



INSTITUT TEKNOLOGI
TELKOM

DTG3F3
Teknik Antena
dan propagasi



Sistem Pencatupan Antena

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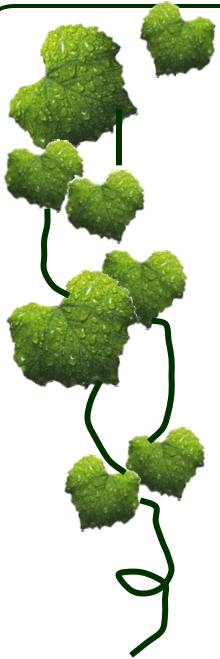
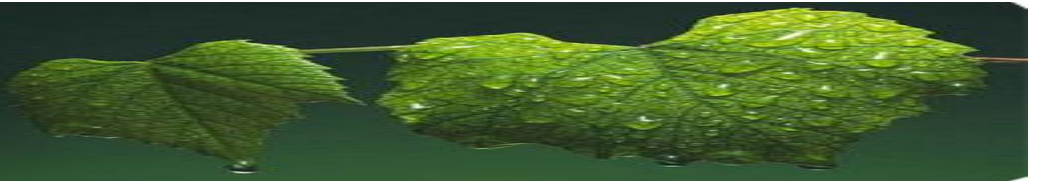
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6

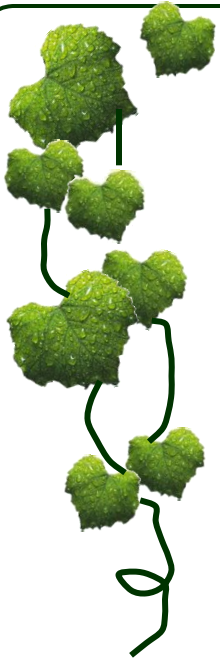
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Where are We ?



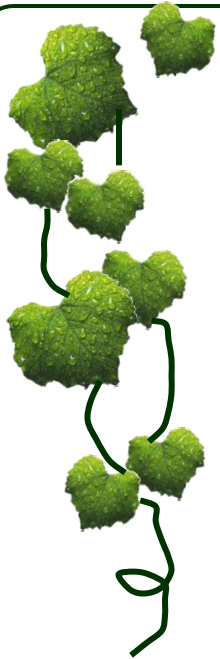
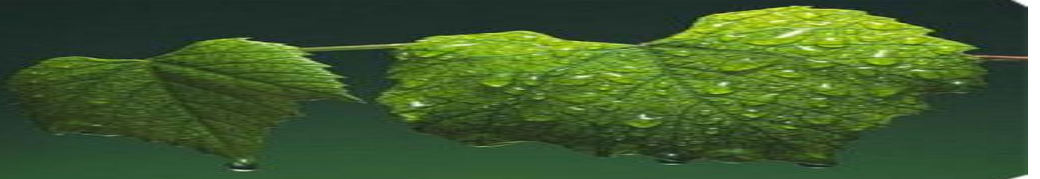
- 1 **PENDAHULUAN** 
- 2 Jenis-jenis antenna feedline
- 3 Feedline pada antena tunggal dan array
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Pendahuluan



- ❑ Antena biasanya tidak dicatu secara langsung dari sumber generator, tetapi signal dikirim menuju antena melalui saluran transmisi
- ❑ Dalam mendesain sistem pencatuan antena, yang perlu diperhatikan adalah :
 - 1) Kondisi matching → perlu matching impedance
 - 2) Sesuai tidaknya saluran (balance/unbalance) dengan jenis antena (balance/unbalance → perlu BALUN)
 - 3) Desain khusus distribusi arus dan fasa pencatuan untuk antena array

