DATA SHEET

T 8493S EN

TROVIS SAFE 3793 Smart Positioner (HART®) for on/off valves in safety-instrumented systems

CE Ex certified **TROVIS SAFE**

Application

Single-acting or double-acting positioner for attachment to pneumatic on/off valves in safety-instrumented systems. Self-calibrating, automatic adaptation to valve and actuator.

Set point	**4 to 20 mA**
Valve travel	**3.6 to 300 mm**
Opening angle	**24 to 170°**

The discrete analysis of the set point w is performed in automatic mode. The positioner moves the valve to the operating point or fail-safe position depending on the adjustable limits. An automated partial stroke test is started when the set point is between the predefined upper and lower test limits.

TROVIS 3793 Positioner used for throttling service ▶ T 8493.

Special features

- High air capacity
- Modular design: easy retrofitting or exchange of pneumatic or option modules
- Integrated EXPERTplus diagnostics with partial stroke testing for valves in safety-instrumented systems ▶ T 8389-2S
- Simple attachment to all common linear and rotary actuators:
  - SAMSON direct attachment
  - NAMUR rib
  - Attachment to rod-type yokes according to IEC 60534-6-1
  - Attachment according to VDI/VDE 3847
  - Rotary actuator attachment according to VDI/VDE 3845
- Non-contact position sensing
- Plain-text display with NAMUR Recommendation NE 107 states and messages on the device
- Integrated diagnostic functions
- Simple one-knob, menu-driven operation
- LCD easy to read in any mounting position thanks to selectable reading direction
- Configurable with a computer over the SSP interface using the TROVIS-VIEW software
- Variable, automatic start-up with four different initialization modes
- Sub (substitution) initialization mode allows the positioner to be started up in case of emergency whilst the plant is running without having to change the valve position.
- All parameters saved in non-volatile EEPROM
- Two-wire system with a small electrical load of 495 Ω
- Adjustable tight-closing function
- Continuous zero monitoring
- Integrated temperature sensor and operating hours counter
- Self-diagnostics, messages as condensed state conforming to NAMUR Recommendation NE 107
- Pressure sensors to monitor the supply air and signal pressure
- Air capacity adjustable by software

Fig. 1: *TROVIS SAFE 3793 Electropneumatic Positioner*

Design and principle of operation

The TROVIS SAFE 3793 Electropneumatic Positioner is mounted on pneumatic control valves and used to assign the valve position (controlled variable x) to the control signal (set point w). The discrete analysis of the set point w is performed in automatic mode. The positioner moves the valve to the operating point or fail-safe position depending on the defined limits. An automated step response test is started when the set point is between the predefined upper and lower test limits.

The positioner mainly consists of a non-contact travel sensor system (2), pneumatics and the electronics with the microcontroller (4). The output of the standard version is either single or double acting; which means both the Output 138 and Output 238 can provide the output variable and route the signal pressure to the actuator.

The positioner can be configured to meet requirements of an application by adding a maximum of two pneumatic modules (A, B) and electronic option modules (C, D). The pneumatic modules mainly consist of a microcontroller, which operates an i/p converter with downstream spool valve. Depending on the actuator used, an output of the positioner can be sealed to achieve a single-acting function. The option modules additionally provide individual functions, e.g. recognition of the end positions.

The valve position is transmitted either as an angle of rotation or a travel to the pick-up lever, from there to the travel sensor (2) and forwarded to the microcontroller (4). The PID algorithm in the microcontroller compares the valve position measured by the travel sensor (2) to the 4 to 20 mA DC control signal issued by the control system after it has been converted by the A/D converter (3). In case of a set point deviation, the pneumatic module (A, B) causes the actuator (1) to be either vented or filled with air. As a result, the closure member of the valve (e.g. plug) is moved to the position determined by the set point.

The pneumatic module is supplied with air. The flow rate of the module's output can be restricted by software.

The positioner is operated by a rotary pushbutton (9) for menu navigation on the plain-text display (8).

