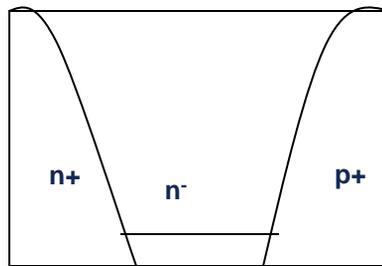


WHY TO NOT USE AN OHMMETER TO SELECT SEMICONDUCTORS

It's cost effective, it's easy, it's common...it's useless! We are talking about the ohmmeter, very popular in the hands of every technician, but absolutely useless to characterize a semiconductor, except in two cases: when device is open or it is completely shorted.

The reason why an ohmmeter may not work is due to the intrinsic unpredictability of charge concentration in the deeper part of dopant profile: a power semiconductor is usually made with n⁻ pre-doped silicon. On this base a p⁺ dopant

In the silicon is created a PiN structure



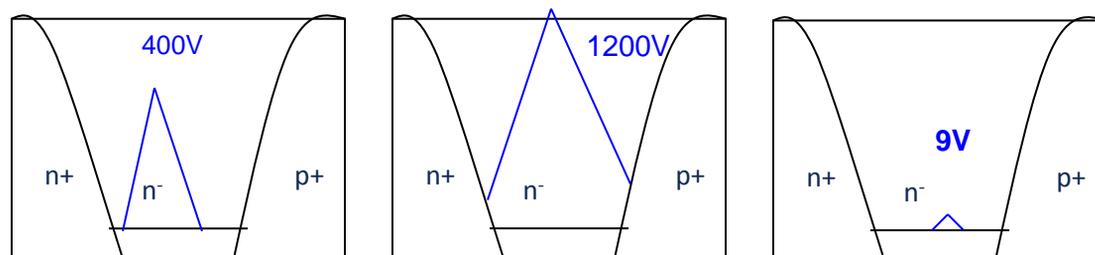
Diffusion process basically consist in creating a dopant atmosphere at very high temperature, close to the silicon melting point. In this condition silicon is able to accept atoms inside its crystal frame (by a substitutive or intrusive way). The mobility allowed by high temperature makes it possible for atoms to move ahead and behind semiconductor's surface in a random way. The point is that in the most superficial layers the dopant concentration is very high, but the concentration suddenly decreases in the inner parts of the silicon, and at the end of the diffusion tail is quite close to zero.

It's a gamble: the dopant atom may move casually ahead or behind: after several steps how many atoms may have moved always forward? It's like flipping a coin several times and getting head the most of the times.

Now, how does an ohmmeter works? An ohmmeter is normally battery equipped (1.5 to 9V), it applies a voltage and reads the current.

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When one applies a voltage on a semiconductor, the electrical field expands, up to the max limit it is designed for. To apply not more than 9V on a device designed to be, for instance, 1200V means to measure the intrinsic layer, or utmost to measure the extreme tail of the diffusion, that is quite variable and change a lot from device to device, and in both cases the result is meaningless vs. the true semiconductor's structure and behavior. Moreover, the value read may change from one ohmmeter to another (if the voltage of the battery is different) and change if the battery is going out of power.



Electrical field behavior at various voltages in a hypothetical 1200V diode (not to scale)

This is why no manufacturers in the world indicate a resistance value on a data sheet and no standards in the world include this parameter. To characterize a semiconductor there are no short ways: if one needs to test a device before using it, he needs at least a curve tracer to test the voltage and a Forward to test the V_{tm} . The ohmmeter is good when an equipment has experienced catastrophic failure: all short circuits and open devices must be replaced, for any value in between a more significant test is strongly recommended.