Pressure sensors

Pressure transmitters with casing (voltage output)

Series/Type: **CAU-T series**
Ordering code:

Date: 2009-08-03
Version: 3

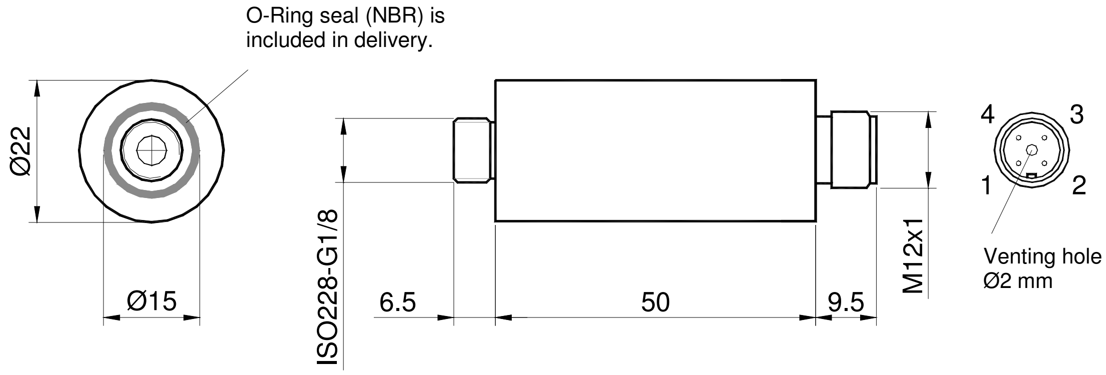
Description

- The transmitters are based on piezoresistive silicon pressure sensors from our own clean room.
- The T-series electronic compensates nonlinearity and temperature errors and supplies a precise calibrated output signal with a high immunity against electromagnetic influences (EMI).

Features

- Piezoresistive MEMS technology
- Measured media (absolute pressure):
  Air, non-aggressive gases (gas humidity 0 ... 85% r.h., without dew)
  Unsuitable for substances which react with glass, silicon, gold, aluminum, stainless steel, NBR, silicone glue or silicone gel.
- Measured media (gauge pressure):
  Air, non-aggressive gases (gas humidity 0 ... 100% r.h.) and non-aggressive fluids.
  Unsuitable for substances which react with glass, silicon, stainless steel, NBR, silicone glue ($p_r \leq 10$ bar) or epoxy glue ($p_r > 10$ bar).
- Voltage output proportional to pressure: 0.5 ... 4.5 V
- Reverse supply voltage protection
- RoHS-compatible, halogen-free
- Compact stainless steel casing (protection IP65) with G1/8" thread

Dimensional drawings



All dimensions in mm

A shielded 4-pole cable (2 m) with a modified (pressure equalization) female M12 locking plug is included in delivery.

Technical data

Absolute maximum ratings

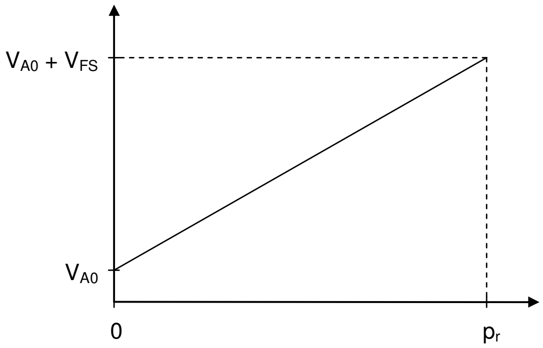
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Temperature ranges						
Storage temperature range	T_{st}	1)	–30		+85	°C
Operating temperature range	T_a	2)	–25		+85	°C
Compensated temperature range	T_c	3)	0		+70	°C
Soldering temperature (cable)	T_{solder}	<5 s (no reflow soldering)			+240	°C
Pressure ranges						
Overpressure	p_{ov}	4), 5)	1.5			p_r
Supply voltage /-current						
Supply voltage	V_{CC}	6)	7.5		30	V
Supply current	I_{CC}	$I_A = 0$			7	mA
Signal output current	I_A	7)			2	mA
Output signal at sensor failure	V_{ERR}				0.01	V
DC break down voltage	V_{is}	8)	500			V

