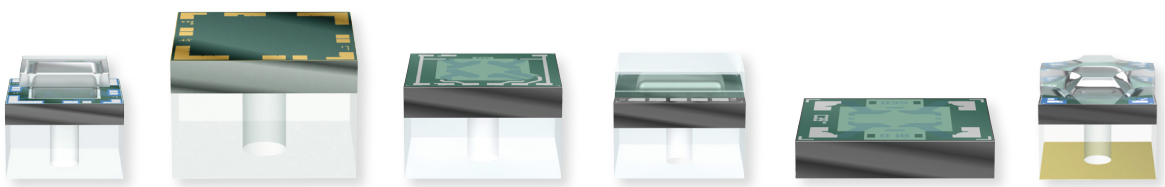
Product Profile 2022

Pressure Sensor Dies

Automotive and Industrial Applications



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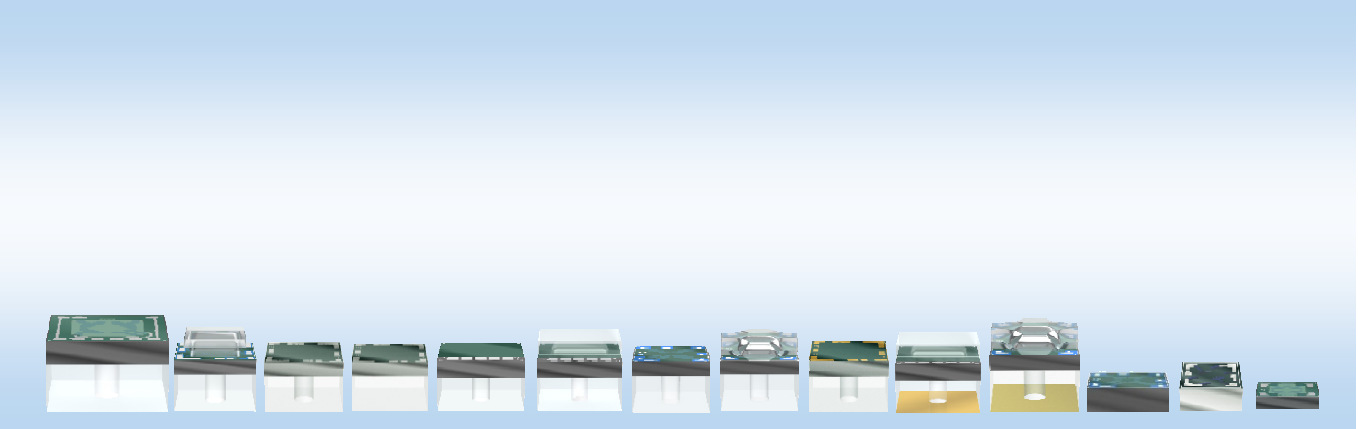
Pressure Sensors Dies for Industrial and Automotive Applications



The high precision of piezoresistive pressure sensors and their possible customization to specific requirements allow their versatile use in a wide range of applications.

For industrial applications, pressure sensors help to operate and control systems more efficiently by providing valuable information. Integrated in an Industry 4.0 sensor network, pressure sensors are mandatory key components. Measurement and control technology for climate management of buildings is based on pressure sensors. Furthermore, hydraulically, or pneumatically operated machines require highly precise pressure sensors for diagnostic functions.

In the automotive industry, pressure sensors measure the pressure of various media to support powertrain management and safety systems. For internal combustion engines and hybrid drive trains, the sensors support a precise engine control for low fuel consumption and a reduction of harmful emissions. This is required to comply with current and future legislation.
All-electrical drives using batteries or hydrogen fuel cell stacks create further requirements for pressure sensors to operate the electrical car efficiently and ensure passenger comfort. Within the battery pack, pressure sensors monitor the safety and correct function. Furthermore, heat pumps and CO_2 climate controls are also requiring robust and accurate pressure sensors.

For medical applications, the long-term stability and high accuracy ensure the functionality of ventilators, anesthesia equipment, blood pressure monitoring and medical cleaning technology. Consumer applications using barometric pressure in portable electronics or sport devices further rely on these key features.

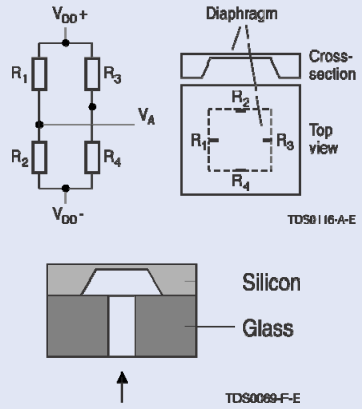
All applications place increasingly demanding requirements on the distinctive characteristics of the pressure dies and call for specific design features already on the die level. The portfolio of pressure sensors has been developed with a strong focus on increased sensitivity and high performance with a smaller die size. In addition, particular attention is paid to specific features for media resistance and easy processability.

Pressure Sensors Dies for Industrial and Automotive Applications

Contents

General Technical Information

Measurement principle



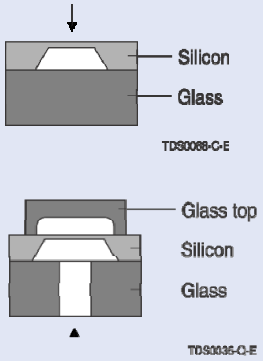
Measurement of pressure with silicon sensor dies is based on the piezo-resistive effect. This is utilized in a silicon diaphragm in which mechanical stress leads to a change of resistivity. The mechanical stress results from a pressure difference across the diaphragm.

A Wheatstone bridge network of implanted resistors in the diaphragm is used to transform the change of resistivity into an electrical signal that is proportional to the applied pressure difference.

Depending on the application, the sensor can be used as a bare die or be bonded to glass for mechanical restraint or to provide a reference vacuum.

Absolute pressure

Absolute pressure sensor dies need a vacuum as a reference point for the pressure to be measured. This reference vacuum is created by bonding the sensor to a solid glass base.



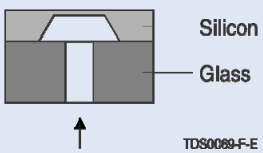
Front side processing
The reference vacuum is created by bonding the glass under vacuum to the silicon. The medium to be measured comes into contact with the active electronic components on the front side of the chip (top side of the chip). Only dry and non-aggressive media may be measured.

Back side processing
To measure the pressure of wet and/ or harsh media, direct contact with the front side needs to be avoided. This is done by creating a backside entry for the media and a reference vacuum on the front side.

Differential pressure

A pressure difference caused by a higher front side pressure leads to a positive change of the output signal. A higher backside pressure leads to a negative change of the output signal. A differential pressure sensor can be used for flow measurement by measuring the pressure drop across a restrictor such as a filter or an orifice.

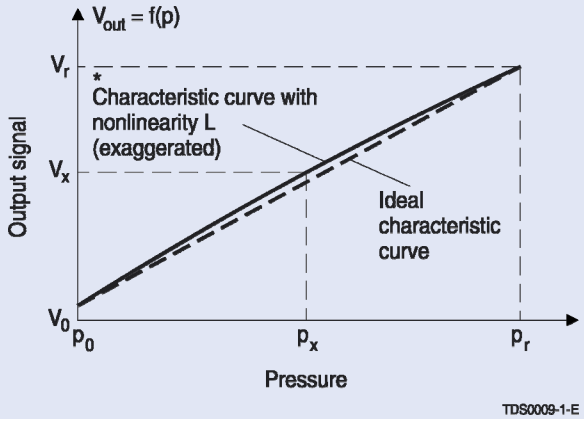
Gauge pressure



A gauge pressure sensor is a special case of a differential pressure sensor where the measurement is related to ambient air pressure, which is exposed from either the front or the backside.

