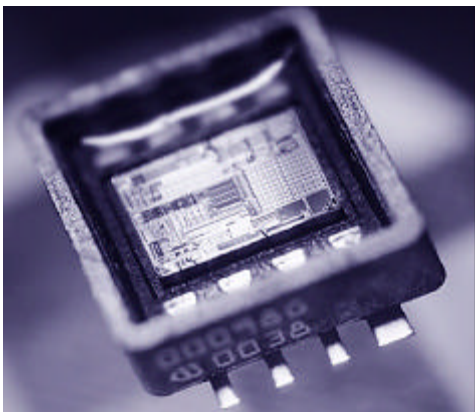


# Surface Mount Capacitive Silicon Absolute Pressure Sensor KP120, KP120 Exxxx



Sensors



Never stop thinking.

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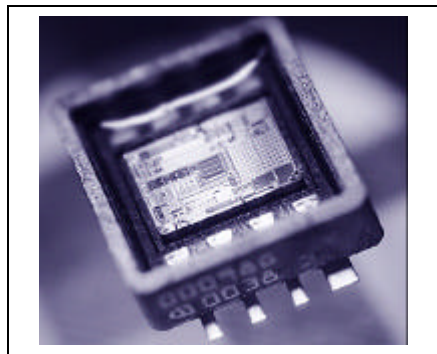
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## Surface Mount Capacitive Silicon Absolute Pressure Sensor

### KP120, KP120 Exxxx

#### Features

- Ratiometric analog output
- Calibrated transfer function
- High accuracy over a large temperature range (1.5 kPa max. error over 0 ... 85 °C)
- CMOS compatible surface micromachining
- SMD housing
- Customized transfer functions available (KP120 Exxxx)



**P-DSOF-8-5**

Type	Ordering Code	Pressure Range	Overall Accuracy	Package
KP120	Q62705-K352	40 kPa - 115 kPa	1.2 kPa	P-DSOF-8-5

#### Product Description

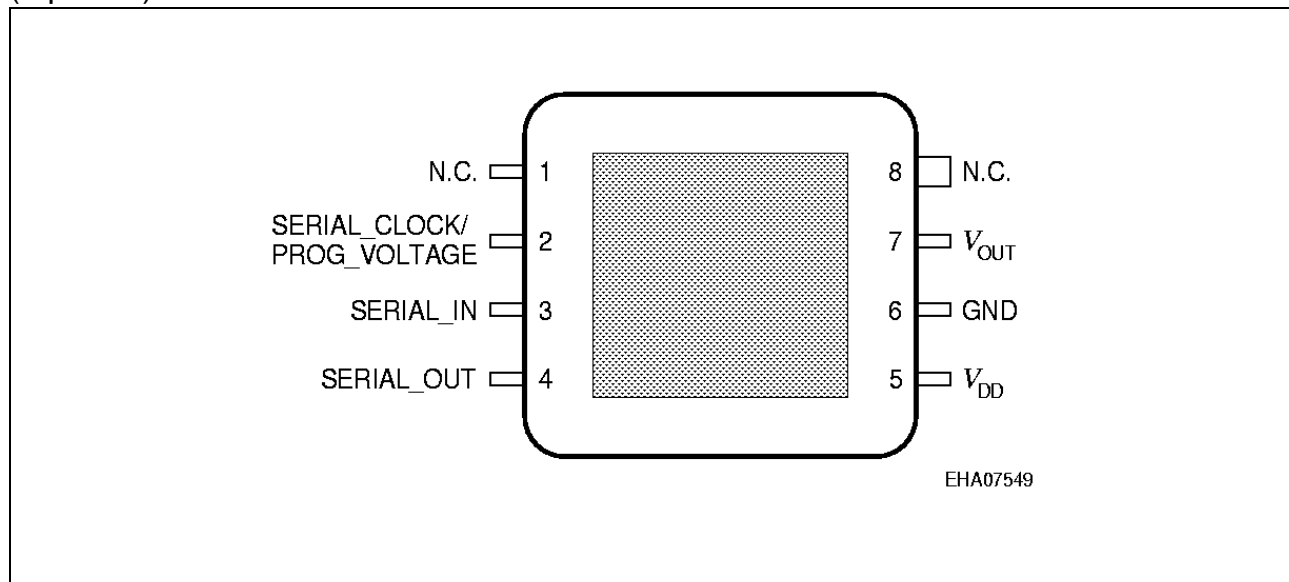
The KP120 is a miniaturized absolute pressure sensor IC based on the capacitive principle. It is surface micromachined with a monolithic integrated signal conditioning circuit realized in the state-of-the-art 0.8  $\mu\text{m}$  BiCMOS technology. As the KP120 is a high precision IC for cost critical solutions the chip is packaged in a low cost SMD housing. High accuracy and high sensitivity enable the dedication in automotive applications as well as consumer products.

