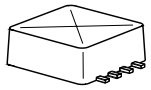
Surface Mount Piezoresistive Silicon Absolute Pressure Sensor

KP 202-R/RK
KP 203-R/RK

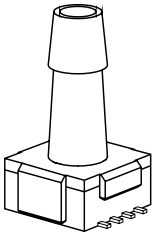
Preliminary

Features

- High sensitivity and linearity
- Fast response
- Very small dimensions
- Low cost
- Produced in qualified semiconductor fabrication lines
- SMD housing
- Built in silicon temperature sensor



P-DSOF-8-1

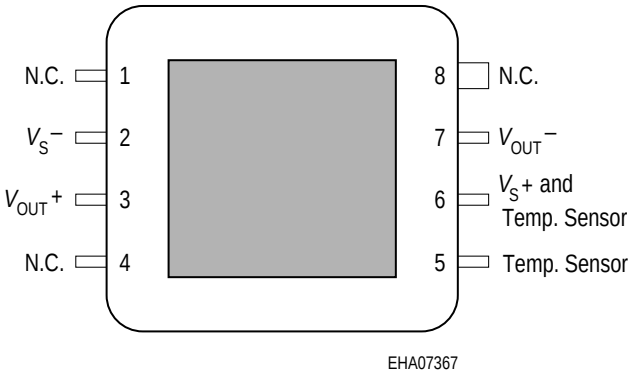


P-DSOF-8-2

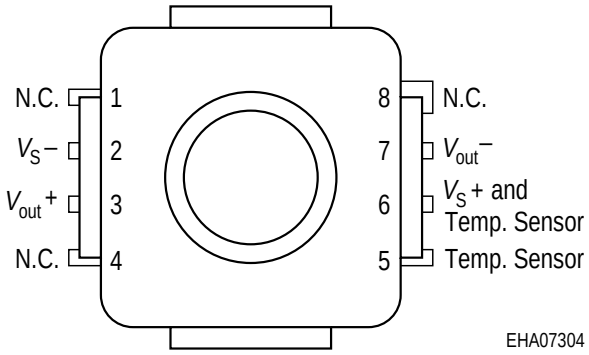
Type	Marking	Ordering Code	Pressure Range	Package
KP 202-R	KP 202-R	on request	0 … 60 kPa (0.6 bar)	P-DSOF-8-1
KP 202-RK			0 … 60 kPa (0.6 bar)	P-DSOF-8-2
KP 203-R	KP 203-R	on request	0 … 160 kPa (1.6 bar)	P-DSOF-8-1
KP 203-RK			0 … 160 kPa (1.6 bar)	P-DSOF-8-2

Pin Configuration

1	Not connected
2	V_S –
3	V_{OUT} +
4	Not connected
5	Temperature Sensor
6	V_S + and Temperature Sensor
7	V_{OUT} –
8	Not connected



KP 20x-R



KP 20x-RK

Electric Network

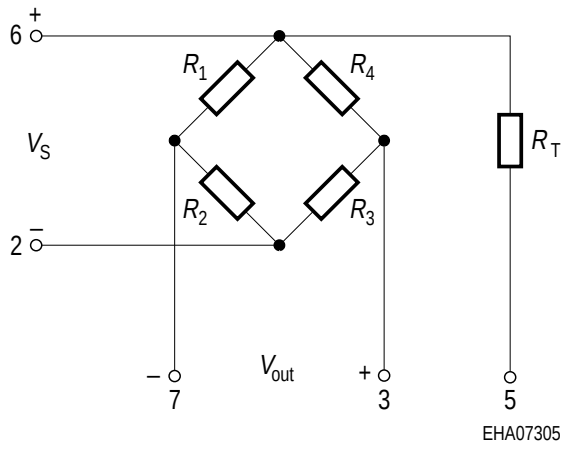
Four piezoresistors form a bridge circuit, providing a very accurate and linear output voltage, directly proportional to the applied pressure.

$$V_{OUT} = V_O + V_{FIN} = V_S \times \frac{R_1(p) \times R_3(p) - R_2(p) \times R_4(p)}{[R_1(p) + R_2(p)] \times [R_3(p) + R_4(p)}$$

with

$$R_1(0) \cong R_2(0) \cong R_3(0) \cong R_4(0) \cong R_B$$

A temperature sensor chip R_T, that is built in the housing, can be used to compensate the temperature drift of the pressure sensor.



