Pressure sensors

Barometric pressure transmitters for SMT

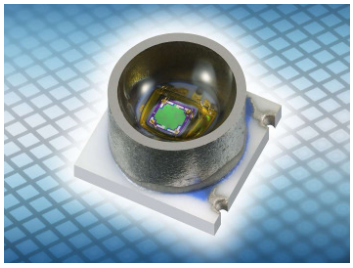
Series/Type: **ASB series**
Ordering code:

Date: 2011-11-10
Version: 2.4

Preliminary data

Description

- Pressure sensor transmitters based on piezoresistive silicon pressure dies
- On board compensation circuit for non-linearity and temperature error
- Miniaturized SMD hybrid package (4.3mm x 4.3mm x 2.4mm)



Features

- Analog ratiometric or fixed voltage interface with adjustable output limits (clipping)
- Diagnosis functions like loss of Vdd/Vss, bridge connections and short cuts
- High immunity against electromagnetic influences
- Plastic free surface mount technology for reflow soldering
- Conforming to RoHS Directive

Options

- Other output characteristics and / or rated pressure ranges upon request

Table of Contents

Preliminary data

1. Technical Data

Absolute maximum ratings

Parameter	Symbol	Conditions	Min.	Max.	Unit
Temperature ranges					
Storage temperature range	T_{st}	1)	-40	+125	°C
Operating temperature range	T_{op}	TN 2)	-40	+85	°C
		TE 2)	-40	+125	°C
Compensated temperature range	T_c	3),4)	0	+70	°C
Soldering temperature	T_{solder}			+260	°C
Pressure ranges					
Rated pressure	p_r	absolute	0.2 (2.9)	1.2 (17.4)	bar (psi)
Overpressure	p_{ov}	4), 5)	2		p_r
Burst pressure			3		p_r
Supply voltage /-current					
Supply voltage	V_{supply}	6)	2.7	5.5	V
Supply current	I_{supply}	I_{out} = 0		2.5	mA
Signal output current	I_{out}	7)		2	mA
Start up time	t_{STA}	8)		10	ms

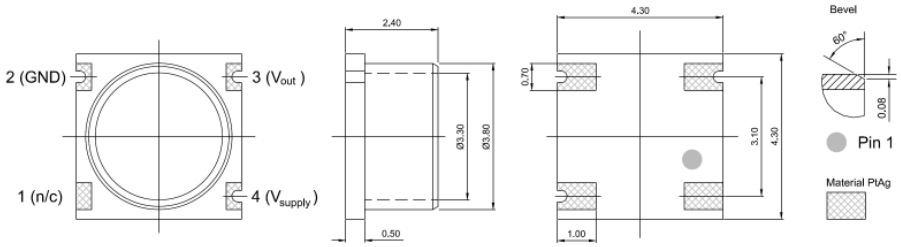
2. Analog Output (VR/V1)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Analog output signal (VR/V1) @ T_{op} = 25°C, V_{supply} = 5 V, I_{out} < 0.1 mA						
Offset (at $p_{r,min}$)	$V_{out,0}$	VR: ratiometric[9)]		10		$\%V_{CC}$
		V1: 0 … 1000 mV[9)]	0	2.5		mV
Signal span (Full Scale)	V_{FS}	VR: ratiometric[10)]		80		$\%V_{CC}$
		V1: 0 … 1000 mV[10)]		1000		mV
Full scale output at $p_{r,max}$	$V_{out,0} + V_{FS}$	VR: ratiometric[9), 10)]		90		$\%V_{CC}$
Diagnostic levels		enabled upon request	disabled			
Non-linearity	L	Simple output [10), 11)]		±0.1		% FS
Response time	t_{10-90}	[12)]		2		ms
Resolution	r_{OUT}	[13)]		12		bit
Basic accuracy		T_{op}: 0 … 70°C		± 2	± 3	% FS