In the automotive field the manifold air pressure (MAP) and barometric air pressure (BAP) are important parameters to compute the air-fuel ratio provided to the engine and for controlling spark advance to optimize engine efficiency.

The IC consists of a surface micromachined pressure sensor, a sigma-delta A/D-converter, a digital filter and the SPI-interface. In normal operation, the applied pressure has to be in the range between 10 kPa and 150 kPa and the KP120, KP120 Exxxx can deliver output voltages between 0.25 V and 4.85 V.

## Pin Configuration

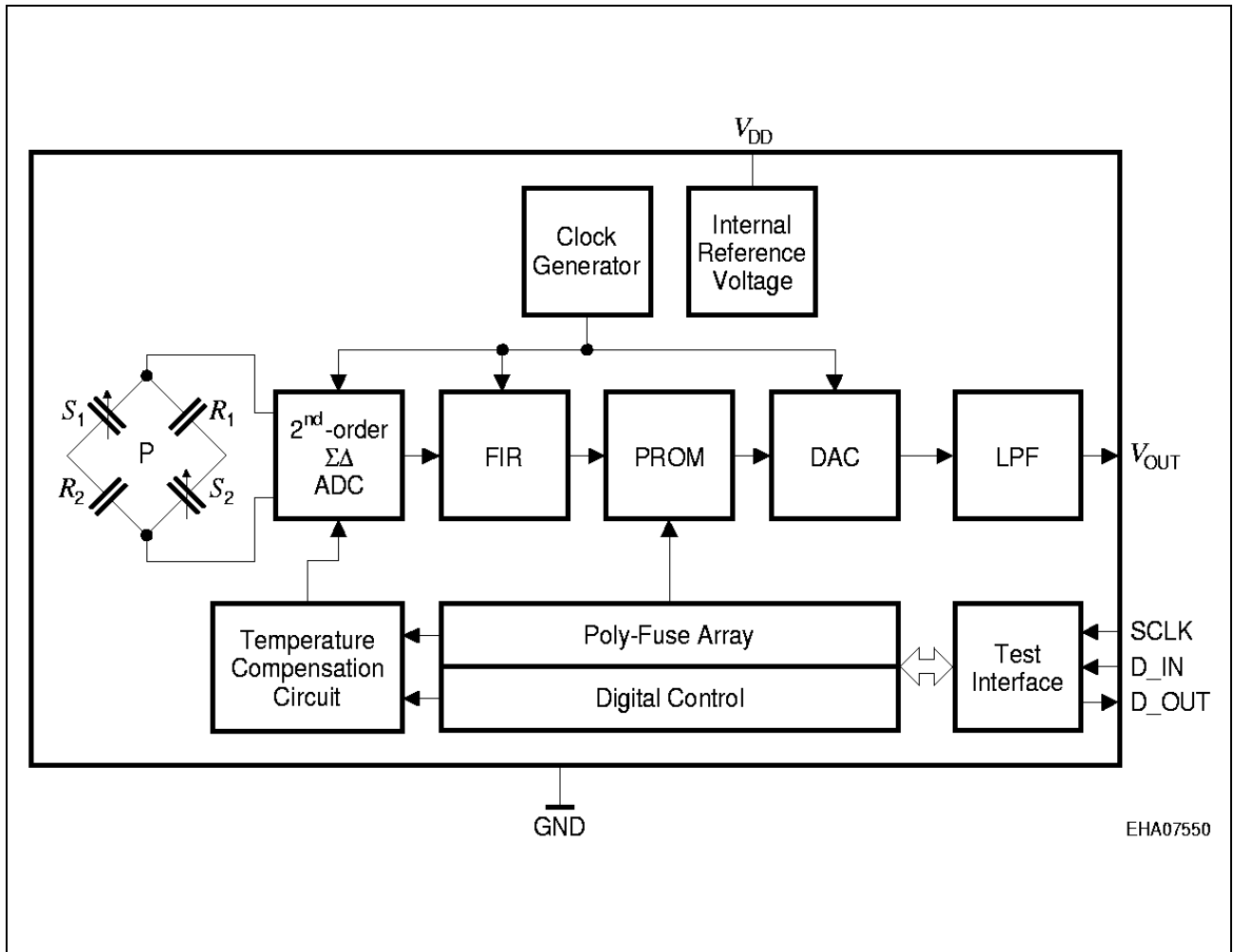
(top view)



