

## What is Mutual Inductance?

When one coil is near another, a varying current in one will produce a varying magnetic field which cuts the turns of the other coil, inducing a current in it. This induced current is also varying, and will therefore induce another current in the first coil. This reaction between two couple circuits is called mutual inductance, and can be calculated and expressed in henrys.

The symbol for mutual inductance is  $M$ . Two circuits thus joined are said to be inductively coupled.

The magnitude of the mutual inductance depends on the shape and size of the two circuits, their positions and distances apart, and the permeability of the medium. The extent to which two inductors coupled is expressed by a relation known as coefficient of coupling ( $k$ ). This is the ratio of the mutual inductance actually present at the maximum possible value.

Thus, when  $k$  is 1, the coils have the maximum degree of mutual induction.

The mutual inductance of two coils can be formulated in terms of the individual inductances and the coefficient of coupling with the formula

### Inductors in Series:

Inductors in series are, just like resistors, additive. Provided that no mutual inductance exists.

In this case, the total inductance  $L$  is:  $L = L_1 + L_2 + \dots$  etc.

Where mutual inductance does exist:  $L = L_1 + L_2 + 2M$

Where  $M$  is the mutual inductance.

This latter expression assumes that the coils are connected in such a way that all flux linkages are in the same direction, i.e. additive. If this is not the case and the mutual linkages subtract from the self-linkages, the following formula should be used:  $L = L_1 + L_2 - 2M$

Where  $M$  is the mutual inductance