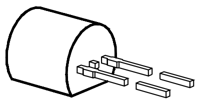
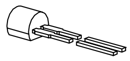
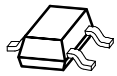
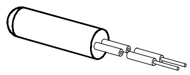
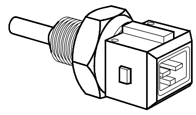
## Silicon Temperature Sensors

| Resistance | Package | | | | |
|---|---|---|---|---|---|
| $R_{25}$<br>Ω |  |  |  |  |  |
| | **Modified TO-92** | **TO-92mini** | **SOT-23** | **Custom** | **Custom** |
| 1940 – 2060 | KT 100 | KT 110 | KT 130 | – | – |
| 1950 – 1990 | KTY 10-5 | KTY 11-5 | KTY 13-5 | – | – |
| 1980 – 2020 | KTY 10-6 | KTY 11-6 | KTY 13-6 | KTY 16-6 | KTY 19-6 |
| 1990 – 2010 | KTY 10-62 | – | – | – | – |
| 2010 – 2050 | KTY 10-7 | KTY 11-7 | KTY 13-7 | – | – |
| 970 – 1030 | – | KT 210 | KT 230 | – | – |
| 975 – 995 | – | KTY 21-5 | KTY 23-5 | – | – |
| 990 – 1010 | – | KTY 21-6 | KTY 23-6 | – | – |
| 1005 – 1025 | – | KTY 21-7 | KTY 23-7 | – | – |

## General Technical Data: KT- and KTY-Series Temperature Sensors

These temperature sensors are designed for the measurement, control and regulation of air, gases and liquids within the temperature range of – 50 °C to + 150 °C. The temperature sensing element is an n-conducting silicon crystal in planar technology. The gentle curvature of the characteristic, $R_T = f(T_A)$, is described as a regression parabola in the following expressions.

The resistance of the sensor can be calculated for various temperatures from the following second order equation, valid over the temperature range – 30 °C to + 130 °C.

$$R_T = R_{25} \times (1 + \alpha \times \Delta T_A + \beta \times \Delta T_A^2) = f(T_A)$$

with: $\alpha = 7.88\ 10^{-3}\ K^{-1}$; $\beta = 1.937\ 10^{-5}\ K^{-2}$

The temperature factor $k_T$ can be derived from this:

$$k_T = \frac{R_T}{R_{25}} = 1 + \alpha \times \Delta T_A + \beta \times \Delta T_A^2 = f(T_A)$$

The temperature at the sensor can be calculated from the change in the sensors resistance from the following equation, which approximates the characteristic curve.

$$T = \left( 25 + \frac{\sqrt{\alpha^2 - 4 \times \beta + 4 \times \beta \times k_T} - \alpha}{2 \times \beta} \right) ^\circ C$$

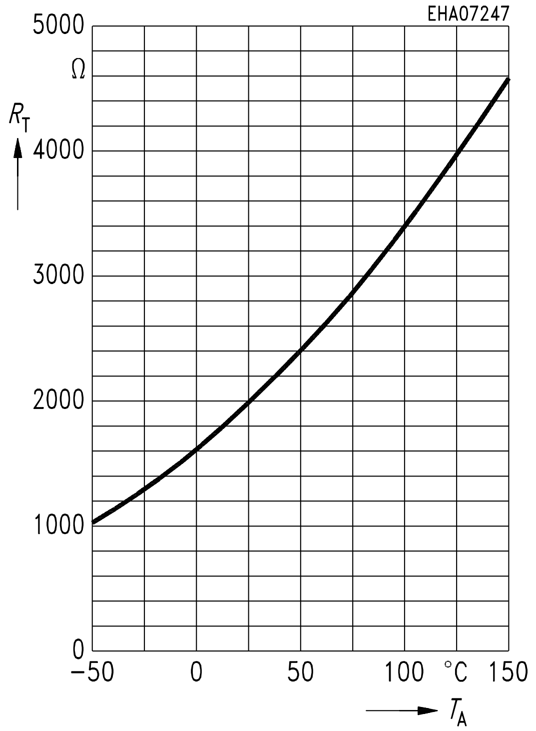
**Table 1**
**Spread of the Temperature Factor $k_T$**

