AMS 3011
Miniaturized pressure transmitter with 0 .. 5 V output

FEATURES

- **Amplified pressure sensor with standardized 0 .. 5 V output**

- **Calibrated and temperature compensated**

- **Wide variety of pressure ranges: 25 mbar up to 10 bar**

- **Differential / gage, bidirectional differential, absolute and barometric versions**

- **Piezoresistive sensing element**

- **High precision digital signal conditioning**

- **High accuracy at room temperature**

- **Low overall error within a temperature range of -25 .. +85 °C**

- **Supply voltage range: 8 .. 36 V**

- **Robust and miniaturized metal package**

- **Pressure connection: M5 female thread**

- **Electrical connection: M5 sensor connector**

- **Simple and quick installation**

- **Dust- and water-tight (IP67)**

- **RoHS and REACH compliant**

GENERAL DESCRIPTION

AMS 3011 is a series of robust pressure transmitters in a matchbox-sized IP67 metal package. This series is suitable for high precision measurements in industrial indoor and outdoor applications as well as in medical instrumentation.

All sensors in this series provide an analog output signal of 0 .. 5 V and can be powered within a wide supply voltage range of $V_S = 8 .. 36\ V$. They are calibrated and temperature compensated in a wide temperature range of -25 .. +85°C.

AMS 3011 comes in a rugged metal package with M5 female threads for pressure connection. Using standard M5 pressure fittings like barbed ports, hose or push-in fittings a wide variety of pressure connections can be established. The sensor's electrical connection is realized with an M5 circular sensor connector. AMS 3011's package is dust- and water-tight conforming to IP67.

The pressure transmitters in the AMS 3011 series are available for various pressure types and ranges: differential (relative) devices in pressure ranges from 0 .. 50 mbar up to 0 .. 10 bar, absolute pressure variants for 0 .. 1 bar and 0 .. 2 bar as well as a barometric type for 0.7 .. 1.2 bar. Bidirectional-differential devices for measurement of positive and negative differential pressure are available from -25 .. +25 mbar up to -1 ..+1 bar.

Customized pressure ranges and output voltage ranges are available on request.

TYPICAL APPLICATIONS

- Static and dynamic pressure sensing

- Barometric pressure sensing

- Vacuum measurement

- Level measurement

- Medical instrumentation

- Indoor and outdoor measurement

- Pneumatic system monitoring

- Test benches

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PRESSURE RANGES

Pressure transmitter type (code)	Pressure type	Pressure range in mbar	Burst pressure[1] in bar	Pressure range in PSI	Burst pressure[1] in PSI
Low pressure					
AMS 3011-0050-D	differential / relative	0 .. 50	> 1	0 .. 0.725	> 15
AMS 3011-0100-D	differential / relative	0 .. 100	> 1	0 .. 1.450	> 15
AMS 3011-0025-D-B	bidirectional differential	-25 .. +25	> 1	-0.362 .. +0.362	> 15
AMS 3011-0050-D-B	bidirectional differential	-50 .. +50	> 1	-0.725 .. +0.725	> 15
AMS 3011-0100-D-B	bidirectional differential	-100 .. +100	> 1	-1.450 .. +1.450	> 15
Standard pressure					
AMS 3011-0200-D	differential / relative	0 .. 200	> 5	0 .. 2.901	> 72
AMS 3011-0350-D	differential / relative	0 .. 350	> 5	0 .. 5.076	> 72
AMS 3011-0500-D	differential / relative	0 .. 500	> 5	0 .. 7.251	> 72
AMS 3011-1000-D	differential / relative	0 .. 1000	> 5	0 .. 14.50	> 72
AMS 3011-0200-D-B	bidirectional differential	-200 .. +200	> 5	-2.901 .. +2.901	> 72
AMS 3011-0350-D-B	bidirectional differential	-350 .. +350	> 5	-5.076 .. +5.076	> 72
AMS 3011-1000-D-B	bidirectional differential	-1000 .. +1000	> 5	-14.50 .. +14.50	> 72
AMS 3011-1000-A	absolute	0 .. 1000	> 5	0 .. 14.50	> 72
AMS 3011-1200-B	barometric	700 .. 1200	> 5	10.15 .. 17.40	> 72
Medium pressure					
AMS 3011-2000-D	differential / relative	0 .. 2000	> 16	0 .. 29.01	> 232
AMS 3011-4000-D	differential / relative	0 .. 4000	> 16	0 .. 58.02	> 232
AMS 3011-7000-D	differential / relative	0 .. 7000	> 16	0 .. 101.52	> 232
AMS 3011-10000-D	differential / relative	0 .. 10000	> 16	0 .. 145.0	> 232
AMS 3011-2000-A	absolute	0 .. 2000	> 5	0 .. 29.01	> 72

