Lecture 3

جَامعة المَنارة
MANARA UNIVERSITY

DIODE EQUIVALENT CIRCUIT

DIODE SPECIFICATION SHEETS

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Resistance Levels

Semiconductors react differently to DC and AC currents.

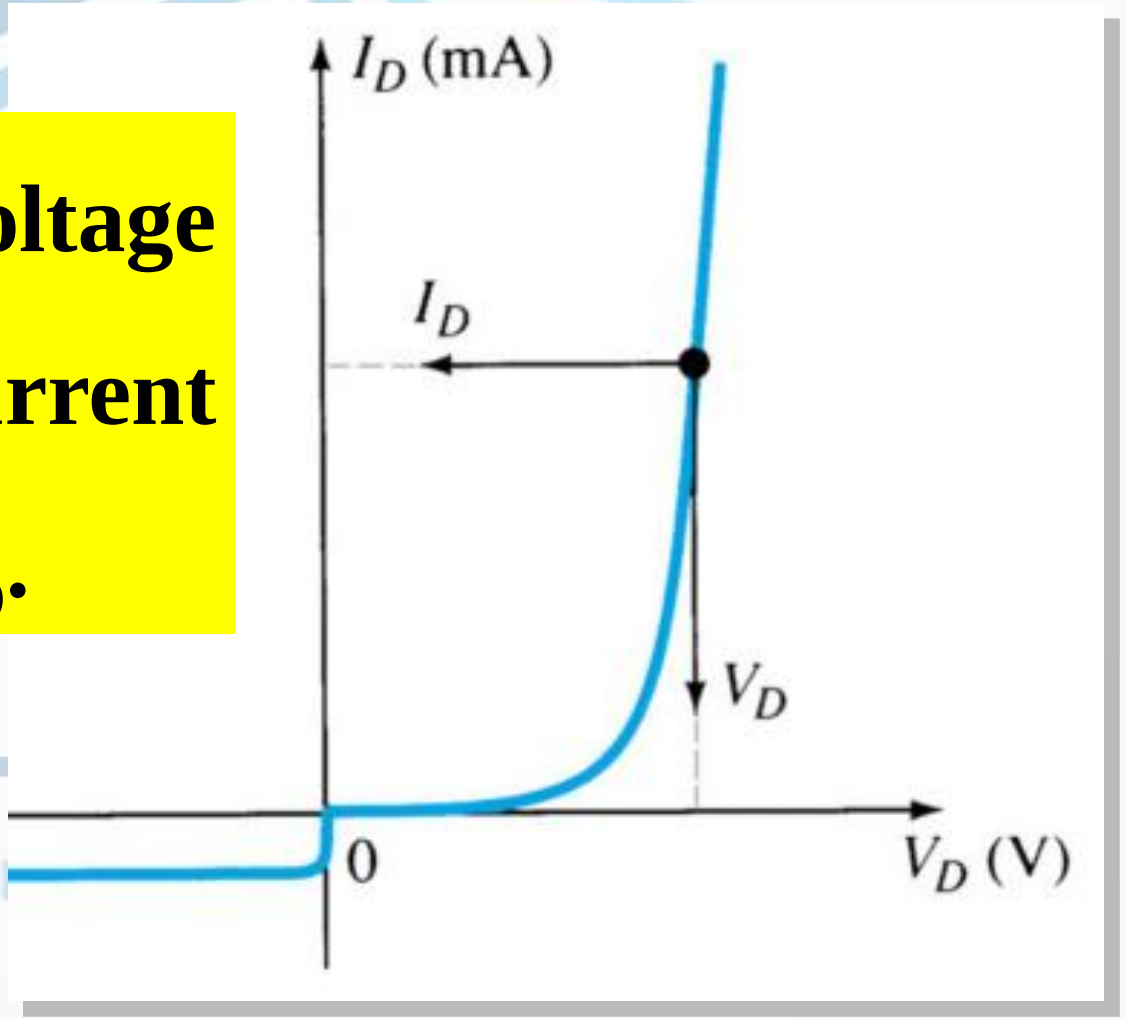
There are three types of resistance:

- **DC (static) resistance**
- **AC (dynamic) resistance**
- **Average AC resistance**

DC (Static) Resistance

$$R_D = \frac{V_D}{I_D}$$

For a specific applied DC voltage V_D, the diode has a specific current I_D, and a specific resistance R_D.



