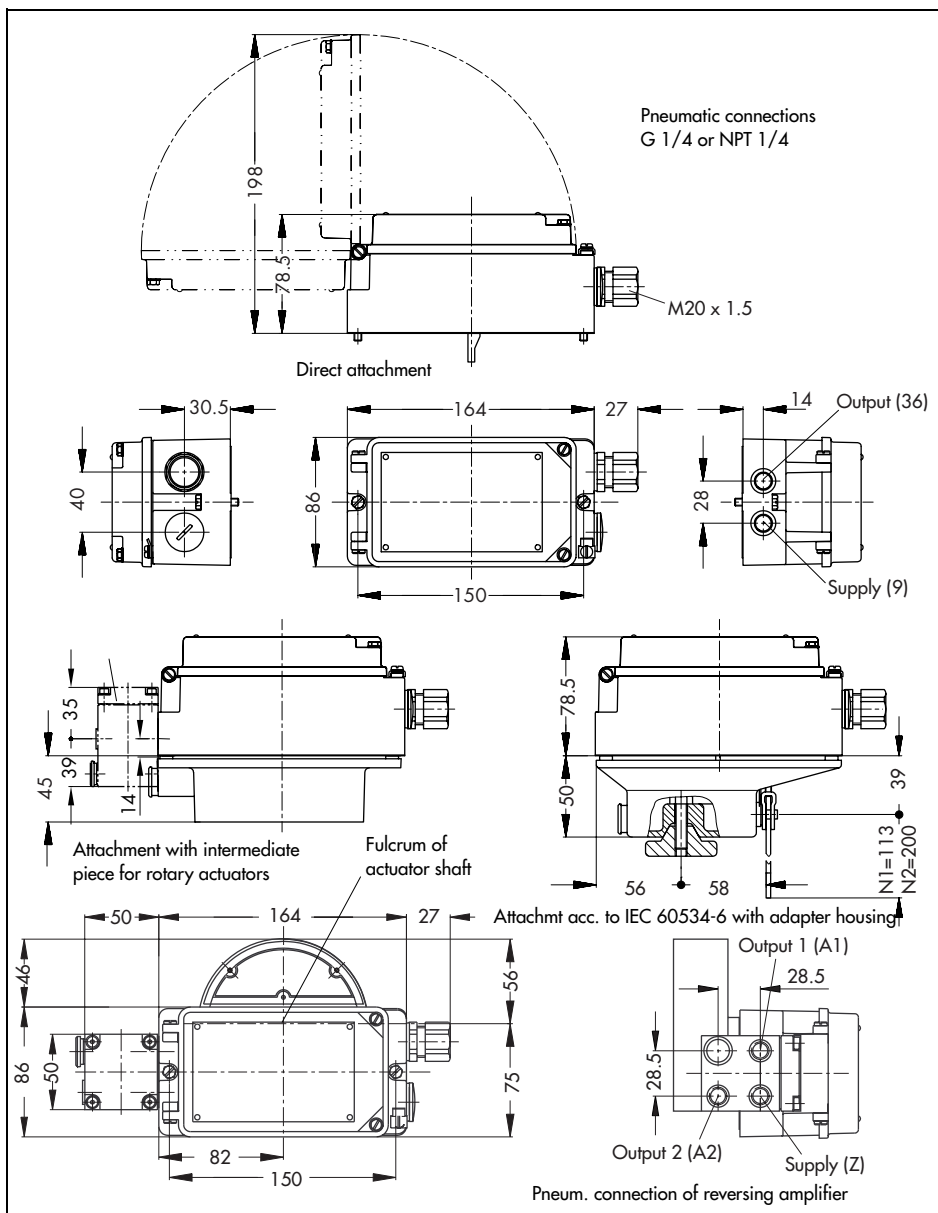
9.4.4.1 Proportional band restricted too much

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

Possible sources of error:

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

Dimensional diagram



T R A N S L A T I O N

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin

PTB

(Symbol)

EC TYPE EXAMINATION CERTIFICATE

(Ex)

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

(3) EC Type Examination Certificate Number

PTB 00 ATEX 2038

(4) Equipment: Model 3780-1... Positioner

(5) Manufacturer: Samson AG

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

(7) This equipment and any acceptable variations thereof are specified in the schedule to this certificate and the documents referred to therein.

(8) The Physikalisch-Technische Bundesanstalt, certified body number 0102 according to 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 specified in Annex II to the Directive.

The examination and test results are recorded in the confidential report

PTB Ex 00-20009

(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" is placed 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) According to the Directive 94/9/EC, 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 this equipment.

