EPCOS Product Brief 2017

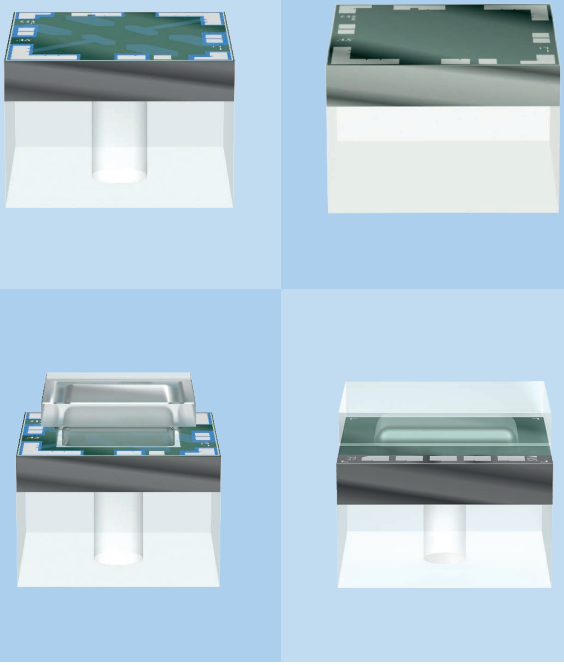
Pressure Sensor Dies

For Industrial and Automotive Applications, 1.65 × 1.65 mm Dies

The C32/ C38 pressure dies with their 1.65 × 1.65 mm footprint can be used for a wide range of pressures and fulfill many requirements of various automotive and industrial applications. The dies are available in various types for absolute and gauge sensing and with a single side or all around bond pad layout. Its robust design ensures high signal stability over a long lifetime and offers a simplified packaging.

Features

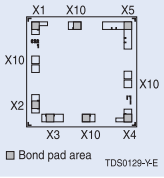
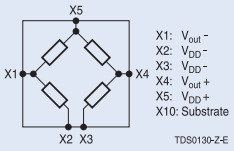
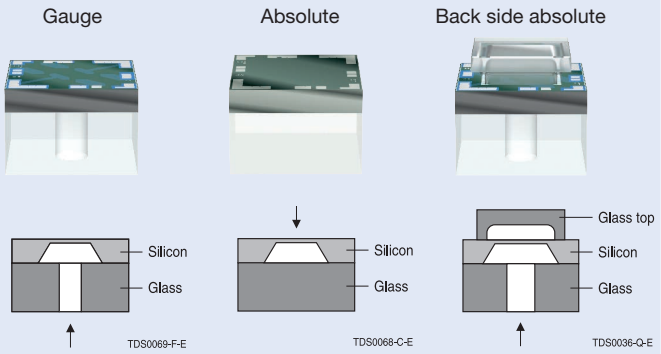
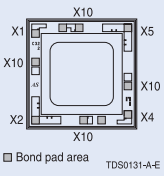
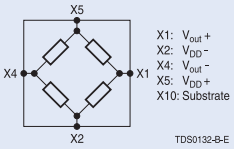
- Piezoresistive MEMS technology
- Rated pressure range of 0.4 bar to 40 bar
- Small dimensions: 1.65 × 1.65 × 1.1 mm
- Wheatstone bridge with mV output, ratiometric to supply voltage
- Outstanding high long-term stability
- Electrical shield on front side
- Gauge or absolute measurement



Pressure Sensor Dies
C32, Standard Dies

Features

- Pressure measurement: gauge, absolute and back side absolute
- 0.4 – 25 bar, 40 bar for front side application
- High signal stability
- Outstanding long-term stability
- Measurement media: non-aggressive gases and fluids
- Gold bond pads available

