

Typical Characteristics Of Contact Temperature Sensors

Type	Range of operation	Sensitivity at $\pm 25^{\circ}\text{C}$	Accuracy	Linearity	Speed in stirred oil	Size	Package	Cost	Comments
Thermo-couples (all types)	-270°C to 1800°C; -270°C to about 3000°C for special types	Typically less than 50 $\mu\text{V}/^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$ with reference	Poor over wide range; better over $\approx 100^{\circ}\text{C}$	Typically 1 s; some types are faster	0.02-in. bead typical; 0.0005-in. units are available	Metallic bead; variety of probes is available	\$1 to \$50 depending on type, specifications, and package	Require reference; low-level output; require stable signal-conditioning components
Thermistors and thermistor composites	-100°C to 450°C	$\approx 5\%/^{\circ}\text{C}$ for thermistors; $\approx 0.5\%/^{\circ}\text{C}$ for linearized units	$\pm 0.1^{\circ}\text{C}$ standard from -40°C to 100°C ; $\pm 0.01^{\circ}\text{C}$ from 0°C to 60°C available	$\pm 0.2^{\circ}\text{C}$ for linearized composite units over 100°C ranges	1 to 10 s is standard; 3- to 10-ms types are available	Beads can be as small as 0.005 in. but 0.04 to 0.1 in. is typical; "flake" types are only 0.001 in. thick	Glass, epoxy, Teflon, encapsulated, metal housing, etc.	\$2 to \$10 for standard units; \$10 to \$350 for high-precision types and specials	Highest temperature sensitivity of any common sensor; special units required for long-term stability above 100°C
Platinum Resistance wire (RTD)	-250°C to 900°C	Approximately $0.5\%/^{\circ}\text{C}$	$\pm 0.1^{\circ}\text{C}$ readily available; $\pm 0.01^{\circ}\text{C}$ in precision standards lab units	Nearly linear over large spans; typically within 1°C over 200°C ranges	Typically several seconds	0.125 to 0.25 in. typical; smaller sizes are available	Glass, epoxy, ceramic, Teflon, metal, etc.	\$25 to \$1000 depending on specifications; most industrial types below \$100	Sets standard for stability over long term; has wider temperature range than thermistor, but lower sensitivity
Diodes and transistors	-270°C to 175°C	$-2.2\text{ mV}/^{\circ}\text{C}$ (approximately $0.33\%/^{\circ}\text{C}$)	$\pm 2^{\circ}\text{C}$ to $\pm 5^{\circ}\text{C}$ over -55°C to 125°C	Within 2° over operating range	1 to 10 s is standard; small diode packages permit speeds in ms range	Standard diode and transistor case sizes; glass passivated chips permit extremely small sizes	Glass, metal	Below \$0.50; cryogenic units are more expensive	Require individual calibration; must be driven from current source for optimum performance; extremely inexpensive; calibrated cryogenic types are available
IC	-85°C to 125°C typical	$0.4\%/^{\circ}\text{C}$ typical	Over -55°C to 125°C	Within 1° (0.2° from 0°C to 70°C typical)	Several seconds	TO-18 transistor package size; also in MiniDIP	Metal, plastic	\$1 to \$10	Current and voltage outputs are available

Courtesy of Jim Williams, Linear Technology Corp.