Pressure sensors

AEA xx.xx C32/2 F00 G08 N

<table>
<thead>
<tr>
<th>Series/Type:</th>
<th>Absolute pressure sensor die</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordering code:</td>
<td></td>
</tr>
<tr>
<td>Date:</td>
<td>2017-12-07</td>
</tr>
<tr>
<td>Version:</td>
<td>4</td>
</tr>
</tbody>
</table>

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EPCOS AG is a TDK Group Company.
Pressure sensors

Applications

- Medical devices
- Automotive
- Automation

Features

- Piezoresistive MEMS technology
- Small dimensions: 1.65 × 1.65 mm
- Square diaphragm
- Absolute pressure measuring
- Measured media (front side): Non-aggressive gases and fluids.
- Wheatstone bridge with mV output, ratiometric to supply voltage
- Rated pressure ranges 1.6 up to 40 bar
- Outstanding long-term stability

Delivery mode

- Tray

Dimensional drawings
**Pressure sensors**

**AEA xx.xx C32/2 F00 G08 N** Absolute pressure sensor die

### Technical data

#### Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum supply voltage</td>
<td>$V_{DD}$</td>
<td>Without damage $^1$</td>
<td></td>
<td></td>
<td>10</td>
<td>V</td>
</tr>
<tr>
<td><strong>Temperature ranges</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>$T_a$</td>
<td>$^2$</td>
<td>−40</td>
<td>135</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>$T_{st}$</td>
<td>$^3$</td>
<td>−40</td>
<td>150</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td><strong>Pressure ranges</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating pressure ranges</td>
<td>$p_r$</td>
<td>Absolute pressure $^4$</td>
<td>1.6</td>
<td>25</td>
<td></td>
<td>bar</td>
</tr>
<tr>
<td>Over pressure</td>
<td>$p_{ov}$</td>
<td>Absolute pressure $^5$</td>
<td>3</td>
<td></td>
<td>$p_r$</td>
<td></td>
</tr>
<tr>
<td>Burst pressure</td>
<td>$p_{burst}$</td>
<td>Absolute pressure $^6$</td>
<td>5</td>
<td></td>
<td>$p_r$</td>
<td></td>
</tr>
</tbody>
</table>

#### Electrical specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic discharge</td>
<td>HBM</td>
<td>(AEC-Q100-00Z-REV-D)</td>
<td>1000</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td><strong>Supply voltage / bridge resistance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating supply voltage</td>
<td>$V_{DD}$</td>
<td>$^7$</td>
<td>1.0</td>
<td>5.0</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Total bridge resistance</td>
<td>$R_b$</td>
<td>@ 25 °C $^8$</td>
<td>2.6</td>
<td>4.0</td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>Temperature coefficient of total bridge resistance</td>
<td>$\alpha_{R_b}$</td>
<td>$^9$</td>
<td>2.0</td>
<td>2.7</td>
<td>$10^{-3}$/K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\beta_{R_b}$</td>
<td>$^9$</td>
<td>0</td>
<td>8</td>
<td>$10^{-6}$/K</td>
<td></td>
</tr>
<tr>
<td><strong>Output signal @ $V_{DD} = 5$ V</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offset</td>
<td>$V_o$</td>
<td>@ 25 °C $^{10}$</td>
<td>−30</td>
<td>30</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>$S$</td>
<td>@ 25 °C $^{11}$</td>
<td></td>
<td></td>
<td></td>
<td>mV/ bar</td>
</tr>
<tr>
<td>Temperature coefficient of offset</td>
<td>$T_{CVo+}$</td>
<td>Unglued $^{11}$</td>
<td></td>
<td></td>
<td></td>
<td>µV/V/K</td>
</tr>
<tr>
<td></td>
<td>$T_{CVo-}$</td>
<td>See next table</td>
<td></td>
<td></td>
<td></td>
<td>µV/V/K</td>
</tr>
<tr>
<td>Temperature coefficient of the sensitivity</td>
<td>$\alpha_S$</td>
<td>$^{15}$</td>
<td>−2.5</td>
<td>−2.2</td>
<td>$10^{-3}$/K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\beta_S$</td>
<td>$^{16}$</td>
<td>0</td>
<td>8</td>
<td>$10^{-6}$/V$^2$</td>
<td></td>
</tr>
<tr>
<td>Pressure hysteresis</td>
<td>pHys</td>
<td></td>
<td>−0.1</td>
<td>0.1</td>
<td></td>
<td>% FS</td>
</tr>
</tbody>
</table>

