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Attenuator

Attenuator - यह एक 2 Port Network होता है जो कि किसी Network में एक निश्चित amount में Voltage, current या Power को Reduce करने के लिए use किया जाता है सभी Frequency के लिए यह एक Purely Resistive network होता है जिसका Propagation Costent एक Real no होता है

Attenuation पर Fequency का कोई प्रभाव नहीं पड़ता क्योंकि Attenuator में केवल Resistive Components होते है Attenuator Symatrical व Symmetrical दोनो प्रकार के हो सकते है Attenuor Fixed व Vorable भी हो सकते है

Attenuator का कार्य Amplifier के कार्य का उल्टा होता है Amplifier का प्रयोग Signal के Level को बढ़ाने के लिए किया जाता है जबकि Attenuator का प्रयोग Singal के Level को कम करने के लिए किया जाता है।

$$\text{Attenuation} = \frac{\text{Input Signal}}{\text{Output Signal}}$$

Attenuation को decibel (dB) Neper (NP) में express किया जाता है।

$$\text{Attenuation in dB} = 10 \log_{10}\left(\frac{P_1}{P_2}\right)$$

P_1 = Input Power
P_2 = output Power

$$\frac{P_1}{P_2} = \frac{I_1^2}{I_2^2} \qquad \left[\frac{P_1}{P_2} = \frac{I_1^2 \cdot R}{I_2^2 \cdot R}\right]$$

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$\frac{P_1}{P_2} = \frac{\frac{V_1^2}{R}}{\frac{V_2^2}{R}} = \frac{V_1^2}{V_2^2}$ $\quad P = VI = I^2R = \frac{V^2}{R}$

I_2 = Output current
V_2 = Output voltage

Attenuation in dB = $10\log\left[\frac{I_1^2}{I_2^2}\right]$

$2\log\left[\frac{I_1}{I_2}\right)$

(or) $20\log\left[\frac{V_1}{V_2}\right)$ $\quad (\log A^2 = 2\log A$

$N = \frac{V_1}{V_2} = \frac{I_1}{I_2}$

(or) $\boxed{N^2 = \frac{P_1}{P_2}}$ $\quad N = \sqrt{\frac{P_1}{P_2}} = \frac{V_1}{V_2} = \frac{I_1}{I_2}$

$\boxed{\text{Attenuation in dB} \quad 20\log N}$

$\log N = \frac{dB}{20}$

$N = \text{Antilog}\ \frac{dB}{20}$

Attenuation in dB = $20\log_{10} N$ $\quad \text{Antilog}\frac{dB}{20}$ $\quad 20\log_{10}N$

$= 2\log_e N \times \log_{10} e$ $\quad 2\log$

$= 20\log_e N \times 0.434$ $\quad \text{Ant}\ \frac{dB}{20}$

$dB = 8.686 \log_e N$

$\log_e N$ = Attenuation in nepers

Attenuation in dB = 8.686 × Attenuation in Np

Attenuation in Np = $\frac{1}{8.686}$ × dB

attenuation in Np = 0.1151 × dB

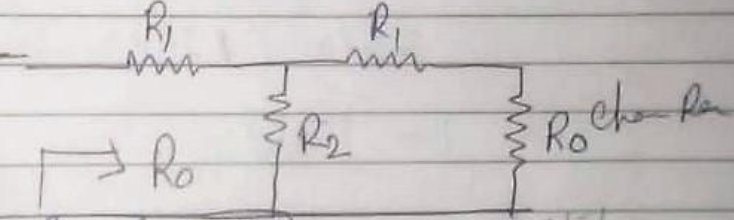
1 dB = 8.686 Np

1 Np = 0.1151 dB

Types of Attenuator -

(1) T attenuator
(2) π attenuator
(3) Lattice T/π & L type attenuator
(4) Brige-T attenuator

(1) T attenuator —



$$N = \frac{R_0 + R_1 + R_2}{R_2}$$

$$R_1 = R_0\left[\frac{N-1}{N+1}\right]$$

$$R_2 = R_0\left[\frac{2N}{N^2-1}\right]$$

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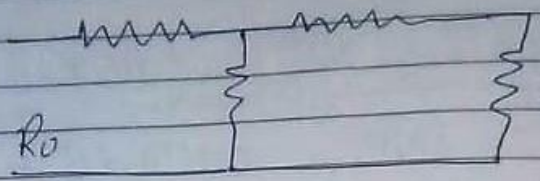
Qu- Design a Symmetrical T type attenuator to give 25 dB attenuation and to work into characteristic Impedance of 600 Ω



dB: 25 dB

$N = \text{antilog}\left(\frac{25}{20}\right)$ / $N = \text{antilog}\left(\frac{dB}{20}\right)$