| $T_A$ °C | $k_T$ min. | $k_T$ typ. | $k_T$ max. |
|---|---|---|---|
| – 50 | 0.506 | 0.518 | 0.530 |
| – 40 | 0.559 | 0.570 | 0.581 |
| – 30 | 0.615 | 0.625 | 0.635 |
| – 20 | 0.676 | 0.685 | 0.694 |
| – 10 | 0.741 | 0.748 | 0.755 |
| 0 | 0.810 | 0.815 | 0.821 |
| 10 | 0.883 | 0.886 | 0.890 |
| 20 | 0.960 | 0.961 | 0.962 |
| 25 | | 1.0 [1)] | |
| 30 | 1.039 | 1.040 | 1.041 |
| 40 | 1.119 | 1.123 | 1.126 |
| 50 | 1.204 | 1.209 | 1.215 |
| 60 | 1.291 | 1.300 | 1.308 |
| 70 | 1.383 | 1.394 | 1.405 |
| 80 | 1.478 | 1.492 | 1.506 |
| 90 | 1.577 | 1.594 | 1.611 |
| 100 | 1.680 | 1.700 | 1.720 |
| 110 | 1.786 | 1.810 | 1.833 |
| 120 | 1.896 | 1.923 | 1.951 |
| 130 | 2.010 | 2.041 | 2.072 |
| 140 | 2.093 | 2.128 | 2.163 |
| 150 | 2.196 | 2.235 | 2.274 |

1) Normalising point

**Sensor Resistance** $R_T = k_T \times R_{25} = f\,(T_A)$

$I_B$ = 1 mA; Example: $R_{25}$ = 2000 Ω

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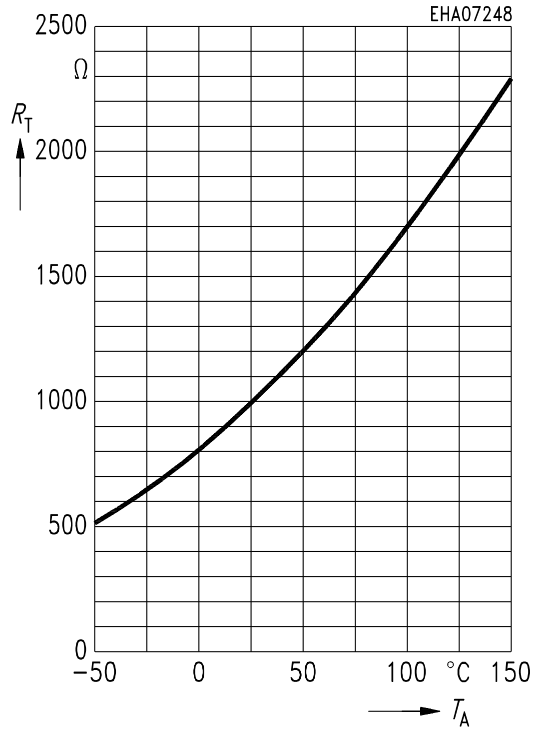
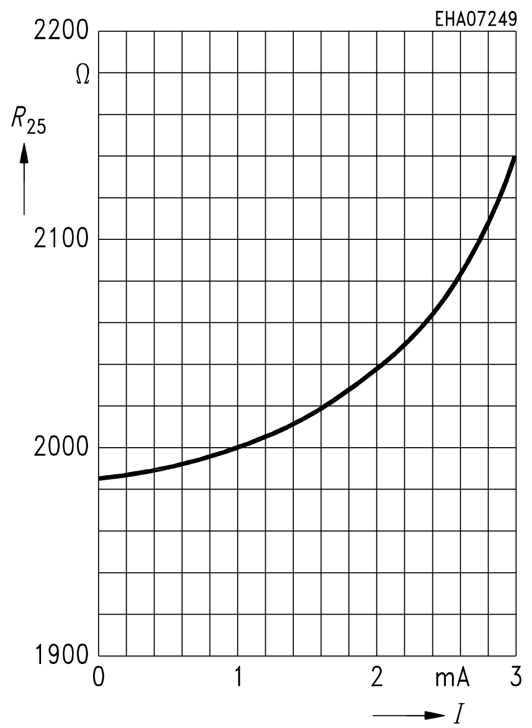