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output signal @ T_a = 25 °C, V_{CC} = 15 V, I_A < 0.1 mA						
Offset	V_{A0}	Simple output AUA, AUR 9)	0.485	0.5	0.515	V
		Symmetrical output AUS 9)	2.485	2.5	2.515	V
Signal span (Full Scale)	V_{FS}	10)	3.985	4.0	4.015	V
Nonlinearity	L	Simple output 10), 11)		±0.1	±0.25	% FS
		Symmetrical output 10), 11)		±0.25	±0.5	% FS
Response time	$t_{10\text{-}90}$	12)		1		ms
Supply voltage rejection	SVR	10), 13)			±0.01	% FS/V

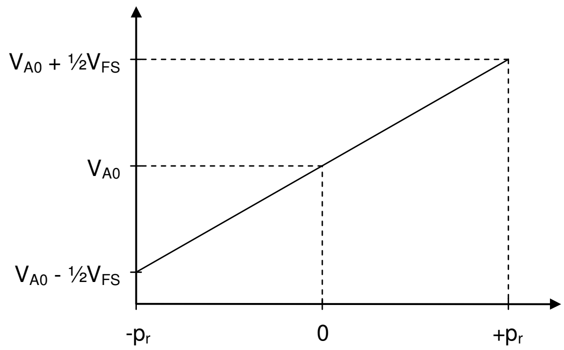
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Data in temperature range @ T_a = –25 ... 85 °C, V_{CC} = 15 V, I_A < 0.1 mA						
Temperature hysteresis		14)		±0.1	±0.5	% FS
Data in temperature range @ T_a = 0 ... 70 °C, V_{CC} = 15 V, I_A < 0.1 mA						
Temperature coefficient of offset	TCV_{A0}	p_r < 0.25 bar 15)		±0.015	±0.05	% FS/K
		p_r ≥ 0.25 bar 15)		±0.015	±0.03	% FS/K
Temperature coefficient of span	TCV_{FS}	16)		±0.015	±0.03	% FS/K

Characteristics

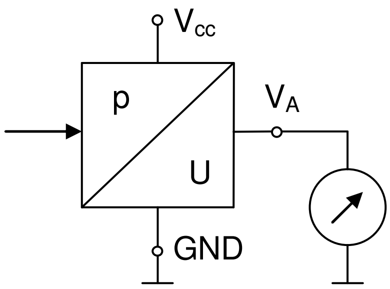
Simple output (AUA, AUR)



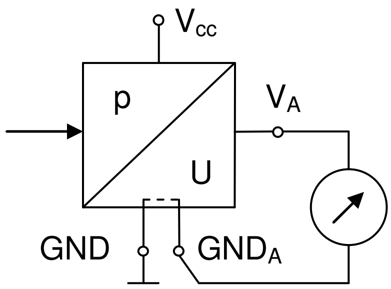
Symmetrical output (AUS)



Connection diagram



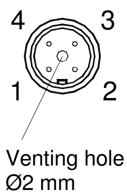
3-wire connection (standard)



4-wire connection (option for long cable)
GND and GND_A are internally connected. To avoid ground loops, it is not allowed to connect GND and GND_A at the end of the cable.

Terminal assignment

Electrical connection	Symbol	Pin (color)
Supply voltage	V_{cc}	1 (brown)
Ground	GND	3 (blue)
Output signal (referenced to GND)	V_A	2 (white)
Ground (Kelvin guidance)	GND_A	4 (black)



