Positioner with HART® Communication

Type 3780

Application

Single-acting or double-acting positioner for attachment to pneumatic control valves. Supplied with an electric input signal from 4 to 20 mA
Travels from 5 to 255 mm · **Opening angle up to 120°**
Smart instrument according to the HART® Field Communication Protocol. Types of protection **EEx ia**, **EEx n** or **EEx d**.

The microprocessor-controlled positioner ensures a predetermined assignment of the valve stem position to the electric input signal. It compares the 4 to 20 mA input signal received from a control system to the travel of the control valve and generates the corresponding output signal pressure (output variable).

Suitable for attachment to both linear and rotary actuators

The Type 3780 Positioner is equipped with an interface which complies with the HART® Field Communication Protocol, enabling connection to a PC or HART®-compatible handheld communicator (configurator) for bidirectional data exchange. SAMSON's TROVIS-VIEW software and the device-specific database module can be used to configure and parameterize the positioner. The positioner can, however, also be operated with other suitable software packages.

Version for hazardous areas with type of protection "Intrinsic safety" EEx ia IIC T6, EEx n for Zone 2 or in combination with Type 3770 Field Barrier with "Flameproof enclosure" EEx d

The digital data processing feature offers the following advantages over conventional positioners:

- Automatic adjustment of zero and span on initialization
- Automatic detection of errors in the actuator or pneumatic system
- Operating direction selectable using software functions and independent of the mounting position
- Selectable characteristics
- Simple modification of control parameters even during operation
- Monitoring and diagnostic functions, e.g. self-test functions for fault alarm output, software limit switches and position transmitters; total valve travel (travel integral)
- Supports extended valve diagnostics using TROVIS EXPERT software
- Continuous monitoring and adjustment of zero
- Minimum air consumption
- Permanent storage of all parameters in the EEPROM
- Optionally available with forced fail-safe venting to vent the actuator via the 2/2-way valve (Fig. 4, item 4) upon failure of the external signal. As a result, the control valve is forced to move to its fail-safe position. This function can be activated using a hardware switch.

Fig. 1 · Type 3780 Positioner with HART Communication

Fig. 2 · Ex d positioner with Type 3770 Field Barrier
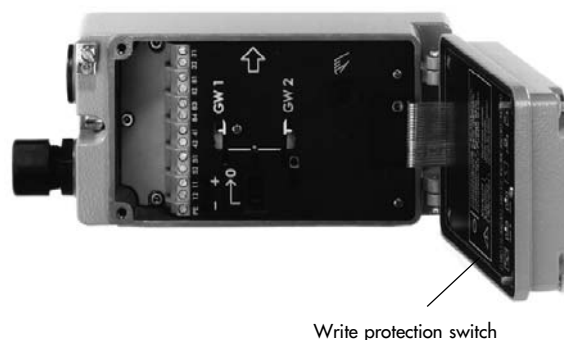

Write protection switch

Fig. 3 · Type 3780 Positioner with opened cover

Principle of operation

The travel of the final control element is sensed using the non-contact inductive travel sensor (1) and transmitted to the microcontroller (2) via a converter. In the microcontroller, the travel is compared to the set point, and the two pneumatic 2/2-way switching valves (3, 4) are activated whenever a system deviation occurs. Depending on the deviation, these valves either add air to (3) or vent air by (4) the pneumatic actuator using corresponding boosters.

A second microcontroller (5) manages the communication according to the HART® Field Communication Protocol. The frequency shift keying (FSK) signal used for communication is superimposed on the electric input signal.

The TROVIS-VIEW software package can be used to alter and select all required parameters and download these to the positioner. After that, the positioner can operate independently of the PC or handheld communicator.

By default, the positioner is equipped with a fault alarm output used to indicate various errors and other relevant alarms.

A write protection switch located on the inside of the cover prevents that saved configuration data are overwritten unintentionally.

