SUBJECT: BASIC ELECTRONICS

Transconductance, Transadmittance, Transresistance, Transimpedance

Elementrix Classes

Transconductance (g_m)

Transconductance refers to the ratio between changes in the current through two output points and changes in the voltage at two input points.

It is also known as **Mutual Conductance**.

$$g_m = \frac{\triangle I_{out}}{\triangle V_{In}}$$

Here, the $\mathbf{g_m}$ is the symbol of Transconductance. The g denotes the conductance and subscript m denotes the mutual. ΔI_{out} is the change in output current and ΔV_{In} is the change in input voltage.

The **SI unit** of Transconductance is **Siemens** which is denoted by the symbol **S**.

The equivalent term of Transconductance used for the **AC power system is Transadmittance**.

Uses with Example:

1. Transconductance is measured for some amplifiers where the input voltage control the output current. These amplifiers are also known as Transconductance Amplifiers or Gm Amplifiers. An amplifier using a Field Effect Transistor(FET) is an example of it where the Gate to Source Voltage controlled the Drain Current.

2. Transconductance is also measured for Voltage Controlled Current Source(VCCS).

Transresistance (r_m)

Transresistance refers to the ratio between changes in the voltage at two output points and changes in the current through two input points.

It is also known as **Mutual Resistance**.

$$r_m = \frac{\triangle V_{out}}{\triangle I_{In}}$$

Here, the $\mathbf{r_m}$ is the symbol of Transresistance. The r denotes the resistance and subscript m denotes the mutual. ΔV_{out} is the change in output voltage and ΔI_{In} is the change in input current.

The transresistance is measured in **Ohm** which is the **SI unit** of it. And it is denoted by the symbol **Ω**.

Actually, the term transresistance is used for the **DC power system** when it comes to the **AC power system it is called Transimpedance**.

Uses with Example:

1. Transresistance is measured in some amplifiers where the input current controlled the output voltage. These amplifiers are also known as Transresistance Amplifiers or Transimpedance Amplifiers. A common example of it is when an operational amplifier is used by connecting its output to the inverting input with a feedback path.

2. Transresistance is also measured for the Current Controlled Voltage source(CCVS).

Relation between g_m and r_m

The relationship between transconductance (g_m) and transresistance (r_m) is reciprocal. Mathematically, it is expressed as:

$$r_m = \frac{1}{g_m}$$

If g_m increases, r_m decreases, and if g_m decreases, r_m increases, maintaining a reciprocal relationship.

For example, if g_m is 2mS (milliSiemens), then r_m would be ½ mS. If g_m increases to 4mS, then r_m would decrease to ¼ mS, and so on.

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