Table 1: **AMS 3011 standard pressure ranges (other ranges on request)**

MAXIMUM RATINGS

Parameter	Minimum	Typical	Maximum	Units
Maximum supply voltage: $V_{S,max}$			36	V
Operating and storage temperature: T	-25		85	°C
Common mode pressure: p_{CM}[2]			16	bar

Table 2: **Maximum ratings**

Notes:

1) Burst pressure is defined as the maximum pressure, which can be applied to one pressure port relative to the other port (or while only one pressure port is connected) without causing damages / leaks.

2) Common mode pressure is defined as the maximum pressure, which can be applied simultaneously on both pressure ports of a differential or bidirectional transmitter without causing damages, while no differential pressure is applied.

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SPECIFICATIONS

All parameters apply to $V_S = 24\ V$, $T_{op} = 25°C$ and $R_L = 10\ k\Omega$, unless otherwise stated.

Parameter	Minimum	Typical	Maximum	Units
Analog output signal				
@ specified minimum pressure (see "pressure ranges")[1]	0	< 0.025	0.05	V
@ specified maximum pressure (see "pressure ranges")[1]		5		V
Full span output (FSO)[2]		5		V
without pressure (only bidirectional differential types)		2.5		V
Accuracy[3] @ $T_{op} = 25°C$				
Low pressure types (50, 100 mbar)		±0.5	±1.0	%FSO
Standard pressure types (200, 350, 500, 1000, 1200 mbar)		±0.5	±1.0	%FSO
Medium pressure types (> 1200 mbar)		±0.5	±1.0	%FSO
Overall error[4] @ $T_{op} = -25 .. 85°C$				
Low pressure types (50, 100 mbar)		±1.0	±2.0	%FSO
Standard pressure types (200, 350, 500, 1000, 1200 mbar)		±0.7	±1.5	%FSO
Medium pressure types (> 1200 mbar)		±0.7	±1.5	%FSO
Long term stability			< 0.5	%FSO/a
Nonlinearity[5]	-0.3	< 0.1	0.3	%FSO
Resolution analog output signal			0.05	%FSO
Supply voltage (V_S to GND)	8	24	36	V
Current consumption			5	mA
Response time (10% .. 90% rise time)		1	2	ms
Load resistor R_L	2			kΩ
Capacitive load			50	nF
Dependency of V_{OUT} on V_S [6]			< 0.1	%FSO
Pressure Changes	10^6			
Compensated operating temperature range T_{OP}	-25		85	°C
Weight without cable		45		gram
Package material	standard: hard-eloxed aluminum on request: stainless steel 316			
Media compatibility	See notes[7], [8]			
Protection classification[9]	IP67			

Table 3: **Specifications**

Specification Notes:

1) Pressure ranges are specified in *Table 1*.
2) The Full Span Output (FSO) is the algebraic difference between the output voltage at the specified minimum pressure and the output voltage at the specified maximum pressure (nominal FSO = 5 V).
3) The accuracy is defined as the maximum deviation of the measurement value from the ideal transfer function at room temperature (RT) in %FSO including the adjustment error (offset and span), nonlinearity, pressure hysteresis and repeatability. Nonlinearity is the measured deviation from the best fit straight line (BFSL) across the entire pressure range. Pressure hysteresis is the maximum deviation of the output value at any pressure within the specified range when the pressure is cycled to and from the specified minimum or maximum pressure. Repeatability is the maximum variation of the output value at any pressure within the specified range over 10 pressure cycles.

