TEMPERATURE DEPENDENCE AND TC OF THE RESISTOR

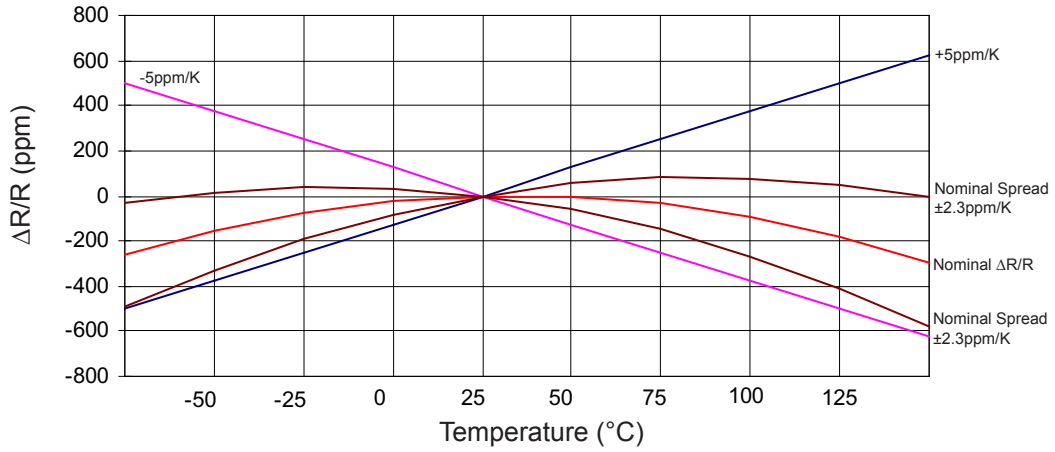
The absolute ohmic value of a resistor is temperature-dependent.

In today's modern fields of measurement and electronics, particularly in such industries as heating and ventilation (HVAC), medical technology, and military applications: precision, stability, and dependability are important criterions. Here the highest demands are made on every component; for this reason, the precision and ultra-precision resistors have been developed. The base of the resistance element is a special resistive film.

With the use of special technological steps we are able to synchronize the substrate and the resistor material. This means that we can produce resistors with a very low temperature coefficient.

1. Ultra-precision-resistors (series USR/USN, UNR, UHR and UPW)

Picture 1 - dR/R (T) for the series USR/USN, UNR and UHR



The TC adjustment is per charge at the reference temperature of 25°C (T0).

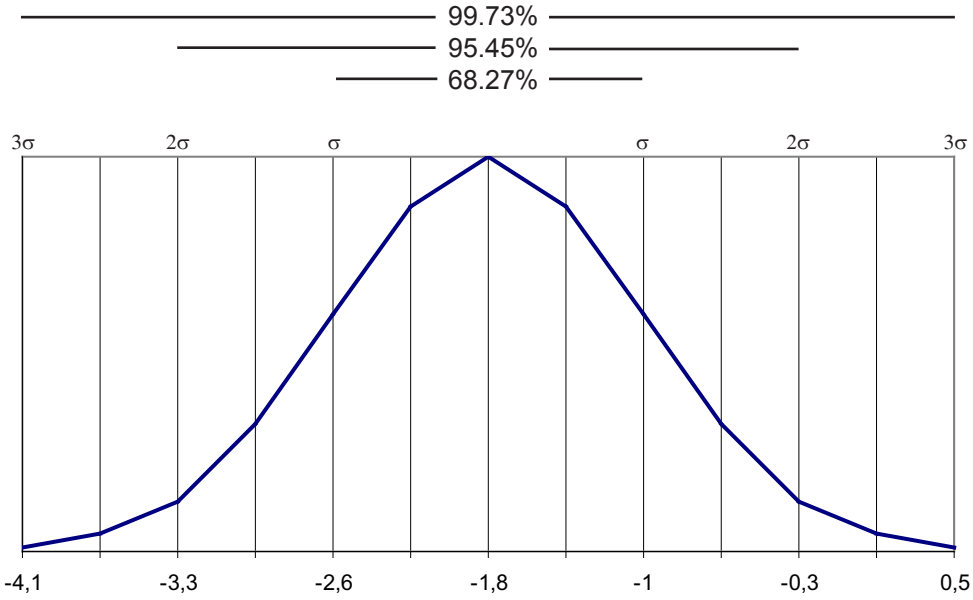
For the series USR/USN as well as UNR and UHR when adjusting the dR/R (T) -curve, we are able to reach a TC1 of -1.8 ppm/K with an inherent temperature of 125°C (T1) and a TC2 of +2.2 ppm/K with an inherent temperature of -55°C (T2). These curves are mentioned as the nominal dR/R-curves or the nominal TCs (Picture 1)

The specific TC is mathematical the rise of the secant between dR/R (T1;2) and dR/R (T0).