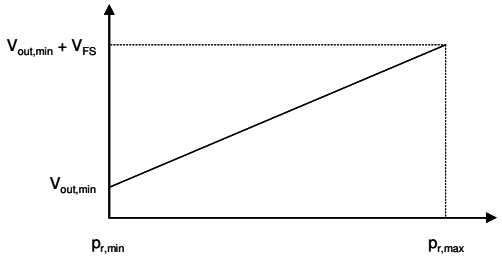
Terminal assignment

Pin	Symbol	Signal
1	-	not connected
2	GND	Ground
3	V_{out}	Output signal
4	V_{supply}	Supply voltage

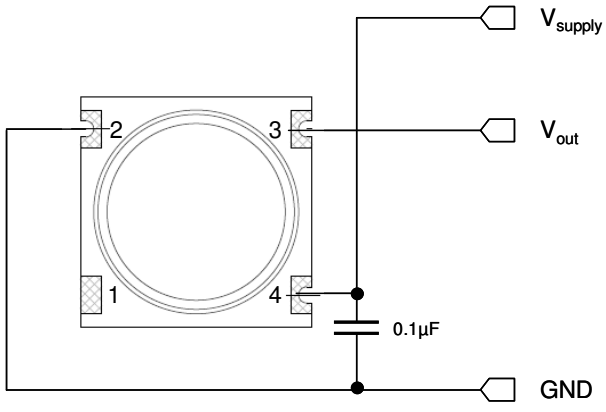
Dimensional drawings



Output Characteristics



Application Circuit



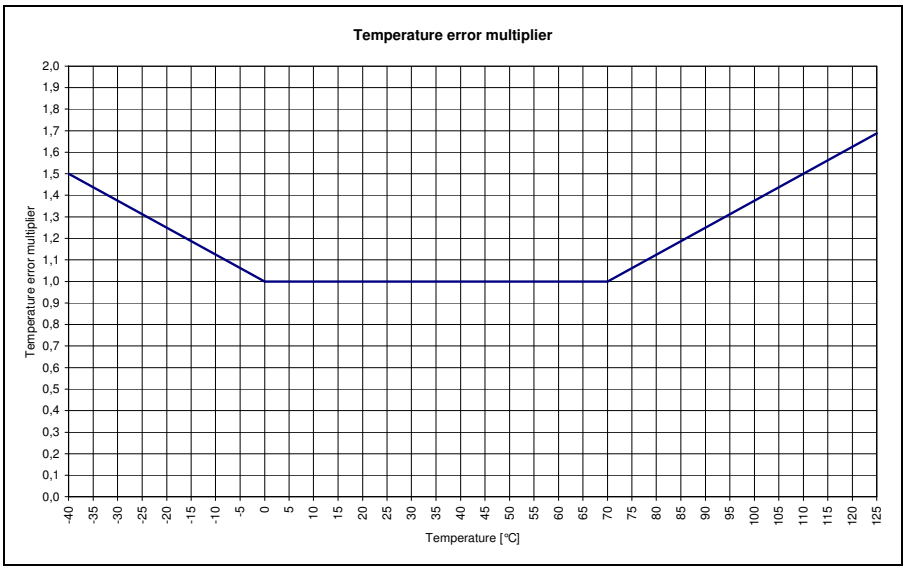
Conversion Formula

VR:
$$p_{meas} = \frac{(p_{r,\max} - p_{r,\min})}{V_{FS}} \cdot \left(\frac{V_{meas}}{V_{Supply}} - V_{out,\min} \right) + p_{r,\min}$$

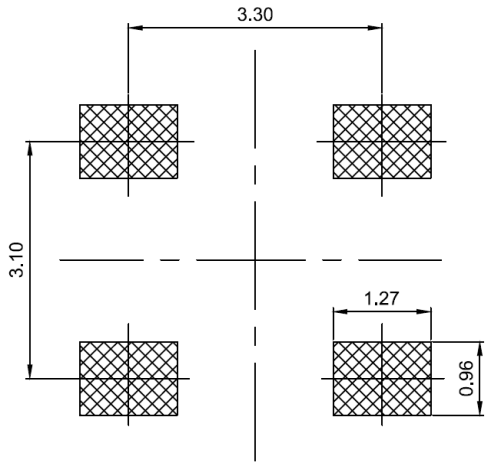
V1
$$p_{meas} = \frac{(p_{r,\max} - p_{r,\min})}{V_{FS}} \cdot (V_{meas} - V_{out,\min}) + p_{r,\min}$$

3. Total Error (Temperature Error Multiplier)

The output accuracy over the whole temperature range can be calculated by multiplying the basic accuracy with a temperature dependant factor as shown in the following graph.