**Long-term stability (Full scale normal output FSON = 120 mV)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature hysteresis of offset</td>
<td>$THV_0$</td>
<td>$^{17}$</td>
<td>−0.2</td>
<td>±0.1</td>
<td>0.2</td>
<td>% FSON</td>
</tr>
<tr>
<td>Temperature cycle drift of offset</td>
<td>$TCDV_0$</td>
<td>$^{17}$</td>
<td>−0.1</td>
<td>±0.05</td>
<td>0.1</td>
<td>% FSON</td>
</tr>
<tr>
<td>High temperature drift of offset</td>
<td>$HTDV_0$</td>
<td>$^{17}$</td>
<td>−0.25</td>
<td>±0.05</td>
<td>0.25</td>
<td>% FSON</td>
</tr>
<tr>
<td>Long term stability of offset</td>
<td>$LTSV_0$</td>
<td>$^{17}$</td>
<td>−0.3</td>
<td>±0.1</td>
<td>0.3</td>
<td>% FSON</td>
</tr>
</tbody>
</table>
# Pressure sensors

**AEA xx.xx C32/2 F00 G08 N**

## Absolute pressure sensor die

### Operating pressures and ordering codes

<table>
<thead>
<tr>
<th>Parameter @ 25 °C, $V_{DD} = 5$ V</th>
<th>Symbol</th>
<th>Typ.</th>
<th>Typ.</th>
<th>Typ.</th>
<th>Typ.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating pressure 4)</td>
<td>$p_r$</td>
<td>1.6</td>
<td>4</td>
<td>10</td>
<td>25</td>
<td>bar</td>
</tr>
<tr>
<td>Temperature coefficient of offset [min/typ/max]</td>
<td>$TCV_0^-$</td>
<td>-4/8/20</td>
<td>-12/0/12</td>
<td>μV/V/K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonlinearity 14) [typ/max]</td>
<td>L</td>
<td>±0.2/±0.3</td>
<td>±0.2/±0.3</td>
<td>±0.2/±0.3</td>
<td>±0.2/±0.3</td>
<td>% FS 12)</td>
</tr>
<tr>
<td>Sensitivity 13) [min/typ/max]</td>
<td>S</td>
<td>45/70/95</td>
<td>23/30/38</td>
<td>9/12/15</td>
<td>3.6/4.8/6</td>
<td>mV/bar</td>
</tr>
<tr>
<td>Burst pressure 6) [min]</td>
<td>$p_{burst}$</td>
<td>8</td>
<td>20</td>
<td>50</td>
<td>125</td>
<td>bar</td>
</tr>
</tbody>
</table>

**Product type**

- AEA 1.600 C32/2 F00 G08 N
- AEA 4.000 C32/2 F00 G08 N
- AEA 10.00 C32/2 F00 G08 N
- AEA 25.00 C32/2 F00 G08 N

**Ordering code**

**Delivery form on tape**

- B5860E0324B497
- B5860E0326B497
- B5860E03215B497
- B5860E03245B497

**Ordering code**

**Delivery in tray**

- B5860H800A001
- B5860H800A002
- B5860H800A003
- B5860H800A004

Other operating pressures upon request.

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BL TPS PS PD SD  
2017-12-07

Please read **Cautions and warnings** and **Important notes at the end of this document.**
Symbols and Terms

1) Maximum power supply V_{DD}
   This is the maximal allowed voltage, which may be applied to the piezoresistive bridge circuit without damage.

2) Operating temperature range T_\text{a}
   This is the operating Temperature range T_{a,min} to T_{a,max}. Because most of the sensor parameters depend on assembling conditions like gluing, wire bonding etc, the die has to be tested over the operating temperature range by the customer fully assembled. For design verification and process control samples, mounted on TO39 base are tested over the temperature range of T_{min} to T_{max}.

