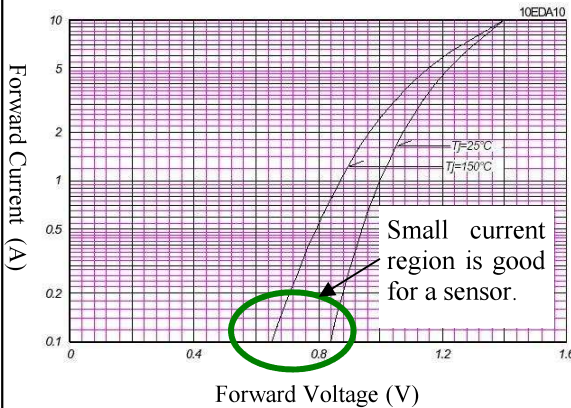


Diode as a Temperature Sensor

Forward voltage of diode linearly varies with temperature. Utilizing this nature, we can use diode (or B-E of bipolar-transistor) as a temperature sensor. Below is the forward voltage characteristic of 10EDB20, 1A 200V diode.



Forward Characteristics if a Diode

Because heat generation by current prevents correct temperature sensing, a small current is employed. Generally, temperature rise of 1°C results in decrease in forward voltage by 2 mV. Let's execute actual measurement on 10EDB20.

$I_F(\mu A)$	27°C	50°C	75°C	80°C	85°C
5	345.2	292.9	236.0	224.7	213.2
10	361.6	310.3	254.2	243.1	232.4
25	388.3	337.5	282.6	271.5	259.9
50	403.5	356.2	304.0	293.4	283.1
100	423.5	376.5	325.8	315.6	305.7
250	449.3	403.9	354.2	344.1	334.2
300	454.1	408.9	359.8	350.0	340.5

Forward Voltage as a function of Forward Current and Temperature (Compensated)

In the table above, forward voltage is compensated by linear regression. Obtained temperature

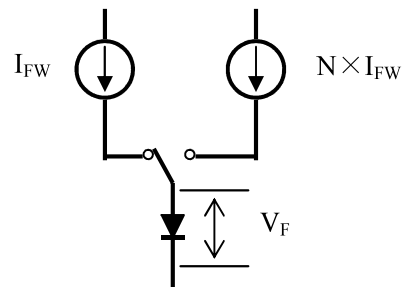
coefficients are;

At 10 μA -2.22mV/°C

At 100 μA -2.03mV/°C

As a result, the coefficient is about -2mV/°C at 1/10,000 of rated current. Likewise, we can know chip temperature of power semiconductors by flowing *one* small current.

In temperature monitor ICs available from Maxim, National semiconductor and others, *two* currents method is used.



Measure Forward Voltage at 2 currents

Supposing ΔV_F is the difference in forward voltage for two currents at a specific temperature;

$$T = \frac{q \Delta V_F}{[n k \ln(N)]} - 273.15$$

Using this equation, we can calculate T(°C).

Constants q, n, and k are;

q : 1.602 $\times 10^{-19}$ coulomb

n : Ideality Factor

k : Boltzman constant 1.38 $\times 10^{-23}$

Referring the table in the left, difference in V_F between at 10 μA and at 100 μA is 72mV at 75°C. We have n of 10EDB20 separately, and it is 1.0293. Calculated ΔV_F is 71 mV using the above relationship. So, two ΔV_F obtained by measurement and by calculation are well agreed.

You may understand that seeing "the difference" is a cleverest ways.