The extended EXPERTplus diagnostics are integrated into the positioner. They provide information on the control valve and positioner and generate diagnostic and status messages, which allow faults to be pinpointed quickly.
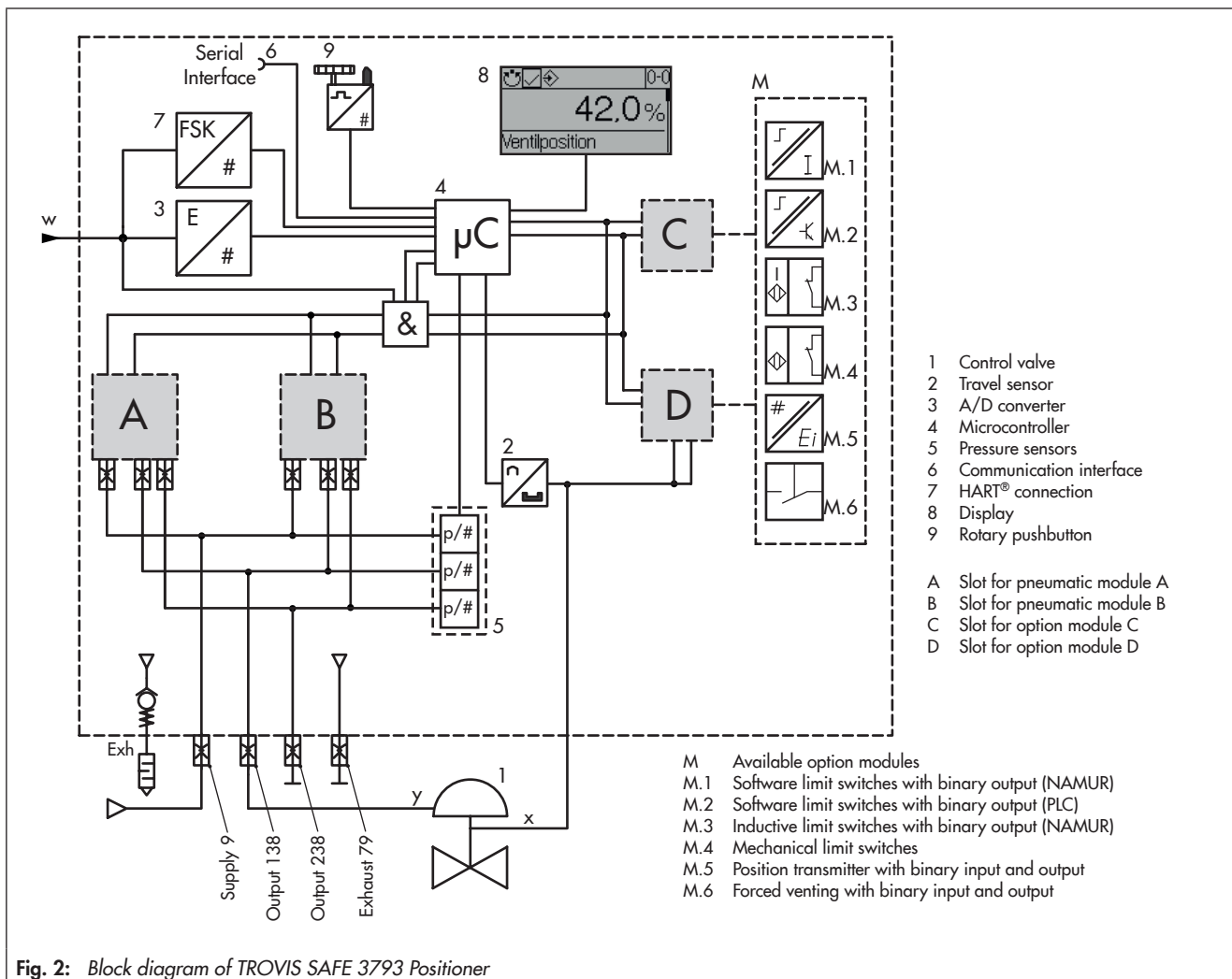

1	Control valve
2	Travel sensor
3	A/D converter
4	Microcontroller
5	Pressure sensors
6	Communication interface
7	HART® connection
8	Display
9	Rotary pushbutton

A	Slot for pneumatic module A
B	Slot for pneumatic module B
C	Slot for option module C
D	Slot for option module D

M	Available option modules
M.1	Software limit switches with binary output (NAMUR)
M.2	Software limit switches with binary output (PLC)
M.3	Inductive limit switches with binary output (NAMUR)
M.4	Mechanical limit switches
M.5	Position transmitter with binary input and output
M.6	Forced venting with binary input and output

Fig. 2: *Block diagram of TROVIS SAFE 3793 Positioner*

Technical data · TROVIS SAFE 3793 Positioner

Travel		
Adjustable travel for	Direct attachment to Type 3277:	3.6 to 30 mm
	Attachment according to IEC 60534-6 (NAMUR):	5 to 300 mm
	Attachment according to VDI/VDE 3847	5 to 300 mm
	Attachment to rotary actuators:	24 to 100° (170° [1])

Set point w	
Signal range	4 to 20 mA, two-wire device, reverse polarity protection, split-range operation (can be configured as required, minimum span 4 mA)
Static destruction limit	40 V, internal current limit approx. 40 mA
Minimum current	3.75 mA for display/operation (HART® communication and configuration) 3.90 mA for pneumatic function
Load impedance	≤ 9.9 V (corresponds to 495 Ω at 20 mA)

Supply air		
Supply air	2.5 to 10 bar/30 to 150 psi	
Air quality acc. to ISO 8573-1	Max. particle size and density:	Class 4
	Oil content:	Class 3
	Pressure dew point:	Class 3 or at least 10 K below the lowest ambient temperature to be expected
Signal pressure (output)	0 bar up to supply pressure	
Hysteresis	≤0.3 %	
Sensitivity	≤0.1 %, adjustable by software	
Start-up time	After interrupted operation < 300 ms: 100 ms After interrupted operation > 300 ms: ≤2 s	
Transit time	Up to 10000 s separately adjustable for exhaust and supply by software	
Direction of action	Reversible	
Air consumption [2]	≤300 l_n/h with 6 bar supply pressure, depending on module	

Air output capacity (when Δp = 6 bar)	
Actuator (supply)	32 m_n^3/h with one pneumatic module ($K_{V\,max\,(20\,°C)}$ = 0.34)
	60 m_n^3/h with two pneumatic modules of the same sort ($K_{V\,max\,(20\,°C)}$ = 0.64)
Actuator (exhaust)	37 m_n^3/h with one pneumatic module ($K_{V\,max\,(20\,°C)}$ = 0.40)
	70 m_n^3/h with two pneumatic modules of the same sort ($K_{V\,max\,(20\,°C)}$ = 0.75)