General Technical Information

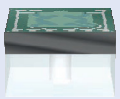
Description of terms

Characteristic curve	The key parameters of the characteristic curve are described below: 
Offset voltage	The output voltage V_{out} at zero pressure, known as the offset voltage, typically varies between ±25 mV[1] due to the spread of the technological parameters.
Sensitivity	The sensitivity is the quotient of the changes of the output voltage and the applied pressure. Thinner diaphragms and larger surfaces increase the sensitivity and decrease the loadbearing capacity of the diaphragm. Every design is therefore a compromise between high sensitivity and a sufficient pressure overload factor. Depending on the pressure range, the sensitivity extends between 2 and 500 mV/bar[1].
Nonlinearity	The nonlinearity describes the deflection of the characteristic curve or the deviation from an ideal straight line. Depending on the pressure range, the nonlinearity typically varies from ±0.1 to ±1.0% FS[2].
Hysteresis	For an output signal indicating the same pressure, the hysteresis represents the greatest difference between measurements made in the direction of increasing and (subsequently) decreasing pressure. This error cannot be determined or compensated. However, this effect is very small and can be neglected in most applications.
Temperature effects	The offset, sensitivity and bridge resistance are functions of the temperature.
Offset V_0	The temperature coefficient of the offset voltage typically varies between ±10 µV/V/K depending on the technological parameters.
Sensitivity S	The temperature coefficient of the sensitivity is much more significant. Depending on the technological parameters, a typical value of α_S ranges between –2.5 and $–1.9 \cdot 10^{-3}$/K. The sensitivity thus decreases with temperature rise. A typical value of β_S is $5 \cdot 10^{-6}/K^2$.
Bridge resistance R_b	The bridge resistance is directly proportional to the temperature (at 25 °C, a typical value range between 3 and 5 kΩ). Depending on the technological parameters, a typical value of α_{Rb} ranges between 2.0 and $2.5 \cdot 10^{-3}$/K. A typical value of β_{Rb} is $6 \cdot 10^{-6}/K^2$.

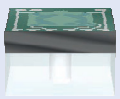
[1] At V_{CC} = 5 V voltage source
[2] FS = $V_r – V_o$ (full scale)

Note: For further details, please refer to page 28.

Overview

Pressure sensor dies						
Type		Pressure measurement	Rated pressure bar		Area mm²	Media	Page
Standard dies							
C32		Absolute, back side	0 … 1.6 0 … 4.0 0 … 10.0 0 … 25.0		1.65 x 1.65	Non-aggressive gases and fluids	8
		Absolute, front side (closed bridge)	0 … 1.6 0 … 4.0 0 … 10.0	0 … 25.0 0 … 40.0	1.65 x 1.65	Dry non-aggressive gases	9
		Absolute, front side (open bridge)	0 … 1.0 0 … 1.6 0 … 4.0	0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	Dry non-aggressive gases	10
		Gauge (open bridge)	0 … 0.4 0 … 1.0 0 … 1.6 0 … 4.0	0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	Non-aggressive gases and fluids Measured media (back side)	11
		Gauge (closed bridge)	0 … 0.4 0 … 1.0 0 … 1.6 0 … 4.0	0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	Non-aggressive gases and fluids Measured media (back side)	12
C33		Absolute, front side	0 … 1.2 0 … 2.5 0 … 4.0	0 … 7.0 0 … 10.0	1.00 x 1.00	Dry non-aggressive gases	13
C35		Gauge	0 … 0.1		2.05 x 2.05	Non-aggressive gases and fluids Measured media (back side)	14
C38		Absolute, back side	0 … 10.0 0 … 25.0 0 … 40.0		1.65 x 1.65	Non-aggressive gases and fluids	15
		Gauge	0 … 10.0 0 … 25.0 0 … 40.0		1.65 x 1.65	Non-aggressive gases and fluids Measured media (back side)	16
C39		Absolute, front side	0 … 1.2		0.65 x 0.65	Dry non-aggressive gases	17
C43		Absolute, front side (open bridge)	0 … 10.0 0 … 25.0 0 … 40.0		1.65 x 1.65	Dry non-aggressive gases	18
		Gauge (open bridge)	0 … 10.0 0 … 25.0 0 … 40.0		1.65 x 1.65	Non-aggressive gases and fluids Measured media (back side)	19

Overview

Pressure sensor dies						
Type		Pressure measurement	Rated pressure bar	Area mm²	Media	Page
Standard dies						
C44		Absolute, back side	0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	Non-aggressive gases and fluids	20
		Gauge	0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	Non-aggressive gases and fluids Measured media (back side)	21
Dies with specific features – High TCR for passive compensation						
C32		Absolute, front side	0 … 0.4 0 … 1.0 0 … 1.6 0 … 4.0 0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	Dry non-aggressive gases	22
		Gauge	0 … 0.4 0 … 1.0 0 … 1.6 0 … 4.0 0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	Non-aggressive gases and fluids Measured media (back side)	23
C35		Gauge	0 … 0.1	2.05 x 2.05	Non-aggressive gases and fluids Measured media (back side)	24
Dies with specific features – gold bond pad layout						
C32		Gauge	0 … 1.6 0 … 4.0 0 … 10.0 0 … 25.0	1.65 x 1.65	High resistance against corrosion Gold bond pads	25
Dies with specific features – solderable back side metallization						
C38		Absolute, back side	0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	For metal-based soldering Gold layer	26
C44		Absolute, back side	0 … 10.0 0 … 25.0 0 … 40.0	1.65 x 1.65	For metal-based soldering Gold layer	27

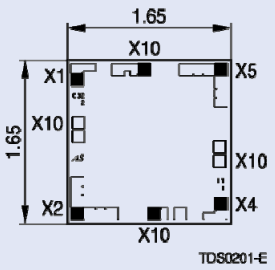
Standard Dies

C32, absolute pressure measurement, back side

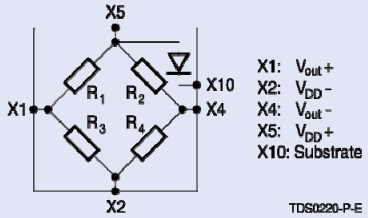
Features

- Media: non-aggressive gases and fluids
- For wet media applications
- High signal stability
- Outstanding long-term stability [12)]

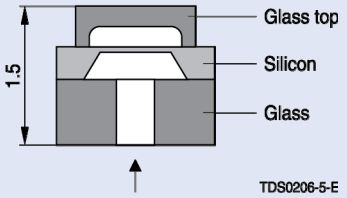
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings								
Operating temperature range T_{op} [1)]		ºC	-40 … +150					
Storage temperature range T_{stg} [2)]		ºC	-50 … +165					
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)								
Supply voltage (max.) V_{DD} [3)]		V	10					
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0					
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0					
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0					
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0					
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1					
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3					
Offset voltage (min./max.) V_O [7)]		mV	-50/ 25		-40/ 25		-35/ 25	-30/ 25
Sensitivity S [8)]		mV/bar	45/70/95		23/30/38		9/12/15	3.6/4.8/6
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) (typ.) TCV_o-	of	µV/V/K µV/V/K	-27/-15/-5 -14/-6/1		-18/-9/-1 -9/-3/2		-13/-6/2 -7/-2/3	-10/-3/4 -6/-1/4
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.3		±0.2/±0.3		±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14)]		bar	4.00		10.0		25.0	62.5
Burst pressure (min.) p_{burst} [15)]		bar	4.80		12.0		30.0	75.0
Rated pressure p_r [13)]		bar	1.60		4.00		10.0	25.0
Ordering codes (tape / tray)			B58600E3224B604	B58600H8400A037	B58600E3264B604	B58600H8400A039	B58600E3215B604	B58600H8400A038	B58600E3245B604	B58600H8400A040

For [1)] … [16)] please refer to page 28.

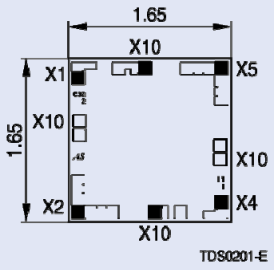
Standard Dies

C32, absolute pressure measurement, front side (closed bridge)

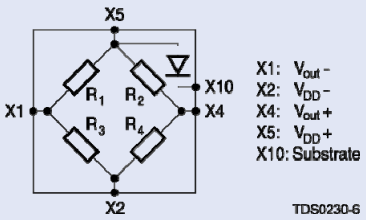
Features

- Media: dry non-aggressive gases
- All around bond pad layout
- High signal stability
- Outstanding long-term stability [12)]

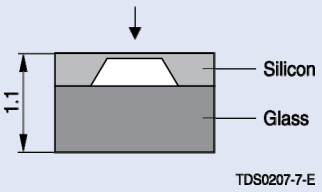
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings								
Operating temperature range T_{op} [1)]		°C	-40 … +150					
Storage temperature range T_{stg} [2)]		°C	-50 … +165					
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)								
Supply voltage (max.) V_{DD} [3)]		V	10					
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0					
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0					
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0					
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0					
Pressure hysteresis (min./max.) pHys [11)]		%FS	-0.1/ +0.1					
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3					
Offset voltage (min./max.) V_O [7)]		mV	-30 … +30					
Sensitivity S [8)]		mV/bar	45/70/95	23/30/38	9/12/15	3.6/4.8/6	2.2/3/3.8	
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-4/8/20 -3/3/9		-12/0/12 -6/0/6			
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3	
Over pressure (min.) p_{ov} [14)]		bar	4.80	12.0	30.0	75.0	120.0	
Burst pressure (min.) p_{burst} [15)]		bar	8.00	20.0	50.0	125.0	200.0	
Rated pressure p_r [13)]		bar	1.60	4.00	10.0	25.0	40.0	
Ordering codes (tape / tray)			B58600E3224B497	B58600H8000A001	B58600E3264B497	B58600H8000A002	B58600E3215B497	B58600H8000A003	B58600E3245B497	B58600H8000A004	B58600E3265B497