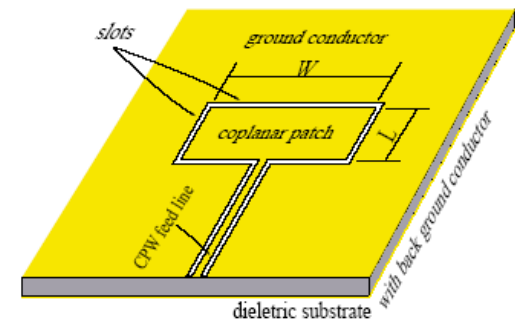
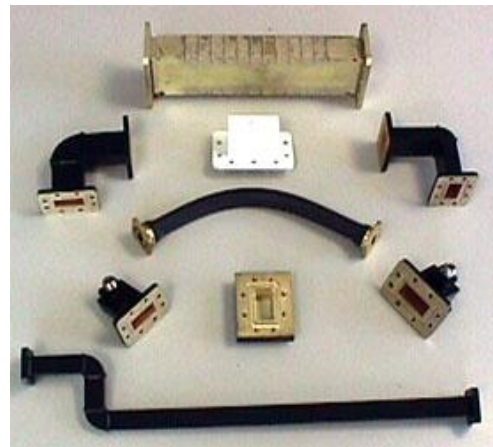
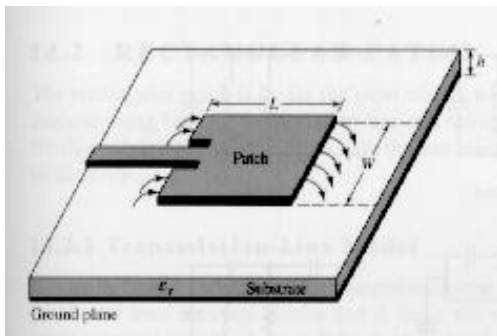
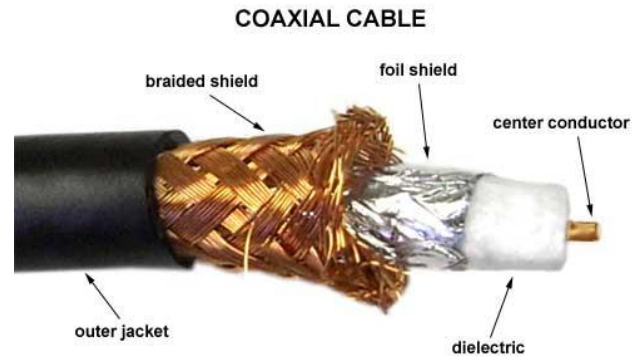
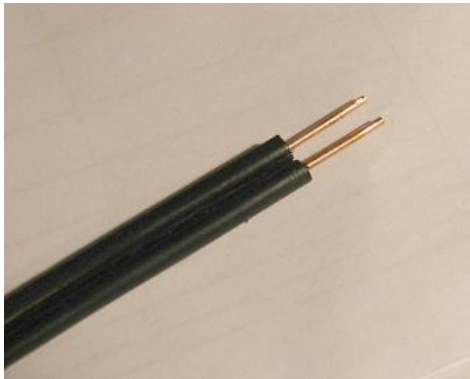
Where are We ?



- 1 **PENDAHULUAN** 
- 2 **JENIS-JENIS ANTENNA FEEDLINE** 
- 3 **Feedline pada Antena Tunggal dan Array**
- 4 **Matching Impedance**
- 5 **Balun**
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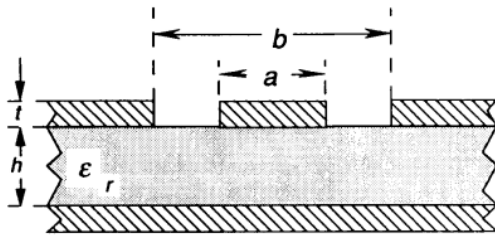
Jenis-jenis antenna feedline

Contoh-contoh Feedline:



Jenis-jenis Antena feedline

Impedansi Karakteristik beberapa saltran (from “*transmission line design handbook*” Brian C.Wadell) :



$$Z_0 = \frac{60.0 \pi}{\sqrt{\epsilon_{eff}}} \frac{1.0}{\frac{K(k)}{K(k')} + \frac{K(k_1)}{K(k_1')}}}$$

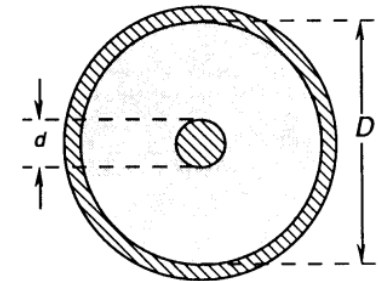
$$k = a/b$$

$$k' = \sqrt{1.0 - k^2}$$

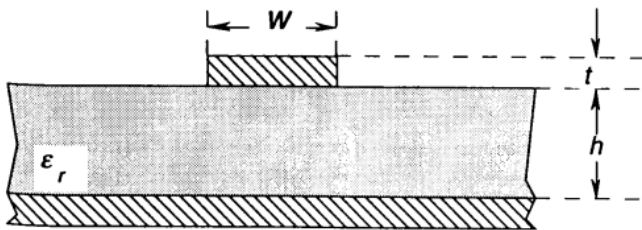
$$k_1' = \sqrt{1.0 - k_1^2}$$

$$k_1 = \frac{\tanh\left(\frac{\pi a}{4.0 h}\right)}{\tanh\left(\frac{\pi b}{4.0 h}\right)}$$