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4) The overall error is defined as the maximum deviation of the measurement value from the ideal transfer function in %FSO across the entire temperature range (-25 … 85 °C).

5) Defined as best fit straight line (BFSL).

6) The given value is the maximum deviation from the output voltage at $V_S = 24\ V$ over the complete supply voltage range at any pressure in the specified range. It is normalized to the FSO.

7) Media compatibility of pressure port 1 (for a description of port 1, see *Figure 3*): fluids and gases non-corrosive to ceramics, silicon, Pyrex, RTV silicone rubber, NBR rubber and package material (aluminum or stainless steel).

8) Media compatibility of pressure port 2 (for a description of port 2, see *Figure 3*): clean, dry gases, non-corrosive to ceramics, silicon, Pyrex, RTV silicone rubber, gold, tin, silver palladium, NBR rubber and package material (alkaline or acidic liquids can destroy AMS 3011).

9) With pressure and electrical connection established.
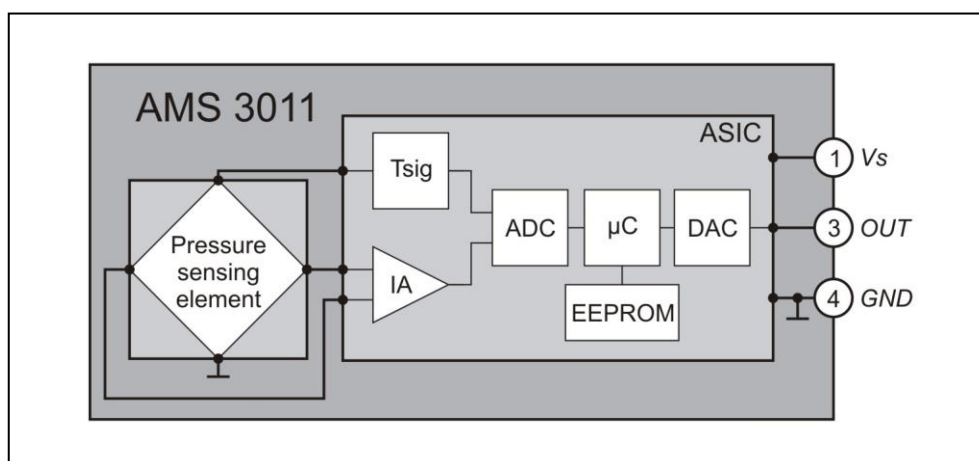
FUNCTIONAL DESCRIPTION

AMS 3011 combines a piezoresistive silicon chip and a mixed-signal integrated circuit (ASIC) on a ceramic substrate housed in a robust metal package. The piezoresistive silicon chip acts as pressure sensing element and the ASIC is used for amplification and signal-conditioning.

The physical pressure, which is applied to AMS 3011's pressure ports, is converted into a differential voltage signal by the sensing element. This differential voltage signal, which is almost proportional to the applied pressure, is converted into a standardized, temperature independent analog output voltage of $V_{OUT} = 0 .. 5\ V$ by the signal-conditioning ASIC.

The signal-conditioning is done in the following way (see *Figure 1*):
At first the sensing element's differential voltage signal is pre-amplified and converted into a digital signal using a 14-bit A/D converter (ADC). This digitized pressure signal is processed mathematically by the ASIC's integrated microcontroller unit. To achieve a calibrated and temperature compensated output signal the microcontroller unit uses individual correction coefficients and a mathematical correction algorithm, which are stored in the ASIC's EEPROM during AMS 3011's factory calibration process. The temperature value needed for the temperature compensation is measured directly at the piezoresistive sensing element, too. To obtain an analog output voltage the corrected digital signal is converted back into an analog voltage by an 11-bit D/A converter (DAC).

