

T 6116 EN

Type 6116 Electropneumatic Converter for Direct Current Signals



Application

Used to convert a direct-current input signal into a pneumatic output signal for measuring and control tasks. Particularly suitable as intermediate element between electric measuring devices and pneumatic controllers or between electric control devices and pneumatic control valves.

The Type 6116 i/p Converter proportionally converts the electric input signal into a pneumatic output signal.

The signal converter accepts a load-independent 4 to 20 mA direct-current input signal.

Depending on the supply air pressure, the converter supplies a pneumatic output signal of 0.2 to 1 bar (3 to 15 psi), 0.4 to 2 bar (6 to 30 psi) or pressure ranges up to 8 bar (120 psi). Depending on the signal range, the Type 6116 is equipped with Type 6109 or Type 6112 i/p Converter module (see Technical data).

Special features

- Continuous, linear characteristic
- High accuracy and excellent dynamic response
- Extremely low air consumption
- Operation without supply pressure regulator possible
- Switch-off electronics guarantee venting at zero point

Versions

- For safe areas: Type 6116-0...
- For hazardous areas:
 - **Type 6116-1...** Ex i acc. to ATEX and GOST (EAC)
 - **Type 6116-2...** Ex d acc. to ATEX, IEC and GOST (EAC)
 - **Type 6116-3...** Explosion-proof acc. to CSA and FM standards
 - **Type 6116-4...** Intrinsically safe according to CSA and FM standards
 - **Type 6116-5...** Explosion-proof/Australia/IEC/Korea
 - **Type 6116-6...** Intrinsically safe/Australia/IEC
 - **Type 6116-7...** Ex d according to JIS standard/Japan

Further versions

- **Type 6116-x2xxxxxxxxx2xxx:** temperatures down to -45 °C
- **Type 6116-0...**
 - AS-interface connection with Type 6150 Slave

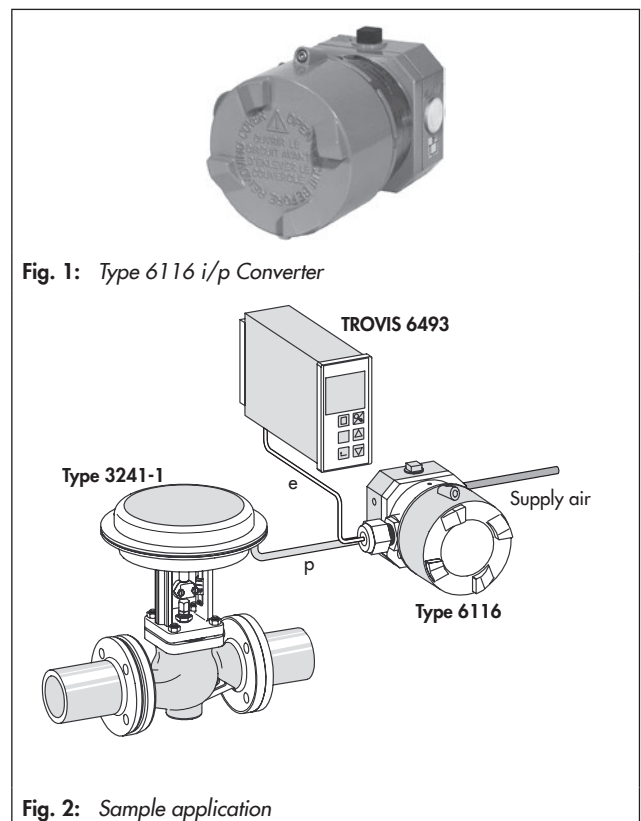


Fig. 1: Type 6116 i/p Converter

Fig. 2: Sample application

- Voltage input (e.g. 0 to 10 V) with Type 6151 u/i Module
- Electropneumatic converter without booster or switch-off electronics · Converters can be combined with SAMSON Type 3760, Type 3766-000 (model index .02 and higher) and Type 4765 Pneumatic Positioners.
- **Type 6116-xx060111000xxxx** for attachment to p/p positioners (½ NPT connection)
- **Type 6116-xx060112000xxxx** for attachment to p/p positioners (M20x1.5 connection)

Principle of operation (see Fig. 4)

The electropneumatic converter consists of an i/p converter module, which operates according to the force-balance principle and a downstream volume booster.