	Layout	Circuit diagram	Cross-section
Open bridge			
Closed bridge			

Technical data

	Symbol	Conditions	Minimum	Typical	Maximum	Unit
Temperature maximum ratings						
Operating temperature range	T_a	[1]	–40	–	135	°C
		For t < 15 min	–40	–	140	°C
Electrical specifications @ V_{DD} = 5 V						
Total bridge resistance	R_b	@ 25 °C [2]	2.6	3.3	4.0	kΩ
Temperature coefficient of total bridge resistance	α_{Rb}	@ 25 °C [3]	2.0	2.3	2.7	10^{-3}/K
	β_{Rb}		0	5.0	8.0	$10^{-6}/K^2$
Temperature coefficient of the sensitivity	α_S	@ 25 °C [4]	–2.5	–2.2	–1.9	10^{-3}/K
	β_S		0	5.0	8.0	$10^{-6}/K^2$
Pressure hysteresis	pHys	[5]	–0.1	–	0.1	% FSON
Long-term stability of offset (Full scale normal output FSON = 100 mV)	$LTSV_0$	[6]	–0.3	±0.1	0.3	% FSON

Rated pressure @ 25 °C, V_{DD} = 5 V

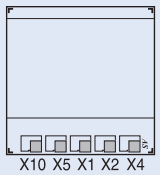
		Operating pressure [7]	Nonlinearity [8]	Sensitivity [9]
Symbol, Unit		p_r, bar	L, % FS	S, mV/bar
Ordering codes				
Gauge	**Absolute**		typ./ max.	min./ typ./ max.
Closed bridge				
B58601H8000A035	B58600H8400A037	1.6	±0.2/±0.3	45/70/95
B58601H8000A033	B58600H8400A039	4.0	±0.2/±0.3	23/30/38
B58601H8000A036	B58600H8400A038	10.0	±0.2/±0.3	9/12/15
B58601H8000A034	B58600H8400A040	25.0	±0.2/±0.3	3.6/4.8/6
Open bridge				
B58601E3224B615	B58600E3224B615	1.6	±0.2/±0.3	45/70/95
B58601E3264B615	B58600E3264B615	4.0	±0.2/±0.3	23/30/38
B58601E3284B615	B58600E3284B615	6.0	±0.2/±0.3	15/20/25
B58601E3215B615	B58600E3215B615	10.0	±0.2/±0.3	9/12/15
B58601E3225B615	B58600E3225B615	16.0	±0.2/±0.3	5.6/7.5/9.4
B58601E3245B615	B58600E3245B615	25.0	±0.2/±0.3	3.6/4.8/6
B58601E3265B615	B58600E3265B615	40.0	±0.2/±0.3	2.2/3/3.8
Closed bridge, low pressure sensors – other pressure ranges upon request				
B58601E3263B145		0.4	±0.4/±0.7	160/215/270
Open bridge, low pressure sensors				
B58601E3263B615		0.4	±0.4/±0.7	160/215/270
B58601E3214B615		1.0	±0.4/±0.7	130/160/190

Pressure Sensor Dies
C38, Standard Dies

Features

- For backside application (gauge and absolute)
- High burst pressure
- Single side bond pads for direct die to ASIC wire bonding
- High signal stability
- Outstanding long-term stability
- Measurement media non-aggressive gases and fluids
- Gold bond pads available

