Silicon diode sensors are typically excited with a constant 10 µA current. The output signal is fairly large: 0.5 V at room

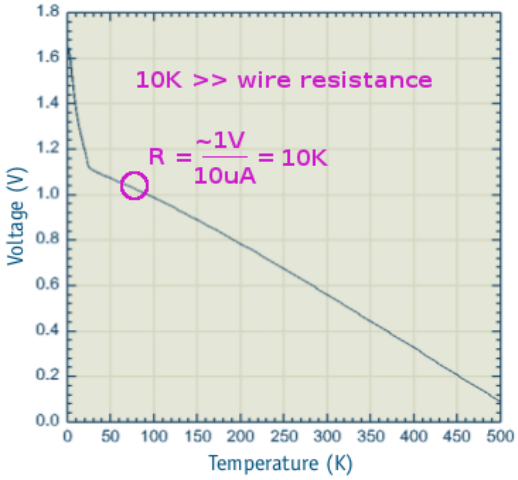

Figure 1 *– Curve DT-670*

The large temperature range, nearly linear sensitivity, large signal and simple instrumentation make the diode useful for applications that require a better accuracy than thermocouples. Also, because of the large signal, a diode can be used in a two-lead measurement with little lead resistance error. AC noise-induced temperature errors, to which resistors are immune (aside from heating effects), can be prevalent in diodes.

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mV signal at 273 K. The straightforward diode thermometry instrumentation is shown in *Figure 2*.

two-lead measurements (i.e., voltmeter does not have separate cabling to diode) have error due to unknown voltage drop:

V = 10uA * (R1 + R2)

which is insignificant for our application

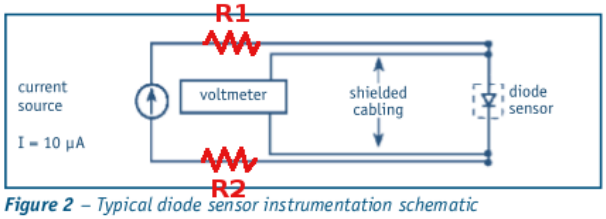

Figure 2 *– Typical diode sensor instrumentation schematic*

An important feature of silicon diodes is their interchangeability. Silicon diodes from a particular manufacturer are interchangeable, or curve-matched over their whole range. This is typically defined in terms of tolerance bands about a standard voltage-temperature response curve. They are classified into different tolerance bands with the best accuracy being about ±0.25 K from 2 K to 100 K and ±0.3 K from 100 K to 300 K.

Power Dissipation

Diode, resistance, and capacitance temperature sensors must all be energized electrically to generate a signal for measurement. The power dissipated within the temperature sensor must be appropriate for the temperature being measured; the joule heating within the temperature sensor causes an incremental temperature rise within the sensor element itself (self-heating). Consequently, this temperature rise must be kept negligible compared to the temperature of interest.

For diodes, a fixed excitation current of 10 µA is a compromise between power dissipation and noise immunity. The power dissipated is the product of voltage times current. Since the voltage increases with decreasing temperature, power also increases, resulting in a practical lower temperature limit for diode thermometers of slightly above 1 K.