When operated, the supplied direct current (4) flows through the plunger coil (2) located in the field of a permanent magnet (3). At the balance beam (1), the force of the plunger coil, which is in proportion to the current, is balanced against the force of the dynamic backpressure. The backpressure is produced on the flapper plate (6) by the air jet leaving the nozzle (7).

The nozzle is supplied with air from the pneumatic output (36). With an input signal of 0 mA, an output pressure of approximately 100 mbar is already issued due to the offset spring.

The supply air (8) flows in the lower diaphragm chamber and a certain amount flows to the output. When the current increases, the flapper moves closer to the nozzle. The force of the resulting backpressure pushes both the diaphragm (5) and sleeve (8) downwards, allowing additional air to enter the chamber. The passing air volume increases until the forces on the diaphragm obtain a state of equilibrium. When the current decreases, this action is reversed. The backpressure created by the nozzle and flapper decreases and the diaphragm is pressed upwards. In this process, it releases the sleeve, if applicable and opens the vent (EXHAUST) until the forces on the diaphragm are balanced again.

Switch-off electronics (see Fig. 5)

Converter modules with an input signal range from 4 to 20 mA have a slide switch which activates the switch-off electronics. The electronics cause the pneumatic output to be vented up to approx. 100 mbar when the input signal falls below 4.08 mA tolerance. In this way, the tight shut-off function of a valve can be guaranteed.

Combined with a Type 3760, Type 3766-000 or Type 4765 Pneumatic Positioner

The Type 6116-xx06011x000xxxx i/p Converter without booster or switch-off electronics can be combined with the above listed positioners to form a version in a flameproof enclosure (Ex d). With Type 3760 and Type 4765 Positioners, the i/p converter is attached to the control valve according to NAMUR and hooked up to the positioner (see Fig. 6).

The Type 3766-000 Positioner can be connected directly to the i/p converter. The positioner type must be specified when ordering any accessories.

Electrical connection

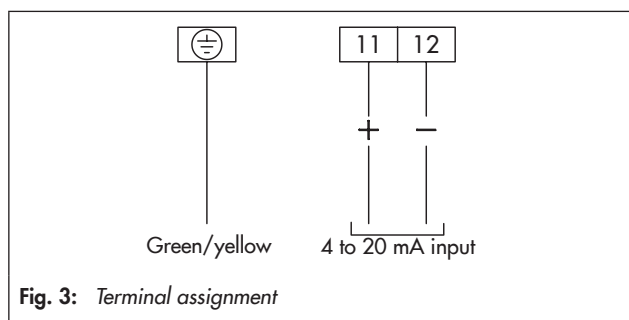


Fig. 3: Terminal assignment

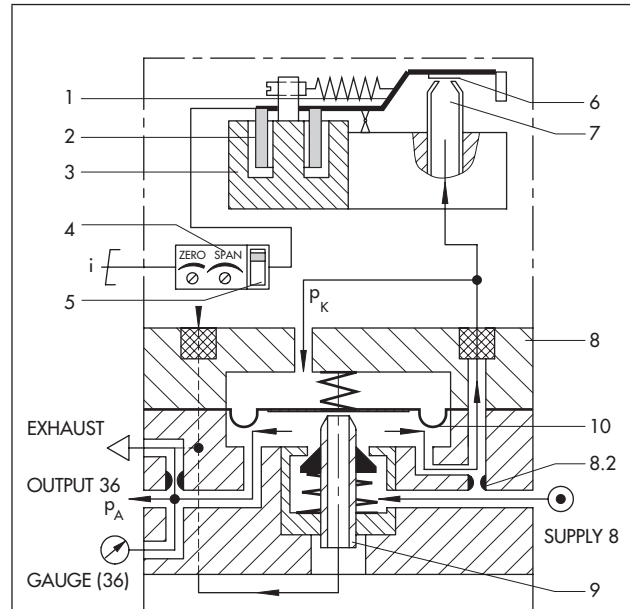
For connection to intrinsically safe circuits, the specifications stated in the certificate of conformity apply as well.

Installation

The converter can be mounted to a wall, pipe or directly to the control valve according to NAMUR.