Rated pressures and ordering codes

Pressure measurement	Absolute					Gauge								Gauge, symmetrical			
Rated pressure p_r bar	1.000	2.500	6.000	10.00	25.00	0.100	0.250	0.400	1.000	2.500	6.000	10.00	25.00	0.100	0.250	0.400	1.000
Product type	AUA 1.000 F V4 TN H S2.0	AUA 2.500 F V4 TN H S2.0	AUA 6.000 F V4 TN H S2.0	AUA 10.00 F V4 TN H S2.0	AUA 25.00 F V4 TN H S2.0	AUR 0.100 F V4 TN H S2.0	AUR 0.250 F V4 TN H S2.0	AUR 0.400 F V4 TN H S2.0	AUR 1.000 F V4 TN H S2.0	AUR 2.500 F V4 TN H S2.0	AUR 6.000 F V4 TN H S2.0	AUR 10.00 F V4 TN H S2.0	AUR 25.00 F V4 TN H S2.0	AUS 0.100 F V4 TN H S2.0	AUS 0.250 F V4 TN H S2.0	AUS 0.400 F V4 TN H S2.0	AUS 1.000 F V4 TN H S2.0
Ordering code	B58620H5810A018	B58620H5810A019	B58620H5810A020	B58620H5810A021	B58620H5810A022	B58621H5810A023	B58621H5810A024	B58621H5810A025	B58621H5810A026	B58621H5810A027	B58621H5810A028	B58621H5810A029	B58621H5810A030	B58623H5810A031	B58623H5810A032	B58623H5810A033	B58623H5810A034

Other rated pressures upon request.

Symbols and terms

1) **Storage temperature range T_{st}**
A storage of the pressure sensor within the temperature range $T_{st,min}$ up to $T_{st,max}$
and without applied pressure and supply voltage will not affect the performance of the pressure sensor.

2) **Operating temperature range T_a**
An operation of the pressure sensor within the temperature range $T_{a,min}$ up to $T_{a,max}$
will not affect the performance of the pressure sensor.

3) **Compensated temperature range T_c**
While operating the pressure sensor within the temperature range $T_{c,min}$ up to $T_{c,max}$,
the deviation of the output signal from the values at 25 °C will not exceed the temperature coefficients.
Out of the compensated temperature range, the deviations may increase.

4) **Rated pressure p_r**
Within the rated pressure range 0 up to p_r (symmetrical output: $-p_r$ up to $+p_r$) the signal output characteristic corresponds to this specification.

5) **Overpressure p_{OV}**
Pressure cycles within the pressure range 0 up to p_{ov} will not affect the performance of the pressure sensor.

6) **Supply voltage V_{CC}**
$V_{CC,max}$ is the maximum permissible supply voltage, which can be applied without damages.
$V_{CC,min}$ is the minimum required supply voltage, which has to be applied for normal operation.

7) **Signal output current I_A**
$I_{A.max}$ is the maximum permissible sink current of the signal output.
Exceeding (e.g. short circuit) may cause irreparable damages.

8) **DC break down voltage V_{is}**
The pressure sensor withstands a high voltage between the stainless steel casing and the electrical connection V_{CC}, V_A and GND (all short circuited) without damage.

9) **Offset V_{A0}**
The offset V_{A0} is the signal output $V_A(p = 0)$ at zero pressure.

10) **Signal span (Full Scale)**
Simple output: $V_{FS} = FS = V_A(p_r) - V_{A0}$
Symmetrical output: $V_{FS} = FS = V_A(+p_r) - V_A(-p_r)$

11) **Nonlinearity L (including pressure hysteresis)**
The nonlinearity is the deviation of the real sensor characteristic $V_A = f(p)$ from the ideal straight line.
It can be approximated by a polynomial of second order, with the maximum at $p_x = p_r / 2$.
The equation to calculate the nonlinearity is:

$$L = \frac{V_A(p_x) - V_{A0}}{V_A(p_r) - V_{A0}} - \frac{p_x}{p_r}$$

12) **Response time $t_{10\text{-}90}$**
Delay between a pressure change (10 ... 90% p_r) and the corresponding signal output change (10 ... 90% FS).

13) **Supply voltage rejection SVR**
While varying the supply voltage within the range $V_{CC,min}$ up to $V_{CC,max}$ at constant pressure and temperature,
the signal output change will not exceed SVR_{max}.

14) **Temperature hysteresis**
The temperature hysteresis is the change of offset, starting from the value at 25 °C after a temperature change
and return to 25 °C. Determined during temperature cycles in operating temperature range (cycles with 1 K/min).