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

Ex II 2 G EEx ia IIC T6

Zertifizierungsstelle Explosionsschutz
By order Braunschweig, 03 May 2000

(Signature) (Seal)

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

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

Physikalisch-Technische Bundesanstalt
Bundesallee 100 - D-38116 Braunschweig

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Electrical data

Signal circuit
 (terminals 11/12)

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

Maximum values: $U_i = 28$ V
 $I_i = 115$ mA
 $P_i = 1$ W
 $C_i = 5.3$ nF
 $L_i =$ negligible

Position indicator
 (terminals 31/32)

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

Maximum values: $U_i = 28$ V
 $I_i = 115$ mA
 $P_i = 1$ W
 $C_i = 5.3$ nF
 $L_i =$ negligible

Version 3780-12...

Limit switches,
 inductive terminals
 41/42 and 51/52)

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

Maximum values: $U_i = 16$ V
 $I_i = 52$ mA
 $P_i = 169$ mW
 $C_i = 60$ nF
 $L_i = 200$ μ H

or

$U_i = 16$ V
 $I_i = 25$ mA
 $P_i = 64$ mW
 $C_i = 60$ nF
 $L_i = 200$ μ H

Electrical data

Signal circuit
 (terminals 11/12)

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

Maximum values: $U_i = 28$ V
 $I_i = 115$ mA
 $P_i = 1$ W
 $C_i = 5.3$ nF
 $L_i =$ negligible

Position indicator
 (terminals 31/32)

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

Maximum values: $U_i = 28$ V
 $I_i = 115$ mA
 $P_i = 1$ W
 $C_i = 5.3$ nF
 $L_i =$ negligible

Version 3780-12...

Limit switches,
 inductive terminals
 41/42 and 51/52)

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

Maximum values: $U_i = 16$ V
 $I_i = 52$ mA
 $P_i = 169$ mW
 $C_i = 60$ nF
 $L_i = 200$ μ H

or

$U_i = 16$ V
 $I_i = 25$ mA
 $P_i = 64$ mW
 $C_i = 60$ nF
 $L_i = 200$ μ H

TRANSLATION

Version 3780-13...
Limit switches,
sensors and
41/42 and 51/52

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

Maximum values:

$U_i = 20 \text{ V}$
 $I_i = 60 \text{ mA}$
 $P_i = 250 \text{ mW}$
 $C_i = 5.3 \text{ nF}$
 $L_i = \text{negligible}$

Forced venting
function
(terminals 81/82)

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

Maximum values:

$U_i = 28 \text{ V}$
 $I_i = 115 \text{ mA}$
 $P_i = 0.5 \text{ W}$
 $C_i = 5.3 \text{ nF}$
 $L_i = \text{negligible}$

Fault alarm output
(terminals 63/64)

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

Maximum values:

$U_i = 20 \text{ V}$
 $I_i = 60 \text{ mA}$
 $P_i = 250 \text{ mW}$
 $C_i = 5.3 \text{ nF}$
 $L_i = \text{negligible}$

(16) Test Report PTB Ex 00-20009

(17) Special conditions for safe use

Not applicable

(18) Special Health and Safety Requirements

In compliance with the standards specified above

Zertifizierungsstelle Explosionsschutz
By order Braunschweig, 03 May 2000

(Signature)

Dr.-Ing. U. Johannmeyer
Regierungsdezektor

ADDENDUM No.: 1

in compliance with Directive 94/9/EC Annex III Clause 6
to the EC Type Examination Certificate PTB 98 ATEX 2038

Equipment:

Model 3780-1... Positioner

Marking:

Ex II 2 G EEx ia IIC T6

Manufacturer:

SAMSON AG

Address:

Weismüllerstr. 3, D-60314 Frankfurt, Germany

Description of the additions and modifications

In future the Model 3780-1... Positioner may be manufactured in compliance with the
certification documents identified in the associated test report.

The coupling circuit, the wiring of the logic board and the wiring of the displacement
transducer were modified because of changed EMC limit values.

The modifications relate to the design and construction.