Sensor Schematic

Piezoresistors $R_1 \ldots R_4$ denote the pressure sensitive resistors connected as a Wheatstone bridge. R_T is a KTY-series temperature dependent resistor with a positive TC.

Absolute Maximum Ratings

Parameter	Symbol	Limit Values	Unit
Supply voltage	$V_{S\,MAX}$	12	V
Overpressure[1)]	p_{MAX}	250	kPa
Burst Pressure KP 202-R, KP 202-RK KP 203-R, KP 203-RK	p_{BURST}	 400 800	kPa
Operating temperature range	T_{OP}	– 40 … + 125	°C
Storage temperature range	T_{STG}	– 40 … + 125	°C
Mechanical shock survival		2000	g

1) Overpressure is limited to p_{MAX}, due to absorption of gas into the protective gel covering the sensor at higher pressures. Abrupt decrease of pressure from values higher than p_{MAX} to low pressures can cause in the gel to rupture.

Electrical Characteristics

at T_A= 25 °C and V_S = 5 V unless otherwise specified

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Pressure Range	P_N				kPa
KP 202-R, KP 202-RK		0	–	60	
KP 203-R, KP 203-RK		0	–	160	
Bridge Resistance	R_B	4	6	8	kΩ
Sensitivity	s				mV/V × kPa
KP 202-R, KP 202-RK		0.24	0.44	0.74	
KP 203-R, KP 203-RK		0.11	0.20	0.30	
Full Scale Span ($p = p_N$, V_S = 5 V)	V_{FIN}				mV
KP 202-R, KP 202-RK		72	132	222	
KP 203-R, KP 203-RK		88	160	240	
Offset signal $p = p_0$	V_O	– 25	–	+ 25	mV
Linearity error (best fit straight line) $p = p_0 \cdots p_N$	F_L				% V_{FIN}
KP 202-R, KP 202-RK		–	± 0.3	–	
KP 203-R, KP 203-RK		–	± 0.3	–	
Pressure Hysteresis	P_H				% V_{FIN}
KP 202-R, KP 202-RK		–	–	–	
KP 203-R, KP 203-RK		–	± 0.1	–	

Temperature Characteristics

at T_1 = 25 °C, T_2 = 90 °C, T_3 = 25 °C and V_S = 5 V unless otherwise specified

Parameter	Symbol	Limit Values			Unit
		min.	typ.	max.	
Temperature Coefficient of Span [1]	TC_{VFIN}	–	– 0.17	-	% K^{-1}
Temperature Coefficient of Offset [1]	TC_{V0}				% K^{-1}
KP 202-R, KP 202-RK		–	± 0.01	–	
KP 203-R, KP 203-RK		–	± 0.01	–	
Temperature Coefficient of Bridge Resistance [2]	TC_{RB}	–	+ 0.26	-	% K^{-1}
Temperature Hysteresis of Span [3]	TH_{VFIN}				% K^{-1}
KP 202-R, KP 202-RK		–	± 0.4	–	
KP 203-R, KP 203-RK		–	± 0.3	–	
Temperature Hysteresis of Offset [3]	TH_{V0}				% V_{FIN}^{-1}
KP 202-R, KP 202-RK		–	± 0.3	–	
KP 203-R, KP 203-RK		–	± 0.3	–	

[1] Change in value of TC V_{FIN} or TCV between 25 °C and 125 °C relative to V_{FIN} (25 °C)
[2] Change in RB between 25 °C and 125 °C relative to RB (25 °C)
[3] Change in V_0 (25 °C) or V_{FIN} (25 °C) after temperature cycle 25 °C → 125 °C → 25 °C relative to V_{FIN} (25 °C)