AC (Dynamic) Resistance

$$r'_d = \frac{26\,\text{mV}}{I_D} + r_B$$

❑ In the forward bias region:

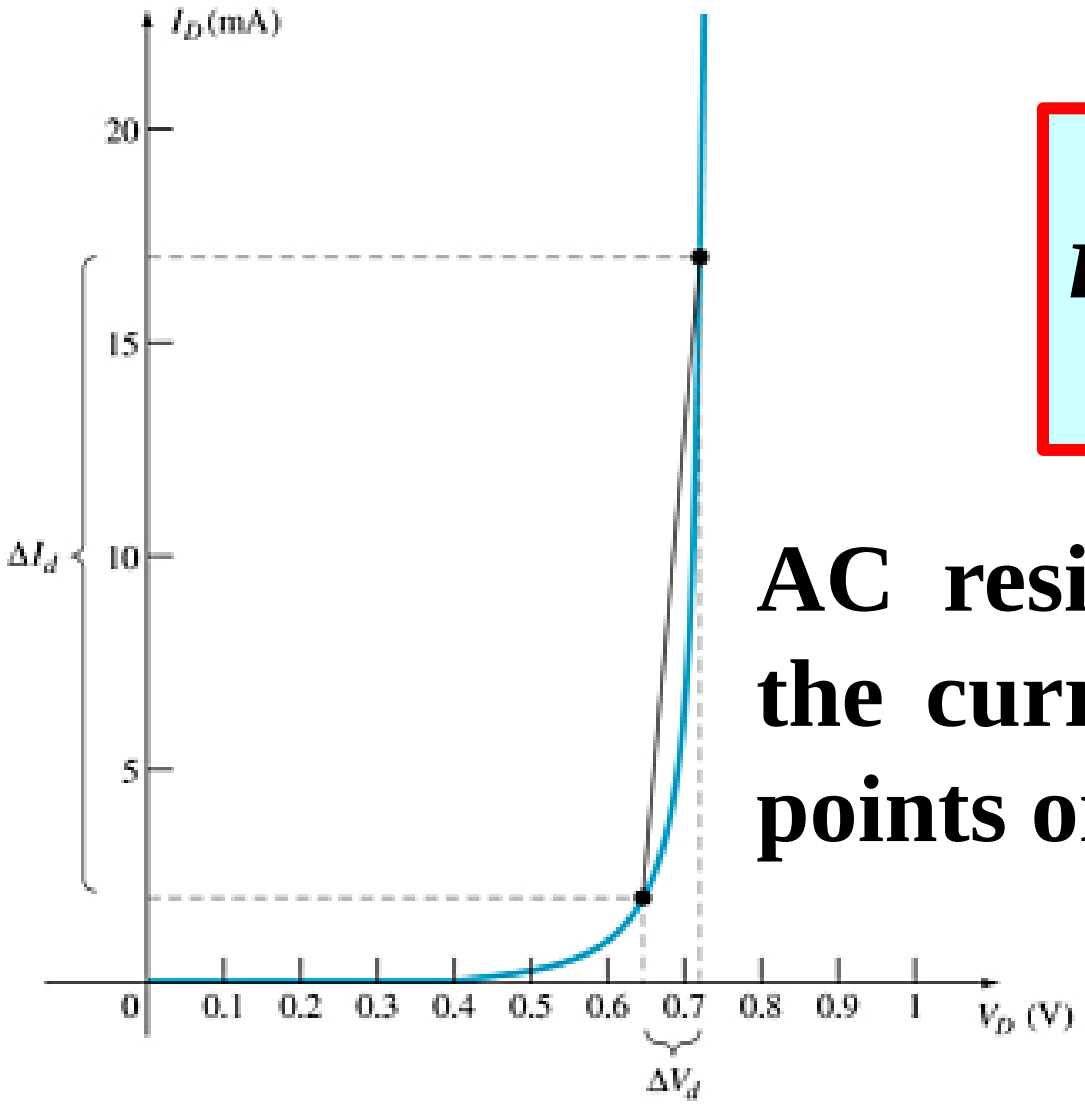
- The resistance depends on the amount of current (I_D) in the diode.
- The voltage across the diode is fairly constant (26 mV for 25°C).
- r_B ranges from a typical 0.1 Ω for high power devices to 2 Ω for low power, general purpose diodes. In some cases r_B can be ignored.

