Condenser Capsule Pick up Patterns

First of all we have to look at the transducer principle of condenser microphones. Any such mic capsule consists of a thin movable membrane positioned at a very close distance to a solid backplate. Both parts are electrically conductive and form the two electrodes of a capacitor. If such a capacitor is constantly charged by applying a certain dc voltage (e.g. 60 or 48 volts) via a very high resistor, there will be voltage variations generated between membrane and backplate proportional to the membrane movements caused by the sound waves.

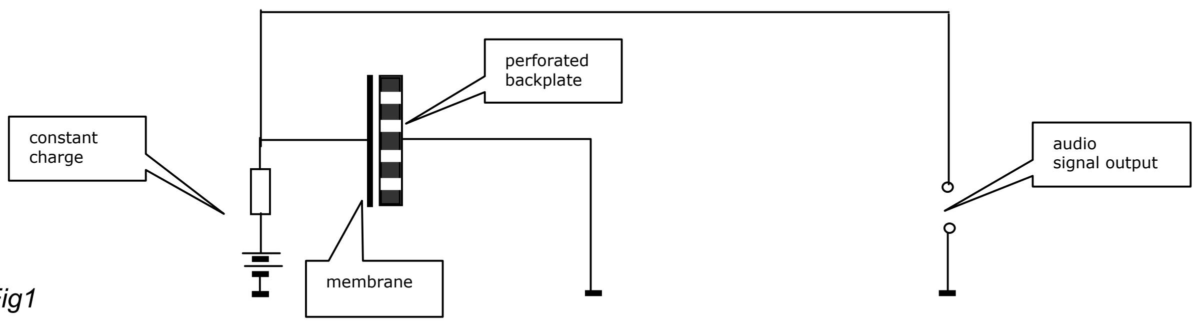


Fig1

Second we have to consider the directivity characteristics of a microphone. Imagine a capsule as described above with a sealed box (volume) attached to the backplate.

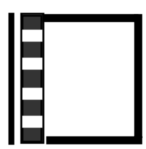


Fig2

The membrane now is moved by the air waves reaching it's front side only. A physical law says that pressure in gaseous media such as air spreads out equally in all directions. This is the reason why such a capsule will have an omnidirectional way of picking up sound. In other words, not regarding from which direction one speaks to the mic, the output voltage will always be the same. We call this principle also 'pressure receiver'.

Now imagine to have a capsule as shown in fig 1 but with a backplate where the amount and diameter of the holes of the perforation does not hinder the sound waves to reach the membrane from all sides. To simplify our imagination we look to a bare diaphragm only.

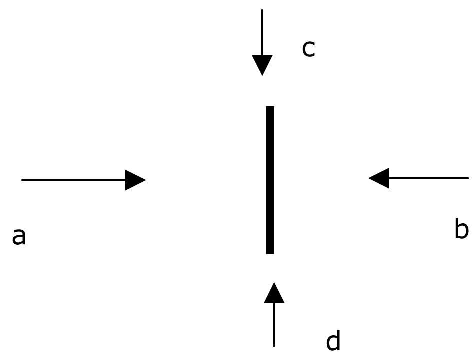


Fig3

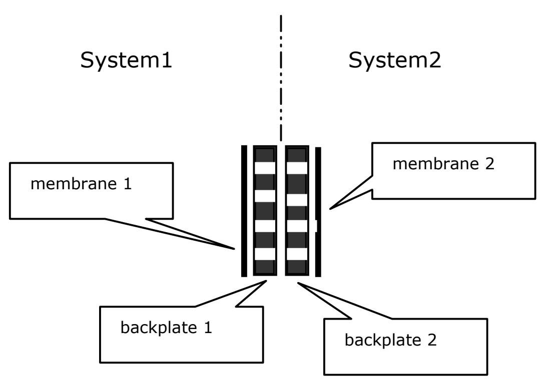
The arrows represent the direction of sound waves. It's easy to find out that the membrane will be moved if the sound comes from a or b but will more or less remain in it's position for sound waves reaching only the rim of the membrane (directions c and d), Such a microphone of course has a figure-of-eight pick-up pattern and the membrane is moved by the pressure difference between front and rear. That's why we also call it pressure gradient receiver.

If we now combine both principles (pressure and pressure gradient receiver) by adding a volume with exactly defined vents, we can obtain any form of pick up pattern from omni, via cardioid, hypercardioid to figure-of-eight. For instance a cardioid mic has it's full sensitivity from the front, Only half it's sensitivity from + and – 90 ° and is almost deaf from the rear (180° direction).

Now we come to our third consideration. For many applications e.g. in the studio or for recordings in concert halls a microphone where the pick up pattern can be changed is often required. How can we reach this?

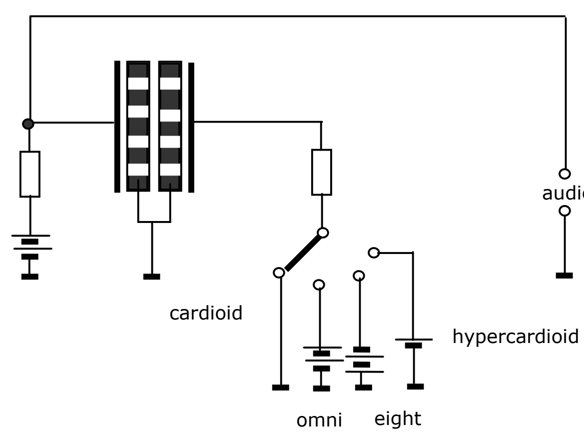
The solution is simple at least theoretically. We take two cardioid capsules and mount them back to back as it is done in AKG's well known CK12.

Fig4



Now remember fig1. We said that a constant charge is necessary to bring the mic to work. If we now apply this charge between membrane 1 and backplate 1 only, we have a cardioid because the second part of the capsule remains inactive and by the movable membrane 2 does not represent an obstacle to the sound waves from the rear or the side of this arrangement. As soon as we also apply a charge to the second system consisting of membrane 2 and backplate 2 we get two cardioid capsules working in opposite directions. What will happen now if a sound source moves around the microphone? Well we get full sensitivity from the front (system1) and from the rear (system2). From the side direction (90°) we have half the sensitivity from each of the two systems summing up to make the full value of the 0° or 180° sensitivity. The result is a mic with omnidirectional characteristics.

If we now reverse the polarity of the voltage making the constant charge of system2 we have a similar situation as just described with the only difference that the 90° components (half the sensitivity from both systems) no longer are added but because of the reversed polarization subtracted. So what do we get? Right, a figure-of-eight. Finally we can also vary the ratio between the charging voltage (actually it's called polarization voltage) and e.g. reduce it for system2. In this case we can get any shape of the pick up pattern, so of course also a hypercardiodid or supercardioid.



This diagram shows a simplified schematics of the CK12 in the C426.

Now you know the whole story!

AKG Acoustics GmbH, A Harman International Company, Lemböckgasse 21-25, A-1230 Wien, Austria
Phone: (+431) 86654-1519, Fax: (+431) 86654-1514, e-mail: service@akg.com