Additional equipment

Options to extend the function range of the positioner include:

– Two inductive limit switches (proximity switches) or two software limit switches (to be configured over the software)

– One analog position transmitter which, independently of the reference input signal, converts the valve stem position into an analog output signal (operating direction can be configured via the software)
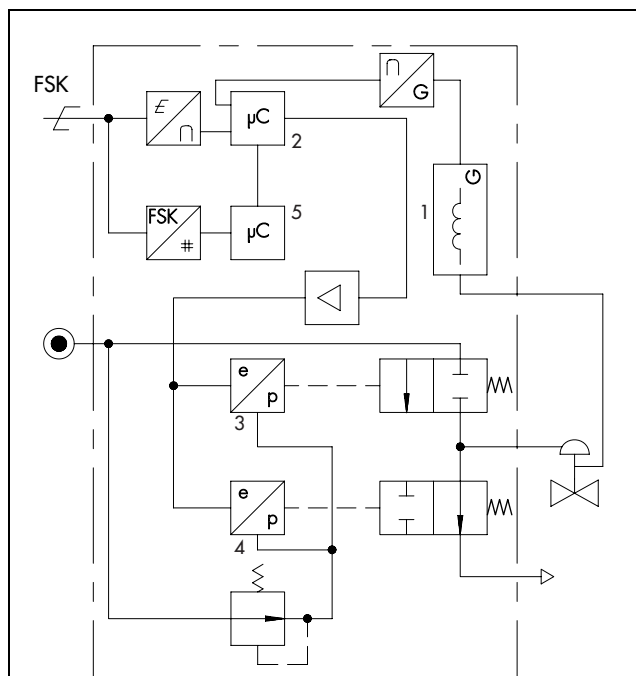
1	Inductive travel sensor	4	2/2-way valve
2	Microcontroller	5	Microcontroller
3	2/2-way valve	FSK	Frequency shift keying signal for communication

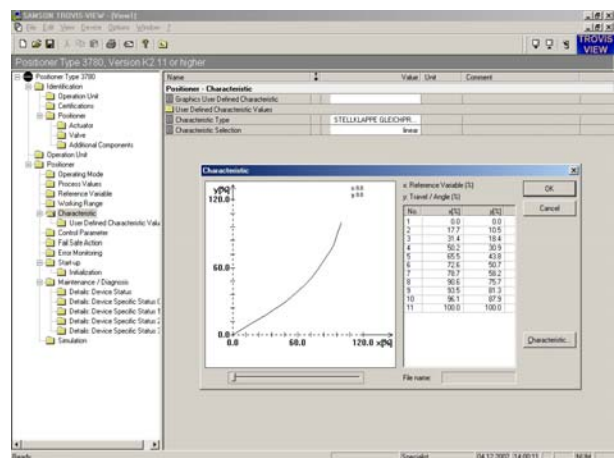Fig. 4 · Functional diagram of Type 3780 Positioner

Fig. 5 · TROVIS-VIEW Configuration and Operator Interface, dialog box for user-defined characteristic

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Table 1 · Technical data

Travel
    Direct attachment to Type 3277:
    Attachment acc. to IEC 60534-6 (NAMUR):
	Adjustable
	 5 to 30 mm
	 5 to 255 mm or 30° to 120° with rotary actuators

Reference input signal w
    Minimum current
    Load impedance
	Signal range: 4 to 20 mA · Span: 4 to 16 mA · Static destruction limit: 500 mA
	3.6 mA
	≤ 10.8 V (corresponds to 540 Ω at 20 mA)

Supply air	1.4 to 6 bar (20 to 90 psi)
Air quality acc. to ISO 8573–1 (2001)	Maximum particle size and density: Class 2 · Oil contents: Class 3 Pressure dew point: Class 3 or at least 10 K below the lowest expected ambient temperature
Output signal pressure	0 bar up to capacity of the supply pressure
Characteristic	Adjustable: linear/equal percentage/reverse equal percentage/freely programmable Deviation from terminal-based conformity: ≤1 %
Dead band	Adjustable from 0.1 to 10 %, default: 0.5 %
Resolution	≤ 0.05 %
Transit time	75 s separately adjustable for exhaust and supply air
Operating direction	Reversible, selection via software
Air consumption	Independent of supply air < 90 l_n/h
Air output capacity — Add air to actuator	At Δp = 6 bar: 9.3 m_n^3/h, at Δp = 1.4 bar: 3.5 m_n^3/h
Air output capacity — Vent air from actuator	At Δp = 6 bar: 15.5 m_n^3/h, at Δp = 1.4 bar: 5.8 m_n^3/h
Permissible ambient temperature	−20 to 80 °C · −40 to 80 °C with metal cable gland For devices equipped with position feedback only −20 to 80 °C The limits of the EC Type Examination Certificate listed in Table 3 additionally apply to explosion-protected devices.
Temperature influence	≤ 0.15 %/10 K
Supply influence	None
Effect of vibration	None up to 250 Hz and 4 g
Explosion protection	⟨Ex⟩ II 2 G EEx ia IIC T6 / II 2 D IP 65 T 80 °C or ⟨Ex⟩ II 3 G EEx nA II T6 / II 3 D IP 65 T 80 °C
Degree of protection	IP 65 using the filter check valve included with the positioner
Electromagnetic compatibility	Complies with EN 61000-6-2, EN 61000-6-3 and NAMUR Recommendation NE 21 requirements
Electrical connection	One M20x1.5 cable gland for 5 to 13 mm clamping range · Second M20 x 1.5 threaded connection additionally exist · Screw terminals for 0.2 to 2.5 mm^2 wire cross-sections
Fault alarm output	For connection to signal converter according to EN 60 947-5-6 · Static destruction limit: 16 V