The standardized output voltage $V_{OUT} = 0 .. 5\ V$ (or $2.5\ V \pm 2.5\ V$ for bidirectional differential types) is a linear function of the applied pressure.[1] It is independent of the applied supply voltage.

Figure 1: **AMS 3011's block diagram**

[1] The applied pressure is the pressure difference between port 1 and port 2 for differential and bidirectional differential pressure transmitters. For relative pressure types it is the pressure difference between port 1 and ambient pressure and for absolute and barometric pressure types it is the pressure at port 2 (for the definition of ports see *Figure 3*).

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INITIAL OPERATION

The pressure transmitters of the series AMS 3011 can be screw mounted in a fast and easy way using the two integrated through bores (Ø 4.3 mm) at the sensor's metal package's edges.

The electrical connection is established using the integrated M5 circular sensor connector and a suitable cable with female M5 sensor connector (see "additional equipment"). Pin 1 (Vs) is directly connected to the power supply's positive output and pin 4 (GND) is connected to GND (see *Figure 2*). Pin 3 (OUT) can be connected to a voltmeter directly to measure the output signal voltage V_{OUT} (referenced to GND) or a load resistor R_L can be connected between pin 3 and GND and V_{OUT} can be measured parallel to R_L. The output voltage $V_{OUT} = 0 .. 5\ V$ at pin 3 is a linear function of the applied pressure and does not depend on the supply voltage. Please ensure that the supply voltage is in the specified range of 8 and 36 V and that the power supply is able to source at least 5 mA (for $R_L \geq 10\ k\Omega$)

The pressure connection is made using the package's M5 female thread pressure ports, where a multitude of pressure fittings can be connected (see "additional equipment"). Depending on the type of pressure transmitter and the application one or two of the pressure ports have to be connected to the measuring media/volume. For the pressures at AMS 3011's pressure ports the following requirements have to be fulfilled, wherein p_1 is the pressure at port 1 and p_2 is the pressure at port 2 (for port definition see *Figure 3*):

for differential pressure (type AMS 3011-XXXX-D): $p_1 > p_2$

for relative / gage pressure (type AMS 3011-XXXX-D): $p_1 > p_{ambient}$, $p_1 =$ measuring pressure

for bidirectional differential pressure (type AMS 3011-XXXX-D-B): $p_1 > p_2$ or $p_1 < p_2$ possible
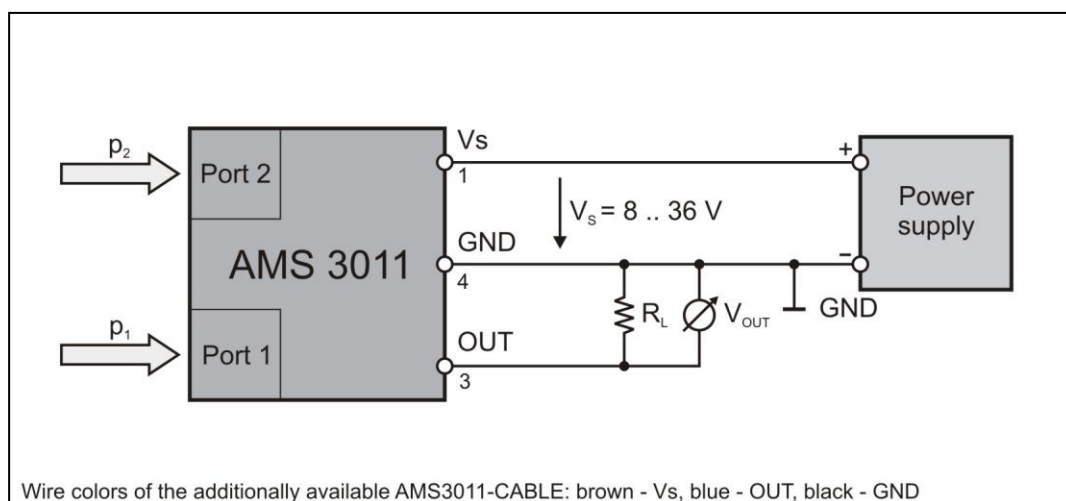
for absolute pressure (type AMS 3011-XXXX-A): $p_2 =$ measuring pressure

for barometric pressure (type AMS 3011-XXXX-B): $p_2 =$ measuring pressure

The maximum pressures (see *Table 1*) and the guidelines concerning media compatibility (see specification notes 7) and 8)) have to be taken into account.