$N = \text{antilog}\left(\frac{25}{20}\right)$

$N = \text{antilog}\ \frac{5}{4}$

antilog (1.25)

$N = 17.8$

$17.8 - 1 = 16.8$

$R_1 = R_0\left[\frac{N-1}{N+1}\right]$

$R_1 = 600\left[\frac{17.8-1}{17.8+1}\right]$

$R_1 = 600\left[\frac{16.8}{18.8}\right]$

$\frac{1680}{188} =$

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antilog 1.25 = 17.8
antilog 1.75 = 56.2
1.5 = 31.62
3 = 1000
2.5 = 316
0.5 = 3.16

Q4: Design T attn 30dB $Z_0 = 600\Omega$

$$N = \text{Ant} \frac{dB}{20}$$

$$\text{Antilog} \frac{30}{20} = 1.5$$

N = antilog 1.5 =

N = 31.62

$$R_1 = R_0 \left[\frac{N-1}{N+1}\right]$$

$$R_1 = 600 \left[\frac{30.62}{32.62}\right] = 600 \left(\frac{3062}{3262}\right)$$

ek 1 type का disc attach 2odB

$R_0 = 75$

$R_1 = R_0 \left(\frac{9}{10}\right) = \frac{9}{10} = 0.9$

$75 \times 0.9 =$

75
0.9
3
0

$R_1 = 60.75$

75
0.81
4
0.81
5 75
1 4 0 5
5 6 7 x
6 0 . 7 5

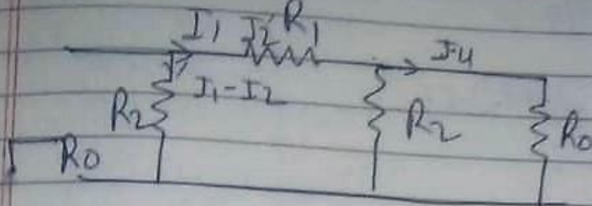
$R_2 = 75 \frac{200}{99}$

$R_2 = 75 \times 0.22$

16.50

1 1
0.22
75
1 1 0
1 5 4 x
0
1 6 . 5

Symmetrical π Attenuator



$$N = 1 + \frac{R_1}{R_0} + \frac{R_1}{R_2}$$

$$R_1 = R_0\left[\frac{N^2 - 1}{2N}\right]$$

$$R_2 = R_0\left[\frac{N+1}{N-1}\right]$$

$R_1 = R_0\left(\frac{N^2-1}{2N}\right)$

$R_2 = R_0\left(\frac{N+1}{N-1}\right)$

Q. π type atte dB = 40 dB $R_0 =$

dizain a π ty wich give the attual 40 dB on R_0 = Char In Tran line = $R_0 = 200\,\Omega$ value the fegen of attenuator

$N =$ antilog $\frac{dB}{20} =$

antilog $\frac{40}{20} = 2$

$N = 100$

$R_1 = R_0 \, \cancel{200} \left[\frac{10000 - 1}{\cancel{200}}\right] = \frac{9999}{\cancel{200}}$ ~~4999~~

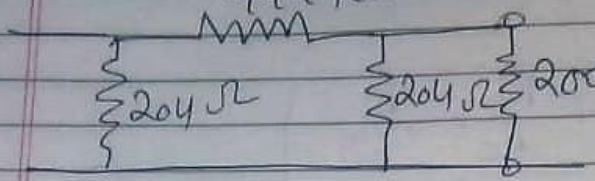
200 × 4.9 = 1000, 800 = 980 ... 1990

$= 9999\,\Omega$

$R_2 = \frac{200 * 101}{99} = \frac{200 \times 1.2}{99}$

204 Ω

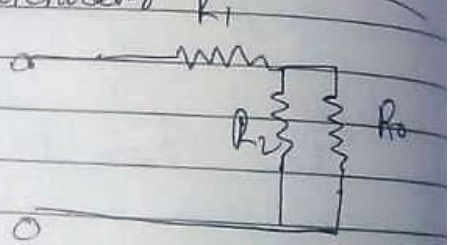
9999 Ω



200
1.02
400
000x
200xx
20410

200
1.02
400
000x
200xx
20410

3- Lattice or T type Attenuator



$N = \text{antilog}\left(\frac{dB}{20}\right)$

$$R_1 = R_0\left(\frac{N-1}{N}\right)$$

$$R_2 = \frac{R_0}{N-1}$$