Forced fail-safe venting
    Input
 	
    K_v value
    Static destruction limit
	To be activated via internal switch
	6 to 24 V DC · R_i approx. 6 KΩ at 24 V DC (voltage-dependent)
	Switching point for "1" signal at ≥ 3 V · Switching point for "0" signal only at 0 V
	0.17
	45 V

Weight	Approx. 1.3 kg
Communication	
Hardware and software requirements	TROVIS-VIEW Configuration and Operator Interface (see Data Sheet T 6661 EN) · Handheld communicator, e.g. Type 375 by Emerson Process Management · DTM acc. to Specification 1.2 · Integration of other user interfaces possible
Data transmission	HART® Field Communication Protocol Impedance in HART frequency range: receive 350 to 450 Ω, send approx. 115 Ω
Software functions	Automatic start-up; setting of characteristic, operating direction, reference input signal range and transit time; limitation of the travel range; cross-over correction; automatic zero correction; fault alarms; total valve travel (travel integral); diagnostic alarms; device information; non-volatile storage of data; test functions; logging via IBIS
Additional equipment	
Inductive limit switches	For connection to signal converter according to EN 60 947-5-6, two SJ2-SN inductive proximity switches
Software limit switches	For connection to signal converter according to EN 60 947-5-6, two configurable limit values Hysteresis: 1 %

Analog position transmitter
    Output
    Characteristic
    Hysteresis
    Operating range
    Power supply
    Permissible load
 	
    Resolution
    High-frequency influence
    Influence of power supply
    Temperature influence
	Two-wire transmitter
	4 to 20 mA ; operating direction reversible
	Linear (deviation ≤ 1%, incl. influence of mechanical deflection for NAMUR attachment)
	≤ 0.3 %
	−10 to +114 %
	12 to 35 V DC
	$R_B = \dfrac{U_S - 12\ V}{20\ mA}$
	≤ 0.05 %
	< 2 % at f = 50 to 80 MHz
	None
	Same as positioner

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Table 2 · Materials

Housing	Die-cast aluminum, chromated and plastic-coated
External parts	Stainless steel 1.4571 and 1.4301

Table 3 · Data which additionally apply to explosion-protected Type 3780-1.... Positioner

Permissible maximum values for	Signal circuit	Position transmitter	Forced venting	Inductive limit switches Type 3780-12	Software limit switches Type 3780-13	Fault alarm output
U_i	28 V			16 V	16 V	20 V
I_i	115 mA			52 mA	25 mA	60 mA
P_i	1 W		0.5 W	169 mW	64 mW	250 mW
C_i	5.3 nF		Negligibly small	60 nF	60 nF	5.3 nF
L_i	45 µH	Negligibly small		200 µH	200 µH	Negligibly small

Ambient temperature ranges in °C			
Temperature class	**T6**	**T5**	**T4**
Signal circuit Forced venting function Fault alarm output Software limit switches	−40 to 60 °C	−40 to 70 °C	−40 to 80 °C
Inductive limit switches at I_i = 52 mA	−40 to 45 °C	−40 to 60 °C	−40 to 75 °C
Inductive limit switches at I_i = 25 mA	−40 to 60 °C	−40 to 80 °C	−40 to 80 °C
Position transmitter	−20 to 60 °C	−20 to 70 °C	−20 to 80 °C