4. Board Layout (Recommendation)



5. Reliability Testing

Test Criterion:

All sensors have to be within the specified tolerances (refer to chapters 1 – 4) before and after each test listed below.

Performed Tests:

Test	Standard	Test conditions
Early Life Failure Rate (ELFR)	following to AEC-Q100-008	- Storage for 24h at +105°C
Preconditioning (PC)	following to AEC-Q100, JEDEC J-STD-020 and JEDEC JESD22-A113	- Parts from ELFR test - 5 cycles shipping conditions (-40°C to +60°C) - Bake 24h at +125°C - Soak 192h at +30°C and 60% r.h. - Apply 3 reflow soldering cycles
High Temperature Storage Life (HTSL)	following to AEC-Q100 and JEDEC JESD22-A103	- Parts from PC test - Storage for 1000h at +125°C - Unpowered
High Temperature Operating Life (HTOL)	following to AEC-Q100 and JEDEC JESD22-A108	- Parts from ELFR test - Operating for 408h at +105°C - Powered with V_{supply} at +5VDC
Variable Frequency Vibration Test (VFV)	following to AEC-Q100 and JEDEC JESD22-B103	- Parts from ELFR test - Logarithmic sweep from 20Hz to 2KHz to 20Hz within 4min - Max. acceleration at 50g - 4 x 4min in each orientation (total 144min)
Mechanical Shock Test (MS)	following to AEC-Q100 and JEDEC JESD22-B104	- Parts from ELFR test - 5 pulses with 1,500g peak acceleration in positive vertical direction - Peak duration 0.5ms
Pressure Cycle Test	(Internal standard)	- Parts from ELFR test - 1,000,000 pressure cycles between minimum rated pressure ($p_{r,min}$) and overpressure (p_{ov}) - Test performed at room temperature

6. Product Key

ASB 1.200 VR TN H19 KXXXX

Customer Specific Index		Optional, reserved
Pressure Feed		Reserved
Operating Temperature Range	TN TE	Normal Temp. Range (-40 °C … +85 °C) Extended Temp. Range (-40 °C … +125 °C)* *only available upon request
Output signal	VR V1	0.1 ... 0.9 V/V (ratiometrical) 0 ... 1 V
Rated pressure range		1.200 bar (17.4 psi)
Measuring type	B	Barometric (Absolute)
Sensor type	AS	Advanced Surface Mount Technology

8. Ordering Codes

Rated Pressure p_r [bar] ([psi])	Normal Temperature Range					
	Ratiometric	**0..1000 mV**				
1.200 (17.4)	Samples available upon request					