**Figure 1**

## Pin Definitions and Functions

Pin No.	Symbol	Function
1	N.C.	Not to be connected
2	SERIAL_CLK/ PROG_VOLT	Used for calibration in manufacturing
3	SERIAL_IN	Used for calibration in manufacturing
4	SERIAL_OUT	Used for calibration in manufacturing
5	$V_{DD}$	5 V Supply voltage
6	GND	0 V Circuit ground potential
7	$V_{OUT}$	Output
8	N.C.	Not to be connected



**Figure 2**      **Block Diagram of the KP120**

## Transfer Function

The device is fully calibrated on delivery. The sensor has a linear transfer function between the applied pressure and the output signal:

$$V_{\text{OUT}} = V_{\text{DD}} \times (\mathbf{a} \times p + \mathbf{b})$$

The output is ratiometric.

The gain **a** and the offset **b** are calibrated to realize the demanded transfer function.

## Transfer Function KP120

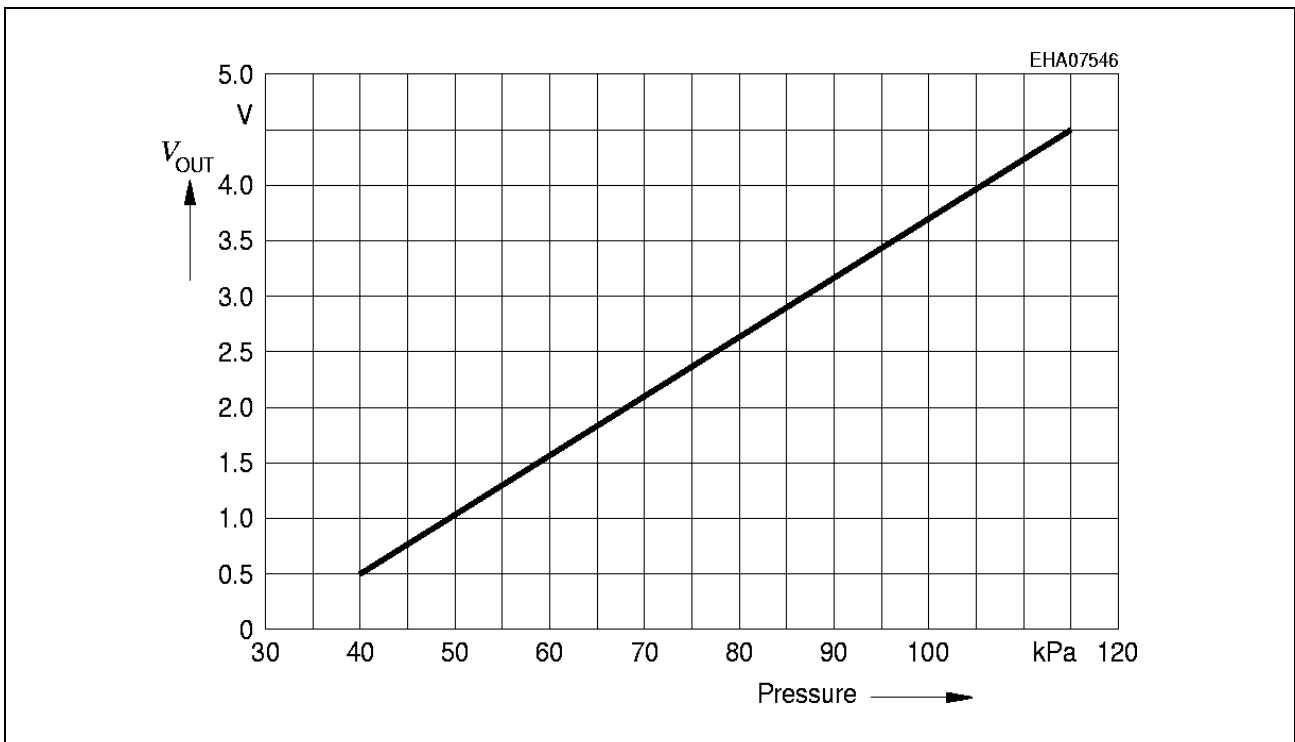
With the parameters **a** and **b** the following calibration is adjusted:

$$p_{\text{N, MIN}} = 40 \text{ kPa} \rightarrow V_{\text{OUT}} = 0.5 \text{ V and}$$

$$p_{\text{N, MAX}} = 115 \text{ kPa} \rightarrow V_{\text{OUT}} = 4.5 \text{ V. (@ } V_{\text{DD}} = 5 \text{ V)}$$

The nominal transfer function for KP120 is given by:

$$V_{\text{OUT}} = 5.000 \text{ V} \times \left( 0.01067 \times \frac{p}{\text{kPa}} - 0.32667 \right)$$



**Figure 3** Nominal Transfer Function for the KP120 Version

## Absolute Maximum Ratings

Parameter	Symbol	Limit Value KP120 and KP120 Exxxx		Unit
		min.	max.	
Supply voltage	$V_{DD}$	– 0.3	6.0	V
Supply voltage <sup>1)</sup>	$V_{DD}$	–	16.5	V
Pressure overload (300 sec.)	$P_{MAX}$	–	360	kPa
Burst pressure	$p_{BURST}$	400	–	kPa
Ambient Temperature	$T_A$	– 40	125	°C

1) 1h@70 °C

*Note: Stresse above those listed here may cause permanent damage to the device.  
Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## ESD Protection

Human Body Model (HBM) tests according to:  
Standard EIA/JESD22-A114-B HBM (covers MIL STD 883D)

Parameter	Symbol	Limit Values		Unit	Notes
		min.	max.		
ESD-Protection	$V_{ESD}$	–	$\pm 2$	kV	$R = 1.5 \text{ k}\Omega$ , $C = 100 \text{ pF}$

**Operating Range**

Parameter	Symbol	Limit Value			Unit
		min.	typ.	max.	
Supply voltage	$V_{DD}$	4.75	5.0	5.25	V
Supply current @ 5 V	$I_{IN}$	2	–	9	mA
Output current (sink/source) <sup>1)</sup>	$I_{OUT}$	– 0.25		0.25	mA
Operating Ambient Temperature <sup>2)</sup>	$T_A$	– 40	–	+125	°C
Minimum rated pressure KP120 KP120 Exxxx	$p_{N, MIN}$	– 10	40 –	– 50	kPa
Maximum rated pressure KP120 KP120 Exxxx	$p_{N, MAX}$	– 100	115 –	– 150	kPa
Pressure span KP120 KP120 Exxxx	$P_{SPAN}$	– 70	75 –	– 105	kPa

1) sink current: current into device  
source current: current driven by device

2) –40 °C ... 125 °C (1000h),  
–40 °C ... 85 °C (5000h)

## Electrical Characteristics

$V_{DD} = 5\text{ V}$ ,  $GND = 0\text{ V}$ ,  $T_A = 0\text{ °C}$  to  $+85\text{ °C}$ , unless otherwise specified.