Summary of the explosion protection certificates for Type 3780

Type of approval	Certificate number	Date	Comments
EC Type Examination Certificate First Addendum Second Addendum	PTB 00 ATEX 2038	2000-05-03 2000-10-10 2004-01-14	⟨Ex⟩ II 2G EEx ia IIC T6; 3.3-volt version Changes in EMC II 2D IP 65 T 80 °C, Zone 21; Type 3780-1
Statement of Conformity First Addendum	PTB 02 ATEX 2033 X	2002-04-05 2004-01-14	⟨Ex⟩ II 3G EEx nA II T6, Zone 2 II 3D IP 65 T 80 °C, Zone 22; Type 3780-8
FMRC approval Revision	OD6A3.AX	1998-02-25 2002-02-20	Class I, II, III; Div. 1, Groups A-G; NEMA Type 4X Cl. I, Div. 2, Groups A, B, C, D; 3.3-volt version; Type 3780-3
CSA approval	LR 54227-29 1181233	1998-08-14 2002-04-15	Class I; Div. 1; Groups A, B, C, D Type 4 Enclosure Class 1, Zone 0, Ex ia IIC T6; 3.3-volt version; Type 3780-3
GOST approval	2002.C299	2002-12-26	1 Ex ia IIC T6 X, valid until 2008-01-01; Type 3780-1
AUS approval	AUS Ex 3621 X	2000-07-18	Ex ia IIC T6, Class I, Zone 0; 5-volt version Ex n IIC T6, Class I, Zone 2; Type 3780-6
JIS approval	C 15863	May 2002	Ex ia IIC T6, 3.3-volt version; Type 3780-7

The test certificates are included in the Mounting and Operating Instructions and are available on request.
Refer to Data Sheet T 8379 EN for EEx d certificates concerning the Type 3770 Field Barrier.

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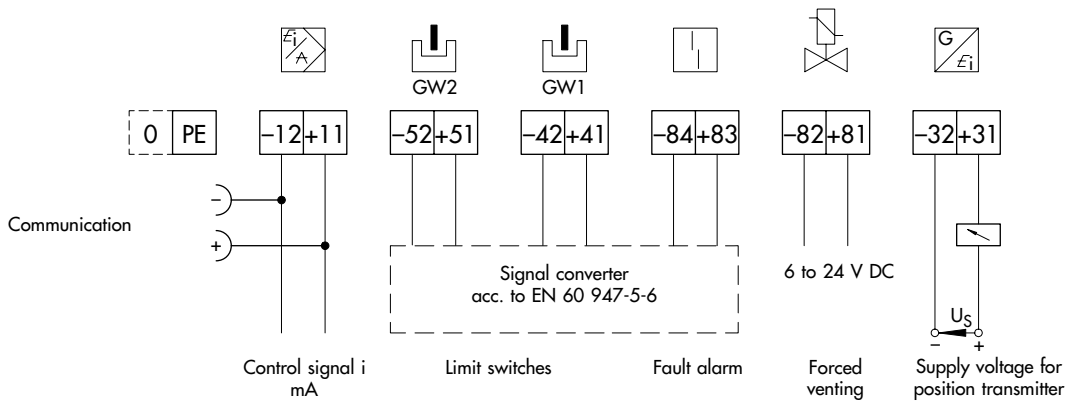
Electrical connection

Fig. 6 · Electrical connection for Type 3780 Positioner including additional equipment

Connecting the positioner

The Type 3780 Positioner can be operated as a single unit (point-to-point communication), in multi-drop mode or over a multiplexer. Figs. 7 to 9 illustrate how the unit is to be connected.

The signal converters in the explosion-protected version (4) are only required when Type 3780 Positioner is used in hazardous areas.
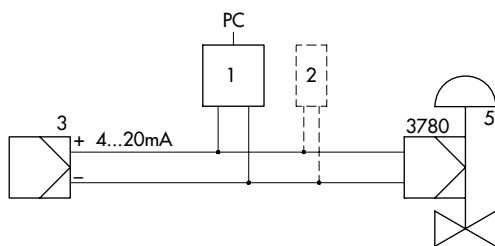
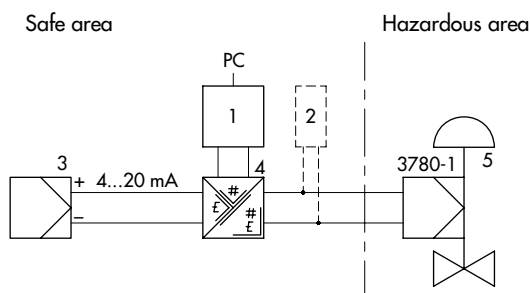

Fig. 7 · Point-to-point communication of Type 3780

Fig. 8 · Point-to-point communication of Type 3780-1 Positioner in hazardous area

