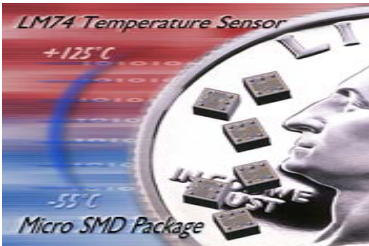




TruTherm™ Technology

National's Thermal Management Position

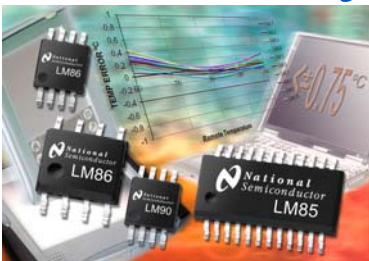
Packaging



Reliability



Accuracy



National is the #1 Solution Provider of Choice

- **Industry leader in accuracy, reliability and packaging**
- **Our thermal management solutions improve system performance, reliability and extend product life**
- **Extensive Portfolio of Sensors**
Analog, Thermostats, Remote Diode
Digital, System Hardware Monitors



Introducing TruTherm™ Technology

- **TruTherm stands for “True Thermal Measurement” and is the brand name for National’s new temperature monitoring technology**
- **TruTherm™ technology is an improved method of measuring temperature on integrated circuits designed in sub-micron (90nm & below) processes**



Problem Statement

- **Complex integrated circuits such as microprocessors, graphics processors and FPGAs are being designed in smaller sub-micron geometries to reach higher speeds & integration**
- **Internal thermal diodes connect to external temperature sensors to accurately monitor temperature, but in sub-micron geometries, readings based on these diodes vary greatly from processor to processor**
- **Traditional approaches to accurately monitor the thermal diodes are no longer sufficient to achieve high-accuracy targets**

