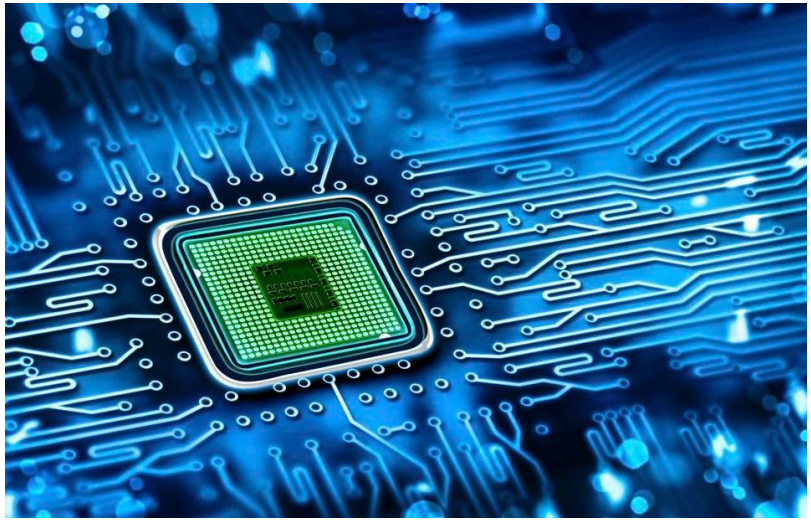
# S PARAMETERS



# S PARAMETERS

**S-Parameters:**

*s*-parameters consists of two fundamental topics:

1. two-port networks,
2. reflections on transmission lines.

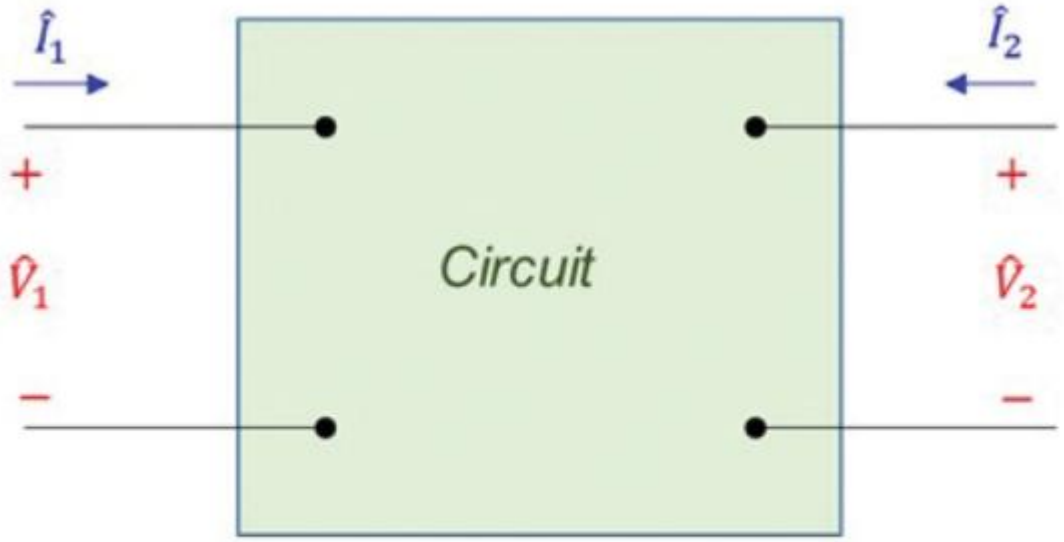



Figure 1: Two-port network

# S PARAMETERS

two-port system provides relations between the input and output reflected waves b1 and b2 and the input and output incident waves a1 and a2 when the structure is to be connected to a source resistance RG and a load resistance RL

The notion of waves rather than voltages and currents is better suited for microwave structures. For a two-port system, the equations relating the incident and reflected waves and the S parameters are given by

$b1 = S11a1 + S12a2$

$b2 = S21a1 + S22a2$

# S PARAMETERS

For a two-port system, the equations relating the incident and reflected waves and the $S$ parameters are given by

$$b_1 = S_{11}a_1 + S_{12}a_2$$
$$b_2 = S_{21}a_1 + S_{22}a_2$$

These equations can be summarized in the matrix form $(b) = (S)(a)$, where

$$\begin{pmatrix} b_1 \\ b_2 \end{pmatrix} = \begin{pmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{pmatrix} \begin{pmatrix} a_1 \\ a_2 \end{pmatrix}$$

The parameter $S_{11}$, called the *input reflection coefficient*,

# S PARAMETERS

The parameter $S_{11}$, called the *input reflection coefficient*, can be computed by setting the output incident wave $a_2$ to zero and taking the ratio of the input reflected wave over the input incident wave:

$$S_{11} = \left.\frac{b_1}{a_1}\right|_{a_2=0}$$

The parameter $S_{21}$, called the *forward transmission coefficient*, can be computed by setting the output incident wave $a_2$ to zero and taking the ratio of the output reflected wave over the input incident wave:

$$S_{21} = \left.\frac{b_2}{a_1}\right|_{a_2=0}$$

# S PARAMETERS

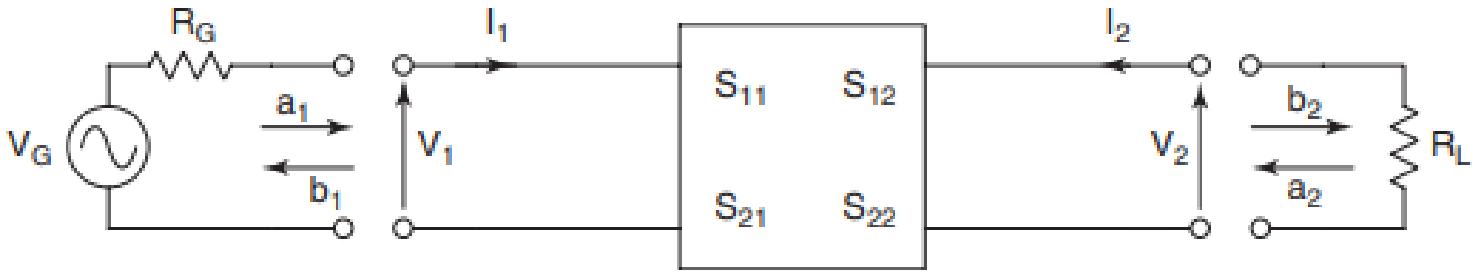



**Figure 1.1** Notation used in defining the scattering matrix of a two-port system.

The parameter $S_{22}$, called the *reflection coefficient at the output of the system*, can be computed by setting the input incident wave $a_1$ to zero and taking the ratio of the output reflected wave over the output incident wave:

$$S_{22} = \left.\frac{b_2}{a_2}\right|_{a_1=0}$$

# S PARAMETERS

The parameter $S_{12}$, called the *reverse transmission coefficient*, can be computed by setting the input incident wave $a_1$ to zero and taking the ratio of the input reflected wave over the output incident wave:

$$S_{12} = \left.\frac{b_1}{a_2}\right|_{a_1=0}$$


Thank
you