1 FSK modem
2 Handheld communicator (suitable for hazardous areas)
3 Controller / control station
4 Signal converter for version for hazardous areas
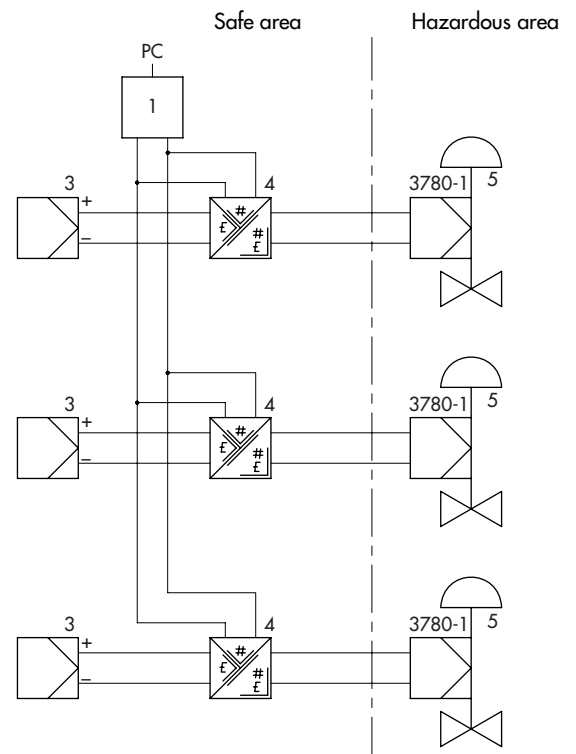5 Control valve

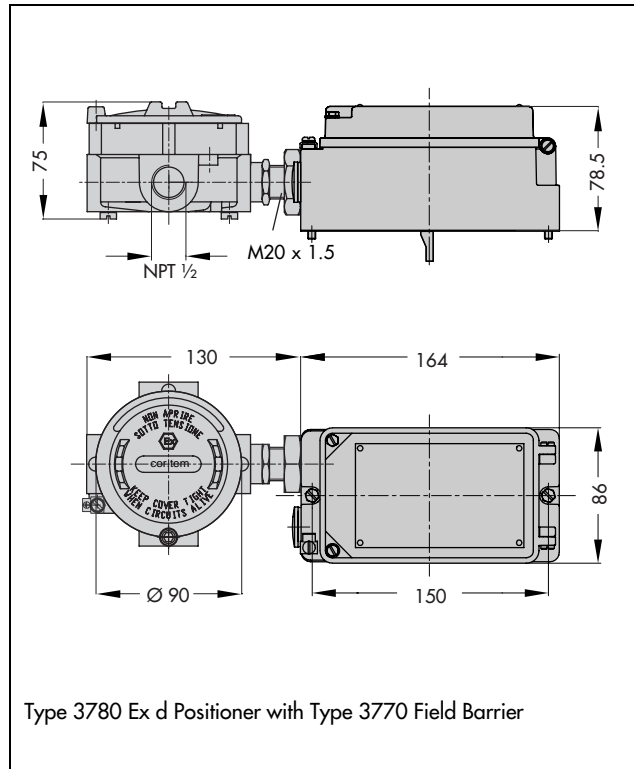Fig. 9 · Communication over multiplexers illustrated in this case using an FSK bus

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Attachment of the positioner

The Type 3780 Positioner can be mounted directly to the Type 3277 Actuator using a connection block. For actuators with fail-safe action "Actuator stem extends" and for Type 3277-5 (120 cm^2 effective area), the signal pressure is routed to the diaphragm chamber through an internal bore in the actuator yoke. For actuators with fail-safe action "Actuator stem retracts" and effective areas of 240 cm^2 or larger, the signal pressure is routed to the diaphragm chamber over ready-made external piping.