For [1)] … [16)] please refer to page

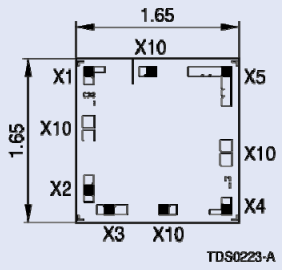
Standard Dies

C32, absolute pressure measurement, front side (open bridge)

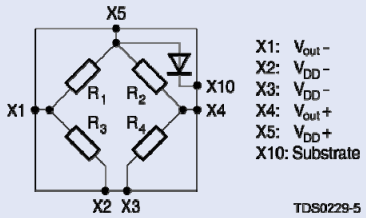
Features

- Media: dry non-aggressive gases
- All around bond pad layout
- High signal stability
- Outstanding long-term stability [12)]

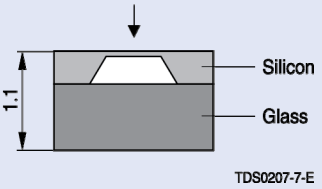
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings												
Operating temperature range T_{op} [1)]		ºC	-40 … +150									
Storage temperature range T_{stg} [2)]		ºC	-50 … +165									
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)												
Supply voltage (max.) V_{DD} [3)]		V	10									
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0									
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0									
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0									
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0									
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1									
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3									
Offset voltage (min./max.) V_O [7)]		mV	-30 … +30									
Sensitivity S [8)]		mV/bar	130/160/190		45/70/95		23/30/38		9/12/15		3.6/4.8/6	2.2/3/3.8
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-4/8/20 -3/3/9						-12/0/12 -6/0/6			
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.3		±0.2/±0.3		±0.2/±0.3		±0.2/±0.3		±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14)]		bar	3.00		4.80		12.0		30.0		75.0	120.0
Burst pressure (min.) p_{burst} [15)]		bar	5.00		8.00		20.0		50.0		125.0	200.0
Rated pressure p_r [13)]		bar	1.00		1.60		4.00		10.0		25.0	40.0
Ordering codes (tape / tray)			B58600E3214B615	B58600E3214B646	B58600E3224B615	B58600E3224B646	B58600E3264B615	B58600E3264B646	B58600E3215B615	B58600E3215B646	B58600E3245B615	B58600E3245B646	B58600E3265B615	B58600E3265B646

For [1)] … [16)] please refer to page 28.

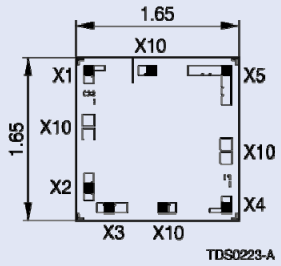
Standard Dies

C32, gauge pressure measurement (open bridge)

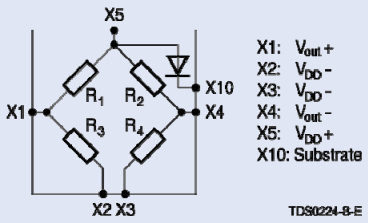
Features

- Media: non-aggressive gases and fluids
- All around bond pad layout
- High signal stability
- Outstanding long-term stability [12)]

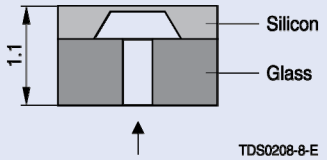
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings												
Operating temperature range T_{op} [1)]		°C	-40 … +150									
Storage temperature range T_{stg} [2)]		°C	-50 … +165									
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)												
Supply voltage (max.) V_{DD} [3)]		V	10									
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0									
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0									
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0									
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0									
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1									
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.2/ ±0.1/ +0.2									
Offset voltage (min./max.) V_O [7)]		mV	-30 … +30									
Sensitivity S [8)]		mV/bar	160/215/270		130/160/190		45/70/95		23/30/38		9/12/15	3.6/4.8/6	2.2/3/3.8
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-20/-8/4 -9/-3/3								-12/0/12 -6/0/6		
Nonlinearity (typ./ max.) L [16)]		%FS	±0.4/±0.7		±0.4/±0.7		±0.2/±0.3		±0.2/±0.3		±0.2/±0.3	±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14)]		bar	1.00		2.50		4.00		10.0		25.0	62.5	75.0
Burst pressure (min.) p_{burst} [15)]		bar	1.20		3.00		4.80		12.0		30.0	75.0	90.0
Rated pressure p_r [13)]		bar	0.40		1.00		1.60		4.00		10.0	25.0	40.0
Ordering codes (tape / tray)			B58601E3263B615	B58601E3263B646	B58601E3214B615	B58601E3214B646	B58601E3224B615	B58601E3224B646	B58601E3264B615	B58601E3264B646	B58601E3215B615	B58601E3215B646	B58601E3245B615	B58601E3245B646	B58601E3265B615	B58601E3265B646

For [1)] … [16)] please refer to page 28.

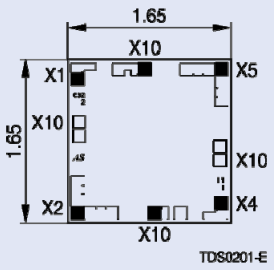
Standard Dies

C32, gauge pressure measurement (closed bridge)

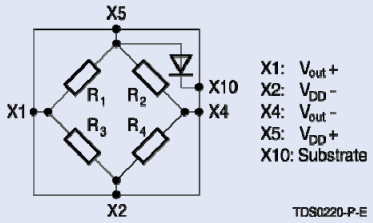
Features

- Media: non-aggressive gases and fluids
- All around bond pad layout
- High signal stability
- Outstanding long-term stability [12)]

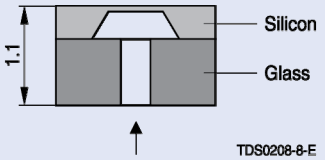
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings												
Operating temperature range T_{op} [1)]		°C	-40 … +150									
Storage temperature range T_{stg} [2)]		°C	-50 … +165									
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)												
Supply voltage (max.) V_{DD} [3)]		V	10									
Operating supply voltage range V_{DD} [4)]		V	1.0… 5.0									
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0									
Temperature coefficient α_{Rb} the bridge resistance β_{Rb} [6)]	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0									
Temperature coefficient α_S sensitivity β_S [10)]	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0									
Pressure hysteresis (min./max.) pHys [11)]		%FS	-0.1/ +0.1									
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.2/ ±0.1/ +0.2									
Offset voltage (min./max.) V_O [7)]		mV	-30 … +30		-25 … +25							
Sensitivity S [8)]		mV/bar	160/215/270	130/160/190	45/70/95	23/30/38	9/12/15	3.6/4.8/6	2.2/3.3.8			
Temperature coefficient TCV_o+ offset voltage (unglued) TCV_o- [9)]	of	µV/V/K µV/V/K	-20/-8/4 -9/-3/3				-12/0/12 -6/0/6					
Nonlinearity (typ./ max.) L [16)]		%FS	±0.4/±0.7	±0.4/±0.7	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3			
Over pressure (min.) p_{ov} [14)]		bar	1.00	2.50	4.00	10.0	25.0	62.5	75.0			
Burst pressure (min.) p_{burst} [15)]		bar	1.20	3.00	4.80	12.0	30.0	75.0	90.0			
Rated pressure p_r [13)]		bar	0.40	1.00	1.60	4.00	10.0	25.0	40.0			
Ordering codes (tape / tray)			B58601E3263B145	On request	On request	On request	B58601E3224B497	B58601H8000A035	B58601E3264B497	B58601H8000A033	B58601E3215B497	B58601H8000A036	B58601E3245B497	B58601H8000A034	B58601E3265B497	B58601E3265B675

For [1)] … [16)] please refer to page 28.