AMS 3011's package is dust- and water-tight according to IP67. Please keep in mind that AMS 3011 is only dust- and watertight if the electrical and the pressure connections are established.

Wire colors of the additionally available AMS3011-CABLE: brown - Vs, blue - OUT, black - GND

Figure 2: Electrical connection of AMS 3011

DIMENSIONS AND PINOUT

Top view

35

25

Front view

2

3.8

4.5

4

25

Through bore
Ø 4.3

Bottom view

Port 2
M5x0.5

Port 1
M5x0.5

M5x0.5

12.5

10.6   10.2   14.2

Side view

12.5

6.5

25

25

Pinout (M5 circular sensor connector)

Pin 1: *Vs*
Pin 2: N.C.
Pin 3: *OUT*
Pin 4: *GND*

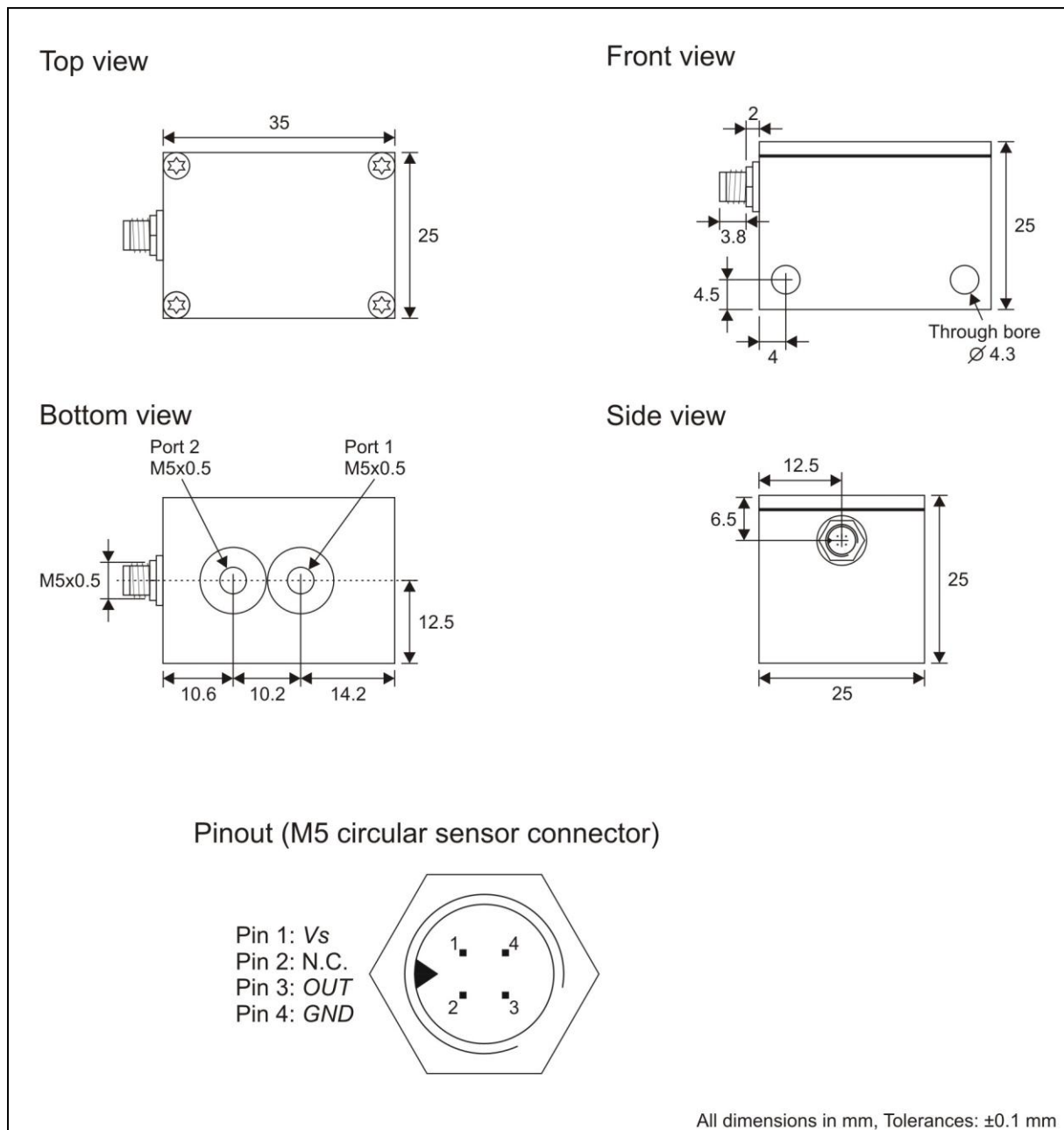1   4

2   3

All dimensions in mm, Tolerances: ±0.1 mm

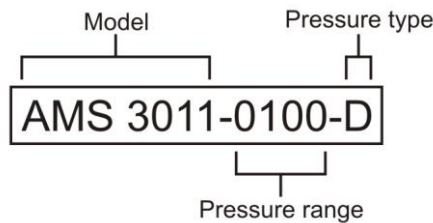*Figure 3:* **Dimensions and pinout of AMS 3011's package**

Notes:

1) For absolute and barometric pressure transmitters only port 2 is available.
2) The electrical connection is established using an M5 sensor connector series 707 from Binder GmbH.
3) For pressure connection Analog Microelectronics recommends the pressure fittings listed in "additional equipment".

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INFORMATION FOR ORDERING

Ordering code:

Pressure range:

Pressure range code	mbar	PSI	kPa
0025	25	0.362	2.5
0050	50	0.725	5
0100	100	1.450	10
0200	200	2.901	20
0350	350	5.076	35
0500	500	7.251	50