Parameter	Symbol	Limit Value			Unit
		min.	typ.	max.	
Output voltage at min. rated pressure <sup>1)</sup> KP120 KP120 Exxxx	$V_{OUT, MIN}$	– 0.25	0.5 –	– 0.5	V
Output voltage at max. rated pressure <sup>1)</sup> KP120 KP120 Exxxx	$V_{OUT, MAX}$	– 4.5	4.5 –	– 4.85	V
Overall accuracy <sup>2)</sup>	$A_{CC}$	see page 11			kPa
Ratiometricity <sup>3)</sup> KP120 KP120 Exxxx	Rat	– –	5 –	– 10	mV
Response time <sup>4)</sup>	$t_R$	–	5	–	ms
Output ripple @ $f > 1\text{ kHz}$ @ $f < 1\text{ kHz}$		– –	– –	10 5	mVpp
Stabilization time <sup>5)</sup>		–	–	20	ms

1) The output of the sensor is ratiometric to the supply voltage  $V_{DD}$  within its specified range of 4.75 to 5.25 V.

2) Accuracy is the deviation in actual output from nominal output over the entire pressure and temperature range according to figure below due to all sources of error including the following:

■Linearity:

Output deviation from a straight line relationship with pressure over the specified pressure range.

3) Definition:

$$\text{Rat} = \frac{V_{OUT}(@V_{DD}) - V_{OUT}(@5\text{ V})}{5\text{ V}} \cdot V_{DD}$$

for  $V_{OUT}$  in the range of  $0.1 \times V_{DD}$  to  $0.9 \times V_{DD}$   
and  $V_{DD}$  in the range of 4.75 V to 5.25 V

4) Response time is defined as the time for the incremental change in the output to go from 10% to 90% of its final value when subjected to a specified step change in pressure.

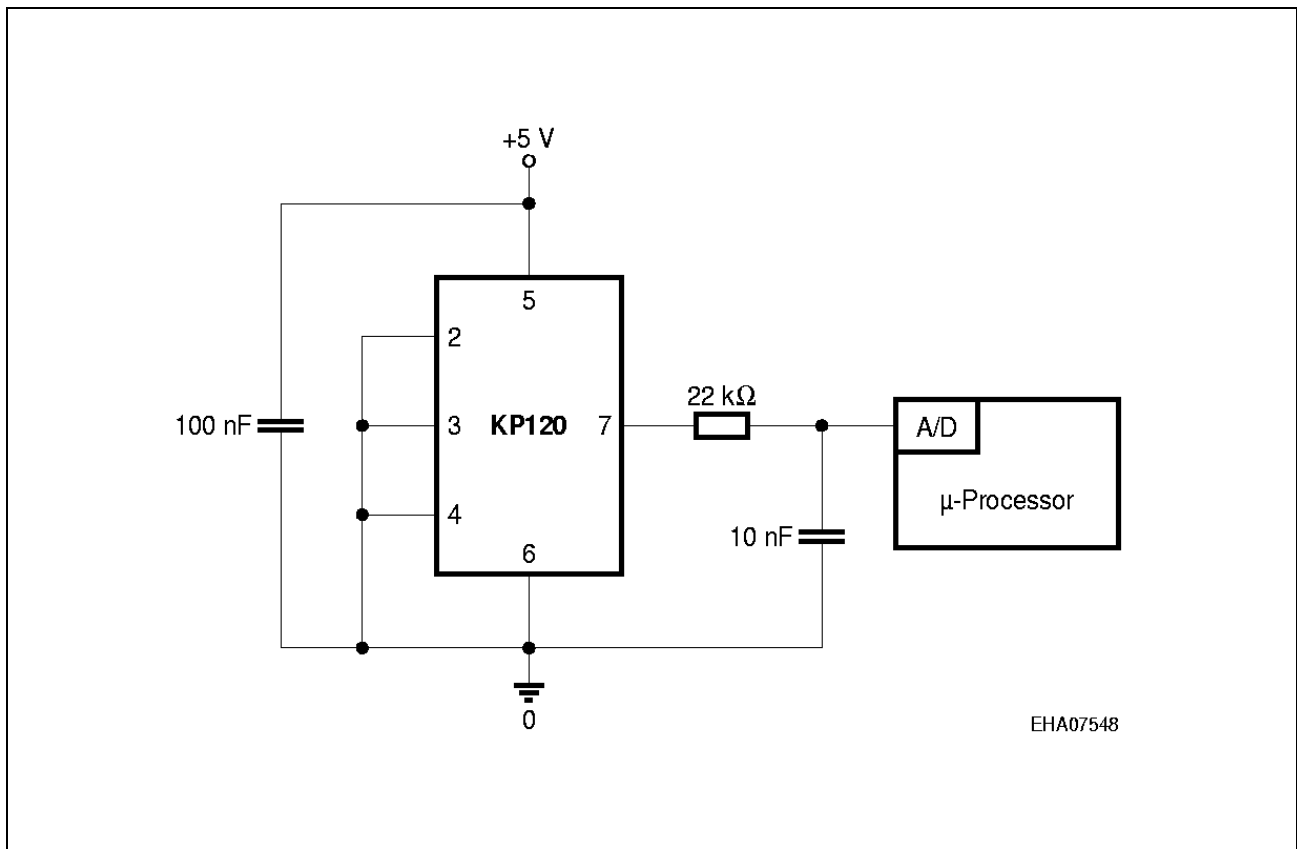
5) Stabilization time is defined as the time required for the product to meet the specified output voltage after the pressure has been stabilized.