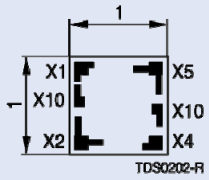
Standard Dies

C33, absolute pressure measurement, front side

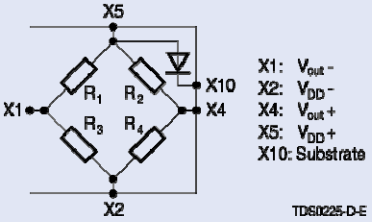
Features

- Media: dry non-aggressive gases
- All around bond pad layout
- High signal stability
- Outstanding long-term stability [12)]

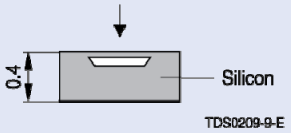
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings							
Operating temperature range T_{op} [1)]		ºC	-40 … +150				
Storage temperature range T_{stg} [2)]		ºC	-50 … +165				
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)							
Supply voltage (max.) V_{DD} [3)]		V	10				
Operating supply voltage range V_{DD} [4)]		V	1.0 … 6.0				
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0				
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0				
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0				
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1				
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.35/ +0.15/ +0.35				
Offset voltage (min./max.) V_O [7)]		mV	-30 … +30				
Sensitivity S [8)]		mV/bar	60/80/100	40/50/60	40/50/60	12/15/18	12/15/18
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K			-15/-5/5 -15/-5/5		
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.4	±0.1/±0.2	±0.15/±0.3	±0.15/±0.3	±0.15/±0.3
Over pressure (min.) p_{ov} [14)]		bar	3.60	7.50	7.50	21.0	21.0
Burst pressure (min.) p_{burst} [15)]		bar	6.00	12.5	12.5	35.0	35.0
Rated pressure p_r [13)]		bar	1.20	2.50	4.00	7.00	10.0
Ordering codes (tape)			B58600E3314B518	B58600E3344B090	B58600E3344B090	B58600E3394B091	B58600E3394B091

For [1)] … [16)] please refer to page 28.

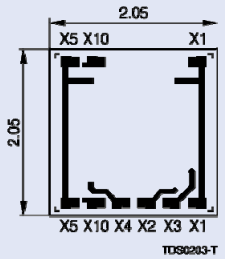
Standard Dies

C35, gauge pressure measurement

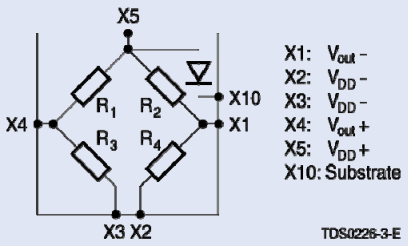
Features

- Media: non-aggressive gases and fluids
- Outstanding long-term stability [12)]
- Various wire bond options (surrounded wire bonding and direct die to ASIC)

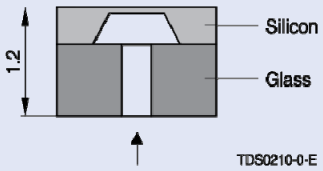
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings			
Operating temperature range T_{op} [1)]		°C	-40 … +150
Storage temperature range T_{stg} [2)]		°C	-50 … +165
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)			
Supply voltage (max.) V_{DD} [3)]		V	10
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K $10^{-6}/K^2$	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K $10^{-6}/K^2$	-2.4/ -2.0/ -1.8 0.0/ 3.0/ 8.0
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.45/ ±0.1/ +0.45
Offset voltage (min./max.) V_O [7)]		mV	-25 … +25
Sensitivity S [8)]		mV/bar	400/550/700
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-15/-5/5 -30/-15/0
Nonlinearity backside (typ./ max.) L [16)] Nonlinearity topside (typ./ max.) L		%FS % FS	±0.5/±1.0 ±0.2/±0.5
Over pressure (min.) p_{ov} [14)]		bar	0.25
Burst pressure (min.) p_{burst} [15)]		bar	0.30
Rated pressure p_r [13)]		bar	0.10
Ordering codes (tape / tray)			B58601E3513B708 / B58601E3513B710

For [1)] … [16)] please refer to page 28

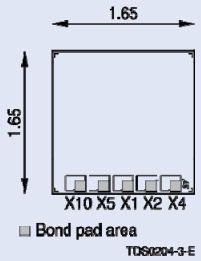
Standard Dies

C38, absolute pressure measurement, back side

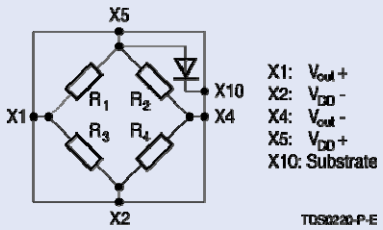
Features

- Media: non-aggressive gases and fluids
- Outstanding long-term stability [12)]
- Single side bond pad layout for direct die to ASIC wire bonding

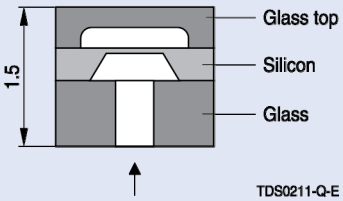
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1)]		°C	-40 … +150		
Storage temperature range T_{stg} [2)]		°C	-50 … +165		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3)]		V	10		
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0		
Total bridge resistance R_b [5)]		kΩ	3.4/ 4.0/ 4.6		
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 6.0/ 8.0		
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 4.0/ 8.0		
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3		
Offset voltage (min./max.) V_O [7)]		mV	-40/ 25	-35/ 25	-35/ 25
Sensitivity S [8)]		mV/bar	7/10/13	4/5/6	2/3/4
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-25/-10/5 -15/-5/5	-25/-10/5 -15/-5/5	-25/-10/5 -15/-5/5
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14)]		bar	30.0	75.0	75.0
Burst pressure (min.) p_{burst} [15)]		bar	50.0	110.0	110.0
Rated pressure p_r [13)]		bar	10.0	25.0	40.0
Ordering codes (tape)			B58600E3815B650	B58600E3845B650	B58600E3865B650

For [1)] … [16)] please refer to page 28.

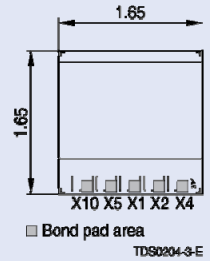
Standard Dies

C38, gauge pressure measurement

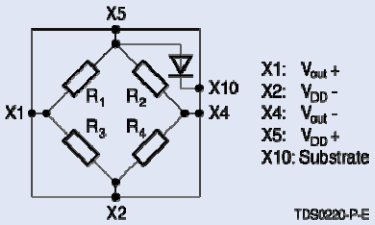
Features

- Media: non-aggressive gases and fluids
- Outstanding long-term stability [12)]
- Single side bond pad layout for direct die to ASIC wire bonding

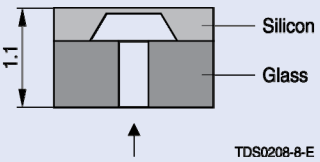
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1)]		°C	-40 … +150		
Storage temperature range T_{stg} [2)]		°C	-50 … +165		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3)]		V	10		
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0		
Total bridge resistance R_b [5)]		kΩ	3.4/ 4.0/ 4.6		
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 6.0/ 8.0		
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 4.0/ 8.0		
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.2/ ±0.1/ +0.2		
Offset voltage (min./max.) V_O [7)]		mV	-25 … +25		
Sensitivity S [8)]		mV/bar	7/10/13	4/5/6	2/3/4
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-12/0/12 -6/0/6	-12/0/12 -6/0/6	-12/0/12 -6/0/6
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14)]		bar	30.0	75.0	75.0
Burst pressure (min.) p_{burst} [15)]		bar	50.0	110.0	110.0
Rated pressure p_r [13)]		bar	10.0	25.0	40.0
Ordering codes (tape)			B58601E3815B650	B58601E3845B650	B58601E3865B650

For [1)] … [16)] please refer to page 28

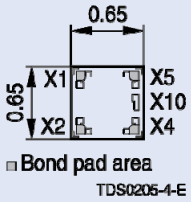
Standard Dies

C39, absolute pressure measurement, front side

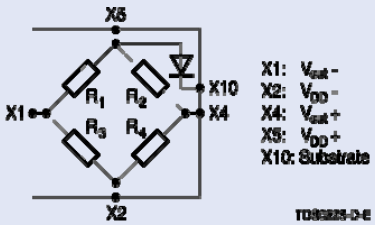
Features

- Media: dry non-aggressive gases
- Outstanding long-term stability [12)]
- Narrow tolerance of sensitivity
- Small die size: 0.65 x 0.65 x 0.24 mm³

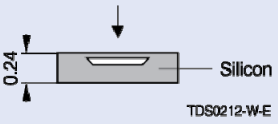
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings			
Operating temperature range T_{op} [1)]		°C	-40 … +135
Storage temperature range T_{stg} [2)]		°C	-40 … +150
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)			
Supply voltage (max.) V_{DD} [3)]		V	10
Operating supply voltage range V_{DD} [4)]		V	1.0 … 6.0
Total bridge resistance R_b [5)]		kΩ	4.8/ 5.7/ 7.2
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	1.2/ 1.5/ 1.8 4.0/ 7.0/ 10.0
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-1.8/ -2.0/ -2.4 0.0/ 4.0/ 8.0
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.35/ ±0.1/ +0.35
Offset voltage (min./max.) V_O [7)]		mV	-30 … +30
Sensitivity S [8)]		mV/bar	60/75/90
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-5/0/5 -5/0/5
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.4
Over pressure (min.) p_{ov} [14)]		bar	3.60
Burst pressure (min.) p_{burst} [15)]		bar	6.00
Rated pressure p_r [13)]		bar	1.20
Ordering codes (tape)			B58600E3914B637

For [1)] … [16)] please refer to page 28.