The electrical data are changed as follows:

Electrical data:

Signal circuit
(terminals 11/12)

Type of protection, Intrinsic safety EEx ia IIC
only for connection to a certified
intrinsically safe circuit

Maximum values:

$U_i = 28 \text{ V}$

$I_i = 115 \text{ mA}$

$P_i = 1 \text{ W}$

$C_i = 5.3 \text{ nF}, L_i = 45 \text{ }\mu\text{H}$

All the other data apply without change also to this Addendum No. 1

Test report: **PTB Ex 00-20260**

Zertifizierungsstelle Explosionsschutz
By order Braunschweig, 10. October 2000

(Signature)

(Seal)

Dr. Ing. U. Johannsmeyer
Regierungsdirektor

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 changes, schedule included.
Extracts or changes shall require the prior approval of the Physikalisch-Technische Bundesanstalt.
Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116 Braunschweig

19Add1.doc



TRANSLATION

Statement of Conformity

- (1)
- (2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres – **Directive 94/9/EC**
- (3) Test Certificate Number
- (4) Equipment: Model 3760-8, Positioner
- (5) Manufacturer: SAMSON AG Mess- und Regeltechnik
- (6) Address: Weismüllerstr. 3, 60314 Frankfurt am Main, Germany
- (7) The equipment and any acceptable variation thereof are specified in the schedule to this certificate and the documents referred to therein.
- (8) The Physikalisch-Technische Bundesanstalt, notified body number 0102, according to Article 9 of the Council Directive 94/9/ 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 specified in Annex II to the Directive.

The examination and test results are recorded in confidential report

PTB Ex 01-21298.

- (9) The essential health and safety requirements are satisfied by compliance with

EN 50021: 1999

- (10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use as specified in the schedule to this certificate.
- (11) In compliance with the Directive 94/9/EC this Statement of Conformity relates only to the design and construction of the equipment specified. Further requirements of this Directive apply to manufacture and marketing of the equipment.

Statements of Conformity without signature and seal are invalid.
This Statement of Conformity may only be reproduced in its entirety and without any changes.
Extracts or changes shall require the prior approval of the Physikalisch-Technische Bundesanstalt.

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



Zertifizierungsstelle Explosionsschutz
by order

Braunschweig, 05 April 2002

(Signature)

(Seal)

Dr. Ing. U. Klausmeyer
Regierungsdirektor

Statements of Conformity without signature and seal are invalid.
This Statement of Conformity may be reproduced only in its entirety without any changes.
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Schedule

(13) Statement of Conformity PTB 02 ATEX 2033 X

(14) Description of Equipment

The Model 3780-8 Positioner serves for converting a load-independent current into a pneumatic control signal. Pneumatic power is supplied by non-combustible media.

The Positioner is intended for use inside and outside of hazardous locations.

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

Temperature classification	Permissible ambient temperature range
16	... 60 °C
15	-40 °C ... 70 °C
14	...80 °C

The same permissible ambient temperature ranges apply to the version with metallic cable entry.

Electrical data

Signal circuit (terminals 11/12)	Type of protection EEx nA II
Position indicator (terminals 31/32)	Type of protection EEx nA II
Limit switches (terminals 41/42 and 51/52)	Type of protection EEx nA II
Forced ventilation (terminals 81/82)	Type of protection EEx nA II
Fault alarm output (terminals 93/94)	Type of protection EEx nA II

(16) Test report PTB Ex 01-21288

(17) Special conditions for safe use

The signal circuit (terminals 11/12) shall be provided with a series connected fuse complying with IEC 60127-2/II, 250 V I or IEC 60127-2/VI, 250 V I with a maximum current rating $I_n \leq 63$ mA, to be installed outside of the hazardous location.

Statements of Conformity without signature and seal are invalid.
This Statement of Conformity may be reproduced only in its entirety without any changes.
Exacts or changes shall require the prior approval of the Physikalisch-Technische Bundesanstalt.

Regierungsdirektor

Statements of Conformity without signature and seal are invalid.
This Statement of Conformity may be reproduced only in its entirety without any changes.
Extracts or changes shall require the prior approval of the Physikalisch-Technische Bundesanstalt.

Installation Manual for apparatus certified by CSA for use in hazardous locations.
Electrical rating of intrinsically safe apparatus and apparatus for installation in hazardous locations.

Table 1: Maximum values

	Control- signal	Position- indicator	Forced venting- function	Limit switches inductive software	Fault- signal
Circuit No.	1	2	5	3 and 4	6
Terminal No.	11 / 12	31 / 32	81 / 82	41 / 42 and 51 / 52	83 / 84
U _i or V _{max}	28V	28V	28V	16V	20V
I _i or I _{max}	115mA	115mA	115mA	25/52 mA	60mA
P _i or P _{max}	1W	1W	500mW	64/169 mW	250mW
C _i	5.3nF	5.3nF	#	60nF	5.3nF
L _i	45µH	#	#	200µH	#