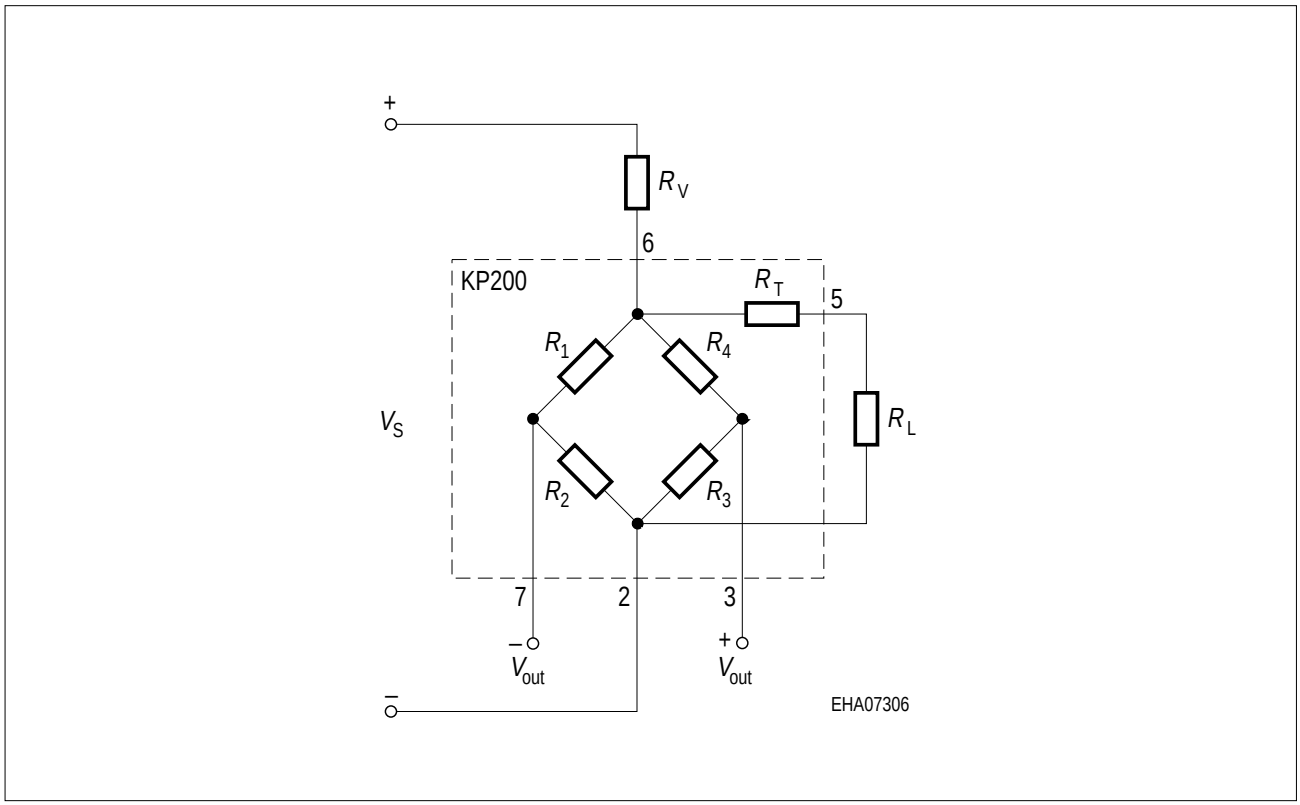
Temperature Compensation

Cost-effective temperature compensation can be achieved using standard ohmic resistors in combination with the built in temperature sensor.

With fixed values for R_V and R_L a temperature compensation error of the output signal (span plus offset) of typical less then ± 1% is achieved in the range 10 °C to 40 °C (see figure below).