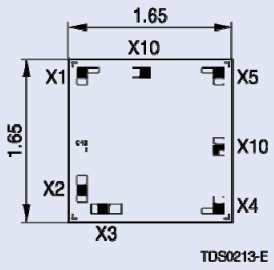
Standard Dies

C43, absolute pressure measurement, front side (open bridge)

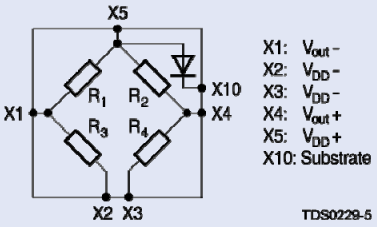
Features

- Media: dry non-aggressive gases
- Outstanding long-term stability [12)]
- High burst pressure up to 200 bar
- High signal stability

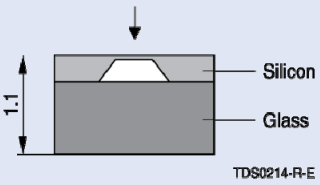
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1)]		°C	-40 … +150		
Storage temperature range T_{stg} [2)]		°C	-40 … +150		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3)]		V	10		
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0		
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0		
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 6.1/ 8.0		
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 3.6/ 8.0		
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.2/ ±0.1/ +0.2		
Offset voltage (min./max.) V_O [7)]		mV	-25 … +25		
Sensitivity S [8)]		mV/bar	9/11.7/15	3.6/4.6/6	2.2/2.8/3.8
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) (typ.) TCV_o-	of	µV/V/K µV/V/K	--7 --5	--7 --5	--7 --5
Nonlinearity (typ./ max.) L [16)]		%FS	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14)]		bar	40.0	100.0	160.0
Burst pressure (min.) p_{burst} [15)]		bar	50.0	125.0	200.0
Rated pressure p_r [13)]		bar	10.0	25.0	40.0
Ordering codes (tape / tray)			B58600E4315B734 / B58600E4315B771	B58600E4345B734 / B58600E4345B771	B58600E4365B734 / B58600E4365B771

For [1)] … [16)] please refer to page 28

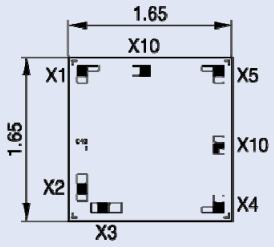
Standard Dies

C43, gauge pressure measurement (open bridge)

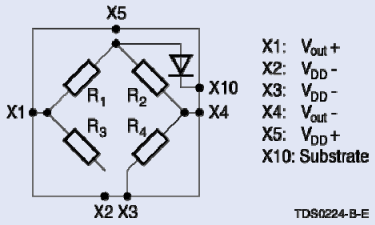
Features

- Media: non-aggressive gases and fluids
- Outstanding long-term stability [12)]
- High burst pressure up to 150 bar
- High signal stability

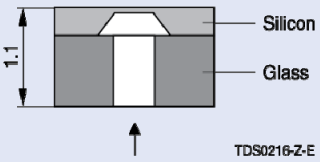
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1)]		°C	-40 … +150		
Storage temperature range T_{stg} [2)]		°C	-40 … +150		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3)]		V	10		
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0		
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0		
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 6.1/ 8.0		
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 3.6/ 8.0		
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.2/ ±0.1/ +0.2		
Offset voltage (min./max.) V_O [7)]		mV	-25 … +25		
Sensitivity S [8)]		mV/bar	9/11/15	3.6/5/6	2.2/3/3.8
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-15/-5/5 -15/-5/5	-15/-5/5 -15/-5/5	-15/-5/5 -15/-5/5
Nonlinearity (typ./ max.) L [16)]		%FS	±0.1/±0.3	±0.1/±0.3	±0.1/±0.3
Over pressure (min.) p_{ov} [14)]		bar	40.0	100.0	120.0
Burst pressure (min.) p_{burst} [15)]		bar	50.0	125.0	150.0
Rated pressure p_r [13)]		bar	10.0	25.0	40.0
Ordering codes (tape / tray)			B58601E4315B734 / B58601E4315B771	B58601E4345B734 / B58601E4345B771	B58601E4365B734 / B58601E4365B771

For [1)] … [16)] please refer to page 28

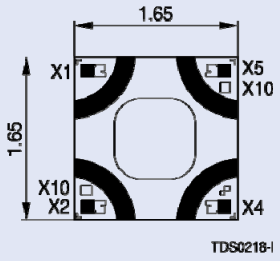
Standard Dies

C44, absolute pressure measurement, back side

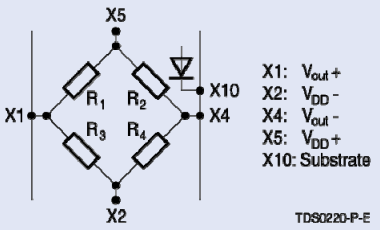
Features

- Media: non-aggressive gases and fluids
- Outstanding long-term stability [12)]
- High burst pressure up to 150 bar
- High signal stability

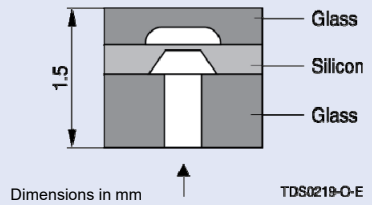
Layout



Circuit diagram



Cross-section



Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1)]		°C	-40 … +150		
Storage temperature range T_{stg} [2)]		°C	-50 … +165		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3)]		V	10		
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0		
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0		
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K $10^{-6}/K^2$	2.0/ 2.3/ 2.7 0.0/ 6.0/ 8.0		
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K $10^{-6}/K^2$	-2.5/ -2.1/ -1.9 0.0/ 4.0/ 8.0		
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3		
Offset voltage (min./max.) V_O [7)]		mV	-30 … +30		
Sensitivity S [8)]		mV/bar	7/10/13	3.5/5/6.5	2/3/4
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-25/-15/-5 -15/-5/5	-20/-10/0 -10/-5/0	-15/-8/0 -10/-4/0
Nonlinearity (typ./ max.) L [16)]		%FS	±0.1/±0.3	±0.1/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14)]		bar	40.0	100.0	120.0
Burst pressure (min.) p_{burst} [15)]		bar	50.0	125.0	150.0
Rated pressure p_r [13)]		bar	10.0	25.0	40.0

Ordering codes (tape / tray)						
	B58600E4415B703	B58600E4415B772	B58600E4445B703	B58600E4445B772	B58600E4465B703	B58600E4465B772

For [1)] … [16)] please refer to page 28.