Environmental conditions and permissible temperatures	
Permissible environmental conditions according to EN 60721-3	
Storage	1K6 (relative humidity ≤95 %)
Transport	2K4
Operation	4K4 −20 to +85 °C: All versions −40 to +85 °C: With metal cable glands −55 to +85 °C: Low-temperature versions with metal cable glands Observe the limits in the test certificate for explosion-protected versions.
Resistance to vibration	
Vibrations (sinusoidal)	According to DIN EN 60068-2-6: 0.15 mm, 10 to 60 Hz; 20 m/s², 60 to 500 Hz per axis 0.75 mm, 10 to 60 Hz; 100 m/s², 60 to 500 Hz per axis
Bumps (half sine)	According to DIN EN 60068-2-29: 150 m/s², 6 ms; 4000 bumps per axis
Noise	According to DIN EN 60068-2-64: 10 to 200 Hz: 1 (m/s²)²/Hz; 200 to 500 Hz: 0.3 (m/s²)²/Hz; 4 h/axis
Recommended continuous operation	≤20 m/s²

[1] On request
[2] Based on temperature range −40 to +85 °C

Influences	
Temperature	≤0.15 %/10 K
Supply air	None
Requirements	
EMC	Complying with EN 61000-6-2, EN 61000-6-3, EN 61326-1 and NAMUR Recommendation NE 21
Degree of protection	IP 66
Conformity	$C\epsilon$
Electrical connections	
Cable glands	Max. four, M20x1.5 or ½ NPT
Terminals	Screw terminals for 0.2 to 2.5 mm² wire cross-section (max. 1.5 mm² with the option modules)
Explosion protection	
	See table for explosion protection certificates
Materials	
Housing and cover	Die-cast aluminum EN AC-AlSi12(Fe) (EN AC-44300) acc. to DIN 1706, chromate and powder coating
Window	Makrolon® 2807
Cable glands	Polyamide, nickel-plated brass, stainless steel 1.4305
Other external parts	Stainless steel 1.4571 and 1.4404 (316 L)
Weight	
	1.4 to 1.6 kg (depending on version)

Summary of explosion protection certificates for TROVIS SAFE 3793 Positioner

TROVIS SAFE 3793	Certification			Type of protection
-110	ATEX	Number	BVS 16 ATEX E117	II 2 G Ex ia IIC T4/T6 Gb II 2 D Ex ia IIIC T 85 °C Db
		Date	2016-12-01	
-510		Number	BVS 16 ATEX E117	II 2 D Ex tb IIIC T 85 °C Db
		Date	2016-12-01	
-810		Number	BVS 16 ATEX E117	II 3 G Ex nA IIC T4/T6 Gc II 2 D Ex tb IIIC T 85 °C Db
		Date	2016-12-01	
-850		Number	BVS 16 ATEX E123	II 3 G Ex nA IIC T4/T6 Gc
		Date	2016-12-01	
-113	EAC	Number	TC RU C-DE.PB.B.00127	1Ex ia IIC T4/T6 Gb X Ex ia IIIC T85°C Db X
		Date	2018-06-28	
-813		Number	TC RU C-DE.PB98.B.00127	2Ex nA IIC T4/T6 Gc X Ex tb IIIC T85°C Db X
		Date	2018-06-28	
-111	IECEx	Number	IECEx BVS 16.0084	Ex ia IIC T4/T6 Gb Ex ia IIIC T 85 °C Db
		Date	2016-12-07	
-511		Number	IECEx BVS 16.0084	Ex tb IIIC T 85 °C Db
		Date	2016-12-07	
-811		Number	IECEx BVS 16.0084	Ex nA IIC T4/T6 Gc Ex tb IIIC T 85 °C Db
		Date	2016-12-07	
-851		Number	IECEx BVS 16.0084	Ex nA IIC T4/T6 Gc
		Date	2016-12-07	
-130	FM	Number	FM16CA0218X	IS Class I, II, III, Division 1, Groups A, B, C, D, E, F, G; Type 4X NI Class I, II, III, Division 2, Groups A, B, C, D, E, F, G; Type 4X Class I, Zone 1, AEx ia IIC; Type 4X
		Date	2018-01-06	
-112	NEPSI	Number	GYJ17.1245X	Ex ia IIC T6...T4 Gb Ex iaD 21 T85
		Date	2017-11-21	
-512		Number	GYJ17.1245X	Ex tD A21 IP66 T85°C
		Date	2017-11-21	
-812		Number	GYJ17.1245X	Ex nA IIC T6...T4 Gc Ex tD A21 IP66 T85°C
		Date	2017-11-21	
-852		Number	GYJ17.1245X	Ex nA IIC T4...T6 Gc
		Date	2017-11-21	

Technical data · Optional additional functions

Analog position transmitter	
Version	Two-wire system, galvanic isolation, reverse polarity protection, reversible direction of action
Auxiliary power	10 to 30 V DC
Output signal	4 to 20 mA
Operating range	3.8 to 20.5 mA
Error indication	2.4 or 21.6 mA
No-load current	1.4 mA
Static destruction limit	38 V DC · 30 V AC

