

Thermal Sensor

L/LK series ironcore flat linear motors monitor the **winding temperature** with **PTC thermistor sensors embedded in the windings**. This page describes the sensor configuration of the series, its resistance-temperature characteristic and the threshold values to be set in the **PLC** for warning, alarm and hardware backup trip.

Related pages: [L/LK ironcore series](#) · [Connection system](#) · [How an ironcore flat linear motor works](#)

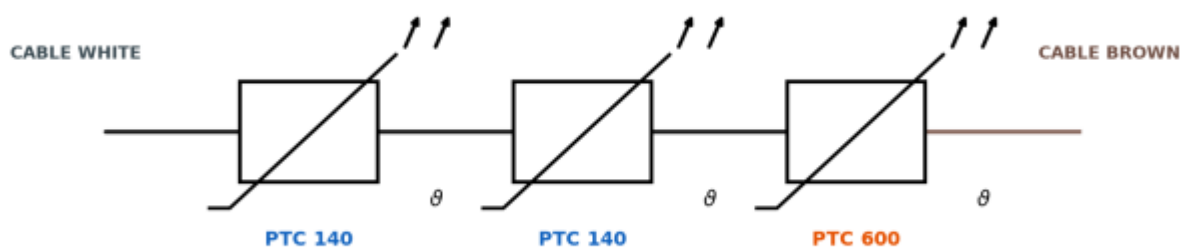
Sensor configuration

The sensor chain consists of **two PTC140 and one PTC600 thermistors connected in series**, embedded in the motor windings:

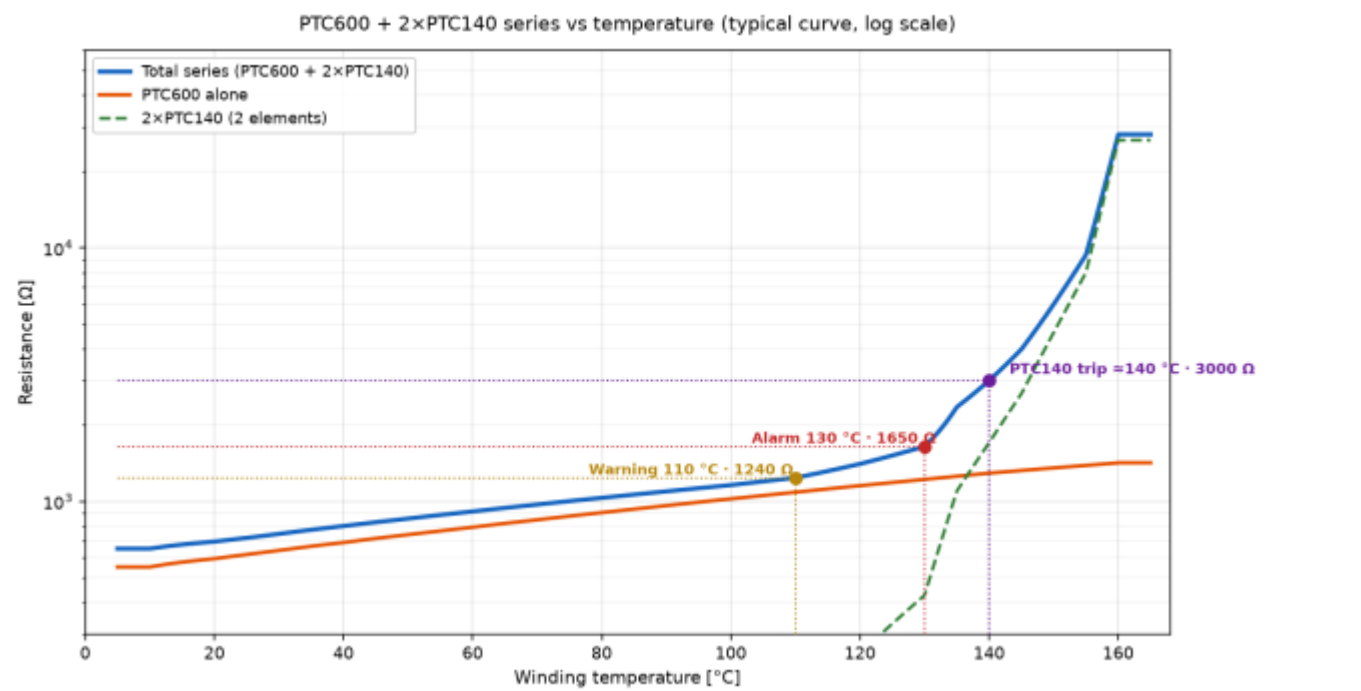
- **PTC600** — monitors the winding temperature across the whole operating range (gradual resistance rise with temperature).
- **2 × PTC140** — **hardware backup**: sharp resistance step at $\approx 140\text{ °C}$, independent of any drive software.