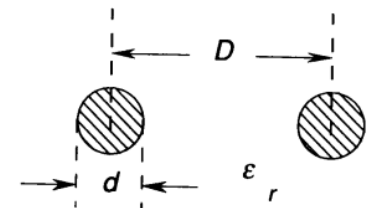
$$\epsilon_{eff} = \frac{1.0 + \epsilon_r \frac{K(k')}{K(k)} \frac{K(k_1)}{K(k_1')}}{1.0 + \frac{K(k')}{K(k)} \frac{K(k_1)}{K(k_1')}}}$$



$$Z_0 = \frac{\eta_0}{2.0 \pi \sqrt{\epsilon_r}} \ln\left(\frac{D}{d}\right) \quad (\Omega)$$

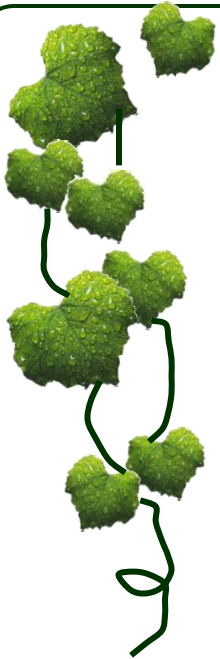
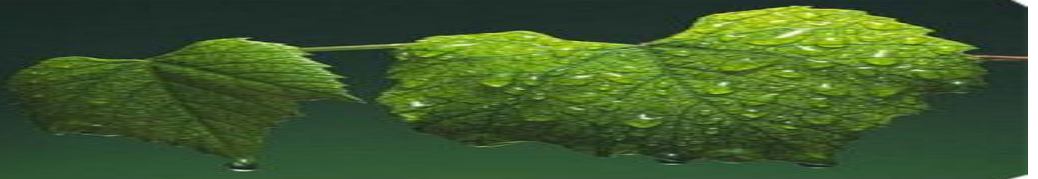





$$Z_c = \begin{cases} \frac{60}{\sqrt{\epsilon_{reff}}} \ln \left[\frac{8h}{W_0} + \frac{W_0}{4h} \right], & \frac{W_0}{h} \leq 1 \\ \frac{120\pi}{\sqrt{\epsilon_{reff}} \left[\frac{W_0}{h} + 1.393 + 0.667 \ln \left(\frac{W_0}{h} + 1.444 \right) \right]}, & \frac{W_0}{h} > 1 \end{cases}$$



$$Z_0 = \frac{\eta_0}{\pi \sqrt{\epsilon_r}} \cosh^{-1} \left(\frac{D}{d} \right) \quad (\Omega)$$