Software limit switches		NAMUR	PLC
Version		Galvanic isolation, reverse polarity protection, switching output acc. to EN 60947-5-6	Galvanic isolation, reverse polarity protection, binary input of a PLC acc. to EN 61131-2, P_{max} = 400 mW
Signal state	Non-conducting	≤1.0 mA	Non-conducting
	Conductive	≥2.2 mA	Conductive (R = 348 Ω)
Static destruction limit		32 V DC/24 V AC	16 V DC/50 mA

Binary output		NAMUR	PLC
Version		Galvanic isolation, reverse polarity protection, switching output acc. to EN 60947-5-6	Galvanic isolation, reverse polarity protection, binary input of a PLC acc. to EN 61131-2, P_{max} = 400 mW
Signal state	Non-conducting	≤1.0 mA	Non-conducting
	Conductive	≥2.2 mA	Conductive (R = 348 Ω)
Static destruction limit		32 V DC/24 V AC	32 V DC/50 mA

Binary input	
Version	Galvanic isolation, reverse polarity protection
Voltage input	0 to 24 V DC
Input resistance	≥7 kΩ
ON switching state	Ue >15 V
OFF switching state	Ue <11 V
Static destruction limit	38 V DC/30 V AC

Forced venting		
Version		Galvanic isolation, reverse polarity protection
Voltage input		0 to 24 V DC
Input resistance		≥7 kΩ
Signal state	Active	Ue <11 V
	Not active	Ue >15 V
Static destruction limit		38 V DC/30 V AC

Inductive limit switches	
Version	For connection to switching amplifier according to EN 60947-5-6, SJ2-SN proximity switches, reverse polarity protection
Measuring plate not detected	≥3 mA
Measuring plate detected	≤1 mA
Static destruction limit	20 V DC
Permissible ambient temperature	−50 to +85 °C

Mechanical limit switches	
Floating contact	Changeover contact/SPDT (single-pole/double-throw type)
Static destruction limit	38 V DC · 30 V AC · 0.2 A
Permissible ambient temperature	−40 to +85 °C

Pressure sensors

Pressure sensors	
Pressure range	0 to 14 bar
Permissible ambient temperature	−40 to +85 °C

Mounting the positioner

The positioner can be attached directly to the Type 3277 Actuator (175 to 750 cm²) over a connection block. In actuators with "actuator stem extends" fail-safe action, the signal pressure is routed over an internal hole in the actuator yoke to the actuator. In actuators with "actuator stem retracts" fail-safe action, the signal pressure is routed to the actuator over ready-made external piping.

Using the appropriate bracket, the positioner can also be attached according to IEC 60534-6-1 (NAMUR recommendation). The positioner can be mounted on either side of the control valve.

A pair of universal brackets is used for the attachment to Type 3278 Rotary Actuators or other rotary actuators according to VDI/VDE 3845. The rotary motion of the actuator is transferred to the positioner over a coupling wheel with travel indication.

A special version of the positioner allows it to be attached according to VDI/VDE 3847. This type of attachment allows the positioner to be replaced quickly while the process is running by blocking the air in the actuator. The positioner can be attached directly to the Type 3277 Actuator using an adapter bracket or adapter block. Alternatively, it can be attached to the NAMUR rib of a control valve using an additional NAMUR connection block.

Version

The TROVIS SAFE 3793 Electropneumatic Positioner can be used as a single or double-acting positioner, depending on the combination of the available pneumatic modules.

The modular design also allows diverse optional additional functions (option modules) to be added and adapt the positioner on site to the specific requirements.

– **TROVIS SAFE 3793** · Electropneumatic positioner for on/off valves, HART® communication, on-site operation, local communication with SSP interface, EXPERTplus diagnostics, pressure sensors to monitor the supply air and signal pressure

Optional modules

The modular design of the positioner allows it to be adapted to specific requirements. The air capacity and direction of action can be varied by the installation of different pneumatic modules (Fig. 3). Optional additional functions are available by using option modules (Fig. 4 and Fig. 5).

If the positioner is ordered with additional pneumatic modules and/or option modules, they are ready installed and connected upon delivery.

Table 1: *Available pneumatic modules*

Article code	Function
P3799-0000	Dummy module (seals the slot connections and must be used when only one pneumatic module is installed)
P3799-0001	Output 138 and Output 238 module (single and double acting)
P3799-0002	Output 138 module (single acting)
P3799-0003	Output 238 module (single acting)

Table 2: *Available option modules*

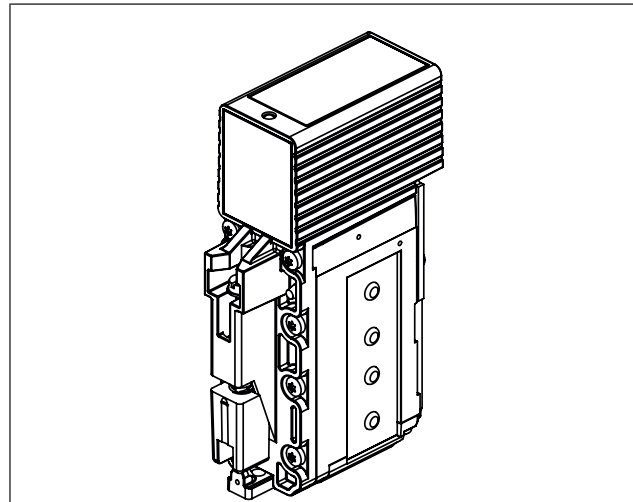| Article code	Inductive limit switches	Mechanical limit switches	Software limit switches (NAMUR)	Software limit switches (PLC)	Analog position transmitter	Forced venting	Binary input	Binary output
Z3799-xxx10		•					•	
Z3799-xxx11			•				•	
Z3799-xxx15	•						•	
Z3799-xxx30		•						
Z3799-xxx40				•		•	•	
Z3799-xxx80					•	•	•	