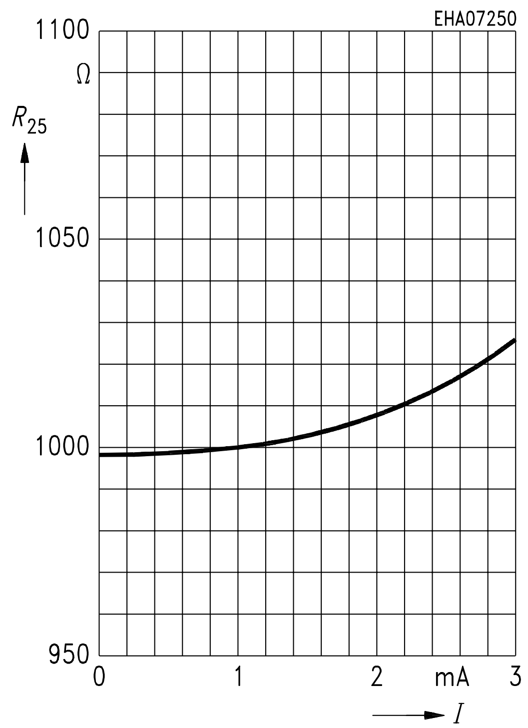

**Typical Dependence of Sensor Resistance on Supply Current**

Example: KTY 10-6 in oil at $T_A$ = 25 °C



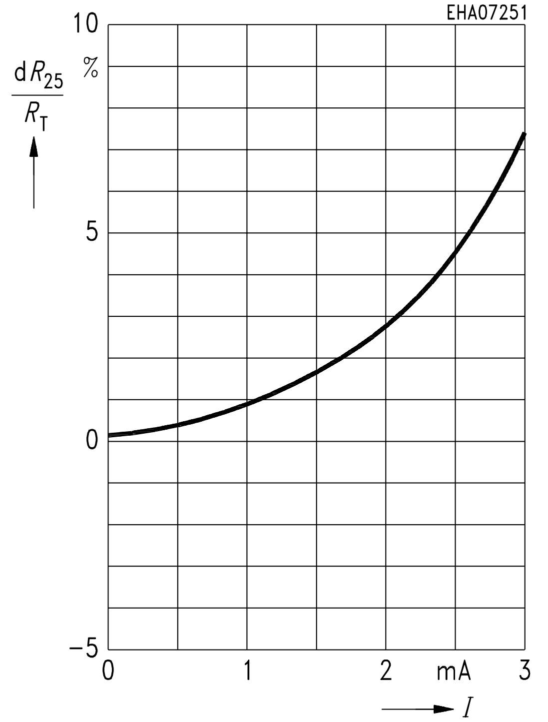

**Typical Dependence of Sensor Resistance on Supply Current**

Example: KTY 21-6 in oil at $T_A$ = 25 °C