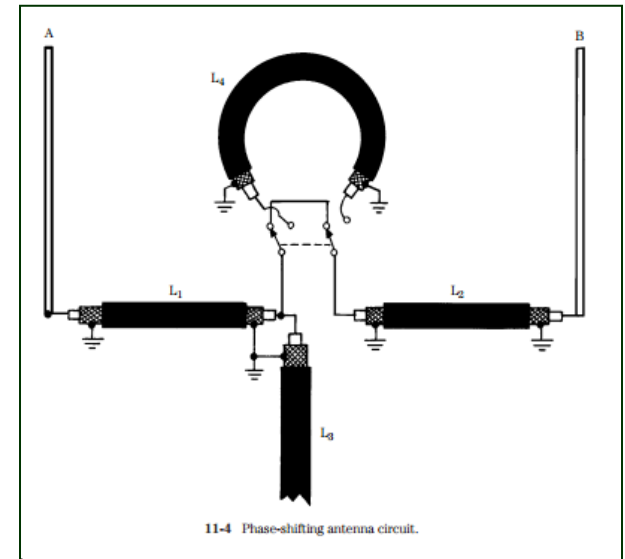
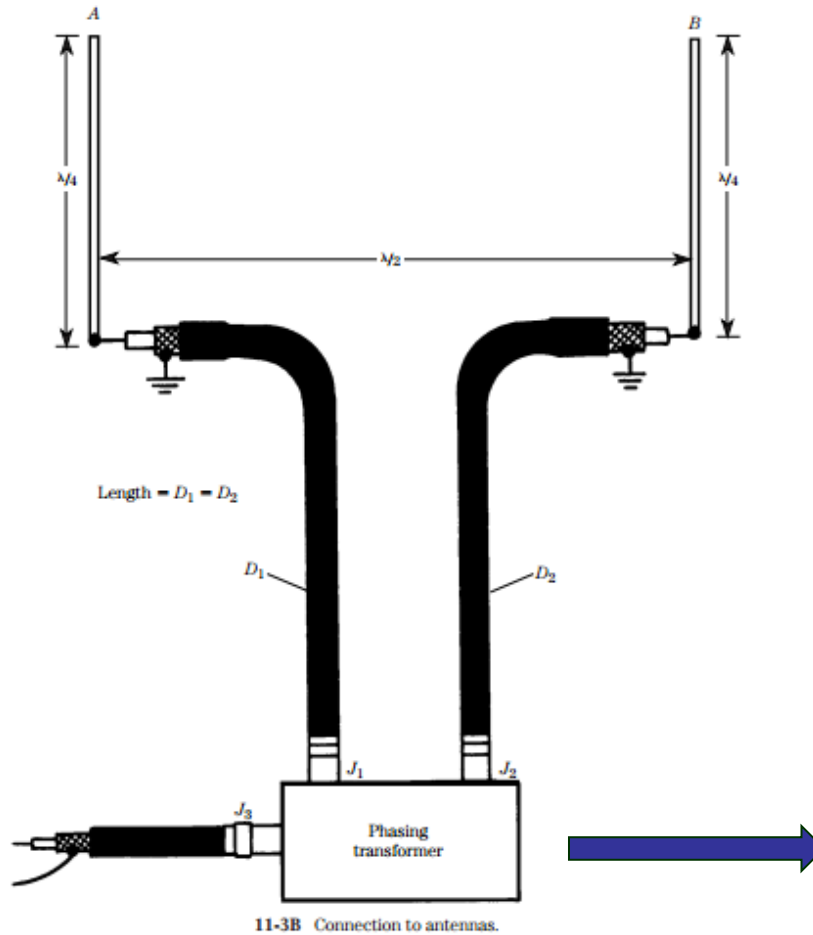
Where are We ?



- 1 ✓ PENDAHULUAN 
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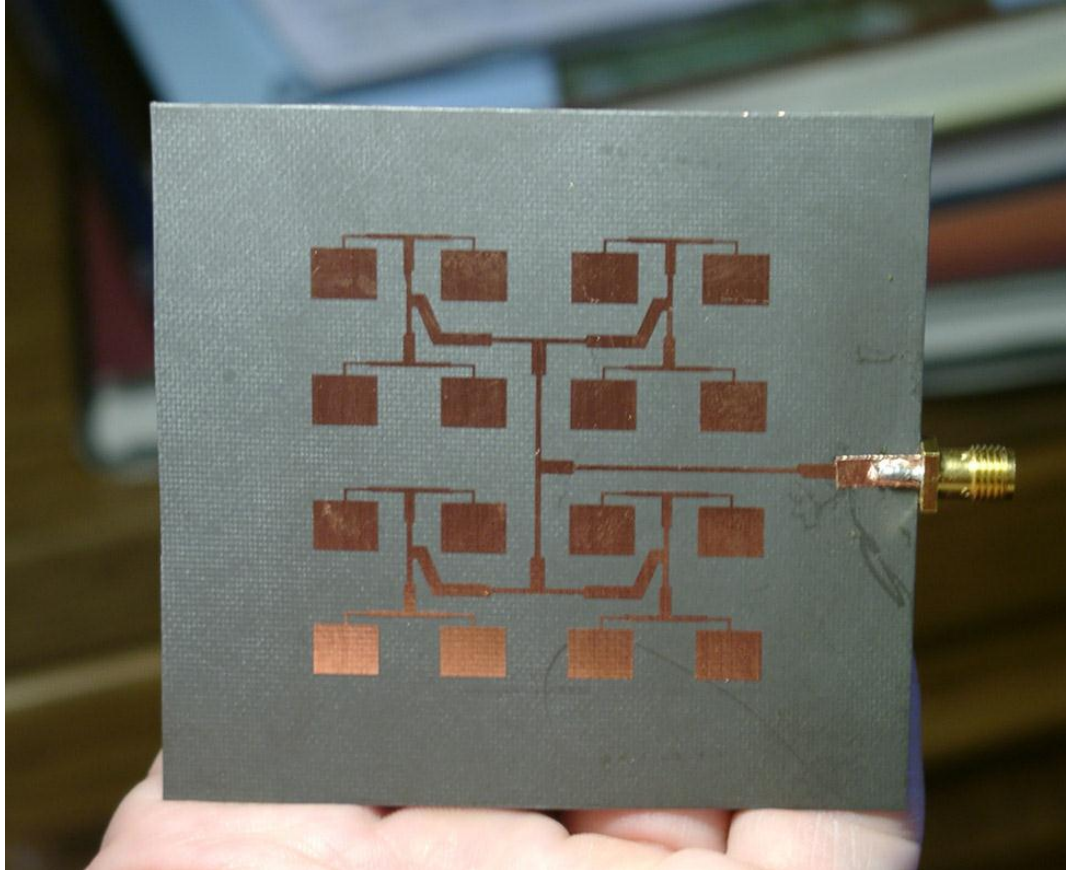
Feedline pada Antena tunggal dan array