Notes: Entity parameters must meet the following requirements:

$$U_0 \text{ or } V_{OC} \text{ or } V_i \leq U_i \text{ or } V_{max}$$

$$I_0 \text{ or } I_{OC} \text{ or } I_i \leq I_i \text{ or } I_{max}$$

$$P_0 \text{ or } P_{max} \leq P_i \text{ or } P_{max}$$

$$C_0 \geq C_i + C_{cable} \text{ and } L_0 \geq L_i + L_{cable}$$

Table 2: CSA - certified barrier parameters of circuit 2 and 5

Barrier	Supply barrier			Evaluation barrier		
	V _{OC}	R _{min}	I _{OC}	V _{OC}	R _{min}	I _{OC}
circuit 2	≤28V	≥300Ω	≤115mA	≤28V	#	0mA
circuit 5	≤28V	≥392Ω	≤115mA	≤28V	#	0mA

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

Temperatur class	Permissible ambient temperature range
T6	- 40°C ... 60°C
T5	- 40°C ... 70°C
T4	- 40°C ... 80°C

Table 4: For the Model 3780 – 32 ... Positioner the correlation between temperature classification, permissible ambient temperature ranges and maximum short-circuit current is shown in the table below:

Temperature 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	

Intrinsically safe if installed as specified in manufacturer's installation manual.

CSA- certified for hazardous locations

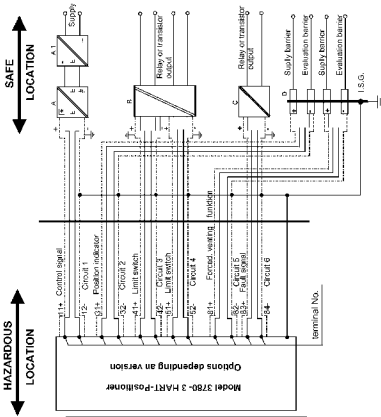
Class I, Division 1, Groups A, B, C, D, / T6

(Type 4 Enclosure)

Class I, Zone 0 Ex ia IIC T6

- Notes:** Max. two cable entries per positioner
 2.) Each pair of wire must be provided with a grounded shield. The shield must extend as close to the terminal as possible. Each shield must be grounded as the I.S. barrier ground.
 3.) Install in accordance with the Canadian Electrical Code, Part I.
 4.) Max. two cable entries per positioner
 5.) Each pair of wire must be provided with a grounded shield. The shield must extend as close to the terminal as possible. Each shield must be grounded as the I.S. barrier ground.
 6.) Install in accordance with the Canadian Electrical Code, Part I.

A = HART- Isolating stage CSA- certified. A1 = Power supply



B and C = Isolating amplifier 1 or 2 channel(s) resp. CSA- certified
 D = CSA- certified I.S. barrier(s)

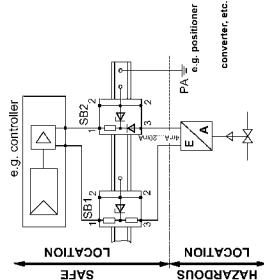
For the permissible maximum values for the intrinsically safe circuits 1 and 5 see Table 1
 For the permissible barrier parameters for the circuits 1 and 5 see Table 2
 Cable entry M 20 x 1.5 or metal conduit according to drawing No. 1050 - 0539 T or 1050 - 0540 T

Revisions Control Number: 2 20, March 02

Addendum to EB 8380-1EN
 AD 80-3 3V3 CSA II.doc

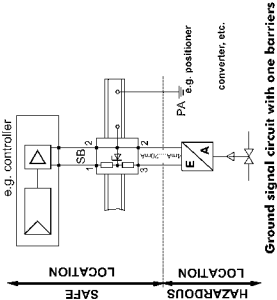
On interconnection to form ground- free signal circuits, only evaluation barriers must be installed in the return line. Correct polarity must be ensured.

Circuit diagram of a ground- free signal circuit.
 (position indicator and forced venting function)



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
 (position indicator and forced venting function)

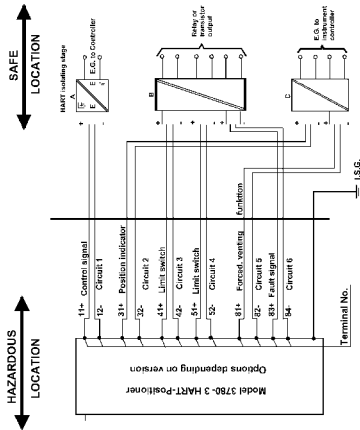


Revisions Control Number: 2 20, March 02

Addendum to EB 8380-1EN
 AD 80-3 3V3 CSA II.doc

CSA- certified for hazardous locations
 Class 1, Division 2, Groups A, B, C, D./ T6
 (Type 4 Enclosure)
 Class 1, Zone 2

HART- positioner with position indicator, forced venting function, fault signal and limit switches.