Since the three elements are connected in **series**, the measured resistance is the **sum** of the three contributions: the PLC reads a single value and discriminates all three protection levels by threshold.

Wire	Colour
Protective ground	yellow-green
PTC chain (2× PTC140 + 1× PTC600)	white / brown



Resistance vs temperature



The characteristic is **non-linear by design**:

- up to $\approx 130\text{ }^{\circ}\text{C}$ the total resistance rises **gradually** (the PTC600 dominates: $\approx 480\text{ }\Omega$ at $10\text{ }^{\circ}\text{C}$ $\rightarrow$ $\approx 1450\text{ }\Omega$ at $160\text{ }^{\circ}\text{C}$);
- at $\approx 140\text{ }^{\circ}\text{C}$ the **two PTC140 trip**, multiplying the total resistance by more than an order of magnitude (from $\approx 3000\text{ }\Omega$ to $> 20\text{ k}\Omega$ within a few kelvin).

This is what allows the **same pair of wires** to carry three different protection levels.

In practice, the curve shows a **linear trait up to $\approx 115\text{ }^{\circ}\text{C}$ of winding temperature** — the curve is the PTC600 one, which dominates the series. Beyond that temperature the **2 × PTC140 come into play**: their characteristic is **switch-like** and the total resistance rises very rapidly.

Measuring device configuration

The configuration refers to the analog input of a **Siemens ET 200SP** station — module **6ES7134-6JD00-0CA1 (AI 4xRTD/TC 2-/3-/4-wire HF)**.

The **ET 200SP** is Siemens' modular distributed I/O system: the I/O station is mounted next to the machine and connects to the controller via PROFINET. The **6ES7134-6JD00-0CA1** is its 4-channel **high-feature analog input** for thermal resistors (RTD), thermocouples, resistors and voltage — resolution up to 16 bits, with per-channel measurement type, interference frequency suppression and smoothing, plus per-channel diagnostics.

Configure the analog input as follows:

Parameter	Setting
Measurement type	Resistor (2-wire)
Measuring range	6000 Ω
Interference suppression	50 Hz

Parameter	Setting
Smoothing	medium or high

Do not use the “PTC” mode: it is designed for Kaltleiter type A according to DIN/VDE 0660-302, i.e. for a **single trip**. For this chain the **ohm reading with the 6000 Ω range** is required — it also returns the linear part of the characteristic.

PLC thresholds

Level	Temperature	Typical series R	PLC threshold	Re-entry hysteresis
Warning	110 °C	$\approx 1240 \Omega$	1240 Ω	1200 Ω
Alarm	130 °C	$\approx 1650 \Omega$	1650 Ω	1550 Ω
PTC140 trip (hardware backup)	$\approx 140 \text{ °C}$	$\approx 3000 \Omega$	3000 Ω	1800 Ω

- **Warning — 1240 Ω** ($\approx 110 \text{ °C}$): the winding is approaching the thermal limit. Reduce the load or improve the cooling. The signal resets automatically when the resistance falls below 1200 Ω .
- **Alarm — 1650 Ω** ($\approx 130 \text{ °C}$): the thermal limit is reached. Stop the drive or force the derating. Resets below 1550 Ω .
- **Hardware backup — 3000 Ω** ($\approx 140 \text{ °C}$): the PTC140 pair has tripped. This level is **independent of any software setting** — the resistance step is generated by the sensors themselves. Resets below 1800 Ω only after cooling down.

PLC logic (Structured Text)

```

R := INT_TO_REAL(raw) * 6000.0 / 27648.0;    // 6000  $\Omega$  range
IF raw >= 32000 OR R < 300.0 THEN              // overrange / broken wire /
short
    fault := TRUE;                             // sensor fault, not a
temperature fault
END_IF;
// debounce approx. 2 s, then:
IF R >= 1240.0 THEN warn := TRUE; END_IF;
IF R <= 1200.0 THEN warn := FALSE; END_IF;
IF R >= 1650.0 THEN alarm := TRUE; END_IF;
IF R <= 1550.0 THEN alarm := FALSE; END_IF;    // manual reset is preferable

```

The raw value is scaled on the **6000 Ω range** (27648 = nominal full scale of a Siemens-type analog input). The **sensor fault** (overrange, broken wire or short circuit) is reported separately from the temperature levels: it must not be confused with a thermal alarm. The **alarm** is better handled with a **manual reset** from the HMI.

Implementation notes

- Evaluate the chain with a **single analog input**: the three levels are discriminated by threshold on the total resistance.

- Set the **re-entry hysteresis** exactly as in the table to avoid warning/alarm chatter around the thresholds.
- The PTC140 trip (3000 Ω) is a **hardware protection**: before reset, check the wiring — a broken lead reads as an open circuit.
- Resistance values are **typical values**: configure the PLC thresholds on the figures of the table, not on the individual sensor datasheets.

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