Using an adapter plate, the positioner can also be easily attached to either side of the actuator according to IEC 60534-6-1 (NAMUR recommendation).
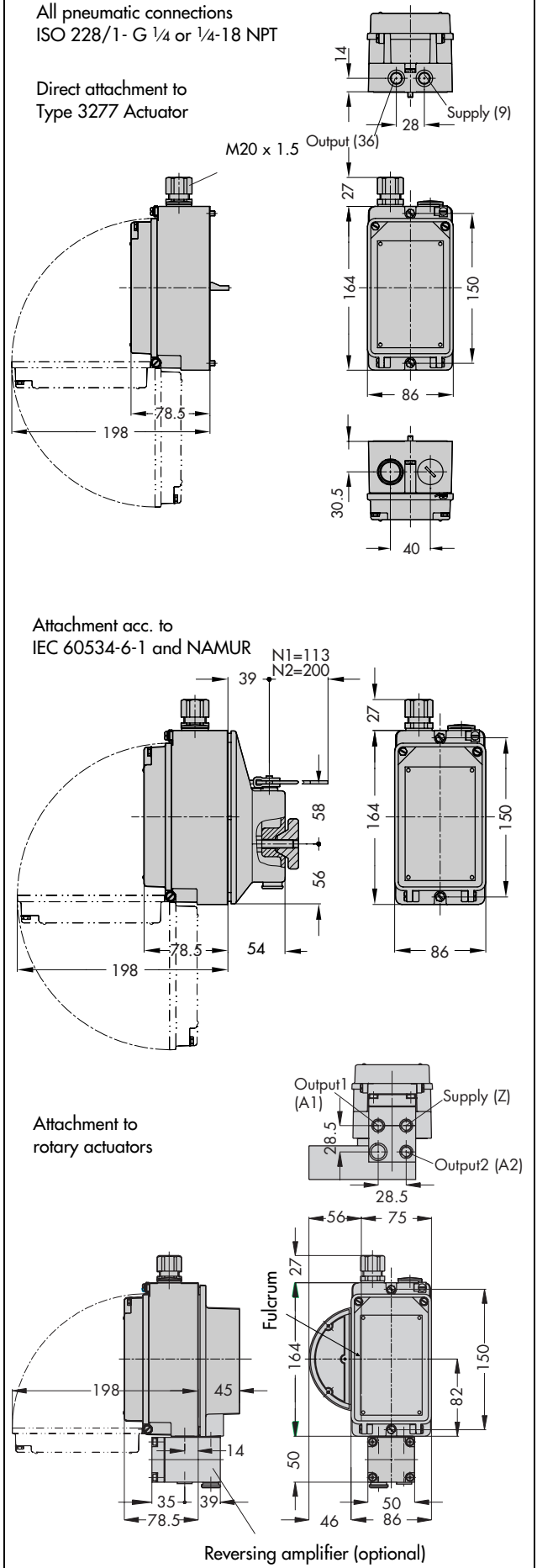
Attachment to the Type 3278 Rotary Actuator or other rotary actuators according to VDI/VDE 3845 requires an intermediate piece. The rotary motion of the actuator is converted into a linear motion via a cam disk. The cam disk is designed for angles of either 0° to 90° or 0° to 120°. The characteristic can be selected using the software.

For double-acting springless actuators (without spring return), a reversing amplifier is required to generate the second opposed signal pressure.

Type 3780 Ex d Positioner with Type 3770 Field Barrier

Dimensions in mm

All pneumatic connections
ISO 228/1- G ¼ or ¼-18 NPT

Direct attachment to
Type 3277 Actuator

Attachment acc. to
IEC 60534-6-1 and NAMUR

Attachment to
rotary actuators

Reversing amplifier (optional)

Article code

Positioner	Type 3780-	x	x	x	x	x	2	1	0	0	0	0	0
Explosion protection													
Without		0											
⟨Ex⟩ II 2 G EEx ia IIC T6 acc. to ATEX		1											
FM/CSA Ex ia		3											
Australia Ex (Zone 0 and Zone 2)		6	0/3										
JIS Japan		7	0/3										
⟨Ex⟩ II 3 G EEx nA II T6 acc. to ATEX		8											
Limit switches													
Without			0										
2 x inductive			2										
2 x software			3										
Forced venting													
Without				0									
With				1									
Position transmitter													
Without					0								
4 ... 20 mA					1								
Pneumatic connections													
¹⁄₄-18 NPT						1							
ISO 228/1 - G ¼						2							

Ordering text

Positioner with HART® Communication
                    Type 3780-... (see article code)
Optional   TROVIS-VIEW operator interface
                    FSK modem

Pressure gauge for signal pressure:
                    Without/without

For positioners with limit switches:
Tag outside active zone   Contact closed/
Tag inside active zone   Contact opened

Attachment to Type 3277 Actuator:
Actuator sizes   120/240 350/700 cm^2
Fail-safe action: Actuator stem extends/retracts

Attachment according to IEC 60534-6-1 (NAMUR):
Travel: … mm
Stem diameter: … mm (if applicable)

If applicable, signal pressure restrictions for actuators with small travel volumes

Attachment to rotary actuators:
Type 3278, actuator sizes 160/320 cm^2

Attachment to single-acting or double-acting rotary actuators according to VDI/ VDE 3845:

If applicable, signal pressure restrictions for actuators with small travel volumes

Specifications subject to change without notice.

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