Ideally, the converter is to be installed horizontally, with the pressure gauge (or screw plug) facing upward. If a different mounting position is used, the zero point must be corrected using the ZERO adjuster.

With degree of protection IP 54, the vent plug must always be installed facing downward.



- 1 Balance beam
- 2 Plunger coil
- 3 Permanent magnet
- 4 Zero point and span adjusters (not in version without electronics)
- 5 Slide switch for switch-off electronics
- 6 Flapper
- 7 Nozzle
- 8 Volume booster
- 9 Sleeve
- 10 Diaphragm

Fig. 4: Functional drawing of Type 6116

For 0.2 to 1 bar output
Remaining pressure
approx. 0.1 bar

For 0.8 to 2.7 bar output
Remaining pressure approx.
0.3 bar

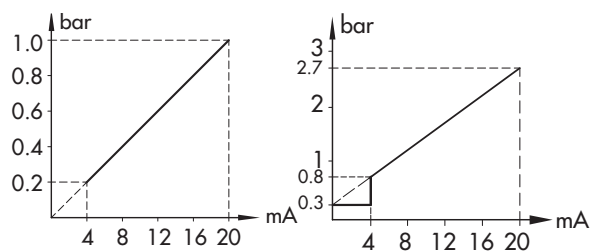


Fig. 5: Switch-off electronics

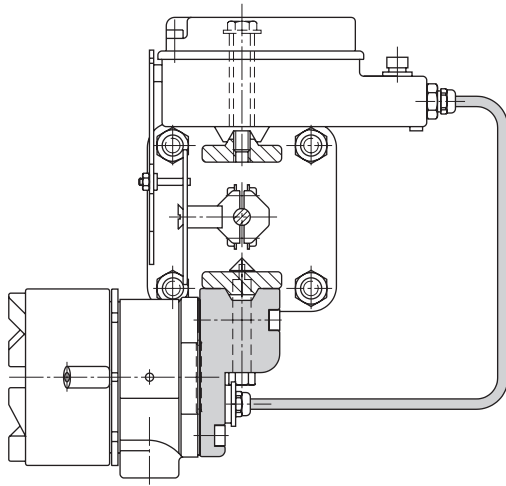


Fig. 6: NAMUR attachment to valve with Type 4765 Positioner

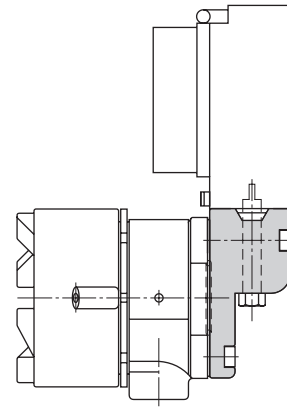



Fig. 7: Direct attachment to Type 3766-000 Positioner

Table 1: Technical data

Type	No explosion protection	6116-0																											
	With explosion protection	Types 6116-1/-2/-3/-4/-5/-6/-7 (see summary of explosion protection certificates)																											
Input ⁵⁾	4 to 20 mA, other signals on request Minimum current >3.6 mA, load impedance ≤6 V (corresponding to 300 Ω at 20 mA) Versions with explosion protection: load impedance 7 V (corresponding to 350 Ω at 20 mA) Versions without switch-off electronics: $R_i = 200 \Omega \pm 7.5 \%$																												
Output ⁵⁾	0.2 to 1 bar (3 to 15 psi) (Type 6109 i/p Converter Module) 0.4 to 2 bar (6 to 30 psi) (Type 6112 i/p Converter Module) Special ranges adjustable according to customer specifications: Output range = Initial value¹⁰⁾ + Span Δp <table border="0" style="width: 100%;"> <tr> <td></td> <td></td> <td style="text-align: right;">With Type 6112 i/p Module</td> </tr> <tr> <td>0.1 to 0.4 bar</td> <td>+ 0.75 to 1.0 bar</td> <td style="text-align: right;">Module A</td> </tr> <tr> <td>0.1 to 0.4 bar</td> <td>+ 1.0 to 1.35 bar</td> <td style="text-align: right;">Module B</td> </tr> <tr> <td>0.1 to 0.4 bar</td> <td>+ 1.35 to 1.81 bar</td> <td style="text-align: right;">Module C</td> </tr> <tr> <td>0.1 to 0.8 bar</td> <td>+ 1.81 to 2.44 bar</td> <td style="text-align: right;">Module D</td> </tr> <tr> <td>0.1 to 0.8 bar</td> <td>+ 2.44 to 3.28 bar</td> <td style="text-align: right;">Module E</td> </tr> <tr> <td>0.1 to 0.8 bar</td> <td>+ 3.28 to 4.42 bar</td> <td style="text-align: right;">Module F</td> </tr> <tr> <td>0.1 to 1.2 bar</td> <td>+ 4.42 to 5.94 bar</td> <td style="text-align: right;">Module G</td> </tr> <tr> <td>0.1 to 1.2 bar</td> <td>+ 5.94 to 8.0 bar</td> <td style="text-align: right;">Module H⁹⁾</td> </tr> </table>				With Type 6112 i/p Module	0.1 to 0.4 bar	+ 0.75 to 1.0 bar	Module A	0.1 to 0.4 bar	+ 1.0 to 1.35 bar	Module B	0.1 to 0.4 bar	+ 1.35 to 1.81 bar	Module C	0.1 to 0.8 bar	+ 1.81 to 2.44 bar	Module D	0.1 to 0.8 bar	+ 2.44 to 3.28 bar	Module E	0.1 to 0.8 bar	+ 3.28 to 4.42 bar	Module F	0.1 to 1.2 bar	+ 4.42 to 5.94 bar	Module G	0.1 to 1.2 bar	+ 5.94 to 8.0 bar	Module H ⁹⁾
		With Type 6112 i/p Module																											
0.1 to 0.4 bar	+ 0.75 to 1.0 bar	Module A																											
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0.1 to 0.8 bar	+ 3.28 to 4.42 bar	Module F																											
0.1 to 1.2 bar	+ 4.42 to 5.94 bar	Module G																											
0.1 to 1.2 bar	+ 5.94 to 8.0 bar	Module H ⁹⁾																											
Max. air output capacity ³⁾	2.0 m ³ /h with an output of 0.6 bar (0.2 to 1.0 bar) 2.5 m ³ /h with an output of 1.2 bar (0.4 to 2.0 bar) 8.5 m ³ /h with an output of 5.0 bar (0.1 to 8.0 bar)																												
Supply air	At least 0.4 bar above the upper signal pressure range value Max. 10 bar without supply pressure regulator Max. 6 bar with devices in Ex d version																												
	Air quality acc. to ISO 8573-1: 2001 Air consumption ²⁾	Maximum 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 0.08 m _n ³ /h at 1.4 bar 0.1 m _n ³ /h at 2.4 bar Max. 0.26 m _n ³ /h at 10 bar																											

Characteristic	Characteristic: Output linear to input	
Hysteresis	≤0.3 % of final value	
Deviation from terminal-based conformity	≤1 % of upper range value (for upper range values up to 5 bar); more exact values on request ≤1.5 % of upper range value (for upper range values above 5 bar)	
Effect in % of the upper range value	Supply air: 0.1 %/0.1 bar ²⁾	
	Alternating load, supply air failure, interruption of the input current: < 0.3 %	
	Ambient temperature: lower range value < 0.03 %/K, span < 0.03 %/K	
Dynamic response	Limiting frequency	5.3 Hz
	Phase shift	-130°
Variable position	Max. 3.5 % depending on attachment: ±1 % in horizontal position (Type 6109) Max. 1 % depending on attachment: ±0.3 % in horizontal position (Type 6112)	
Ambient conditions, degree of protection, compliance and weight		
Storage temperature	-45 to +80 °C	
Ambient temperature ¹⁾	With Type 6109	-30 to +70 °C ⁶⁾ ; -30 to +60 °C ¹⁾
	With Type 6112	-40 to +70 °C ^{6) 7)} ; -40 to +60 °C ^{1) 7)}
Degree of protection	IP 54 ⁴⁾ , IP 65 ⁸⁾ , NEMA 4	
Compliance		
Weight	Approx. 0.85 kg	
Explosion protection		
ATEX, IECEx, ...	Refer to Table 3	
Materials		
Enclosure	Die-cast aluminum, chromated and plastic coated	
Cable gland (standard)	Black polyamide (6 to 12 mm clamping range, -20 to +80 °C) ¹²⁾	