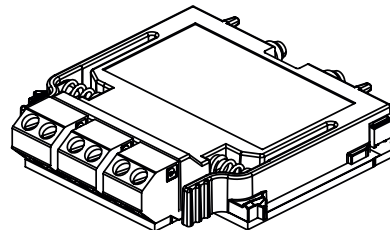**Fig. 3:** *Pneumatic module*
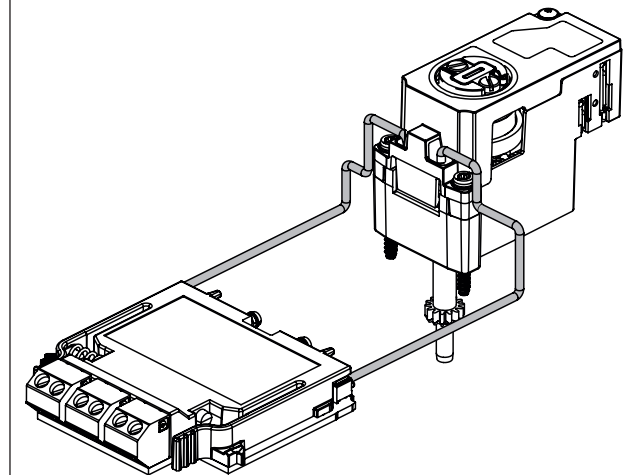

Fig. 4: *Option module*

Fig. 5: *Option module with hardware limit switches*

Operation

The positioner is operated using one proven, user-friendly rotary pushbutton: the various menu levels, parameters and values are selected by turning the button. By pressing the button, the required setting is activated. All parameters can be checked and changed on site.

All values are displayed on the plain-text display. The reading direction of the display can be rotated by 180°.

The initialization key activates initialization which is started according to the ready adjusted parameters (autotune). After initialization is completed, the positioner immediately starts closed-loop operation.

To configure the positioner with SAMSON's TROVIS-VIEW software, the positioner is equipped with an additional digital interface to be connected to the USB interface of a computer using an adapter.

Additionally, all parameters of the TROVIS SAFE 3793 Positioner can be accessed using HART® communication.

Dimensions in mm

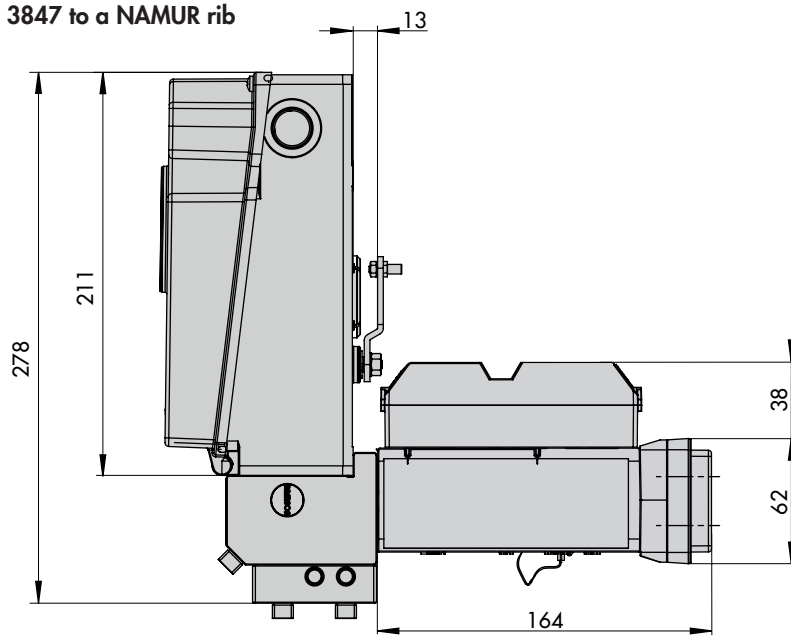**Attachment according to IEC 60534-6 (NAMUR)**

