Functionality of PSpice Models for Vishay NTC, PTS (Platinum Thin Film SMD), and TFPT (Nickel Thin Film SMD) Thermistors

The PSpice libraries and symbols (.lib and .olb files) available for download from the Vishay website are functional for PSpice DC, AC, or TEMP sweep and time transient simulations.

The PSpice models include:

- Self heating (thermal capacity, dissipation coefficient)
- The extended Steinhart & Hart coefficient for NTC (from the program “My_Vishay_NTC_curve”)
- The polynomial coefficients for TFPT
- The Callendar Van Dusen coefficients for PTS

If you need to simulate temperature stimulus for one or more sensors in the same application, another type of personalized model is available on request. Contact Vishay at edesign.ntc@vishay.com for more details.

In order to show the functionality of the models, the following PSpice simulations were performed using the Cadence OrCAD PSpice 16.6 program and compared to experimental measurements.

REPRODUCTION OF THE RESISTANCE TEMPERATURE CURVES

The first graphs (1 and 2) present the 100 % fit between the R-T tables and the PSpice simulation traces (voltage / current) for NTC (defined in the program “My_Vishay_NTC_curve”) and for PTS (Callendar Van Dusen coefficients) thermistors.

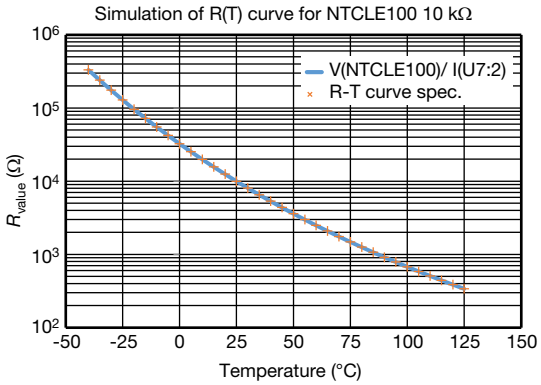

Fig. 1 - Resistance Temperature Curve of NTCLE100E3103

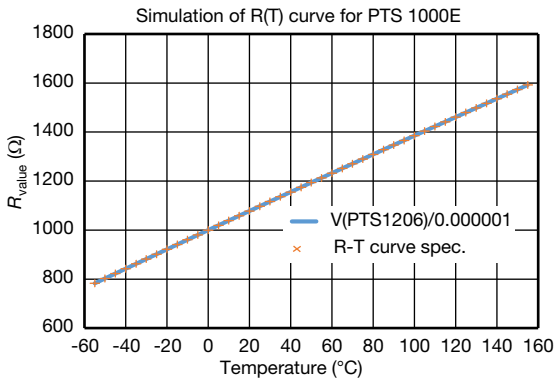

Fig. 2 - Resistance Temperature Curve of TFPT

VOLTAGE / CURRENT RELATION FOR NTC THERMISTORS

An NTC thermistor has a negative temperature coefficient, which induces a drop in electrical resistance when its temperature rises. As current flowing through the component remains low, the thermistor is similar to a fixed resistor. When current increases, self heating by Joule effect occurs and the voltage stops increasing in a linear way. This voltage reaches a maximum, and for higher currents the curve presents a negative differential resistance zone. The measurements and the simulation were performed at a ambient temperature of 27 °C for both NTC thermistor types (leaded through-hole and SMD).

In the graph below, the simulation curves are blue and measurement points are orange.

