how does an electret microphone work

An **electret microphone** is a type of **condenser (capacitor) microphone** that has a *permanently charged material* inside — which lets it work without needing an external high-voltage power supply.

Here's the idea step-by-step.

🎤 1. The basic principle: sound → electrical signal

An electret mic converts **sound waves** into electricity using **capacitance changes**.

Inside the microphone are two main parts:

- a **thin movable diaphragm**
- a **fixed back plate**

Together, they form a tiny capacitor.

When sound waves hit the diaphragm:

- air pressure makes it vibrate
- the distance between diaphragm and back plate changes
- the capacitor's electrical properties change

This variation creates an electrical signal that matches the sound.

⚡ 2. What makes it an *electret* microphone?

In a normal condenser microphone, the capacitor plates must be charged using an external voltage (like phantom power).

An electret microphone instead uses an **electret material**.

An **electret** is:

- a dielectric material

- that holds a **permanent electric charge**
- similar to how a magnet permanently holds a magnetic field

Because the charge is already built in:
✓ no external polarization voltage is needed
✓ the microphone can be very small and cheap

🔋 3. Why it still needs power

Even though the electret provides the charge, the microphone usually still needs **low-voltage power** (typically 1.5–5 V).

That power runs a tiny internal amplifier:

👉 usually a **JFET transistor**

Why this is needed:

- the capacitor signal has **very high impedance**
- cables and circuits cannot handle it directly
- the JFET converts it into a usable low-impedance output

So power is for amplification — **not** for creating the charge.

🧩 4. Internal structure (simplified)

Code

```
Sound waves
     ↓
[ Diaphragm ]  ← moves
     ||
[ Electret layer ]
     ||
[ Back plate ]
     ↓
Capacitance change
     ↓
JFET buffer amplifier
     ↓
Audio signal output
```

✅ 5. Why electret microphones are everywhere

They are used in:

- smartphones
- laptops
- headsets
- hearing aids
- lavalier microphones
- webcams

because they are:

- tiny
- inexpensive
- sensitive
- low power

🧠 Quick analogy

Think of it like:

- **sound pushes a charged membrane**
- movement changes an electric field
- electronics translate that movement into voltage

If you want, I can also explain:

- the difference between **electret vs dynamic microphones**
- how MEMS microphones evolved from electrets
- or show the exact circuit used with Arduino/Raspberry Pi.