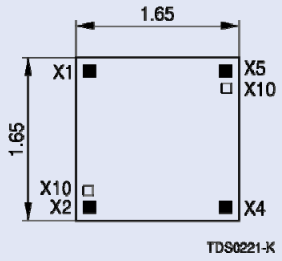
Standard Dies

C44, gauge pressure measurement

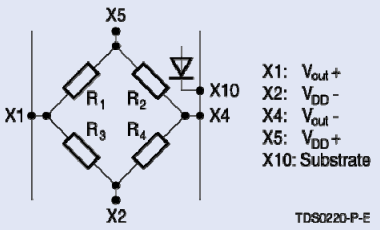
Features

- Media: non-aggressive gases and fluids
- Outstanding long-term stability [12)]
- High burst pressure up to 150 bar
- High signal stability

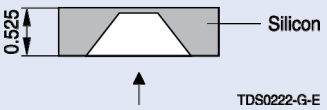
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1)]		°C	-40 … +150		
Storage temperature range T_{stg} [2)]		°C	-50 … +165		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3)]		V	10		
Operating supply voltage range V_{DD} [4)]		V	1.0 … 5.0		
Total bridge resistance R_b [5)]		kΩ	2.6/ 3.3/ 4.0		
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K $10^{-6}/K^2$	2.0/ 2.1/ 2.7 0.0/ 6.2/ 8.0		
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K $10^{-6}/K^2$	-2.5/ -2.1/ -1.9 0.0/ 4.0/ 8.0		
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.2/ ±0.02/ +0.2		
Offset voltage (min./max.) V_O [7)]		mV	-25 … +25		
Sensitivity S [8)]		mV/bar	7/11/13	3.6/5/6	2.2/3/3.8
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-15/-5/5 -15/-5/5	-15/-5/5 -15/-5/5	-15/-5/5 -15/-5/5
Nonlinearity (typ./ max.) L [16)]		%FS	±0.1/±0.3	±0.1/±0.3	±0.3/±0.4
Over pressure (min.) p_{ov} [14)]		bar	40.0	100.0	120.0
Burst pressure (min.) p_{burst} [15)]		bar	50.0	125.0	150.0
Rated pressure p_r [13)]		bar	10.0	25.0	40.0
Ordering codes (tape)			B58601E4415B705	B58601E4445B705	B58601E4465B705

For [1)] … [16)] please refer to page 28

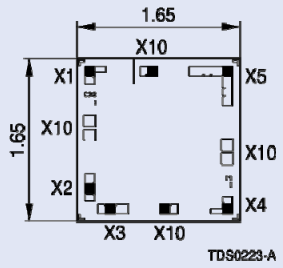
Dies with Specific Features

C32, absolute pressure measurement, front side (open bridge) – High TCR for passive compensation

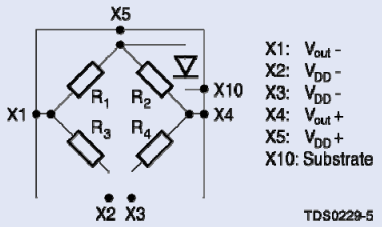
Features

- Media: dry non-aggressive gases
- All around bond pad layout
- High signal stability
- Outstanding long-term stability [12)]

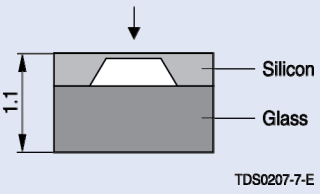
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings													
Operating temperature range T_{op} [1)]		°C	-40 … +150										
Storage temperature range T_{stg} [2)]		°C	-50 … +165										
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5V (min./ typ./ max.)													
Supply voltage (max.) V_{DD} [3)]		V	10										
Operating supply voltage range V_{DD} [4)]		V	0.8 … 5.0										
Total bridge resistance R_b [5)]		kΩ	4.0/ 5.0 /6.0										
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.6/ 2.9/ 3.2 0.0/ 5.0/ 8.0										
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0										
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1										
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ +0.15/ +0.3				-0.3/ ±0.1/ +0.3						
Offset voltage (min./max.) V_O [7)]		mV	-30… +30										
Sensitivity S [8)]		mV/bar	160/215/275		130/160/190		45/70/95		23/30/38		9/12/15	3.6/4.8/6	2.2/3/3.8
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-4/8/20 -3/3/9								-12/0/12 -6/0/6		
Nonlinearity (typ./ max.) L [16)]		%FS	±0.3/±0.5		±0.2/±0.3								
Over pressure (min.) p_{ov} [14)]		bar	1.20		3.00		4.80		12.0		30.0	75.0	120.0
Burst pressure (min.) p_{burst} [15)]		bar	2.00		5.00		8.00		20.0		50.0	125.0	200.0
Rated pressure p_r [13)]		bar	0.40		1.00		1.60		4.00		10.0	25.0	40.0
Ordering codes (tape / tray)			B58600E3263B709	B58600E3263B711	B58600E3214B709	B58600E3214B711	B58600E3224B709	B58600E3224B711	B58600E3264B709	B58600E3264B711	B58600E3215B709	B58600E3215B711	B58600E3245B709	B58600E3245B711	B58600E3265B709	B58600E3265B711

For [1)] … [16)] please refer to page 28.

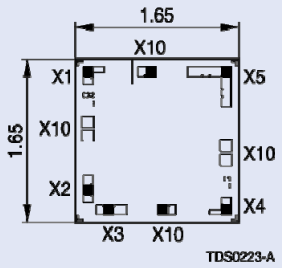
Dies with Specific Features

C32, gauge pressure measurement (open bridge) – High TCR for passive compensation

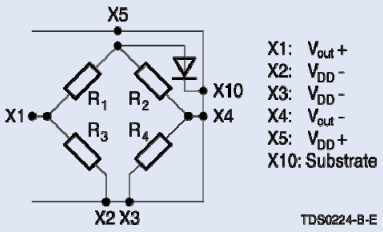
Features

- Media: non-aggressive gases and fluids
- All around bond pad layout
- High signal stability
- Outstanding long-term stability [12)]

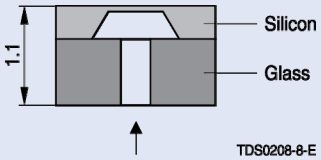
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings													
Operating temperature range T_{op} [1)]		°C	-40 … +150										
Storage temperature range T_{stg} [2)]		°C	-50 … +165										
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5V (min./ typ./ max.)													
Supply voltage (max.) V_{DD} [3)]		V	10										
Operating supply voltage range V_{DD} [4)]		V	0.8… 5.0										
Total bridge resistance R_b [5)]		kΩ	4.0/ 5.0 6.0										
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.6/ 2.9/ 3.2 0.0/ 5.0/ 8.0										
Temperature coefficient α_S [10)] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.2/ -1.9 0.0/ 5.0/ 8.0										
Pressure hysteresis (min./max.) pHys[11)]		%FS	-0.1/ +0.1										
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ +0.15/ +0.3				-0.2/ ±0.1/ +0.2						
Offset voltage (min./max.) V_O [7)]		mV	-25… +25										
Sensitivity S [8)]		mV/bar	160/215/275		130/160/190		45/70/95		23/30/38		9/12/15	3.6/4.8/6	2.2/3.8
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-20/-8/4 -9/-3/3								-12/0/12 -6/0/6		
Nonlinearity (typ./ max.) L [16)]		%FS	±0.5/±0.75				±0.2/±0.3						
Over pressure (min.) p_{ov} [14)]		bar	1.00		2.50		4.00		10.0		25.0	62.5	100.0
Burst pressure (min.) p_{burst} [15)]		bar	1.20		3.00		4.80		12.0		30.0	75.0	120.0
Rated pressure p_r [13)]		bar	0.40		1.00		1.60		4.00		10.0	25.0	40.0
Ordering codes (tape / tray)			B58601E3263B709	B58601E3263B711	B58601E3214B709	B58601E3214B711	B58601E3224B709	B58600E3224B711	B58601E3264B709	B58600E3264B711	B58601E3215B709	B58600E3215B711	B58601E3245B709	B58600E3245B711	B58601E3265B709	B58600E3265B711

For [1)] … [16)] please refer to page 28.

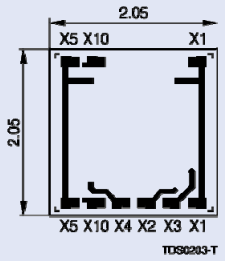
Dies with Specific Features

C35, gauge pressure measurement – High TCR for passive compensation

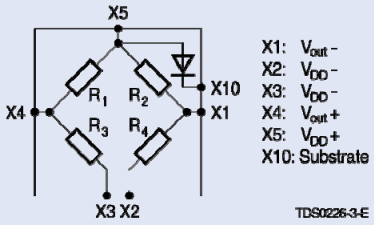
Features

- Media: non-aggressive gases and fluids
- Outstanding long-term stability [12)]
- Various wire bond options (surrounded wire bonding and direct die to ASIC)

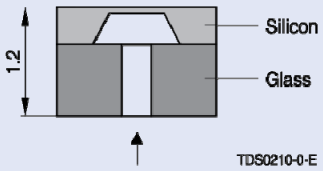
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings				
Operating temperature range T_{op} [1)]			ºC	-40 … +150
Storage temperature range T_{stg} [2)]			ºC	-50 … +165
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)				
Supply voltage (max.) V_{DD} [3)]			V	10
Operating supply voltage range V_{DD} [4)]			V	1.0 … 5.0
Total bridge resistance R_b [5)]			kΩ	4.0/ 5.0/ 6.0
Temperature coefficient α_{Rb} [6)] the bridge resistance β_{Rb}		of	10^{-3}/K $10^{-6}/K^2$	2.6/ 2.9/ 3.2 0.0/ 5.0/ 8.0
Temperature coefficient α_S [10)] sensitivity β_S		of	10^{-3}/K $10^{-6}/K^2$	-2.4/ -2.0/ -1.8 0.0/ 3.0/ 8.0
Pressure hysteresis (min./max.) pHys[11)]			%FS	-0.1/ +0.1
Long-term stability of offset $LTSV_o$ [12)] (Full scale normal output FSON = 120 mV)			%FSON	-0.45/ ±0.1/ +0.45
Offset voltage (min./max.) V_O [7)]			mV	-25 … +25
Sensitivity S [8)]			mV/bar	400/550/700
Temperature coefficient TCV_o+ [9)] offset voltage (unglued) TCV_o-		of	µV/V/K µV/V/K	-15/-5/5 -30/-15/0
Nonlinearity backside (typ./ max.) L [16)] Nonlinearity topside (typ./ max.) L			%FS % FS	±0.5/±1.0 ±0.2/±0.5
Over pressure (min.) p_{ov} [14)]			bar	0.25
Burst pressure (min.) p_{burst} [15)]			bar	0.30
Rated pressure p_r [13)]			bar	0.10
Ordering codes (tape / tray)				B58601E3513B709 / B58601E3513B711

For [1)] … [16)] please refer to page 28.