1000	1000	14.50	100
1200	1200	17.40	120
2000	2000	29.01	200
4000	4000	58.02	400
7000	7000	101.52	700
10000	10000	145.0	1000

Table 4: Pressure ranges

Pressure type:

Pressure type code		Available pressure ranges
D	differential / relative (gage)	0 .. 50 mbar to 0 .. 10000 mbar
D-B	bidirectional differential	-25 .. +25 mbar to -1000 .. +1000 mbar
A	absolute	0 .. 1000 mbar and 0 .. 2000 mbar
B	barometric (absolute)	700 .. 1200 mbar

Table 5: Pressure types

ADDITIONAL EQUIPMENT

ORDER NUMBER	DELIVERY FORM
AMS3011-CABLE	3-wire cable with mating M5 sensor connector (2 m long) wiring: brown – Vs, blue – OUT, black – GND

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Matching pressure fittings

ORDER NUMBER	DELIVERY FORM
AMS3011-Barb-3	M5 barbed fitting with Ø = 3 mm, type: Festo CN-M5-PK-3
AMS3011-Barb-4	M5 barbed fitting with Ø = 4 mm, type: SMC M-5AN-6
AMS3011-Hose-4	M5 hose nipple with cap nut for tubing with Ø = 2.4 / 4 mm, type: SMC M-5H-4
AMS3011-Hose-6	M5 hose nipple with cap nut for tubing with Ø = 4 / 6 mm, type: SMC M-5H-6
AMS3011-PushIn-3	Push-In fitting for tubing with $Ø_{OD}$ = 3 mm, type: Festo QSM-M5-3-I
AMS3011-PushIn-4	Push-In fitting for tubing with $Ø_{OD}$ = 4 mm, type: Festo QSM-M5-4-I
AMS3011-PushIn-6	Push-In fitting for tubing with $Ø_{OD}$ = 6 mm, type: Festo QSM-M5-6-I

NOTES

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