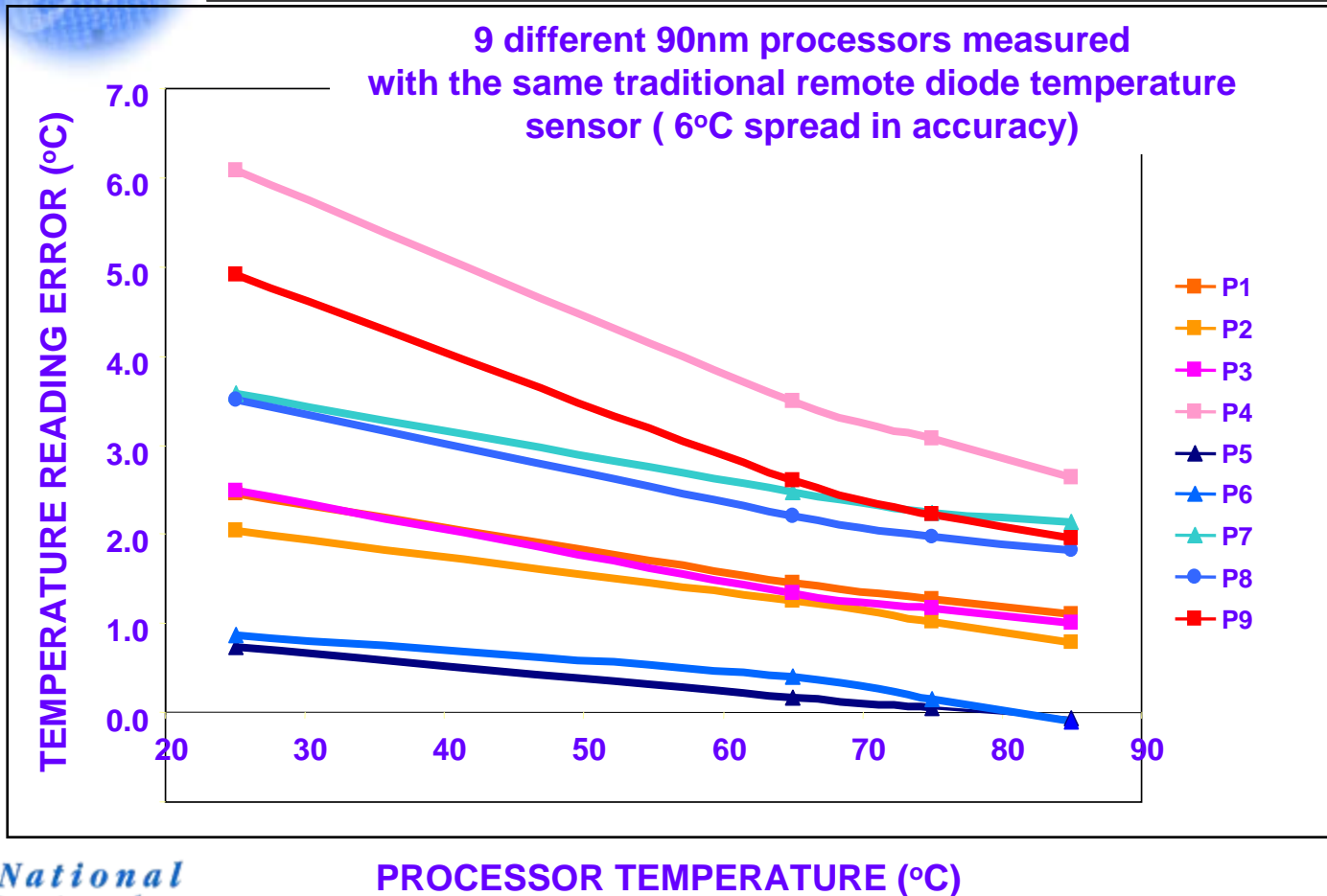


TruTherm™ Technology Benefits

Highly accurate temperature readings for sub-micron integrated circuits

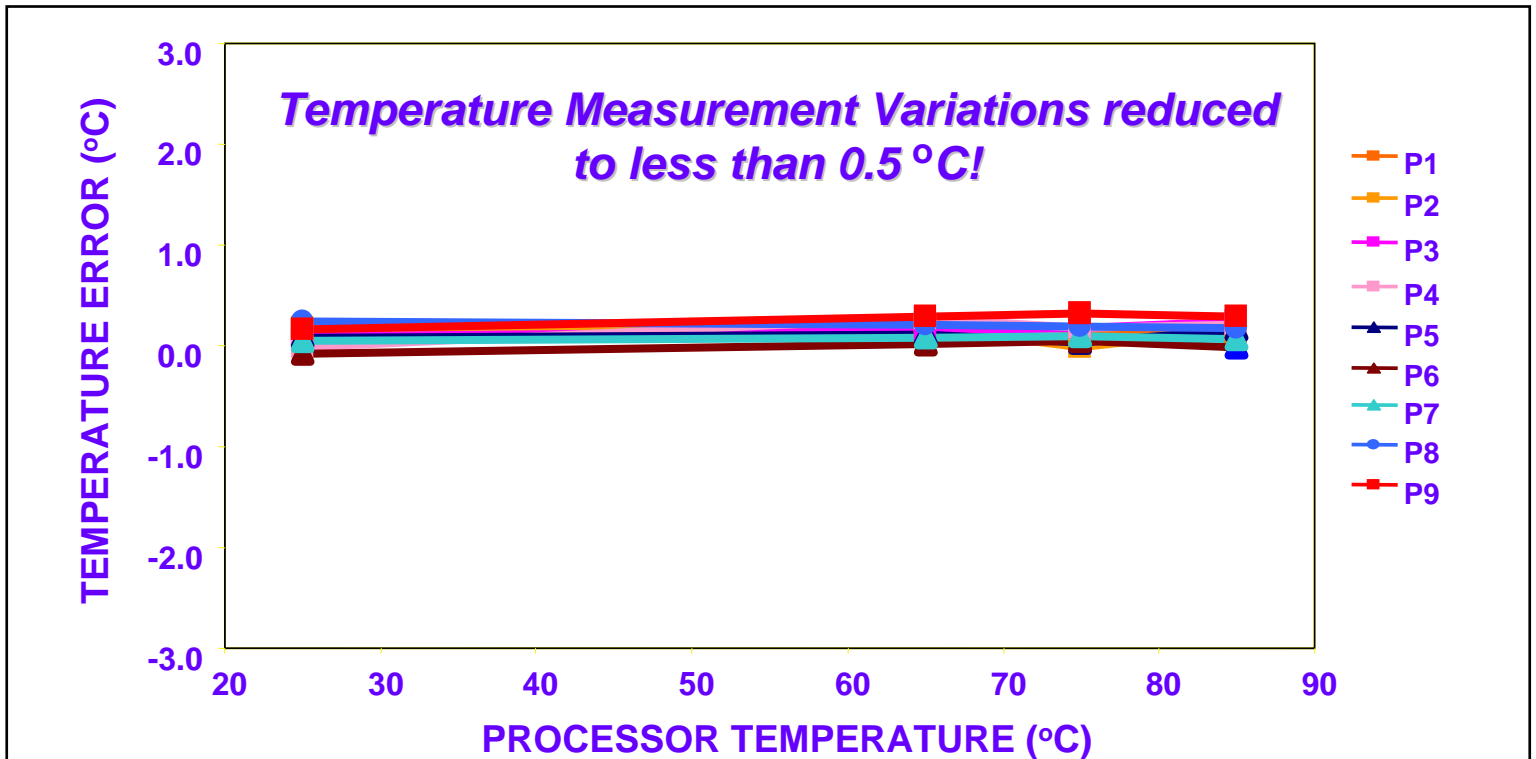
- **Improves overall temperature accuracy for all systems**
- **Extends system life by reducing the chances of device overheating**
- **More accurate temperature readings enable precise fan control methods, resulting in quieter systems and lower acoustic noise**