Feedline pada antenna array:



Feedline pada Antena tunggal dan array

Feedline pada antenna array:



Feedline pada Antena tunggal dan array

Feedline pada antenna array:

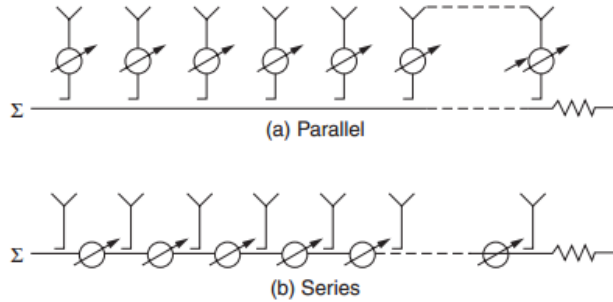


FIGURE 20-18 End-fed series feeds

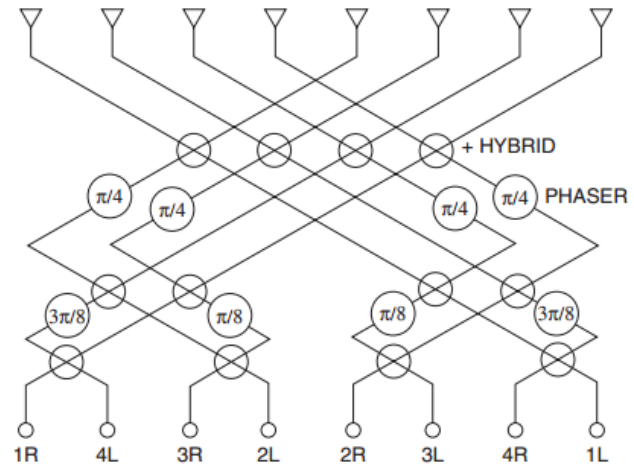
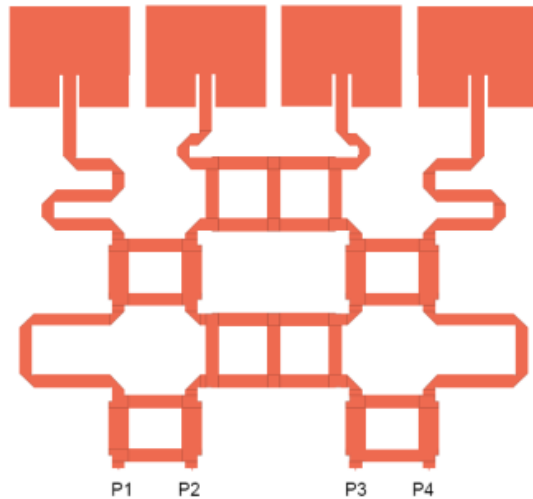


FIGURE 20-23 Butler matrix beamformer (after Hansen³ © Wiley 1998)

