Antimetric electrical network

An antimetric electrical network is an electrical network that exhibits anti @-@ symmetrical electrical properties . The term is often encountered in filter theory , but it applies to general electrical network analysis . Antimetric is the diametrical opposite of symmetric ; it does not merely mean " asymmetric " (i.e. , " lacking symmetry ") . It is possible for networks to be symmetric or antimetric in their electrical properties without being physically or topologically symmetric or antimetric .

Definition

References to symmetry and antimetry of a network usually refer to the input impedances of a two @-@ port network when correctly terminated . A symmetric network will have two equal input impedances , Zi1 and Zi2 . For an antimetric network , the two impedances must be the dual of each other with respect to some nominal impedance R0 . That is ,

<formula>

or equivalently

<formula>

It is necessary for antimetry that the terminating impedances are also the dual of each other , but in many practical cases the two terminating impedances are resistors and are both equal to the nominal impedance R0 . Hence , they are both symmetric and antimetric at the same time .

Physical and electrical antimetry

Symmetric and antimetric networks are often also topologically symmetric and antimetric , respectively . The physical arrangement of their components and values are symmetric or antimetric as in the ladder example above . However , it is not a necessary condition for electrical antimetry . For example , if the example networks of figure 1 have an additional identical T @-@ section added to the left @-@ hand side as shown in figure 2 , then the networks remain topologically symmetric and antimetric . However , the network resulting from the application of Bartlett 's bisection theorem applied to the first T @-@ section in each network , as shown in figure 3 , are neither physically symmetric nor antimetric but retain their electrical symmetric (in the first case) and antimetric (in the second case) properties .

Two @-@ port parameters

The conditions for symmetry and antimetry can be stated in terms of two @-@ port parameters . For a two @-@ port network described by impedance parameters (z @-@ parameters) ,

<formula>

if the network is symmetric , and

<formula>

if the network is antimetric . Passive networks of the kind illustrated in this article are also reciprocal , which requires that

<formula>

and results in a z @-@ parameter matrix of ,

<formula>

for symmetric networks and

<formula>

for antimetric networks .

For a two @-@ port network described by scattering parameters (S @-@ parameters) ,

<formula>

if the network is symmetric , and

<formula>

if the network is antimetric . The condition for reciprocity is ,
<formula>
resulting in an S @-@ parameter matrix of ,
<formula>
for symmetric networks and
<formula>
for antimetric networks .

= = Applications = =

Some circuit designs naturally output antimetric networks . For instance , a low @-@ pass Butterworth filter implemented as a ladder network with an even number of elements will be antimetric . Similarly , a bandpass Butterworth with an even number of resonators will be antimetric , as will a Butterworth mechanical filter with an even number of mechanical resonators .

= = Glossary notes = =