Temperature Measurement Without TruTherm™ Technology





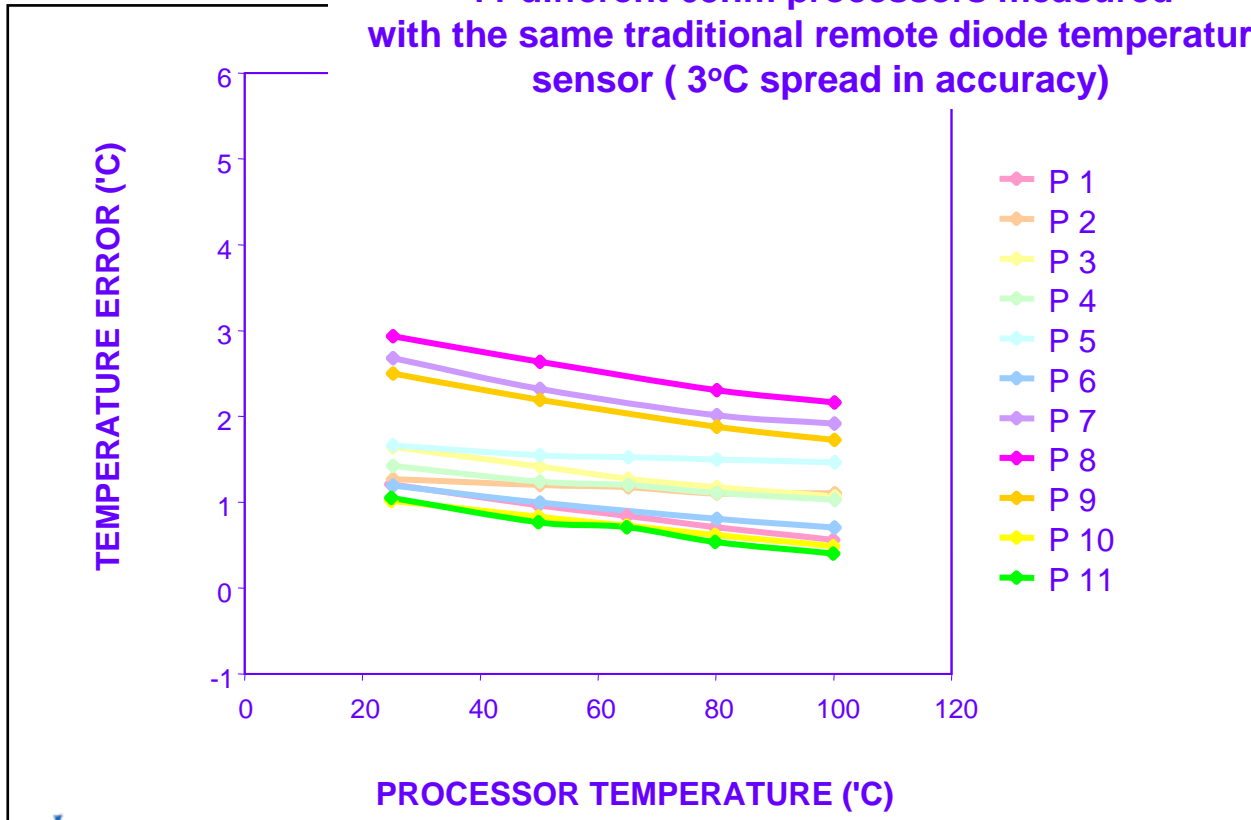
Temperature Measurement With TruTherm™ Technology