❑ In the reverse bias region:

$$r'_d = \infty$$

The resistance is effectively infinite. The diode acts like an open.

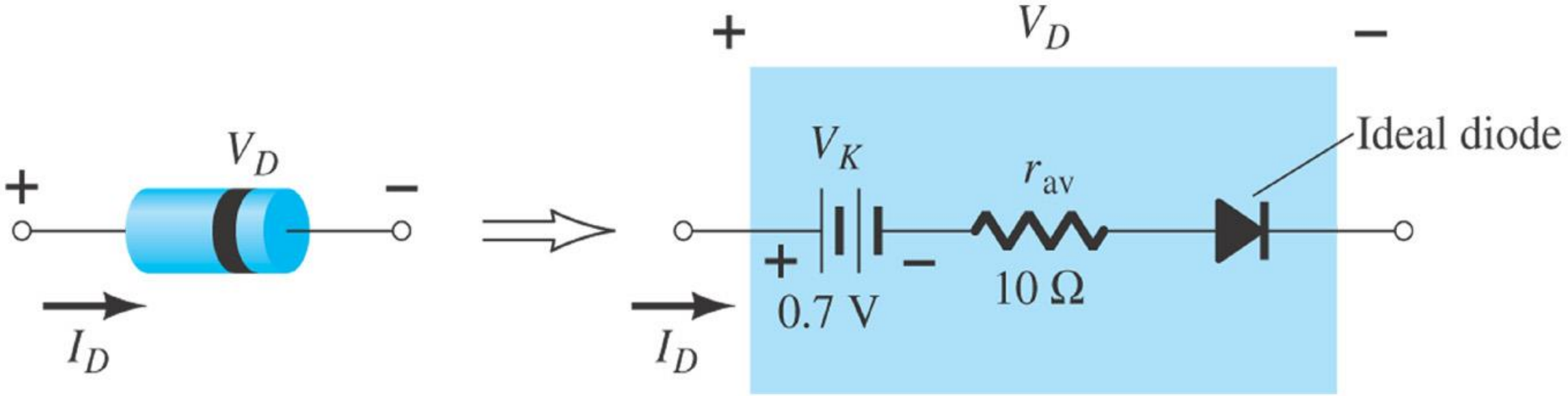
Average AC Resistance



$$r_{av} = \frac{\Delta V_d}{\Delta I_d} \quad \text{pt. to pt.}$$

AC resistance can be calculated using the current and voltage values for two points on the diode characteristic curve.