- Notes:**
 1.) Install in accordance with the Canadian Electrical Code, Part I.
 2.) A, B and C of any manufacturer, for the maximum values for the individual circuits see Table 1.
 3.) The cables shall be protected by conduits.
 4.) Cable entry only rigid metal conduit according to drawing No. 1050-0539 1 and 1050-0540 1

Addendum Page 6
 Installation Manual for apparatus approved by FM for use in hazardous locations.
 Electrical rating of intrinsically safe apparatus and apparatus for installation in hazardous locations.

Table 1: Maximum values

Circuit No.	Control-signal	Position-indicator	Forced venting-function	Limit switches Inductiv software	Fault-signal
1	1	2	5	3 and 4	3 and 4
Terminal No.	11 / 12	31 / 32	81 / 82	41 / 42 and 51 / 52	83 / 84
U _i or V	28V	28V	28V	16V	20V
I _i or I _{max}	115mA	115mA	115mA	25/52 mA	60mA
P or P	1W	1W	500mW	64/169 mW	250mW
C _i	5.3nF	5.3nF	#	60nF	5.3nF
L _i	45µH	#	#	200µH	#

Notes: Entry parameters must meet the following requirements:

$$U_0 \text{ or } V_{oc} \text{ or } V_i \leq U_0 \text{ or } V_{max}$$

$$I_0 \text{ or } I_{ic} \text{ or } I_i \leq I_0 \text{ or } I_{max}$$

$$P_0 \text{ or } P_{max} \leq P_0 \text{ or } P_{max}$$

$$C_d \geq C_i + C_{cable} \text{ and } L_d \geq L_i + L_{cable}$$

Table 2: FM – approved barrier parameters of circuit 2 and 5

Barrier	Supply barrier			Evaluation barrier		
	V _{oc}	R _i	I _{gc}	V _{oc}	R _i	I _{gc}
circuit 2	≤28V	≥300Ω	≤115mA	≤28V	#	0mA
circuit 5	≤28V	≥392	≤115mA	≤28V	#	0mA

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

Temperatur class	Permissible ambient temperature range
T6	- 40°C ... 60°C
T5	- 40°C ... 70°C
T4	- 40°C ... 80°C

Table 4: For the Model 3780 – 32 Positioner the correlation between temperatur classification, permissible ambient temperature ranges and maximum short- circuit current is shown in the table below:

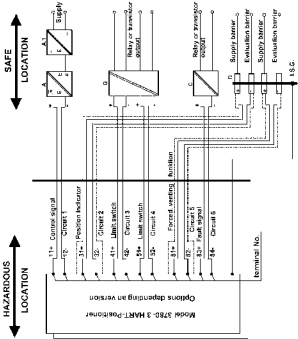
Temperature class	Permissible ambient temperature range	Maximum short-circuit current
T6	- 40°C ... 45°C	52mA
T5	- 40°C ... 60°C	
T4	- 40°C ... 75°C	
T6	- 40°C ... 60°C	25mA
T5	- 40°C ... 80°C	
T4	- 40°C ... 80°C	

Intrinsically safe II installed as specified in manufacturer's installation manual.

FM - approved for hazardous locations
Class I, II, III, Division 1, Groups A, B, C, D, E, Fand G
Class I, Zone 0 A Ex ia IIC T6
(NEMA Type 4X)

Notes:

- 1.) The apparatus may be installed in intrinsically safe circuits only when used in conjunction with the FM approved apparatus. For maximum values of U_0 or V_{max} , I_0 or I_{max} : P_0 or P_{max} ; C_1 and L_1 of the varrious apparatus see Table 1 on page 6.
- 2.) The apparatus may be installed in intrinsically safe circuits only when used in conjunction with the FM approved intrinsically safe barrier.
For barrier selection see Table 2 on page 6.
- 3.) Installation must be in accordance with the National Electrical Code ANSI/NFPA 70 and ANSI/ISA RP 12.6.
- 4.) Use only supply wires suitable for 5°C above surrounding temperature.



A = HART- isolating stage FM- approved. A1 = Power supply
B and C = Isolating amplifier 1 or 2 channel(s) resp. FM- approved
D = FM- approved I.S. barrier(s)

For the permissible maximum values for the intrinsically safe circuits 1 and 5 see Table 1
For the permissible barrier parameters for the circuits 1 and 5 see Table 2
Cable entry M 20 x 1.5 or metalconduit according to drawing No. 1050 – 0539 T or 1050 – 0540 T



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EB 8380-1 EN

S/Z 2003-04