Normally there is a spread of values when the TC-adjustment is made. The reason for this belongs to the technical process and the normal difference in the materials. Therefore it is possible that the real dR/R (T)-curves, the TK1 and TK2 of all the resistors varies from the nominal mentioned parameters.

In the normal production process and big charges the TCs of all resistors are within the Gaussian distributian.
For the series USR/USN as well as UNR and UHR the nominal spread is ± 2.3 ppm/K (for TK1 as well as TK2).
This is the 3σ - area.
The TCs of 99.73% of all resistors in one charge belong to this area (Picture 2).

Picture 2 - nominal distribution of the TCs - series USR/USN and UNR



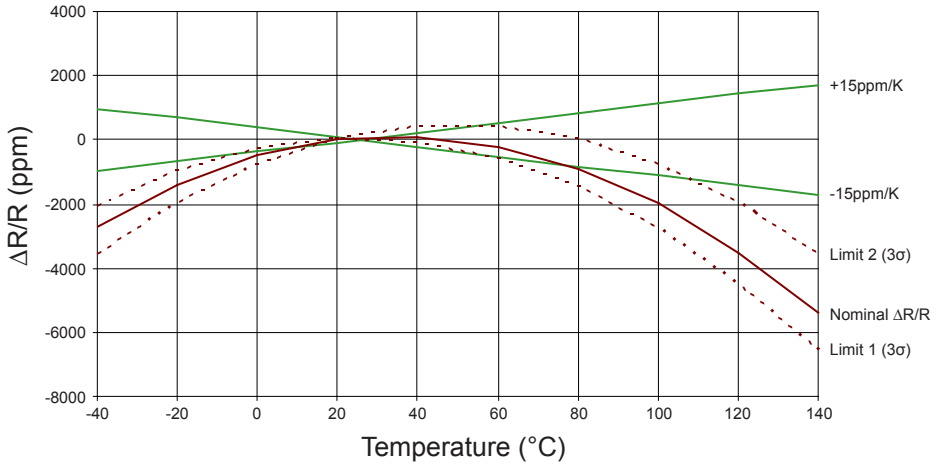
For a reduced temperature range from 0...60°C the nominal TCs are -0.6 ppm/K / +0.6 ppm/K and the nominal spread (3σ-area) of one charge is at ±2.5 ppm/K.

Upon customer request we can measure each resistor to secure that the TC in the temperature range of 25...60°C of all delivered resistors is ±1.0 ppm/K.

For the series UPW the TK1 is -3.6 ppm/K and the TK2 is +4.4 ppm/K. The nominal spread of the TCs of all resistors of one charge is at 25°C ±2.8 ppm/K.

2. Precision-Resistors (series FPR/FPN, FHR/FHN and FNR/FNN)

Picture 3 - dR/R (T) for the series FPR/FPN, FHR/FHN and FNR/FNN



The dR/R (T)-curve of the precision-resistors series FPR, FHR and FNR as well as the precision-networks series FPN, FHN and FNN compared with the ultra-precision-resistor series USR/USN, UNR and UHR is more curved.

Even then we can reach nominal-TCs in a temperature range of 20...60°C smaller than ±15 ppm/K and in a temperature range of 20...40°C smaller than ±10 ppm/K. This is possible through the use of a 4-pol technology. The current intake and the voltage tapping are separated (Kelvin-connection).

In picture 3 the middle nominal dR/R (T)-curve as well as the border-curves of the nominal spread (3σ - area) are mentioned. These curves are only for low-ohm values used with a 4-pol connection.

For 2-pol resistors the influence of the contact-elements to the TCs of the complete resistance is very big. In picture 4 the change of the TC for 2-pol resistors is mentioned (depending on the nominal resistor value).

Picture 4 - TC-shift (low-ohm 2-pol resistors)