¹⁾ Details (including electric specifications and installation instructions) can be found in the EC type examination certificate

²⁾ Measured with average output pressure

³⁾ Measured with 2 m hose with 4 mm inside diameter

⁴⁾ Observe recommended mounting position

⁵⁾ See Table 2 when combined with a positioner

⁶⁾ Devices without explosion protection

⁷⁾ Special version down to -45 °C, temperature range on request

⁸⁾ Possible by using accessories

⁹⁾ Max. possible output pressure 8 bar

¹⁰⁾ Initial value raised up to 3.0 bar (special version)







¹¹⁾ Metal cable glands and vent plugs are required for temperatures below -20 °C.

¹²⁾ Devices with type of protection "Flameproof enclosure" are delivered without cable gland.

Table 2: Technical data (positioner attachment)

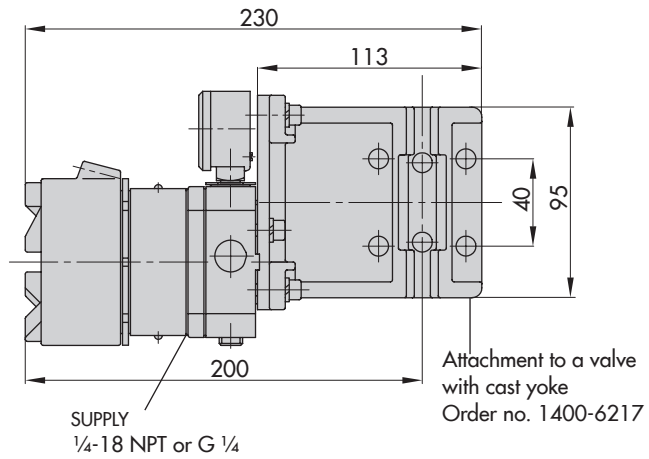
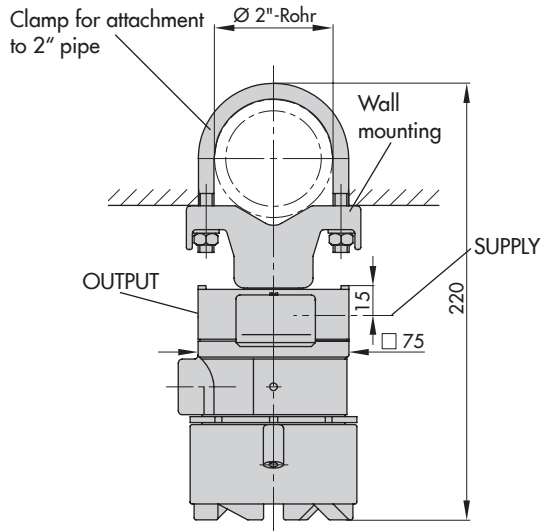
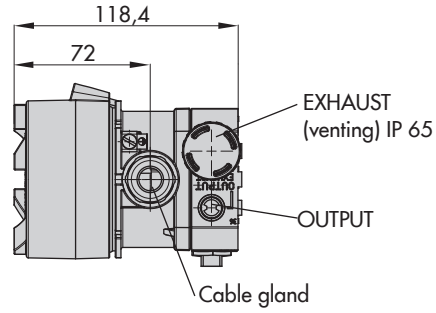
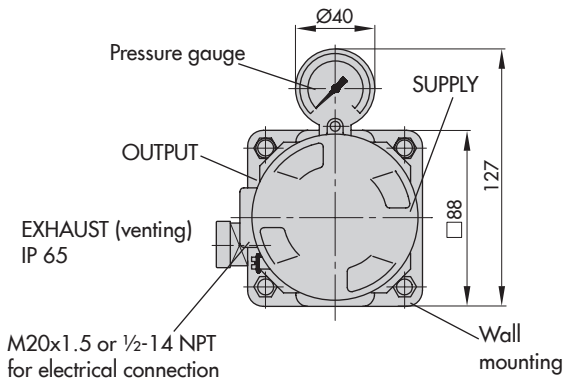
Type 6116-xx06011x000xxx (for positioner attachment) · Further data same as in Table 1	
Input	4 to 20 mA, other signals on request Internal resistance approx. 200 Ω at 20 °C
Output	0.2 to 1 bar for positioner