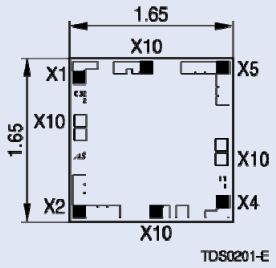
Dies with Specific Features

C32, gauge pressure measurement – gold bond pad layout

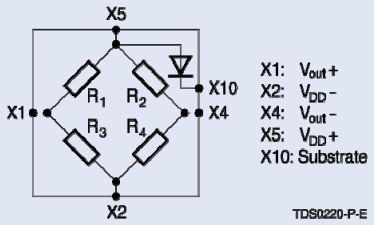
Features

- Media: non-aggressive gases and fluids
- Designed for gold wire bonding
- High corrosion resistance for front side application
- High temperature resistance up to +165 ºC

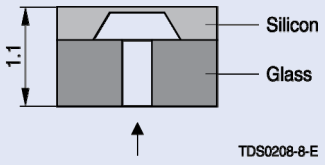
Layout



Circuit diagram



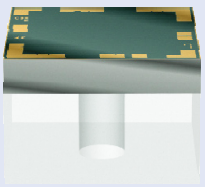
Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings				
Operating temperature range T_{op} [1]		ºC	-40 … +165	
Storage temperature range T_{stg} [2]		ºC	-50 … +180	
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)				
Supply voltage (max.) V_{DD} [3]		V	10	
Operating supply voltage range V_{DD} [4]		V	1.0 … 5.0	
Total bridge resistance R_b [5]		kΩ	2.6/ 3.3/ 4.0	
Temperature coefficient α_{Rb} [6] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 5.0/ 8.0	
Temperature coefficient α_S [10] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 5.0/ 8.0	
Pressure hysteresis (min./max.) pHys[11]		%FS	-0.1/ +0.1	
Long-term stability of offset $LTSV_o$ [12] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3	
Offset voltage (min./max.) V_O [7]		mV	-30… +30	
Sensitivity S [8]		mV/bar	45/70/95	9/12/15
Temperature coefficient TCV_o+ [9] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-20/-8/4 -9/-3/3	-12/0/12 -6/0/6
Nonlinearity (typ./ max.) L [16]		%FS	±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14]		bar	4.00	25.0
Burst pressure (min.) p_{burst} [15]		bar	4.80	30.0
Rated pressure p_r [13]		bar	1.60	10.0



For [1] … [16] please refer to page 28.

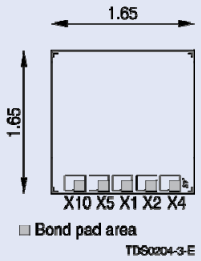
Dies with Specific Features

C38, absolute pressure measurement, back side – solderable back side metallization

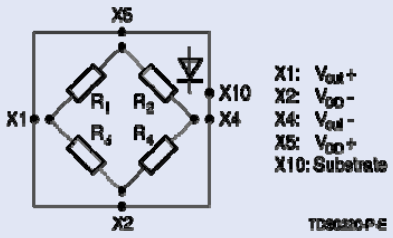
Features

- Media: non-aggressive gases and fluids
- Back side solder joint for high media resistance
- Stable assembly for high pressure requirements (operating pressure up to 40 bar)

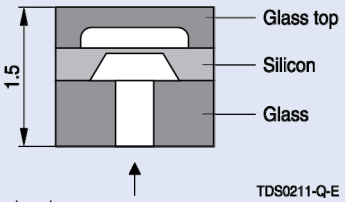
Layout



Circuit diagram



Cross-section



Dimensions in mm

Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1]		°C	-40 … +150		
Storage temperature range T_{stg} [2]		°C	-50 … +165		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3]		V	10		
Operating supply voltage range V_{DD} [4]		V	1.0 … 5.0		
Total bridge resistance R_b [5]		kΩ	3.4/ 4.0/ 4.6		
Temperature coefficient α_{Rb} [6] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 6.0/ 8.0		
Temperature coefficient α_S [10] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 4.0/ 8.0		
Pressure hysteresis (min./max.) pHys[11]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3		
Offset voltage (min./max.) V_O [7]		mV	-40/ 25	-35/ 25	-35/ 25
Sensitivity S [8]		mV/bar	7/10/13	4/5/6	2/3/4
Temperature coefficient TCV_o+ [9] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-25/-10/5 -15/-5/5	-25/-10/5 -15/-5/5	-25/-10/5 -15/-5/5
Nonlinearity (typ./ max.) L [16]		%FS	±0.2/±0.3	±0.2/±0.3	±0.2/±0.3
Over pressure (min.) p_{ov} [14]		bar	30.0	75.0	75.0
Burst pressure (min.) p_{burst} [15]		bar	50.0	110.0	110.0
Rated pressure p_r [13]		bar	10.0	25.0	40.0
Ordering codes (tape)			B58600E3815B769	B58600E3845B769	B58600E3865B769

For [1] … [16] please refer to page 28.

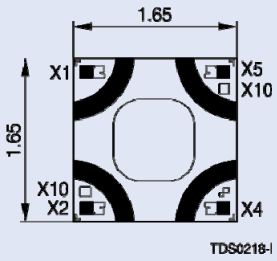
Dies with Specific Features

C44, absolute pressure measurement, back side – solderable back side metallization

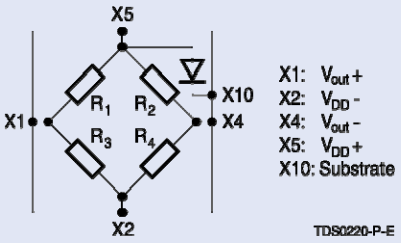
Features

- Media: non-aggressive gases and fluids
- Back side solder joint for high media resistance
- Stable assembly for high pressure requirements (operating pressure up to 40 bar)

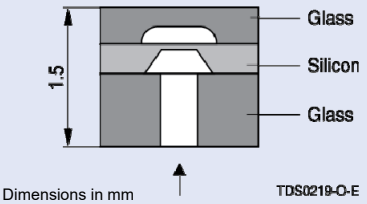
Layout



Circuit diagram



Cross-section



Technical data

Temperature maximum ratings					
Operating temperature range T_{op} [1]		°C	-40 … +150		
Storage temperature range T_{stg} [2]		°C	-50 … +165		
Electrical specifications @ T_{op} = 25 °C, V_{DD} = 5 V (min./ typ./ max.)					
Supply voltage (max.) V_{DD} [3]		V	10		
Operating supply voltage range V_{DD} [4]		V	1.0 … 5.0		
Total bridge resistance R_b [5]		kΩ	2.6/ 3.3/ 4.0		
Temperature coefficient α_{Rb} [6] the bridge resistance β_{Rb}	of	10^{-3}/K 10^{-6}/K²	2.0/ 2.3/ 2.7 0.0/ 6.0/ 8.0		
Temperature coefficient α_S [10] sensitivity β_S	of	10^{-3}/K 10^{-6}/K²	-2.5/ -2.1/ -1.9 0.0/ 4.0/ 8.0		
Pressure hysteresis (min./max.) pHys[11]		%FS	-0.1/ +0.1		
Long-term stability of offset $LTSV_o$ [12] (Full scale normal output FSON = 120 mV)		%FSON	-0.3/ ±0.1/ +0.3		
Offset voltage (min./max.) V_O [7]		mV	-30… +30		
Sensitivity S [8]		mV/bar	7/10/13	3.5/5/6.5	3.5/5/6.5
Temperature coefficient TCV_o+ [9] offset voltage (unglued) TCV_o-	of	µV/V/K µV/V/K	-25/-15/-5 -15/-5/5	-20/-10/0 -10/-5/0	-20/-10/0 -10/-5/0
Nonlinearity (typ./ max.) L [16]		%FS	±0.1/±0.3	±0.1/±0.3	±0.15/±0.4
Over pressure (min.) p_{ov} [14]		bar	40.0	100.0	120.0
Burst pressure (min.) p_{burst} [15]		bar	50.0	125.0	150.0
Rated pressure p_r [13]		bar	10.0	25.0	40.0
Ordering codes (tape)			B58600E4415B702	B58600E4445B702	B58600E4445B702

For [1] … [16] please refer to page 28

Symbols and Terms

1) Operating temperature range T_{op}

This is the operating temperature range $T_{op,min}$ to $T_{op,max}$. 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.