Pressure gauge bracket
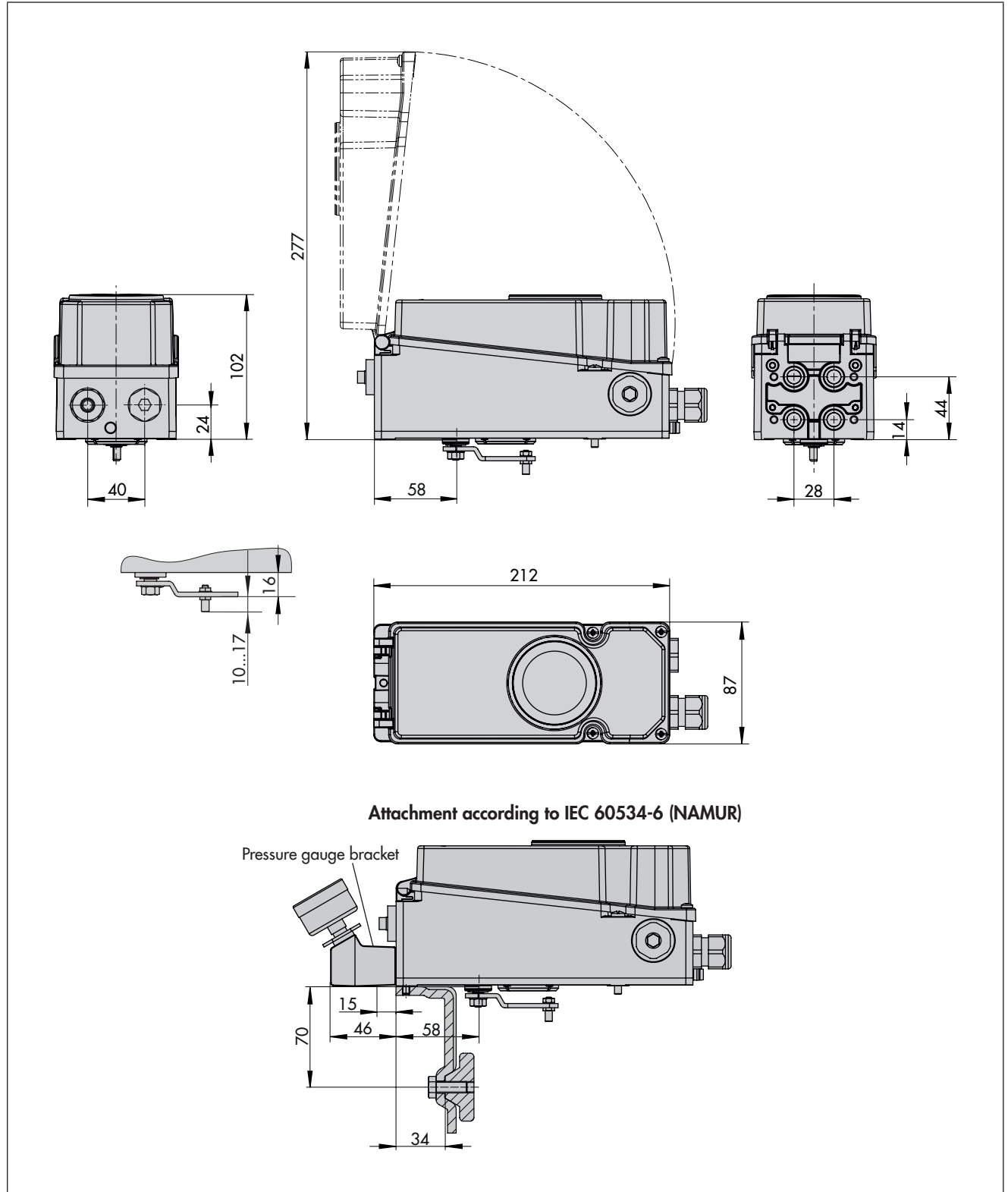
Attachment according to VDI/
VDE 3847 onto Type 3277 Actuator

13

278

211

24

62

164
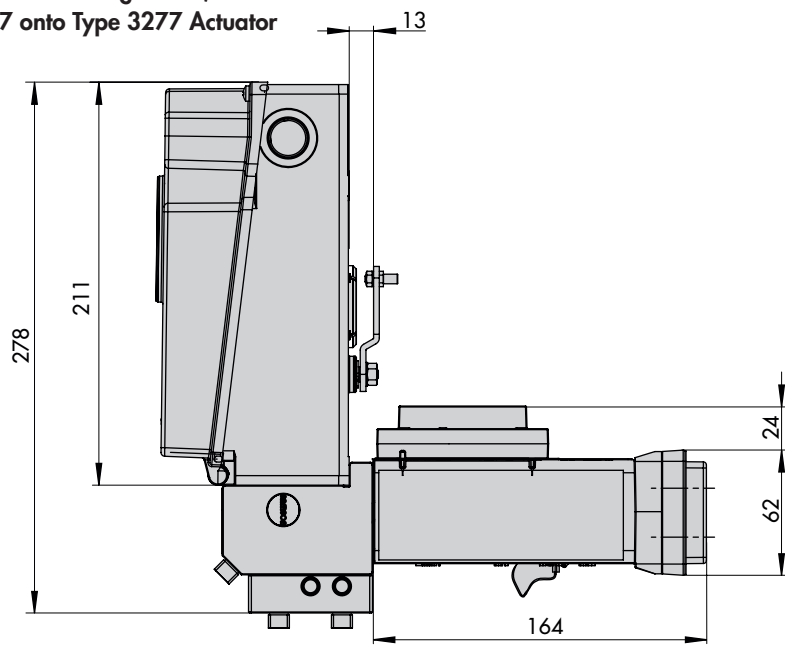
Attachment according to VDI/
VDE 3847 to a NAMUR rib