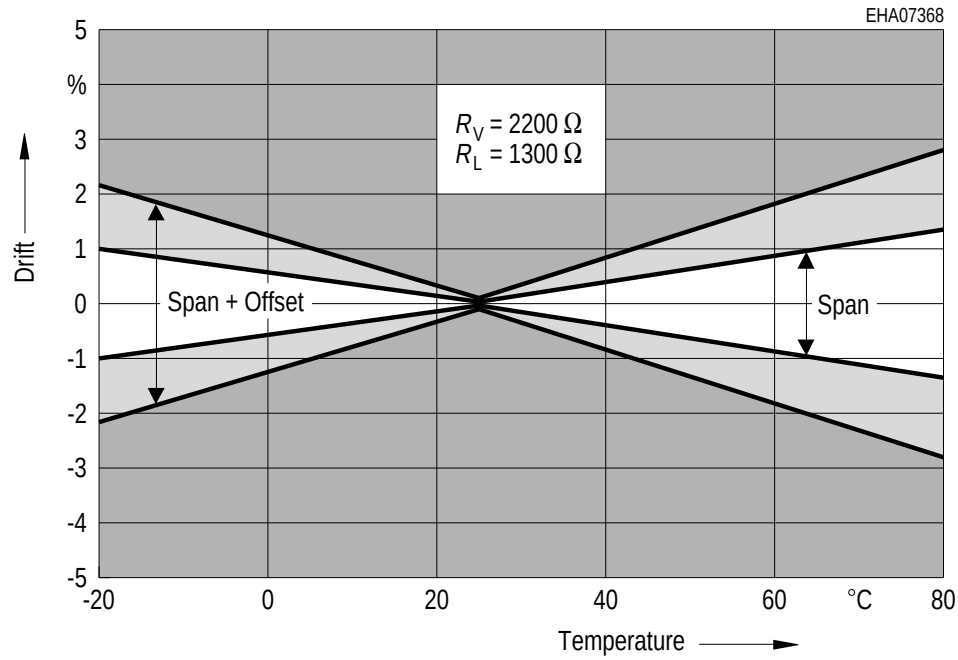
A better temperature compensation is possible by measurement of the temperature coefficients of the sensor. In this case R_V is optimized as described in Siemens databook 03.97 pages 45-46 (or website: http://www.siemens.de/semiconductor).

Alternatively an ASIC can be used for calibration and compensation.



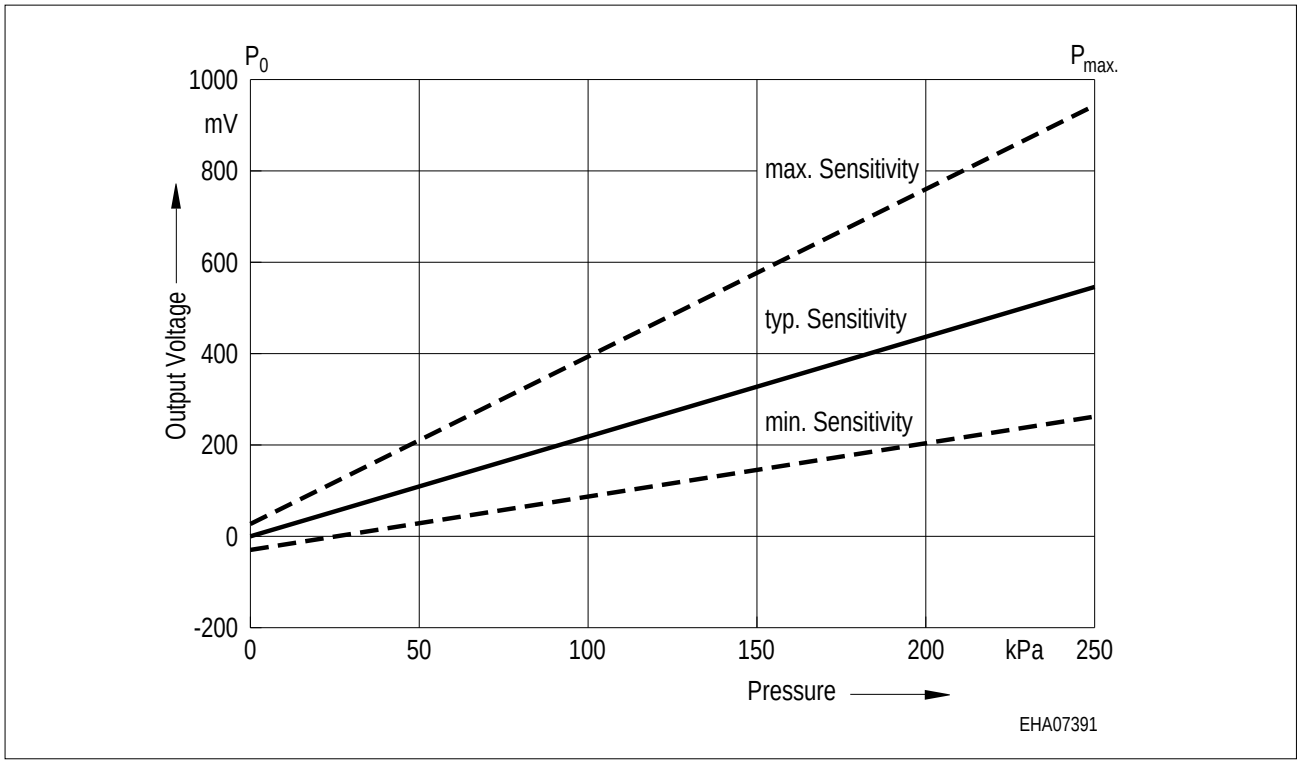
Electrical Circuit for Temperature Compensation