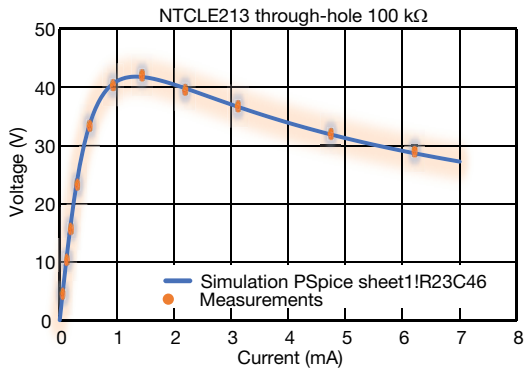

Fig. 3 - Voltage / Current Curve for NTCLE213 100 kΩ

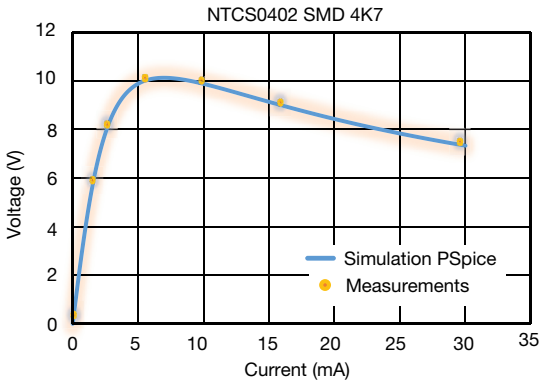

Fig. 4 - Voltage Curve for NTCS0403 4.7 kΩ

VOLTAGE / CURRENT CURVE FOR PLATINUM SMD

A thin film platinum component has a voltage / current curve deviating from a straight line; due to its positive temperature coefficient, the voltage increases with current in a non-linear way.

In the graph below, the simulation curves are blue and measurement points are orange.

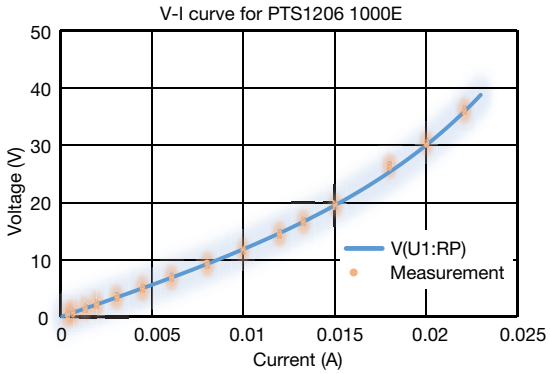

Fig. 5 - Voltage / Current Curve for PTS1206 1000 Ω

VOLTAGE / CURRENT CURVE FOR TFPT

The voltage / current relation of a TFPT (thin film nickel on an alumina substrate) thermistor is very similar to that of a PTS. The graph below shows the agreement between the steady-state simulation and the measurements for a TFPT with R_{25} = 10 kΩ, in a 1206 case at ambient temperature of 27 °C.

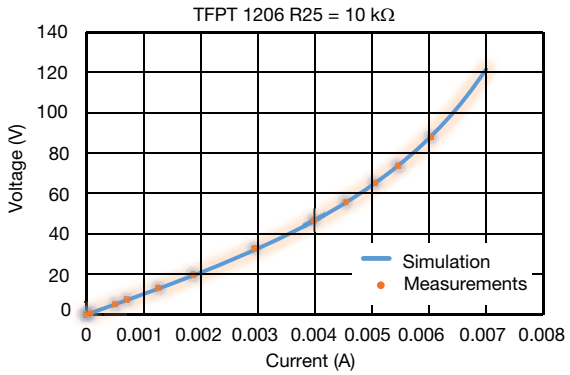

Fig. 6 - Voltage / Current Curve for TFPT1206 10 kΩ

TRANSIENT SIMULATION V(t) VARIATION AT FIXED CURRENT

When a current step is applied to this type of component (NTC thermistor or PTC thermistor), whether TFPT or PTS its temperature increases in time until a steady state is reached. The transient is strongly influenced by the thermal capacity of the components and by the dissipation coefficient of the device. The graph below shows a NTCLE203E3 2 kΩ in a current step of 20 mA at an ambient temperature of 27 °C.

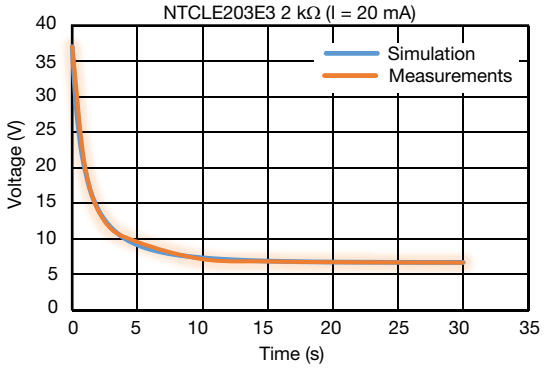

Fig. 7 - Comparison of PSpice Transient Simulation and the Measurements for an NTC Thermistor

For any supplementary information, address your question to edesign.ntc@vishay.com.