Table 3: Summary of explosion protection certificates for Type 6116 i/p Converter ¹⁾

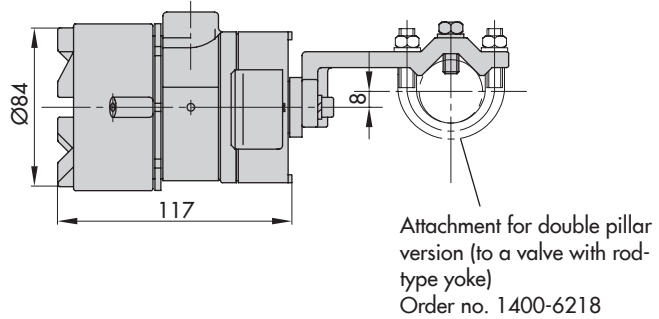
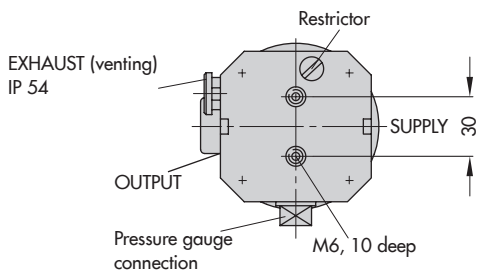
Type	Certification		Type of protection	Comments	
-1	 EC Type Examination Certificate First Addendum	Number	PTB 02 ATEX 2199	II 2 G Ex ia IIC T6	-45 °C ambient temperature
		Date	2003-03-07 2014-03-03		
-2		Number	RU C-DE ... 00749	IEx ia IIC T6/T5/T4 Gb X	Ex zone 1
		Date	2015-01-28		
		Valid until	2020-01-27		
-2	 EC Type Examination Certificate First Addendum	Number	PTB 98 ATEX 1024 X	II 2 G Ex d IIC T6	-45 °C ambient temperature
		Date	1998-04-30 2002-01-08		
	 EC type Examination Certificate	Number	BVS 14 ATEX E 104 X	II 2 G Ex d IIC T* Gb	Ambient temperature T6: -45 to +50 °C T5: -45 to +65 °C T4: -45 to +80 °C
		Date	2014-06-27		
-3		Number	IECEX BVS 14.0066X	Ex d IIC T* Gb	Ambient temperature T6: -45 to +50 °C T5: -45 to +65 °C T4: -45 to +80 °C Hazardous area: zone 1, zone 2
		Date	2014-07-01		
-3		Number	RU C-DE ... 00749	IEx d IIC T6/T5/T4 Gb X	
		Date	2015-01-28		
-3	CSA	Number	1471157 (LR 54227-18)	Cl. I, Gr. B, C, D Cl. II, Gr. E, F, G Cl. III Type 4 Enclosure	Ambient temperature -45 to +70 °C Division 1
		Date	2014-11-14		
		Valid until	2017-11-10		
-3	FM	Number	1W5A4.AE	Cl. I, II, III; Div 1; Gr. B, C, D, E, F, G Cl. I; Div. 2; Gr. B, C, D Cl. II; Div. 2; Gr. F, G Cl. III Type 4X Enclosure	
		Date	1993-04-01		
-4	CSA	Number	1607866 (LR 54227-16)	Ex ia IIC T6; Class I, Zone 0: Cl. I, Div. 1, Gr. A, B, C, D; Cl. II, Div. 1, Gr. E, F, G; Cl. III Cl. I, Div. 2, Gr. A, B, C, D; Cl. II, Div. 2, Gr. E, F, G Cl. III; Type 4 Enclosure	Ambient temperature T6: 60 °C T5: 70 °C T4: 80 °C
		Date	2005-09-16		
-4	FM	Number	3020228	IS, Cl. I, II, III; Div. 1, Gr. A, B, C, D, E, F, G Cl. I, Zone 0 AEx ia IIC NI, Cl. I, Div. 2, Gr. A, B, C, D; S, Cl. II, Div. 2, Gr. F, G; S, Cl. III; Type 4X Enclosure	
		Date	2005-02-28		
-5	KCS Korea	Number	11-KB4B0-0213	Ex d IIC T6/T4	Ambient temperature T6: -20 to +47 °C T4: -20 to +60 °C Zone 1 and zone 2
		Date	2011-10-24		
-5	IECEX	Number	IECEX TSA 05.0015	Ex d IIC T6/T4	Ambient temperature T6: 47 °C; T4: 60 °C
		Date	2005-04-22		
-6	IECEX	Number	IECEX TSA 05.0008X	Ex ia IIC T6 Ex n IIC T6	
-7	JIS	Number	TC 13622	Ex d IIC T6	
		Date	2017-05-20		