**Typical Deviation of Sensor Resistance from the Basic Resistance $R_{25}$ ($I_B$ = 1mA) Versus Supply Current**

Example: KTY 10-6 in oil at $T_A$ = 25 °C

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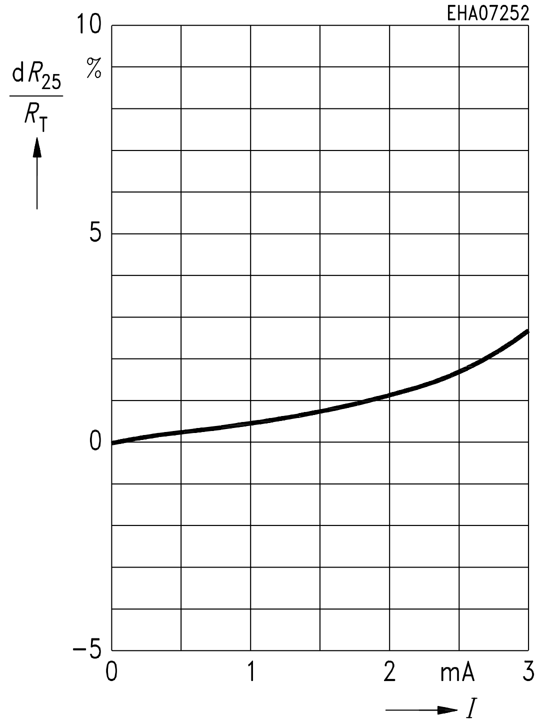
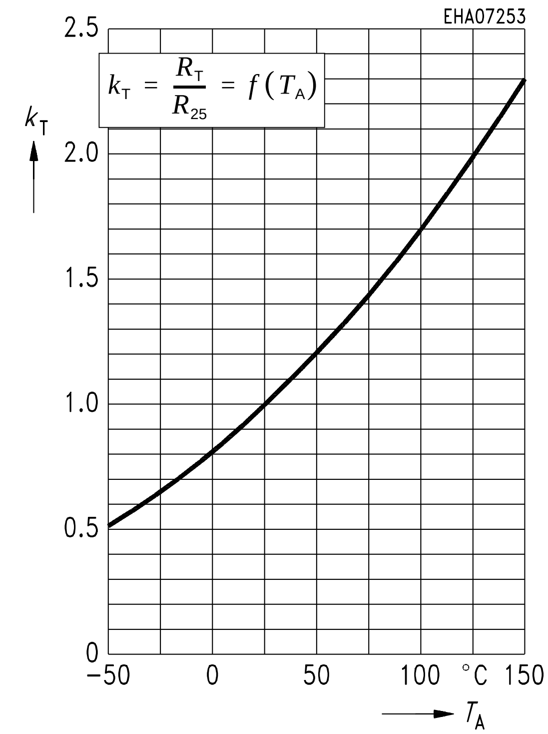
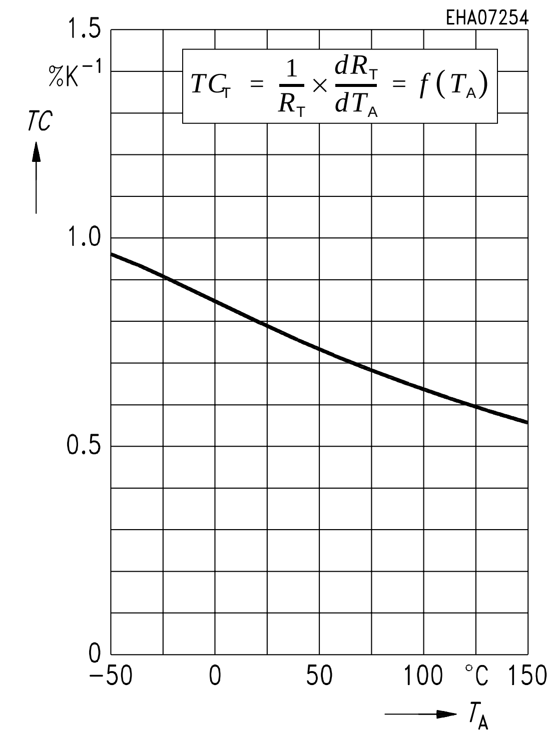



