



# DID YOU KNOW?

## ULTRA PRECISION THIN FILM RESISTORS

Today, a broad range of test and measurement equipment, and a growing number of industrial sensor applications, require precise components to achieve high accuracy. For those applications, ultra precision thin film resistors are the optimum choice. In these devices, specified tolerance and temperature coefficients are commonly used as indicators of precision. However, it is often overlooked that both are only valid for specific conditions:

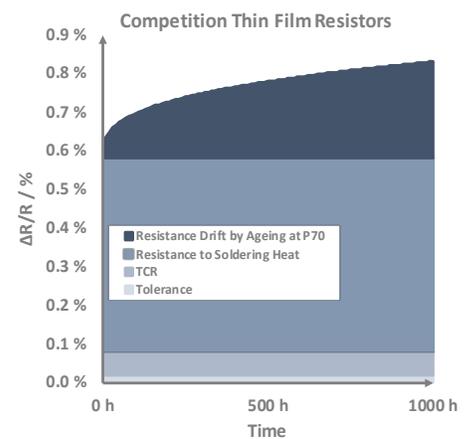
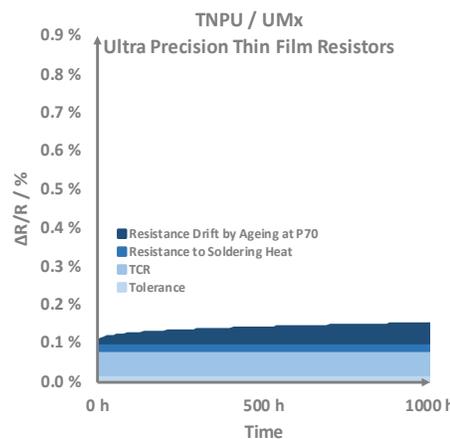
**Tolerance** — A resistor's tolerance indicates the permitted variation of the nominal resistance value. Since the resistance value is determined at the time of packing and under standard atmospheric conditions, i.e. at 20 °C, the specified tolerance is only applicable to the unused component in a comparable environment.

**Temperature Coefficient** — A resistor's temperature coefficient of resistance (TCR) indicates the permissible change of the resistance value depending on temperature. The TCR is specified for a limited temperature range. The latter can deviate from the resistor's permissible operating temperature range.

Aside from tolerance and temperature coefficient, a resistor's precision is further influenced by the soldering process, or aging of the resistor during the application's lifetime. For a meaningful assessment of the resistor's suitability in a high accuracy application, these factors should therefore also be considered.

**Resistance to Soldering Heat** — Prior to use, a surface-mount resistor is soldered to the PCB. During the soldering process the resistor is in contact with melted solder at a temperature of up to 260 °C. The solder heat imposes thermal stress on the resistor that may already change its resistance value, even to a larger extent than the specified tolerance.

**Excellent Long Term Stability** — All resistors are affected by ageing: they change resistance with the film temperature experienced through electrical load or ambient temperature. This resistance drift depends on operating time, and will thus reduce an application's accuracy over lifetime, until calibration is eventually required.



The diagrams provided show the precision over lifetime, considering the above factors, for the Vishay TNPu e3 and UMx series of ultra precision thin film resistors in comparison to conventional thin film devices of equivalent tolerance and TCR.

TNPu e3 and UMx ultra precision thin film resistors are the optimum choice for applications that require high accuracy and long term stability, including:

- Test and measurement equipment
- Industrial sensor applications
- Operational amplifier circuits
- Load resistors in industrial interfaces