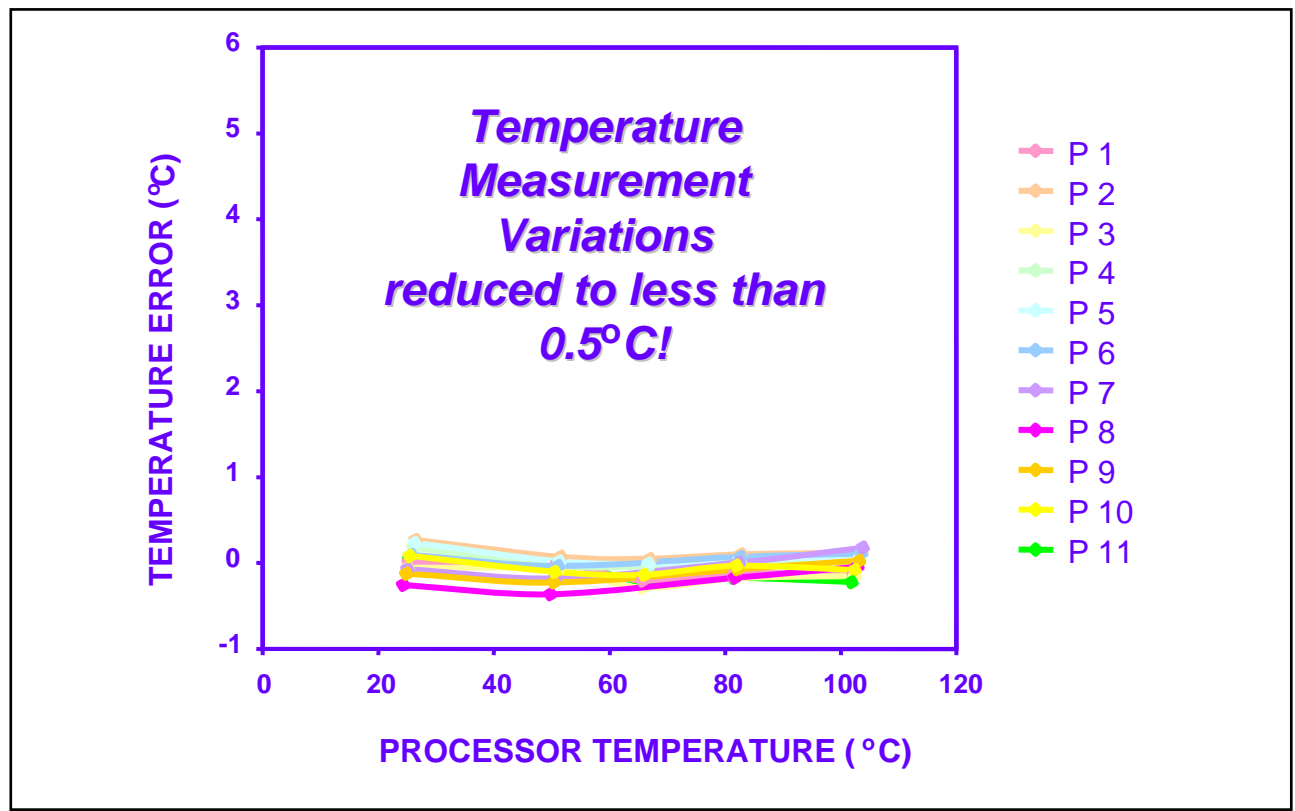
Temperature Measurement Without TruTherm™ Technology

11 different 65nm processors measured with the same traditional remote diode temperature sensor (3°C spread in accuracy)





Temperature Measurement With TruTherm™ Technology





LM95231 with TruTherm™ Technology

- **High-precision, 2 remote and local digital temperature sensor**
- **Features a precision sigma-delta analog-to-digital converter for reduced sensitivity to noise and includes digital filtering and remote diode fault detection**
- **Compatible with the SMBus 2.0 and I2C bus specifications**
- **Space-saving 8-pin MSOP package**



LM95235 with TruTherm™ Technology

- **High-precision, 1 remote and local digital temperature sensor**
- **Features a diode model selection bit to select between a typical Intel® processor on a 65 nm or 90 nm process or MMBT3904, as well as an offset register for maximum flexibility and best accuracy**
- **Three TCRT outputs with limit comparison registers**
- **Compatible with the SMBus 2.0 specifications**
- **Space-saving 8-pin MSOP package**



LM94 with TruTherm™ Technology

- **Hardware Monitor with PI Loop Fan Control for Server Management**
- **Measures temperature of four remote diode connected transistors as well as its own die and 16 power supply voltages**
- **Dynamic Vccp monitoring with support for VRD10, 10.2 and 11 specifications**
- **GPIOs, VRD_HOT, and PROCHOT digital functions for Server Management**
- **Compatible with the SMBus 2.0 specifications with block read/writes**
- **56-pin TSSOP package**



Summary

- ***TruTherm™ technology revolutionizes temperature measurement accuracy for sub-micron integrated circuits.***
- ***The LM95231, LM95235 and LM94 are first in a family of TruTherm technology-based products by National Semiconductor***