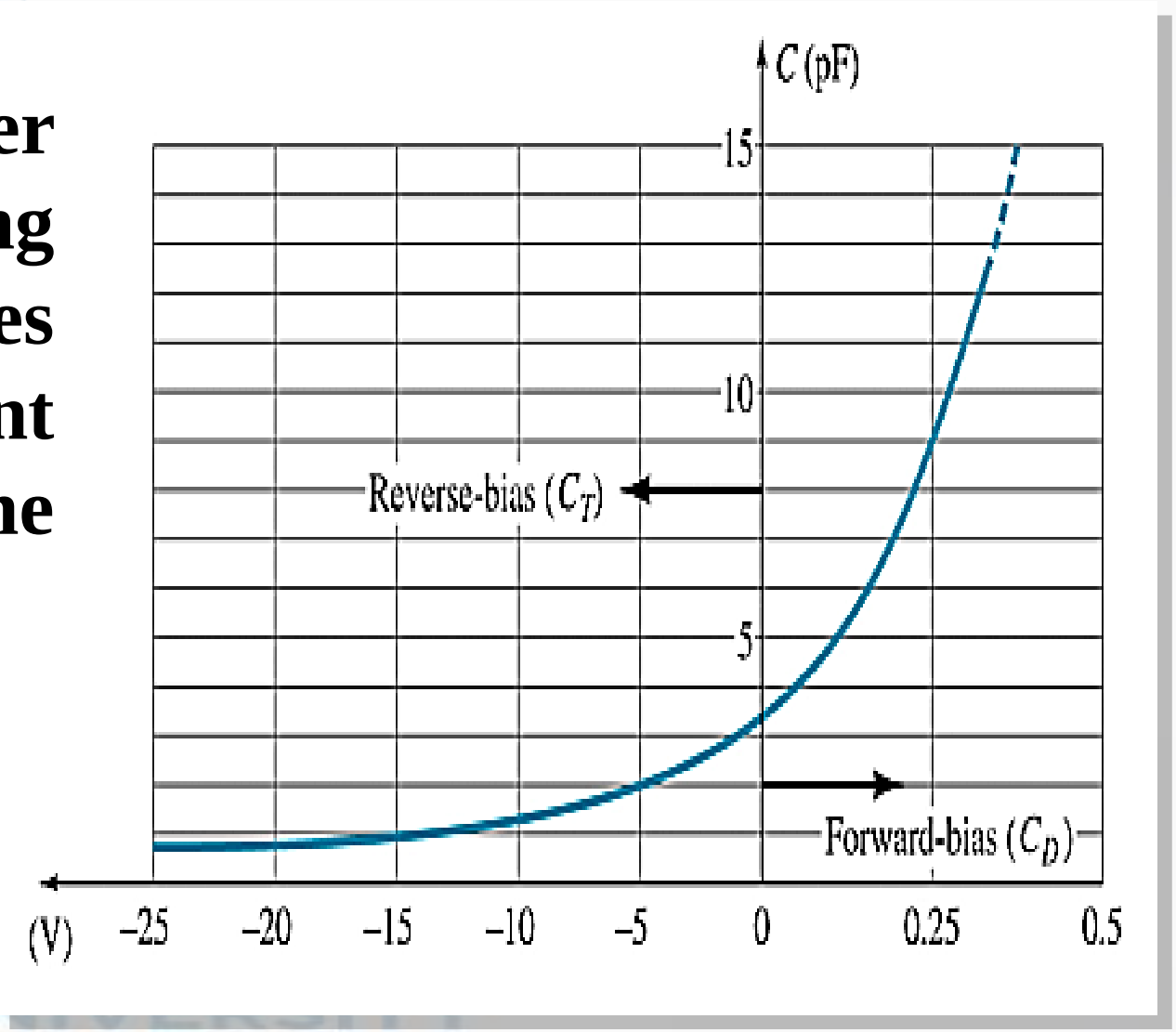
Diode Equivalent Circuit



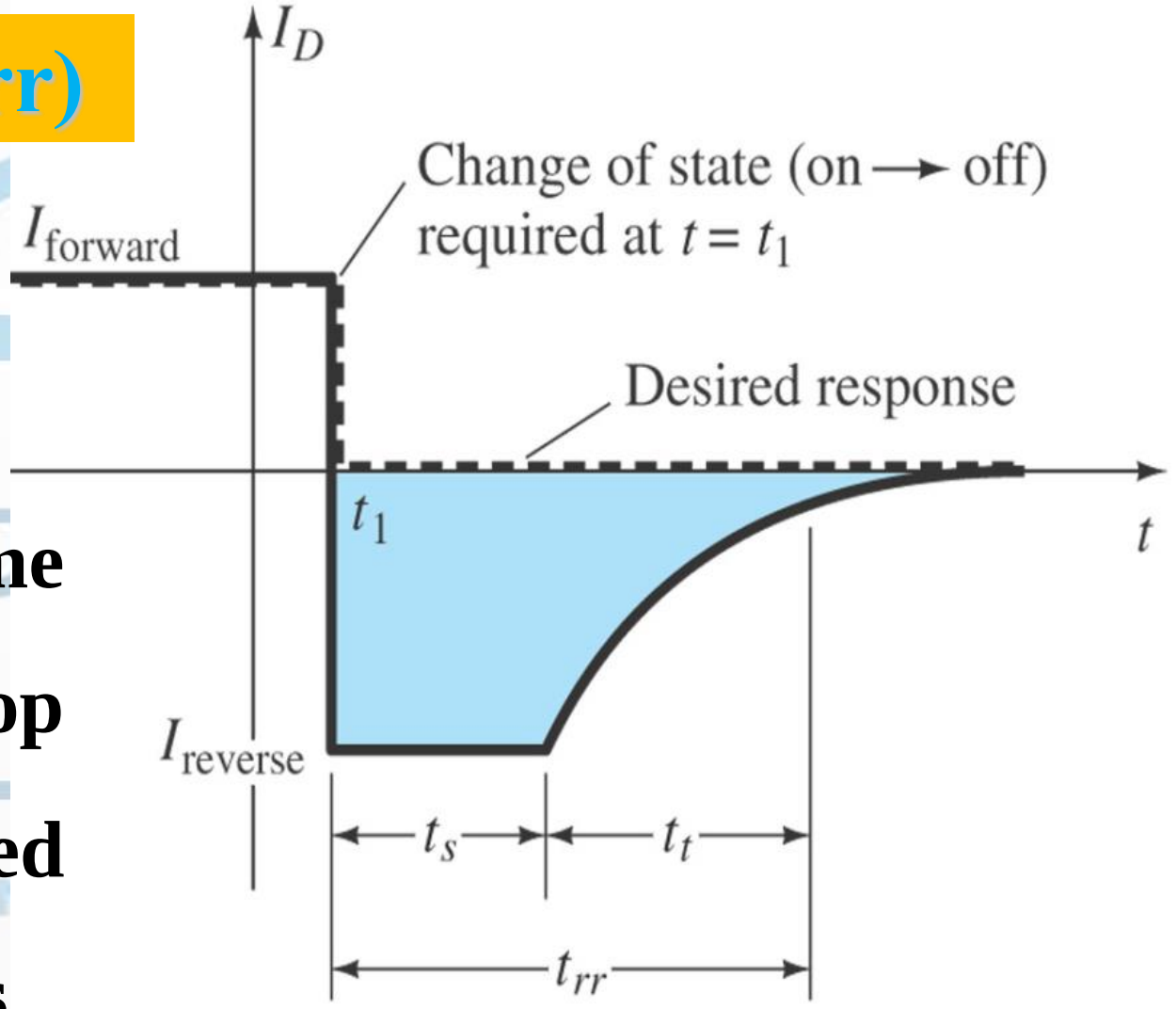
Diode Capacitance

In reverse bias, the depletion layer is very large. The diode's strong positive and negative polarities create capacitance, C_T. The amount of capacitance depends on the reverse voltage applied.

In forward bias storage capacitance or **diffusion capacitance** (C_D) exists as the diode voltage increases.



Reverse Recovery Time (trr)