¹⁾ The test certificates are included in the mounting and operating instructions or are available on request.

Wall and pipe mounting · Order no. 1400-6216

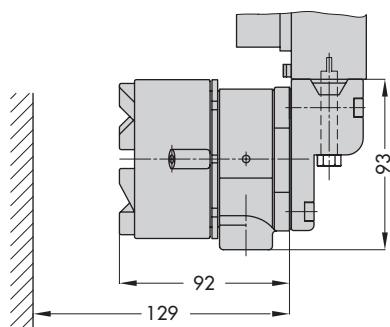


Rear view, without mounting parts

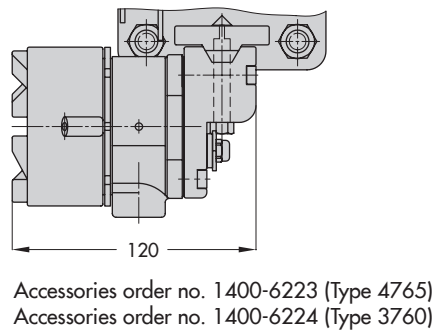


Type 6116-xx06011x000xxxx without booster for positioner attachment

Combined with Type 3766-000 Positioner
 Accessories order no. 1400-6227



Attachment according to NAMUR with Type 4765 and Type 3760



Article code

Order no.		Type 6116-																		
Explosion protection	Without	0																		
	Intrinsically safe Ex II 2 G Ex ia IIC T6 according to ATEX and GOST (EAC) ^{1) 2)}	1																		
	Flameproof enclosure Ex II 2 G Ex d IIC T6 acc. to ATEX and GOST (EAC) ³⁾	2																		
	Explosion-proof acc. to CSA and FM standards ^{5) 12)}	3																		
	Intrinsically safe according to CSA and FM standards ¹⁾	4																	3	
	Explosion proof Ex d IIC T6/T4 acc. to IECEx TSA (Australia) ^{4) 6)}	5																		
	Intrinsically safe Ex ia/Ex n IIC T6 acc. to IECEx TSA (Australia) ¹⁾	6	2																2	
Ex d IIC T6 acc. to JIS standard (Japan) ⁴⁾	7																			
i/p converter module	Type 6109 ⁴⁾	1	0	1																
	Type 6112	2																		
Input	4 to 20 mA		0	1																
	4 to 12 mA ^{1) 11)}	2	0	3																
	12 to 20 mA, without switch-off electronics ^{1) 7) 11)}	2	0	4																
	0 to 20 mA, without switch-off electronics ⁷⁾	2	0	5																
	4 to 20 mA, without switch-off electronics ⁷⁾ for positioner attachment		0	6																
Output	0.2 to 1.0 bar				0	1														
	3 to 15 psi				0	2														
	0.4 to 2.0 bar	2			0	4														
	6 to 30 psi	2			0	5														
	Special ranges ⁸⁾				1	1														
	Initial value 0.1 to 0.4 bar; span 0.75 to 1.00 bar	2			1	2														
	Initial value 0.1 to 0.4 bar; span 1.00 to 1.35 bar	2			1	3														
	Initial value 0.1 to 0.4 bar; span 1.35 to 1.81 bar	2			1	4														
Initial value 0.1 to 0.8 bar; span 1.81 to 2.44 bar	2			1	5															
Initial value 0.1 to 0.8 bar; span 2.44 to 3.28 bar	2			1	6															
Initial value 0.1 to 0.8 bar; span 3.28 to 4.42 bar	2			1	7															
Initial value 0.1 to 1.2 bar; span 4.42 to 5.94 bar	2			1	8															
Initial value 0.1 to 1.2 bar; span 5.94 to 8.00 bar	2			1	8															
Direction of action	Increasing/increasing																		1	
	Increasing/decreasing ¹⁾																		2	
Electrical connection	½ - 14 NPT																		1	
	M20x1.5																		2	
Pneumatic connection	Positioner attachment (without booster) ⁹⁾		0	6	0	1	1							0	0	0				
	¼ -18 NPT													1						
	ISO-228/1 - G ¼													2						
Degree of protection	Without (vent for positioner attachment)		0	6	0	1	1							0	0					
	IP 54													1						
	IP 65													2						
NEMA 4 ¹⁰⁾														3						
Output pressure gauge	Without															0				
	With ¹⁾															1				
Temperature range	T _{min} ≥ -25 °C (Type 6109, standard)	1																	0	
	T _{min} ≥ -45 °C (Type 6112, metal cable gland, subjected to a routine test)	2																	1	
	T _{min} ≥ -40 °C (Type 6112, standard)	2																	2	
Special version	Without																		0 0 0	
	IECEx approval, Ex d IIC T4/T5/T6 Gb (Type 6116-2)																		2 5 1	
	GOST approval, Ex ia or Ex d (Type 6116-1 or Type 6116-2)																		2 5 2	
	KCS approval, Korea (Type 6116-5)																		2 6 2	