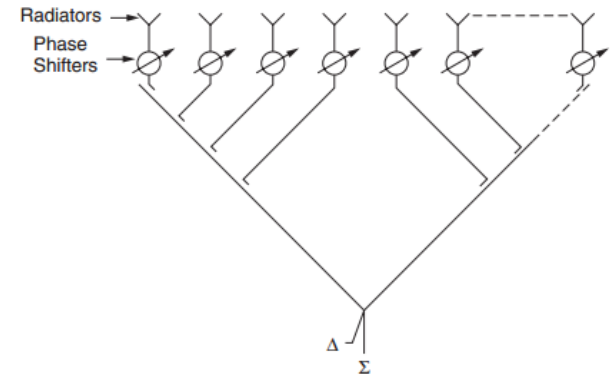
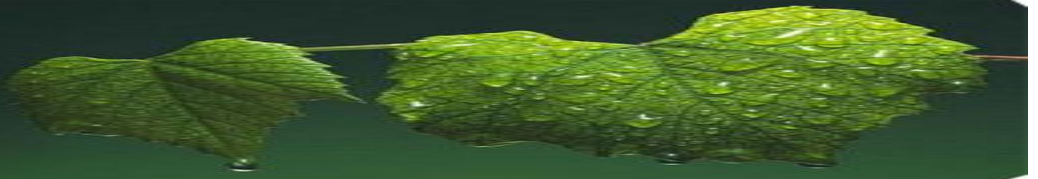


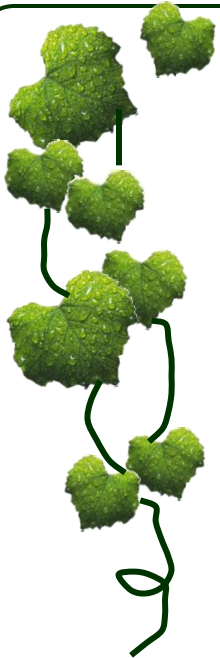
FIGURE 20-20 Equal-path length feed

Where are We ?



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- 7

Matching Impedance



Umumnya, impedansi antena berbeda dengan impedansi karakteristik saluran. Hal ini karena sulit mengkompromikan antara impedansi antena dengan diagram pancar yang dibutuhkan. Impedansi karakteristik saluran umumnya :

300 Ω atau 600 Ω balans (two wire cable), atau

50 Ω (RG8/U, RG58/U)

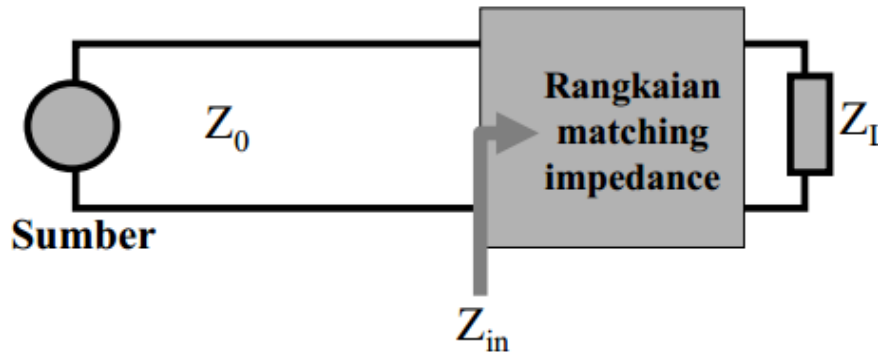
75 Ω (RG11/U, RG59/U)

50 Ω (GR-874)

Dasar-dasar transformasi sudah diberikan pada matakuliah Saluran Transmisi. Penyesuaian Impedansi bertujuan :

Agar terjadi transfer daya maksimum dari saluran transmisi ke antena atau mencegah kerusakan pemancar karena daya pantulan dari antena.

