## CURRENT ELECTRICITY LIMITATIONS OF OHM'S LAW

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Although Ohm's law has been found valid over a large class of materials, there do exist materials and devices used in electric circuits where the proportionality of V and I does not hold. The deviations broadly are one or more of the following types

(a) V ceases to be proportional to I.

(b) The relation between V and I depend on the sign of V. In other words, if I is the current for a certain V, then reversing the direction of V keeping its magnitude fixed, does not produce a current of the same magnitude as I in the opposite direction.



The dashed line represents the linear Ohm's law. The solid line is the voltage V versus current I for a good conductor.



Characteristic curve of a diode. Note the different scales for negative and positive values of the voltage and current



Variation of current versus voltage for GaAs.

(c) The relation between V and I is not unique, i.e., there is more than one value of V for the same current I. A material exhibiting such behavior is GaAs.

Materials and devices not obeying Ohm's law in the form of are actually widely used in electronic circuits. In this and a few subsequent chapters, however, we will study the electrical currents in materials that obey Ohm's law.