¹⁾ Not for positioner attachment

²⁾ With degree of protection IP 54/IP 65 only

³⁾ Supply pressure max. 6 bar; output 5.6 bar

⁴⁾ Only with 0.2 to 1 bar/3 to 15 psi

⁵⁾ With ½ NPT electrical connection, degree of protection NEMA 4 or positioner attachment

⁶⁾ With ½ NPT electrical connection, degree of protection IP 65 or positioner attachment

⁷⁾ Without switch-off electronics and without potentiometer for zero point and span correction

⁸⁾ Specify setting range, e.g. "set to 0.1 to 4 bar"; output pressure max. 8 bar. Initial value raised to max. 3.0 bar (special version)

⁹⁾ Only with Ex d or explosion-proof according to CSA and FM standards

¹⁰⁾ Only explosion-proof or intrinsically safe according to CSA and FM standards

¹¹⁾ 4 to 12 mA and 12 to 20 mA input only up to 4.0 bar span

¹²⁾ Only with 0.2 to 1 bar (3 to 15 psi) and 0.4 to 2 bar (6 to 30 psi) output

Accessories	Order no.
Wall and pipe mounting	1400-6216
Mounting bracket (1.4301) for wall mounting	1400-7432
Mounting unit for Type 6116 in various versions	M6116
Attachment to Type 3766 ¹⁾	1400-6227
Attachment to Type 4765 ¹⁾	1400-6223
Attachment to Type 3760 ¹⁾	1400-6224
Mounting on cast yoke according to NAMUR ¹⁾	1400-6217
Mounting on rod-type yoke according to NAMUR ¹⁾	1400-6218
Male screw fitting G ¼ on hose with 4 mm inside diameter and 6 mm outside diameter, brass	8582-1452
Male screw fitting ¼ NPT on hose with 4 mm inside diameter and 6 mm outside diameter, brass	8582-1523
Cable gland M20x1.5, black polyamide (6 to 12 mm clamping range)	8808-1011
Cable gland M20x1.5, blue polyamide (6 to 12 mm clamping range)	8808-1012
Cable gland M20x1.5, nickel-plated brass (6 to 12 mm clamping range)	1890-4875
Cable gland M20x1.5, stainless steel 1.4305 (8 to 14.5 mm clamping range)	8808-0160
Cable gland ½ NPT, black polyamide (6 to 12 mm clamping range)	8808-0145
Cable gland ½ NPT, blue polyamide (6 to 12 mm clamping range)	8808-0146
Cable gland ½ NPT, nickel-plated brass (6 to 12 mm clamping range)	8808-0140
Vent plug G ¼, stainless steel 1.4305, IP 66 (–45 to +80 °C)	1790-7253
Vent plug G ¼, stainless steel 1.4305, NEMA 4 (–45 to +80 °C)	1790-9646

¹⁾ Only mounting part without assembly and without any possibly required piping. Order together with mounting unit (M6116).