15) **Temperature coefficient of offset TCV_{A0}**
Offset at temperature T_x: $V_{A0}(T_x) = V_{A0}(25\ °C) + V_{FS}(25\ °C) \cdot (T_x - 25\ °C) \cdot TCV_{A0}$
Values are valid within the compensated temperature range $T_{c,min}$ up to $T_{c,max}$
Out of the compensated temperature range, the deviation may increase.

16) **Temperature coefficient of span TCV_{FS}**
Span at temperature T_x: $V_{FS}(T_x) = V_{FS}(25\ °C) \cdot [\ 1 + (T_x - 25\ °C) \cdot TCV_{FS}\ ]$
Values are valid within the compensated temperature range $T_{c,min}$ up to $T_{c,max}$
Out of the compensated temperature range, the deviation may increase.

Cautions and warnings

Storage (general)

All pressure sensors should be stored in their original packaging. They should not be placed in harmful environments such as corrosive gases nor exposed to heat or direct sunlight, which may cause deformations. Similar effects may result from extreme storage temperatures and climatic conditions. Avoid storing the sensor dies in an environment where condensation may form or in a location exposed to corrosive gases, which will adversely affect their performance. Plastic materials should not be used for wrapping/packing when storing or transporting these dies, as they may become charged. Pressure sensor dies should be used soon after opening their seal and packaging.

Operation (general)

Media compatibility with the pressure sensors must be ensured to prevent their failure. The use of other media can cause damage and malfunction. Never use pressure sensors in atmospheres containing explosive liquids or gases.

Ensure pressure equalization to the environment, if gauge pressure sensors are used. Avoid operating the pressure sensors in an environment where condensation may form or in a location exposed to corrosive gases. These environments adversely affect their performance.

If the operating pressure is not within the rated pressure range, it may change the output characteristics. This may also happen with pressure sensor dies if an incorrect mounting method is used. Be sure that the applicable pressure does not exceed the overpressure, as it may damage the pressure sensor.

Do not exceed the maximum rated supply voltage nor the rated storage temperature range, as it may damage the pressure sensor.

Temperature variations in both the ambient conditions and the media (liquid or gas) can affect the accuracy of the output signal from the pressure sensors. Be sure to check the operating temperature range and thermal error specification of the pressure sensors to determine their suitability for the application.

Connections must be wired in accordance with the terminal assignment specified in the data sheets. Care should be taken as reversed pin connections can damage the pressure transmitters or degrade their performance. Contact between the pressure sensor terminals and metals or other materials may cause errors in the output characteristics.

Design notes (dies)

This specification describes the mechanical, electrical and physical requirements of a piezoresistive sensor die for measuring pressure. The specified parameters are valid for the pressure sensor die with pressure application either to the front or back side of the diaphragm as described in the data sheet. Pressure application to the other side may result in differing data. Most of the parameters are influenced by assembly conditions. Hence these parameters and the reliability have to be specified for each specific application and tested over its temperature range by the customer.

Handling/Mounting (dies)

Pressure sensor dies should be handled appropriately and not be touched with bare hands. They should only be picked up manually by the sides using tweezers. Their top surface should never be touched with tweezers. Latex gloves should not be used for handling them, as this will inhibit the curing of the adhesive used to bond the die to the carrier. When handling, be careful to avoid cuts caused by the sharp-edged terminals. The sensor die must not be contaminated during manufacturing processes (gluing, soldering, silk-screen process).

The package of pressure sensor dies should not to be opened until the die is mounted and should be closed after use. The sensor die must not be cleaned. The sensor die must not be damaged during the assembly process (especially scratches on the diaphragm).

Soldering (transducers, transmitters)

The thermal capacity of pressure sensors is normally low, so steps should be taken to minimize the effects of external heat. High temperatures may lead to damage or changes in characteristics.

A non-corrosive type of flux resin should normally be used and complete removal of the flux is recommended. Avoid rapid cooling due to dipping in solvent. Note that the output signal may change if pressure is applied to the terminals during soldering.

This listing does not claim to be complete, but merely reflects the experience of EPCOS AG.

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