→ Reflection Coefficient :- When a wave travels along a transmission line and reaches the load end.

- If load impedance $Z_L = Z_0$, wave fully absorbed and it has No reflection.
- If $Z_L \neq Z_0$, part of wave reflects back and Reflection occurs.

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Definition of Reflection coefficient:-

Reflection coefficient is defined as:-

$$\Gamma = \frac{\text{Reflected Wave Amplitude}}{\text{Incident Wave Amplitude.}}$$

or mathematically:

$$\Gamma = \frac{V_r}{V_i}$$

Where

- V_i = Incident Voltage
- V_r = Reflected Voltage

Derivation of Reflection coefficient

At load end ($x = 0$)

Total Voltage.

$$V = V_i + V_r$$

Total Current

$$I = \frac{V_i}{Z_0} - \frac{V_r}{Z_0}$$

Negative sign because reflected current flows opposite direction.

Now load impedance.

$$Z_L = \frac{V}{I}$$

Substitute values;

$$Z_L = \frac{V_i + V_r}{\frac{V_i}{Z_0} - \frac{V_r}{Z_0}}$$

Multiply numerator and denominator by Z_0.

$$Z_L = Z_0 \frac{V_i + V_r}{V_i - V_r}$$

Now devide numerator & denominator by V_i

$$Z_L = Z_0 \frac{1 + \frac{V_r}{V_i}}{1 - \frac{V_r}{V_i}}$$

But

$$\Gamma = \frac{V_r}{V_i}$$

So

$$Z_L = Z_0 \frac{1 + \Gamma}{1 - \Gamma}$$

Solving for Γ

$$\boxed{\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}}$$ Reflection coefficient