Broken line denotes sensor assembly. R_V and R_L need to be added externally.

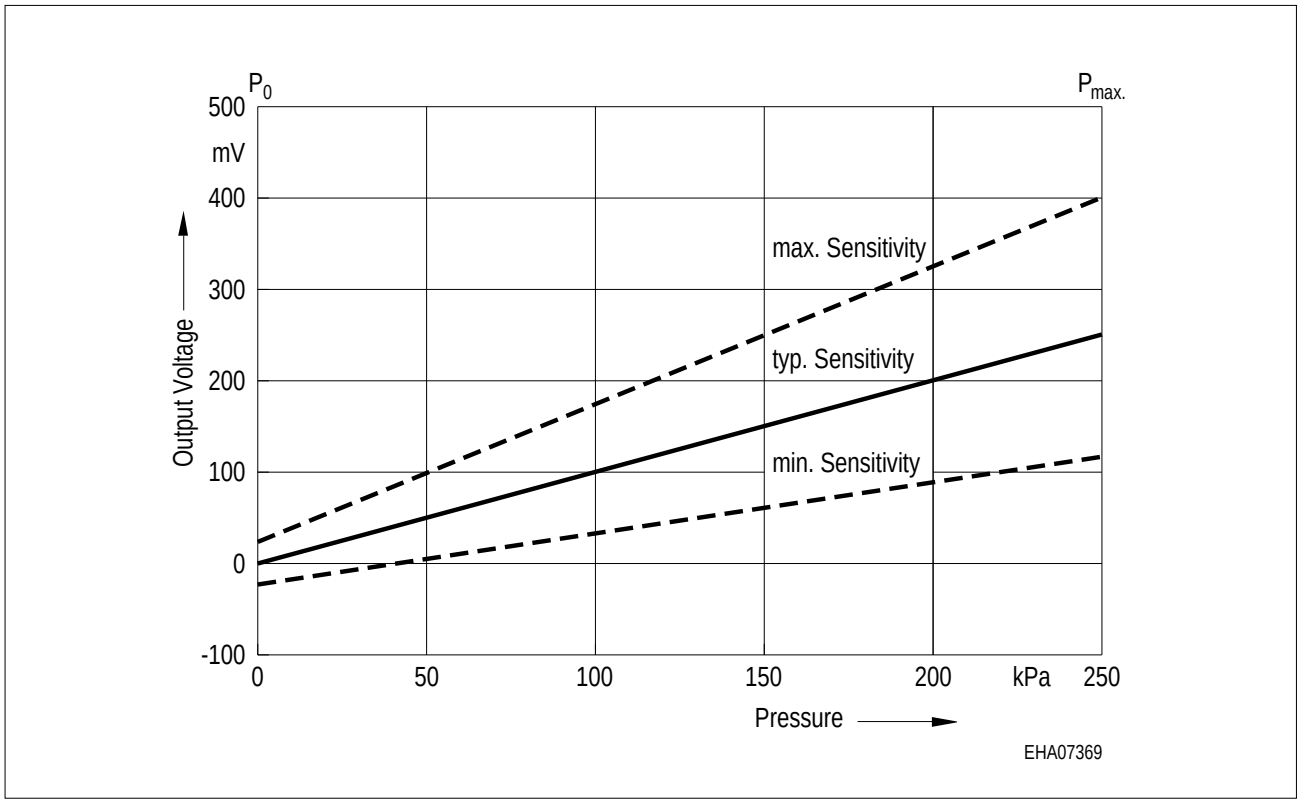


Error Band of Typical Signal Drift after Temperature Compensation Using Fixed Values for R_V and R_L

Using fixed resistor R_V = 2200 Ω and R_L = 1300 Ω. Graph shows typical results for compensated span + offset signals.