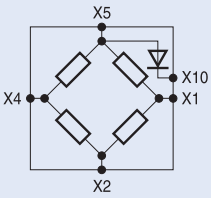
Layout



Bond pad area

TDS0133-C-E

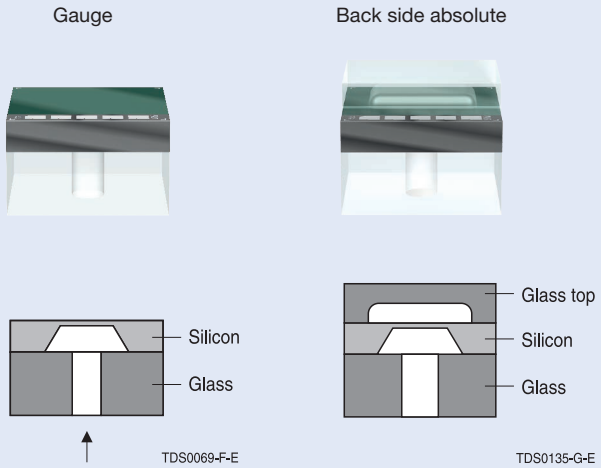
Circuit diagram



X1: $V_{out}+$
X2: $V_{DD}-$
X4: $V_{out}-$
X5: $V_{DD}+$
X10: Substrate/ Shield

TDS0134-F-E

Cross-section



TDS0069-F-E

TDS0135-G-E

Technical data

	Symbol	Conditions	Minimum	Typical	Maximum	Unit
Temperature maximum ratings						
Operating temperature range	T_a	[1]	–40	–	135	°C
		For t < 15 min	–40	–	140	°C
Electrical specifications @ V_{DD} = 5 V						
Total bridge resistance	R_b	@ 25 °C [2]	3.4	4.0	4.6	kΩ
Temperature coefficient of total bridge resistance	α_{Rb}	@ 25 °C [3]	2.0	2.3	2.7	10^{-3}/K
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Long-term stability of offset (Full scale normal output FSON = 100 mV)	$LTSV_0$	[6]	–0.3	±0.1	0.3	% FSON

Rated pressure @ 25 °C, V_{DD} = 5 V				
		Operating pressure [7]	**Nonlinearity [8]**	**Sensitivity [9]**
Symbol		p_r	L	S
Unit		bar	% FS	mV/bar
Ordering codes				
Gauge	**Absolute**		typ./ max.	min./ typ./ max.
B58601E3815B650	B58600E3815B650	10	±0.2/±0.3	1.4/2/3.3
B58601E3845B650	B58600E3845B650	25	±0.2/±0.3	0.8/1/1.2

Symbols and Terms

1) Operating temperature range T_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 in AK transducer package (AK2 series) are tested over a reduced measuring temperature range of $T_{meas,min}$ to $T_{meas,max}$.

2) Total bridge resistance R_S
The total bridge resistance is defined between pad X5 and X2, (see the dimensional drawing in the 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).

3) Temperature coefficients of resistance α_{Rb} and β_{Rb}:
The temperature coefficients of resistance are tested for design verification on samples, mounted on AK transducer package (AK2 series) over a 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:

$$R_b(T) = R_b(T = 25\ °C)\left[1 + \alpha_{Rb}(T - 25\ °C) + \beta_{Rb}(T - 25\ °C)^2\right]$$

The coefficients α_{Rb} and β_{Rb} are calculated using the three measurement points of $R_b(T)$ at T_{min}, T_R and T_{max}.

4) Temperature coefficients of sensitivity α_S and β_S:
These parameters may be influenced by assembly.
The temperature coefficients of sensitivity are tested for design verification on samples, mounted on AK transducer package (AK2 series) over a 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:

$$S(T) = S(T = 25\ °C)\left[1 + \alpha_S(T - 25\ °C) + \beta_S(T - 25\ °C)^2\right]$$

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

5) Pressure hysteresis pHys
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, $p_{r,min}$:

$$pHys = \frac{V_{out,2}(p_k) - V_{out,1}(p_k)}{FS}$$

With k = min, 1, 2, 3, max. The pressure steps are: $p_{rmin} = 0$, $p_1 = 0.25 \cdot p_{r,max}$, $p_2 = 0.5 \cdot p_{r,max}$, $p_3 = 0.75 \cdot p_{r,max}$, $p_{r,max}$.
This parameter is tested for design verification on samples, mounted on AK transducer package (AK2 series).

6) Reliability data
For long-term stability of offset voltage $LTSV_0$ please refer to the defined Aktiv Sensor's standard AS100001 in chapter "Reliability data" on the internet.

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

8) 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 $p_x = p_{r,max}/2$. The nonlinearity is defined at $p_x = p_{r,max}/2$, 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 AK transducer package (AK2 series).

9) 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 AK transducer package (AK2 series).

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