**Typical Relationship of the Temperature Factor**

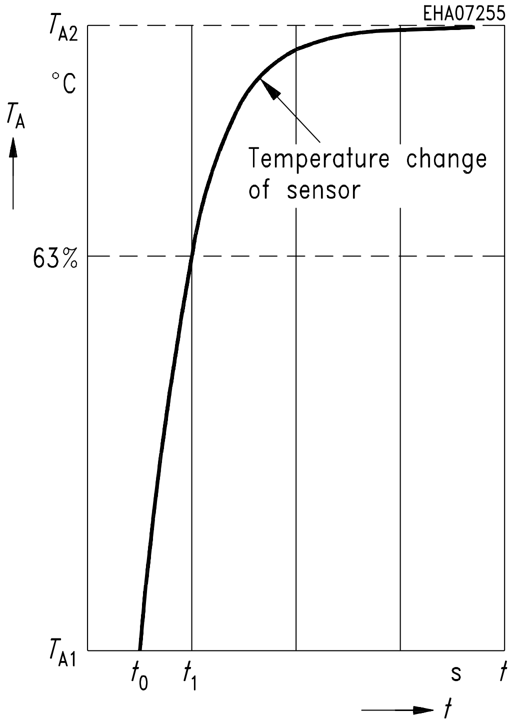



**Typical Relationship of the Temperature Factor**

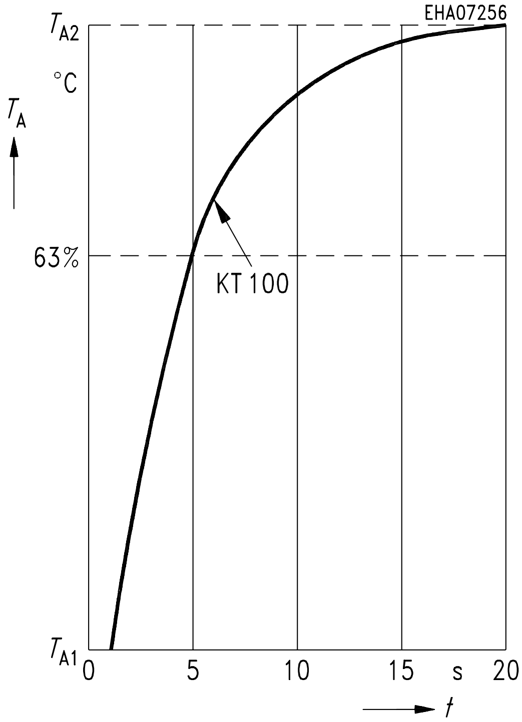


**Definition of the**
**Thermal Time Constant $\tau$**

$\Delta T_A = T_{A2} - T_{A1}$; $\tau = t_1 - t_0$

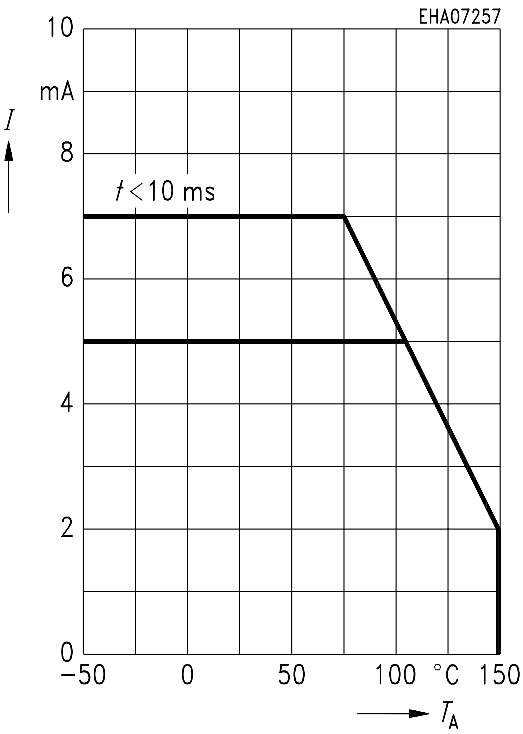



**Thermal Time constant $\tau$ = 5 s**




**Peak Current in Air**

$R_{25}$ = 2000 Ω; $\hat{I} = f(T_A)$

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