13

278

211

38

62

164

Attachment to rotary actuators according to VDI/VDE 3845
Fixing level 1, AA1 to AA4 size
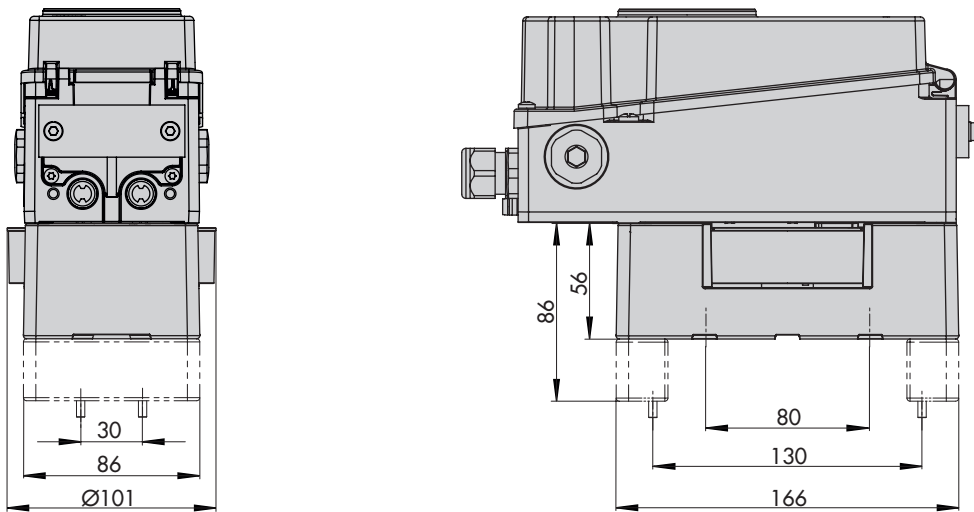
Lever
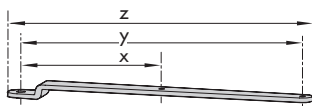
Lever	x	y	z
M	25 mm	50 mm	66 mm
L	70 mm	100 mm	116 mm
XL	100 mm	200 mm	216 mm
XXL	200 mm	300 mm	316 mm

Fixing levels according to VDI/VDE 3845 (September 2010)
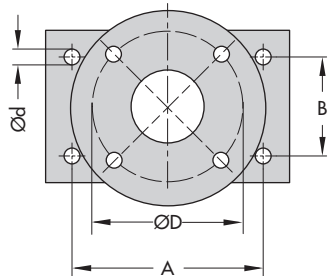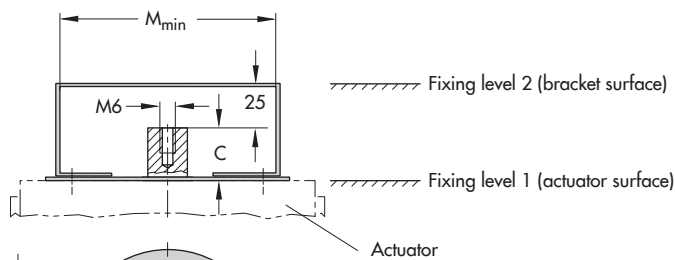
Dimensions in mm						
Size	A	B	C	Ød	M_{min}	D[1]
AA0	50	25	15	5.5 for M5	66	50
AA1	80	30	20	5.5 for M5	96	50
AA2	80	30	30	5.5 for M5	96	50
AA3	130	30	30	5.5 for M5	146	50
AA4	130	30	50	5.5 for M5	146	50
AA5	200	50	80	6.5 for M6	220	50

[1] Flange type F05 acc. to DIN EN ISO 5211

Pressure gauge bracket, two pressure gauges
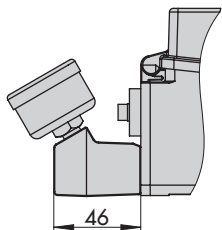
Pressure gauge bracket, three pressure gauges

46

46

72

100

Connecting plate

15

Electrical connection

−12   +11
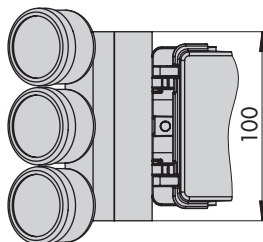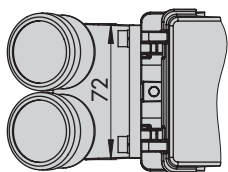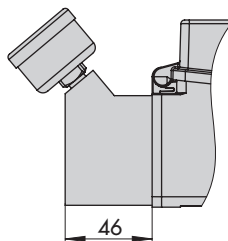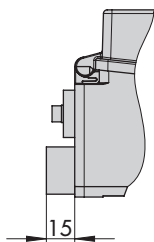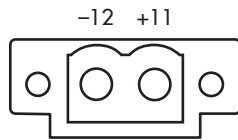
Set point (mA signal)

Table 3: *Slot position and terminal assignment of the option modules*

Z3799-xxx10 [N] · Software limit switches with binary output (NAMUR)	
Slot	Terminal assignment
C or D	

Description		Terminal
Software limit switch (NAMUR 1)	N	+45 / −46
Software limit switch (NAMUR 2)	N	+55 / −56
Binary output (NAMUR)	N	+83 / −84

Z3799-xxx11 [X] · Software limit switches with binary output (PLC)	
Slot	Terminal assignment
C or D	

Description		Terminal
Software limit switch (PLC 1)	X	+91 / −92
Software limit switch (PLC 2)	X	+93 / −94
Binary output (PLC)	X	+95 / −96

Z3799-xxx14 [P] · Inductive limit switches with binary output (NAMUR)	
Slot	Terminal assignment
D	

