

## Antennas



*Radio broadcasting and communications seem to hold a strange kind of magical allure that attracts a wide variety of people and hold them there for years. There is something fascinating about the ability to project yourself over vast intercontinental distance. The antenna is arguably one of the most important (magical) parts of the receiving and transmitting station.*

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## Antennas

- An antenna is basically a transducer that converts electrical alternating current oscillation at some frequency to an electromagnetic wave at the same frequency.

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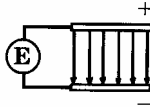
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## Voltage and electric field



When a capacitor is connected across a source of voltage, such as a battery, it is charged some amount, depending on the voltage and the value of the capacitance.

Because of the electromotive force of the battery, negative charges flow to the lower plate, leaving the upper plate positively charged.

Accompanying the accumulation of charge, is the building of the electrical field.

The flux lines are directed from the positive to the negative charges.

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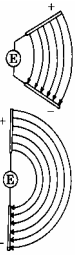
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## Voltage and electric field



If the two plates of the capacitor are spread farther apart, the electrical field must curve to meet the plates at right angles.

Instead of flat metal plates, as in the capacitor, the two elements can take the form of metal rods or wires.

Assume that the sphere, E, is a transmitter supplying RF energy. Then the two wires can serve as an antenna, the RF energy is radiated from the antenna as charges move back and forth along the wires.

Alternately compressing and expanding the flux lines of the electrical field (the reversal in polarity of the transmitting signal also reverses the direction of the electrical field).

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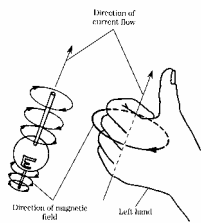
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## Current and magnetic field



A moving charge along a conductor constitutes a current and produces a magnetic field around the conductor.

The intensity of this field is directly proportional to the flow of charges.

When the antenna is uncharged, the current flow is maximum, since there is no opposing electric field.

The current flow accumulates charges on the antenna, and an electrical field is built in increasing opposition to the electromotive force of the source.

The current flow decreases and when the antenna is fully charged, the current no longer flows.

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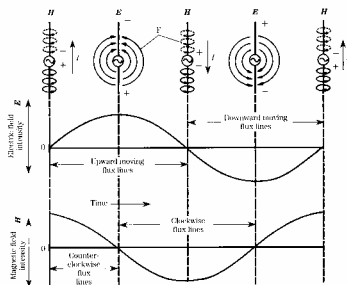
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## Combine electric and magnetic fields



When RF energy from a transmitter is supplied to an antenna, the effect of charge, voltage, current and the electric and magnetic field are taking place simultaneously.

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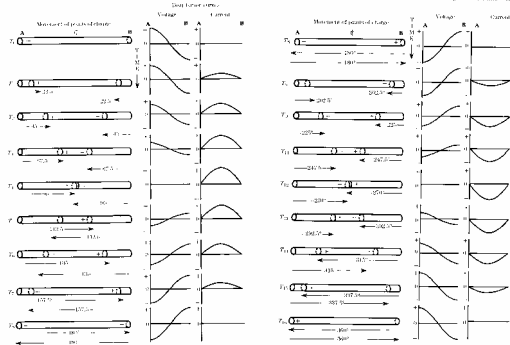
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## Combine electric and magnetic fields




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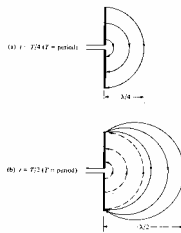
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## Combine electric and magnetic fields



The lines of force created between the arms in the first quarter of the period during which time the charge has reached its maximum value and the lines have traveled outwardly to radial distance  $\bullet/4$ .

During the next quarter of the period, the original lines travel an additional  $\bullet/4$  (a total of  $\bullet/2$  from the initial point) and the charge density on the conductor begins to diminish.

This can be thought of as being accomplished by introducing opposite charges which at the end of the first half period have neutralized the charges on the conductor.

The lines of force created by the opposite charges travel a distance  $\bullet/4$  during the second quarter of the first half (dashed).

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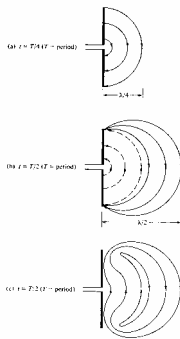
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## Combine electric and magnetic fields



The result is that there are lines of force pointed **upwards** in the first  $\bullet/4$  distance and the same amount of lines of force directed **downwards** in the second  $\bullet/4$ .

Since there is **no net charge on the antenna**, then the lines of force are forced to detached themselves from the conductor and to unite together and form closed loops.

In the remaining second half of the period, the same procedure is followed but in the opposite direction.

After that the process is repeated over and over again.

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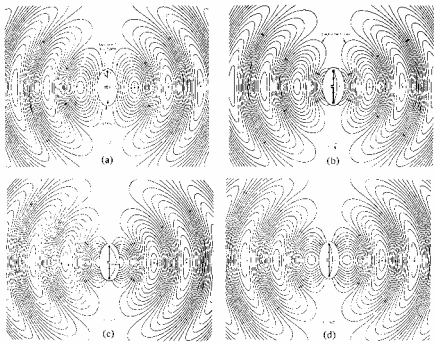
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Combine electric and magnetic fields



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Fundamental parameters of  
antennas

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