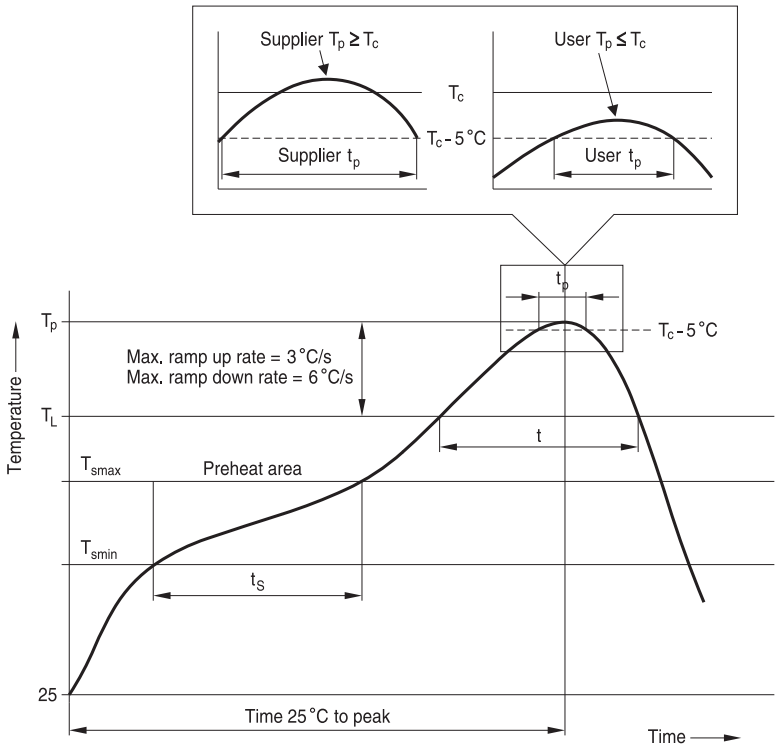
9. Packaging

Packaging for samples is separated in ESD bags and ESD box.

(Tape and reel packaging acc. to IEC 60286-3 will be defined.)

10. Reflow soldering

Recommended temperature characteristic for reflow soldering following JEDEC J-STD-020D



Profile feature		Sn-Pb eutectic assembly	Pb-free assembly
Preheat and soak			
- Temperature min	T_{smin}	100 °C	150 °C
- Temperature max	T_{smax}	150 °C	200 °C
- Time	t_{smin} to t_{smax}	60 … 120 s	60 … 180 s
Average ramp-up rate	T_{smax} to T_p	3 °C/s max.	3 °C/s max.
Liquidous temperature	T_L	183 °C	217 °C
Time at liquidous	t_L	60 … 150 s	60 … 150 s
Peak package body temperature	T_p [A)]	220 °C … 235 °C [B)]	245 °C … 260 °C [B)]
Time (t_p)[3)] within 5 °C of specified classification temperature (T_c)		20 s [C)]	30 s [C)]
Average ramp-down rate	T_p to T_{smax}	6 °C/s max.	6 °C/s max.
Time 25 °C to peak temperature		maximum 6 min	maximum 8 min

A) Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and a user maximum.

B) Depending on package thickness. For details please refer to JEDEC J-STD-020D.

C) Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.

Symbols and terms

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

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

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

4) **Rated pressure p_r**
Within the rated pressure range 0 up to $p_{r,max}$ the signal output characteristic corresponds to this specification.

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

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

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

8) **Start up time t_{STA}**
Time between the start up of the normal operation after power on and the first valid output signal.

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

10) **Signal span (Full Scale)**
Simple output: $V_{FS} = FS = V_{out}(p_{r,max}) - V_{A0}$

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

$$L = \frac{V_{out}(p_x) - V_{out,0}}{V_{out}(p_r) - V_{out,0}} - \frac{p_x}{p_r}$$

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

13) **Resolution r_{OUT}**
The resolution of the output DAC (digital/analog converter). For ratiometric output only 80% of DAC range is used.

Cautions and warnings

Storage

The 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 pressure sensors in an environment where condensation may form or in a location exposed to corrosive gases, which will adversely affect their performance.

Soldering

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

A no-clean flux should normally be used. Flux removal processes are not recommended.
Avoid rapid cooling due to dipping in solvent. Note that the output signal may change if pressure is applied to the terminals during soldering.

Operation

Media compatibility with the pressure sensors must be ensured to prevent their failure (see page 2).
The use of other media can cause damage and malfunction.
Never use them in atmospheres containing explosive liquids or gases.

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

If the operating pressure is not within the rated pressure range, it may change the output characteristics.
Be sure that the applicable pressure does not exceed the overpressure, it may damage the pressure sensor.

Do not exceed the maximum rated supply voltage, it may damage the pressure sensor.

Do not exceed the rated storage temperature range, 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 this publication.
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 characteristics.

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

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