3) Storage temperature range T_\text{st}
   If the pressure sensor dies are stored in the temperature range T_{st,min} to T_{st,max} without applied voltage power supply, this will not affect the performance of the pressure sensor dies.

4) Operating pressure range p_\text{r}
   In the operating pressure range 0 to p_{r,max} the pressure sensor die output characteristic is as defined in this specification.

5) Over pressure p_{OV}
   Pressure cycles in the pressure range 0 to p_{OV} do not affect the performance of the pressure sensor dies.

6) Burst pressure p_{burst}
   Up to the burst pressure p_{burst} the diaphragm of the sensor die will not be destroyed mechanically. This parameter is tested at room temperature on samples mounted on an aluminium socket by applying the specified burst pressure for 30 seconds. The evaluation of this test is done by optical inspection of the diaphragm. Since the burst pressure depends on several assembling conditions, this parameter has to be verified by the customer with his assembling possibilities.

7) Operating power supply V_{DD}
   The pressure sensor parameters are defined for a power supply voltage of V_{DD} = 5 V. In the operating power supply voltage range V_{DD,min} to V_{DD,max} the ratiometric parameters r(V_{DD}) like sensitivity, offset voltage and the temperature coefficient of the offset voltage are defined by:
   \[
   r(V_{DD}) = r(5[V]) \frac{V_{DD}}{5[V]}
   \]

8) Total bridge resistance R_b
   The total bridge resistance is defined between pad X5 and X2, (see the dimensional drawing in this data sheet) of the closed piezoresistive bridge circuit. The total bridge resistance is in a good approximation the output impedance of the piezoresistive bridge circuit. This parameter is tested completely on a wafer (wafer level test measurement).

9) Temperature coefficients of resistance \alpha_{Rb} and \beta_{Rb}:
   The temperature coefficients of resistance are tested for design verification on samples, mounted on a TO39 base over the temperature range T_{min} to T_{max} with T_{R} = 25 °C.
   The temperature coefficients of first and second order are defined with the polynomial:
   \[
   R_b(T) = R_b(T = 25\degree C)[1 + \alpha_{Rb}(T - 25\degree C) + \beta_{Rb}(T - 25\degree C)^2]
   \]
   The coefficients \alpha_{Rb} and \beta_{Rb} are calculated using the three measurement points of R_b(T) at T_{meas,min}, T_{R} and T_{meas,max}.

10) Offset voltage V_o
    The offset voltage V_o is the output voltage V_{out}(p = 0 bar abs) at zero absolute pressure and for a bridge voltage power supply V_{DD} = 5 V. Before anodic glass bonding the offset voltage is tested completely on a wafer (wafer level test measurement) with limits -25 mV < V_o < 25 mV.
    For design verification V_o is measured on samples, mounted on a TO39 base by extrapolating the output characteristic to zero bar. Since the offset voltage depends on several assembling conditions, this parameter has to be verified by the customer with his assembling possibilities.

11) Temperature coefficients of offset voltage TCV_o
    The temperature coefficients of offset voltage are defined for a bridge voltage power supply V_{DD} = 5 V. These parameters strongly depend on assembly conditions like gluing, wire bonding etc.
    The temperature coefficients of offset voltage are tested for design verification on samples, mounted on a TO39 over the temperature range T_{min} to T_{max}. Therefore TCV_o and TCV_\text{Vo} are defined for the measurement temperature range by:
    \[
    TCV_o^+ = \frac{V_o(T_{min} - V_o(25\degree C))}{T_{max} - 25\degree C} \quad TCV_o^- = \frac{V_o(T_{max} - V_o(25\degree C))}{T_{min} - 25\degree C}
    \]
    Since the TCV_o depends on several assembling conditions, this parameter has to be verified by the customer with his assembling possibilities.
Pressure sensors

12) Full scale value FS

\[ FS = V_{out}(p_{r\ max}) - V_0 \]

13) Sensitivity S

The sensitivity is defined for a bridge voltage power supply \( V_{DD} = 5 \) V. It can be determined by the formula:

\[ S = \frac{V_{out}(p_{r\ max}) - V_0}{p_{r\ max}} \]

This parameter is tested for process control on samples, mounted on a TO39 base.