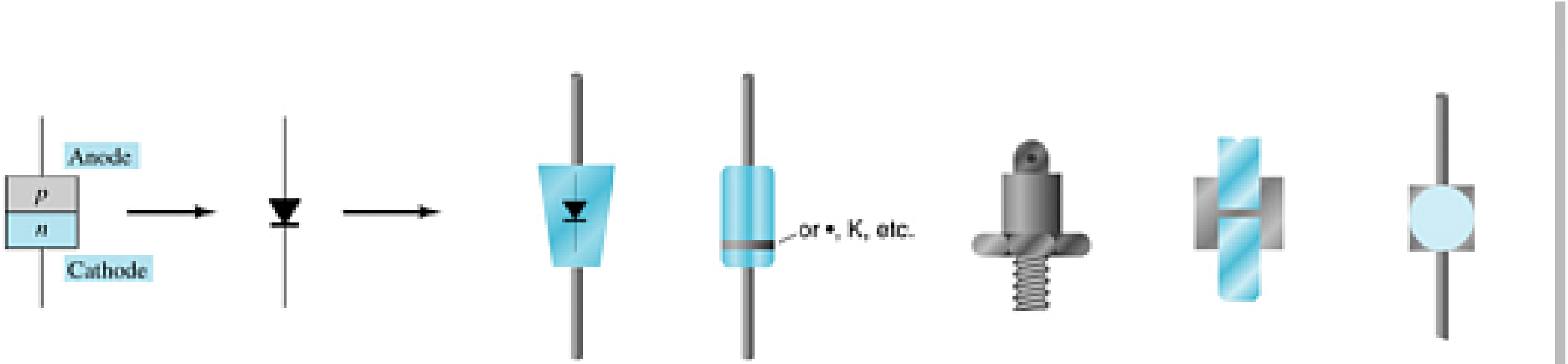
Reverse recovery time is the time required for a diode to stop conducting once it is switched from forward bias to reverse bias.

Diode Specification Sheets

Data about a diode is presented uniformly for many different diodes. This makes cross-matching of diodes for replacement or design easier.

1. **Forward Voltage (V_F) at a specified current and temperature**
2. **Maximum forward current (I_F) at a specified temperature**
3. **Reverse saturation current (I_R) at a specified voltage and temperature**
4. **Reverse voltage rating, PIV or PRV or V(BR), at a specified temperature**
5. **Maximum power dissipation at a specified temperature**
6. **Capacitance levels**
7. **Reverse recovery time, t_{rr}**
8. **Operating temperature range**

Diode Symbol and Packaging



The anode is abbreviated A

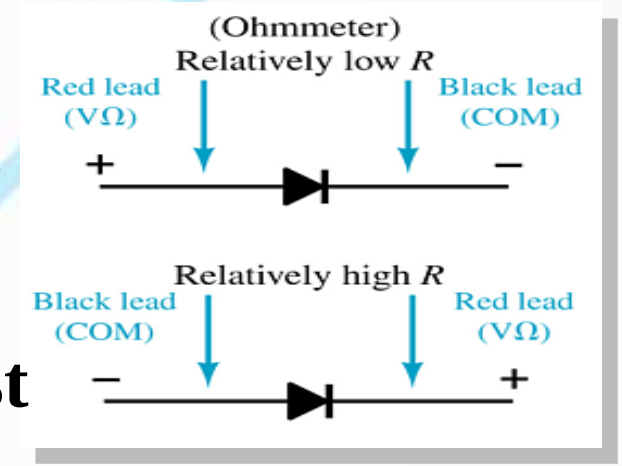
The cathode is abbreviated K

Diode Testing

1. Diode Checker

- Gallium arsenide ≅ 1.2 V
- Silicon diode ≅ 0.7 V
- Germanium diode ≅ 0.3 V

Many digital multimeters have a diode checking function.
The diode should be tested out of circuit.
A normal diode exhibits its forward voltage:

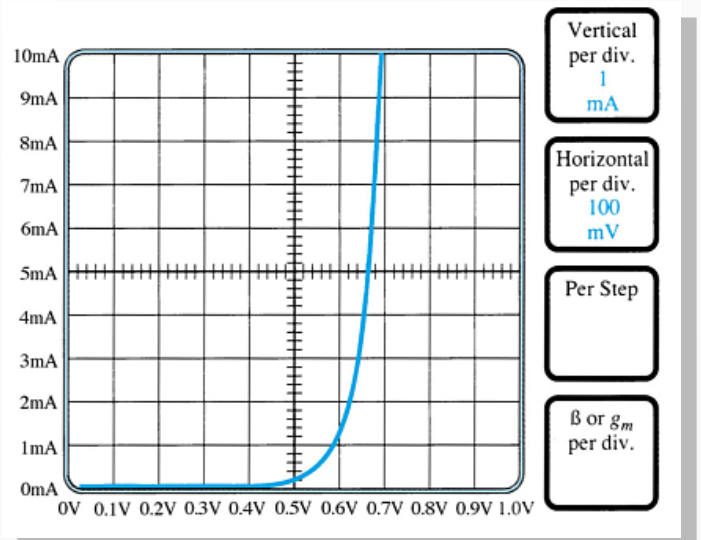


2. Ohmmeter

An ohmmeter set on a low Ohms scale can be used to test a diode. The diode should be tested out of circuit.

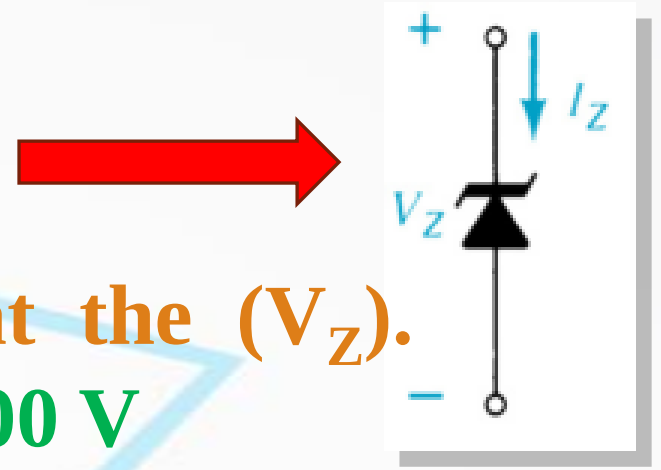
3. Curve Tracer

A curve tracer displays the characteristic curve of a diode in the test circuit. This curve can be compared to the specifications of the diode from a data sheet.



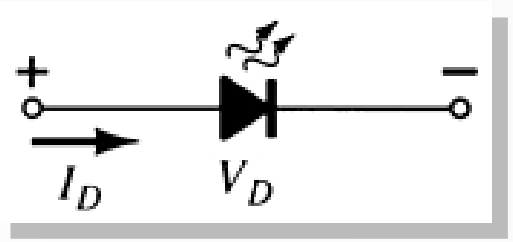
Other Types of Diodes

1.Zener Diode



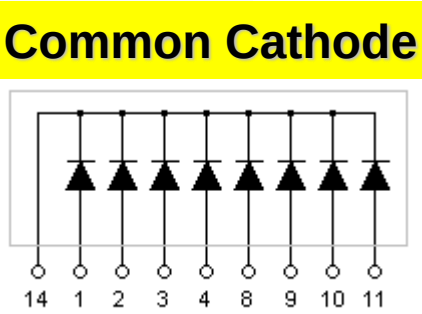
A Zener is a diode operated in reverse bias at the (V_Z).
Common Zener voltages are between 1.8 V and 200 V

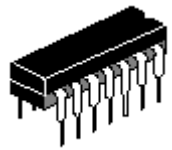
2.Light-Emitting Diode (LED)

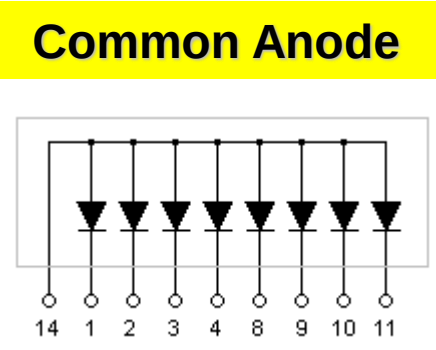


An LED emits photons when it is forward biased.
These can be in the infrared or visible spectrum.
The forward bias voltage is usually in the range of 2 V to 3 V.

3.Diode Arrays







Multiple diodes can be packaged together in (IC).