## Circuitry

It is recommended, that the input circuit of the pressure sensor IC is protected against overload voltage and electro-magnetic influences. Therefore, a 100 nF capacitance should be arranged in parallel (like shown in <Fett>Figure 4).

The output circuitry acts as a low pass decoupling filter (cut off frequency here: 720 Hz) between the output of the sensor IC and the A/D input of the  $\mu$ C.

*Note: Circuitries of customer specific applications may deviate from this circuitry.*



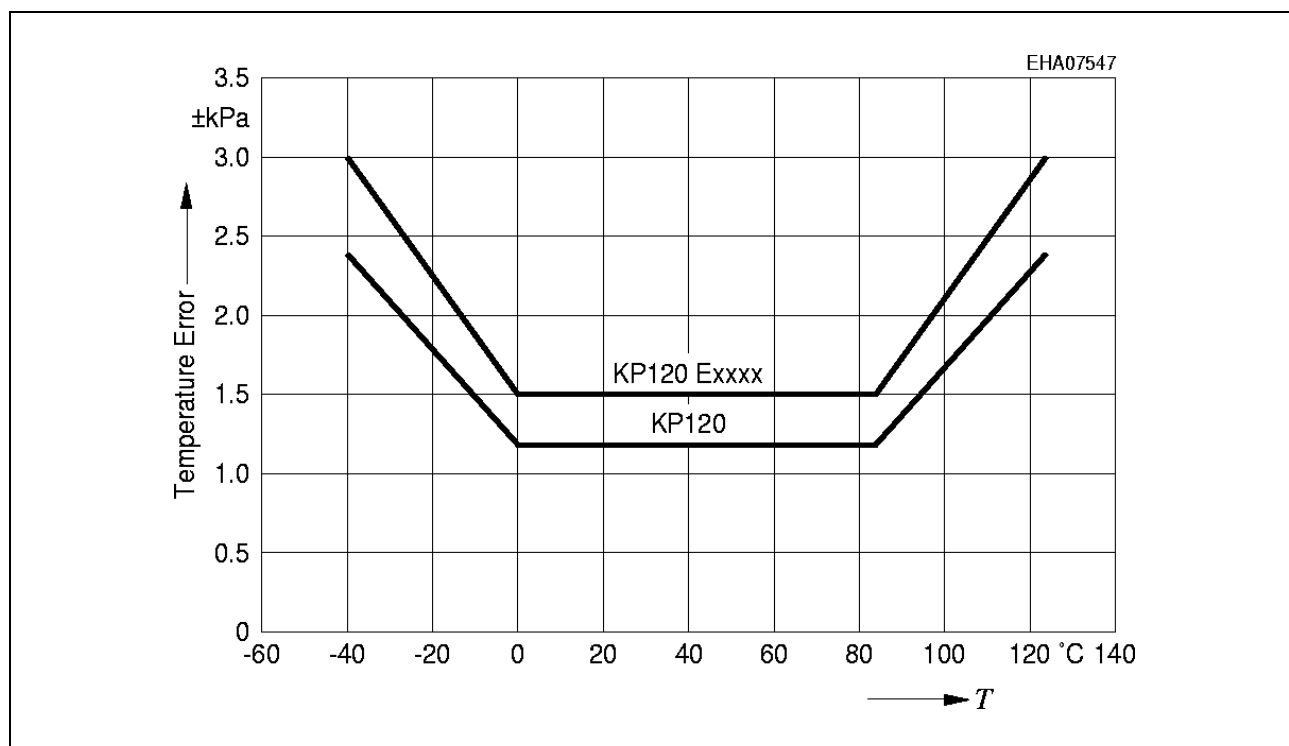
**Figure 4 Feasible In-/Output Circuitry of the KP120, KP120 Exxxx**