14) Nonlinearity L

This parameter may be influenced by assembly.

The nonlinearity is measured using the endpoint method. Assuming a characteristic, this can be approximated by a polynomial of second order, where the maximum is at \( p_x = \frac{p_{r\ max}}{2} \). The nonlinearity is defined at \( p_x = \frac{p_{r\ max}}{2} \), using the equation:

\[ L = \frac{V_{out}(p_x) - V_0}{V_{out}(p_{r\ max}) - V_0} - \frac{p_x}{p_{r\ max}} \]

This parameter is tested for process control on samples, mounted on a TO39 base.

15) Temperature coefficient of sensitivity \( \alpha_S \) and \( \beta_S \):

These parameters may be influenced by assembly.

The temperature coefficients of sensitivity are tested for design verification on samples, mounted on a TO39 base over the temperature range \( T_{\ min} \) to \( T_{\ max} \) with \( T_R = 25 \) °C.

The temperature coefficients of first and second order are defined with the polynomial:

\[ S(T) = S(T = 25^\circ C)[1 + \alpha_S(T - 25^\circ C) + \beta_S(T - 25^\circ C)^2] \]

The coefficients \( \alpha_S \) and \( \beta_S \) are calculated using the three measurement points of \( S(T) \) at \( T_{\ meas,\ min} \), \( T_R \) and \( T_{\ meas,\ max} \).

16) Pressure hysteresis \( p_{\ Hys} \)

The pressure hysteresis is the difference between output voltages at constant pressure and constant temperature while applying a pressure cycle with pressure steps of \( p_{r\ min} \), \( p_1 \), \( p_2 \), \( p_3 \), \( p_{r,\ max} \), \( p_3 \), \( p_2 \), \( p_1 \), \( p_{r,\ min} \):

\[ p_{\ Hys} = \frac{V_{out,2}(p_k) - V_{out,1}(p_k)}{FS} \]

With \( k = \min, 1, 2, 3, \ max \). The pressure steps are: \( p_{\ min} = 0 \), \( p_1 = 0.25p_{r,\ max} \), \( p_2 = 0.5p_{r,\ max} \), \( p_3 = 0.75p_{r,\ max} \), \( p_{r,\ max} \).

This parameter is tested for design verification on samples, mounted on a TO39 base. Since the \( p_{\ Hys} \) depends on several assembling conditions, this parameter has to be verified by the customer with his assembling possibilities.

17) Reliability data

For long-term stability of offset voltage \( LTV_0 \) please refer to the defined Aktiv Sensor's standard AS100001 in chapter "Reliability data" on the internet. Since the \( LTV_0 \) depends on several assembling conditions, this parameter has to be verified by the customer with his assembling possibilities.
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 above the rated overpressure 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).
Pressure sensors
AEA xx.xx C32/2 F00 G08 N Absolute pressure sensor die

Storage conditions
Used materials for storage should be ESD protective according to JESD625, non-outgassing, and chemically stable. Furthermore, the following storage conditions should be preserved:

1. Storage in cabinets (if shipment package is opened):
   a. Atmosphere: inert gas, dry air or dry nitrogen
   b. Temperature range (in cabinet): 20±3 °C
   c. Relative humidity range (in cabinet): < 40 %
   d. Particle count (in cabinet): Class 6 per ISO 14644:1999 (equivalent FED STD 209E Class 1000)
   e. Shelf life under these conditions: 24 months for deliveries in trays
   f. Shelf life under these conditions: 12 months for deliveries on tape

2. Storage in containers (if shipment package is sealed):
   a. Sealed as delivered or backfilled with inert gas, dry air or dry nitrogen and re-sealed
   b. Temperature range: 20±3 °C
   c. Relative humidity range: < 50 %
   d. Particle count (during backfill): Class 6 per ISO 14644:1999 (equivalent FED STD 209E Class 1000)
   e. Shelf life under these conditions: 12 months for deliveries in trays
   f. Shelf life under these conditions: 6 months for deliveries on tape

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

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2. We also point out that in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.

3. The warnings, cautions and product-specific notes must be observed.

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