Description		Terminal
Binary output (NAMUR)	P	+83 / −84
Inductive limit switch 1	P	+41 / −42
Inductive limit switch 2	P	+51 / −52

Z3799-xxx30 [M] · Mechanical limit switches	
Slot	Terminal assignment
D	

Description	Switching function		Terminal
Mechanical limit switch 1 (changeover contact)	NC		47
	C	M	48
	NO		49
Mechanical limit switch 2 (changeover contact)	NC		57
	C	M	58
	NO		59

Z3799-xxx40 [T] · Position transmitter with binary input (24 V) and binary output (NAMUR)

Slot	Terminal assignment
C or D	

Description		Terminal
Position transmitter 4 to 20 mA	T	+31 / −32
Binary input 24 V	T	+87 / −88
Binary output (NAMUR)	T	+83 / −84

Z3799-xxx80 [V] · Forced venting with binary input (24 V) and binary output (NAMUR)

Slot	Terminal assignment
C or D	

NOTICE!
Observe rotary switch position for forced venting.

Description		Terminal
Forced venting	V	+81 / −82
Binary input 24 V	V	+87 / −88
Binary output (NAMUR)	V	+83 / −84

Article code

Positioner	TROVIS SAFE 3793-	x	x	x	5	x	x	x	x	x	x	x	x	0	0	0	x	0	x	0	x	0	0	9	9	x	x
With LCD, autotune, HART® communication																											
Explosion protection																											
Without		0	0	0																							
ATEX · II 2 G Ex ia IIC T4/T6 Gb / II 2 D Ex ia IIIC T 85 °C Db		1	1	0																							
ATEX · II 2 D Ex tb IIIC T 85 °C Db		5	1	0																							
ATEX · II 3 G Ex nA IIC T4/T6 Gc / II 2 D Ex tb IIIC T 85 °C Db		8	1	0																							
ATEX · II 3 G Ex nA IIC T4/T6 Gc		8	5	0																							
EAC · 1Ex ia IIC T4/T6 Gb X / Ex ia IIIC T85°C Db X		1	1	3																							
EAC · 2Ex nA IIC T4/T6 Gc X / Ex tb IIIC T85°C Db X		8	1	3																							
IECEx · Ex ia IIC T4/T6 Gb / Ex ia IIIC T 85 °C Db		1	1	1																							
IECEx · Ex tb IIIC T 85 °C Db		5	1	1																							
IECEx · Ex nA IIC T4/T6 Gc / Ex tb IIIC T 85 °C Db		8	1	1																							
IECEx · Ex nA IIC T4/T6 Gc		8	5	1																							
FM · IS Class I, II, III, Division 1, Groups A, B, C, D, E, F, G; Type 4X / NI Class I, II, III, Division 2, Groups A, B, C, D, E, F, G; Type 4X / Class I, Zone 1, AEx ia IIC; Type 4X		1	3	0																							
NEPSI · Ex ia IIC T6...T4 Gb / Ex iaD 21 T85		1	1	2																							
NEPSI · Ex tD A21 IP66 T85°C		5	1	2																							
NEPSI · Ex nA IIC T6...T4 Gc / Ex tD A21 IP66 T85°C		8	1	2																							
NEPSI · Ex nA IIC T4...T6 Gc		8	5	2																							
Pneumatics																											
Single/double acting, $K_V = 0.35$					0	1																					
Single/double acting, $K_V = 0.70$					0	2																					
Single acting, 2x independent $K_V = 0.35$					0	3																					

Positioner	TROVIS SAFE 3793-	x	x	x	5	x	x	x	x	x	x	x	x	x	0	0	0	x	0	x	0	x	0	0	9	9	x	x
Option module 1 (slot C)																												
Without/dummy module						0	0																					
Software limit switches + binary output (NAMUR), [N]						1	0																					
Software limit switches + binary output (PLC), [X] [1]						1	1																					
Position transmitter + binary input/output (NAMUR), [T]						4	0																					
Forced venting + Binary input/output (NAMUR), [V]						8	0																					
Option module 2 (slot D)																												
Without/dummy module								0	0																			
Software limit switches + binary output (NAMUR), [N]								1	0																			
Software limit switches + binary output (PLC), [X] [1]								1	1																			
Inductive limit switches + binary output (NAMUR), [P]; −50 to +85 °C								1	5																			
Mechanical limit switches, [M]; −40 to +85 °C								3	0																			
Position transmitter + binary input/output (NAMUR), [T]								4	0																			
Pressure sensors																												
Without										0																		
Standard (Supply 9, Output 138, Output 238); −40 to +85 °C										1																		
Electrical connection																												
M20x1.5 (one cable gland, three blanking plugs)											1																	
½-14 NPT (one cable gland, three blanking plugs)											4																	
Housing material																												
Aluminum (standard)												0																
Special applications																												
Without													0															
Additional certification																												
Without														0														
Permissible ambient temperature																												
Standard: −20 to +85 °C, plastic cable gland																		0										
−40 to +85 °C metal cable gland																		1										
−55 to +85 °C, low-temperature version with metal cable gland																		2										
Display text in different languages																												
Standard (English and German)																				0								
Special version																												
Without																						0						
Cover without window																						1						
Hardware version																												
1.00.00																									9	9		
Firmware version																												
1.00.05																											9	6

[1] The option module for Software limit switches + Binary output (PLC), [X] is not available in the explosion-protection version.