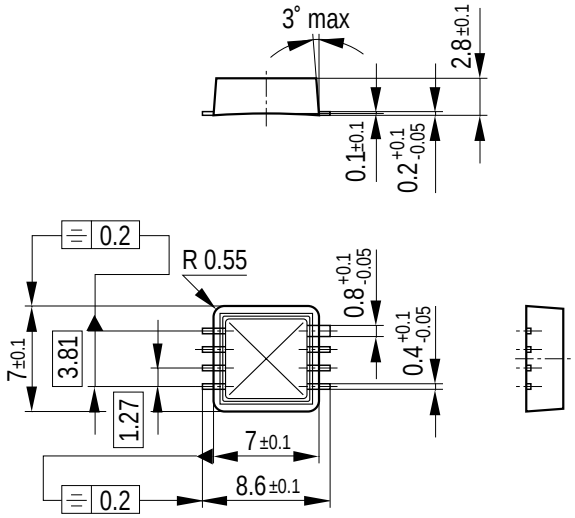
Output Voltage for Nominal and Maximal Pressure Range KP 202-R, KP 202-RK



Output Voltage for Nominal and Maximal Pressure Range KP 203-R, KP 203-RK

Package Outlines

P-DSOF-8-1
(Plastic Dual Small Outline Flat Package)



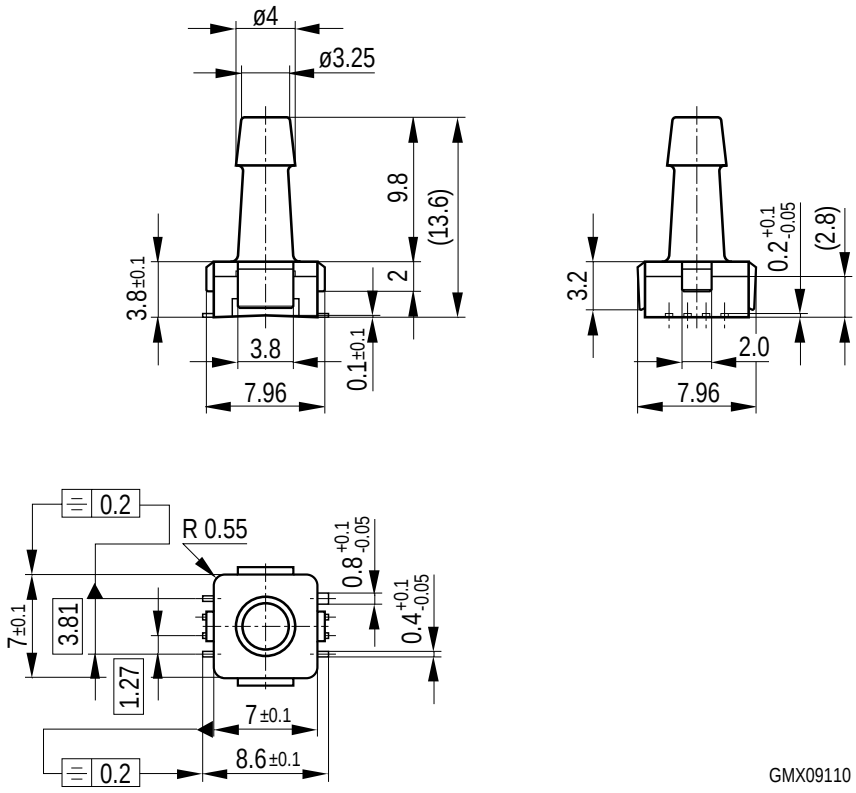
The package is made of a thermoplast housing and copper leadframe with NiPdAu finish. The chip is glued into the premolded plastic package using silicone glue, gold-wire bonded and covered with a protective gel. The pressure vent hole in the rear side of the package is 2.0 ± 0.3 mm in diameter. Finally the pressure port cap is mounted on the housing.

Sorts of Packing
Package outlines for tubes, trays etc. are contained in our Data Book “Package Information”.

Dimensions in mm

P-DSOF-8-2 Subject to change

(Plastic Dual Small Outline Flat Package)



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Dimensions in mm