The output circuit is protected against short circuit to  $V_{DD}$  and GND.

## Overall Accuracy

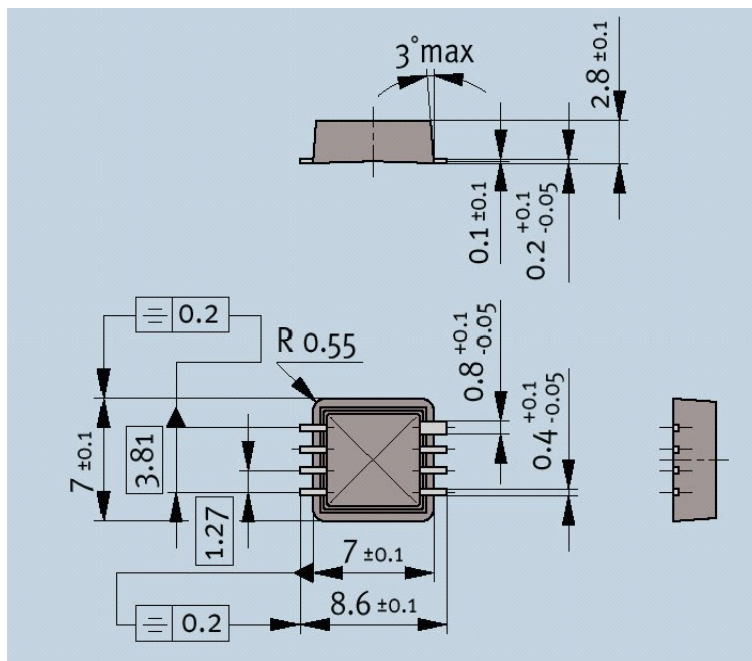
The maximum temperature error is determined by a continuous line through four relevant break points:

Break point (°C)	Overall Accuracy (kPa) KP120	Overall Accuracy (kPa) KP120 Exxxx
-40	± 2.4	± 3.0
0	± 1.2	± 1.5
85	± 1.2	± 1.5
125	± 2.4	± 3.0



**Figure 5 Overall Accuracy over Temperature**

## (Plastic Dual Small Outline Flat Package)



GMX09490

Dimensions in mm

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**Revision History:V1.1**

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Previous Version: 1.0

Page	Subjects (major changes since last revision)
7,8	Sink and source current defined within operating range

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