2) Storage temperature range T_{stg}

If pressure sensor dies are stored in the temperature range $T_{stg,min}$ to $T_{stg,max}$ without applied voltage, this will not affect the performance of the pressure sensor dies.

3) Maximum supply voltage $V_{DD,max}$

This is the maximum permissible voltage that may be ap- plied to the piezoresistive bridge circuit without damage.

4) Operating supply voltage V_{DD}

Pressure sensor parameters are defined for a power supply voltage of V_{DD} = 5 V. For the operating voltage range $V_{DD,min}$ to $V_{DD,max}$ the ratiometric parameters r(V_{DD}) such as sensitivity, offset voltage and the temperature coefficient of the offset voltage are defined by:

$$r(V_{DD}) = r(5\,\text{V})\frac{V_{DD}}{5\,\text{V}}$$

5) Total bridge resistance R_b

Total bridge resistance is defined between pads X5 and X2 (see the dimensional drawing in the data sheet) of the closed piezoresistive bridge circuit. In approximation, the total bridge resistance equals the output impedance of the piezoresistive bridge circuit.

6) Temperature coefficients of total bridge resistance α_{Rb} and β_{Rb}:

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

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

The coefficients α_{Rb} and β_{Rb} are calculated using the three measurement points of $R_b(T)$ at T_{min} to T_{max} with T_R = 25 °C.

7) Offset voltage V_o

The offset voltage V_o is the output voltage V_{out} (p = 0 bar) at zero gauge/ absolute pressure and for a supply voltage V_{DD} = 5 V.

8) Sensitivity S

Sensitivity is defined for a bridge voltage supply V_{DD} = 5 V. It can be determined by the formula:

$$S = \frac{V_{out}(p_{r,max}) - V_o}{p_{r,max}}$$

9) Temperature coefficient of offset voltage TCV_0.

The temperature coefficients of offset voltage are defined for a supply voltage V_{DD} = 5 V. TCV_0+ and TCV_0– are defined for the measurement temperature range T_{min} to T_{max} by:

$$TCV_0+ = \frac{V_o(T_{max}) - V_o(25\,°C)}{T_{max} - 25\,°C}\quad TCV_0- = \frac{V_o(T_{min}) - V_o(25\,°C)}{T_{min} - 25\,°C}$$

10) Temperature coefficient of sensitivity α_S and β_S:

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

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

The coefficients α_S and β_S are calculated using three measurement points of S(T) at T_{min} to T_{max} with T_R = 25 °C.

11) Pressure hysteresis pHys

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: $p_{r,min}$=0, p_1=0.25 · $p_{r,max}$, p_2=0.5 · $p_{r,max}$, p_3=0.75 · $p_{r,max}$, $p_{r,max}$.

12) Reliability data

For long-term stability of offset voltage $LTSV_0$ refer to TDK standard AS100001 in chapter “Reliability data” on the internet.

13) Rated pressure range p_r

For the rated pressure range 0 bar to $p_{r,max}$ the pressure sensor die output characteristic is according to this specification.

14) Overpressure p_{ov}

Pressure cycles in the pressure range from 0 bar to p_{ov} do not affect the performance of the pressure sensor dies.

15) Burst pressure p_{burst}

The diaphragm of the sensor die will not suffer mechani- cal destruction up to the burst pressure p_{burst}.

16) Nonlinearity L

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:

$$L = \frac{V_{out}(p_x) - V_o}{V_{out}(p_{r,max}) - V_o} - \frac{p_x}{p_{r,max}}$$

Pressure Units

Conversion table for pressure units						
bar	psi	kPa	cm H_2O	inch H_2O	mm Hg	lbf/ft^2
0.016	0.232	1.6	16.32	6.43	12.0	33.416
0.025	0.363	2.5	25.49	10.04	18.8	52.213
0.040	0.58	4.0	40.79	16.06	30.0	83.54
0.060	0.87	6.0	61.18	24.09	45.0	125.31
0.100	1.45	10.0	101.97	40.15	75.0	208.85
0.160	2.32	16.0	163.2	64.25	120.0	334.16
0.250	3.63	25.0	254.9	100.35	188.0	522.125
0.400	5.8	40.0	407.9	160.59	300.0	835.4
0.600	8.7	60.0	611.8	240.87	450.0	1253.1
1.000	14.5	100.0	1019.7	401.46	750.0	2088.5
1.600	23.2	160.0	1632.0	642.52	1200.0	3341.6
2.500	36.3	250.0	2549.0	1003.54	1875.0	5221.25
4.000	58.0	400.0	4079.0	1605.91	3000.0	8354.0
6.000	87.0	600.0	6118.0	2408.66	4500.0	12531.0
10.00	145.0	1000.0	10197.0	4014.57	7501.0	20885.0
16.00	232.0	1600.0	16316.0	6423.62	12001.0	33416.0
25.00	363.0	2500.0	25494.0	10037.01	18752.0	52212.5
40.00	580.0	4000.0	40790.0	16059.06	30002.0	83540.0
60.00	870.0	6000.0	61184.0	24088.19	45003.0	125310.0
100.00	1450.0	10000.0	101974.0	40147.24	75006.0	208850.0

Cautions and Warnings

Storage

All pressure sensors should be stored in their original pack- age. 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 occur 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 get charged. Pressure sensor dies should be used soon after opening their seal and packaging.

Storage conditions

Materials used for storage should be ESD protective according to JESD625, non-outgassing, and chemically stable. Furthermore, the following storage conditions should be observed:

- Storage in cabinets (if shipping package is opened)
  - Atmosphere: inert gas, dry air or dry nitrogen
  - Temperature range (in cabinet): 20 ±3 °C
  - Relative humidity range (in cabinet): < 40%
  - Particle count (in cabinet): class 6 of ISO 14644:1999 (equivalent to FED STD 209E class 1000)
  - Shelf life under these conditions: 24 months for deliveries in trays
  - Shelf life under these conditions: 12 months for deliveries on tape
- Storage in containers (if shipping package is sealed)
  - Sealed as delivered or backfilled with inert gas, dry air or dry nitrogen and re-sealed
  - Temperature range: 20 ±3 °C
  - Relative humidity range: < 50%
  - Particle count (during backfill): class 6 of ISO 14644:1999 (equivalent to FED STD 209E class 1000)
  - Shelf life under these conditions: 12 months for deliveries in trays
  - Shelf life under these conditions: 6 months for deliveries on tape

Operation

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 pressure sensors in an environment where condensation may occur or in a location exposed to corrosive gases. These environments adversely affect their performance. If operating pressure is above the rated overpressure, it may change the output characteristics. This may also happen with pressure sensor dies if an incorrect mounting method is used. Make sure the applicable pressure does not exceed the overpressure, as it may damage the pressure sensor.

Do not exceed the maximum rated supply voltage or 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 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 sheet. Care should be taken as reversed pin connections can damage the pressure sensors or degrade their performance. Contact between the pressure sensor terminals and metals or other materials may cause errors in the output characteristic.

Design notes

This document describes the mechanical, electrical and physical requirements of a piezoresistive sensor die for measuring pressure. The specified parameters apply when pressure is applied (to the diaphragm) in the direction shown in the cross-section. Pressure applied in the other direction may yield different results. 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

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, as this will inhibit the curing of the adhesive used to bond the die to the carrier. 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 must be avoided).

Important Notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule we are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether a product with the properties described in the product specification is suitable for use in a particular customer application.

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.**

4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.tdk-electronics.tdk.com/material). Should you have any more detailed questions, please contact our sales offices.

5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available.
The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply.**

7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard.** The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements (“CSR”) TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System.** For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.

8. The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, ModCap, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap, XieldCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.tdk-electronics.tdk.com/trademarks.

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