Matching Impedance



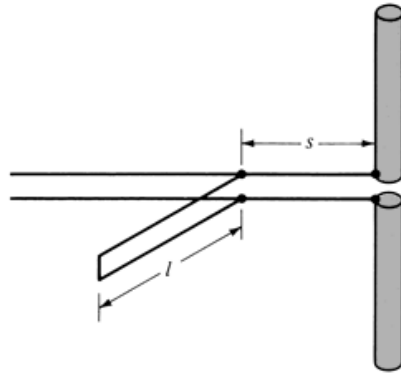
Pada matching impedansi, diperlukan :

$$Z_{in} = Z_0$$

agar tidak terjadi pantulan ke sumber (transmitter)

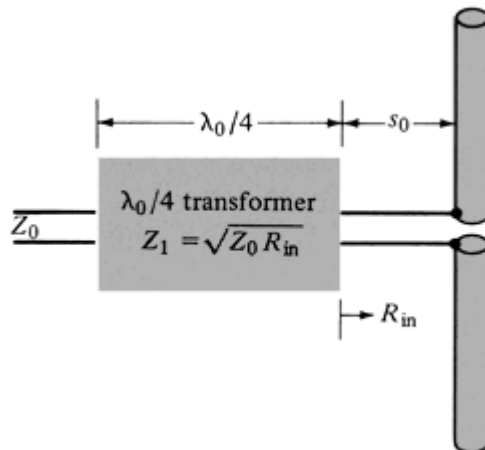
Matching Impedance

Contoh Teknik Matching Impedance:



STUB

- Stub seri, stub paralel
- Stub OC, stub SC
- Stub tunggal, stub ganda, stub triple

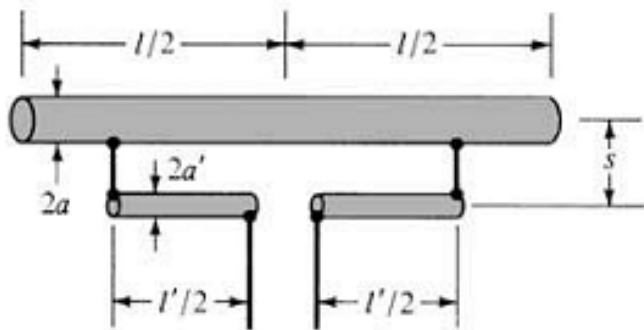


TRAFO $\lambda/4$

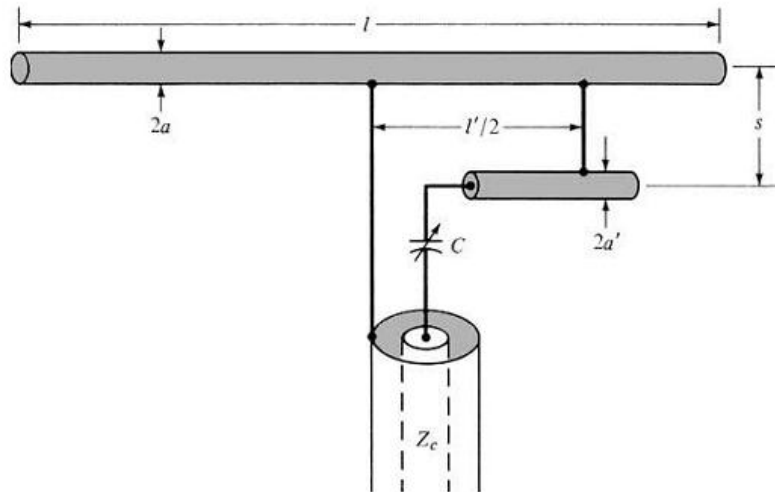
- Single section
- Multiple section (Binomial design, Tschescheff design)

Matching Impedance

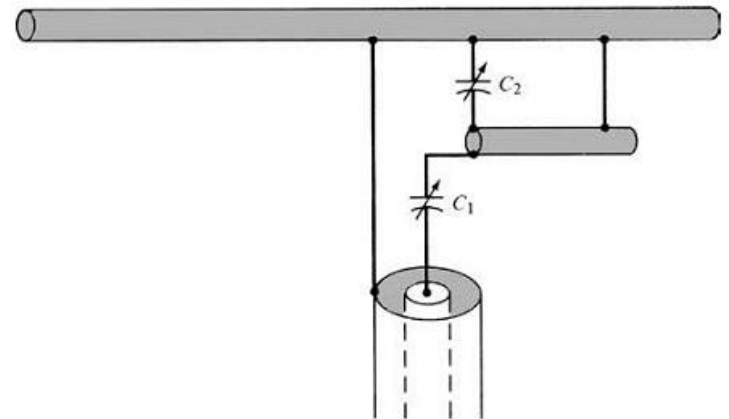
Contoh Teknik Matching Impedance:



T-MATCH



GAMMA MATCH



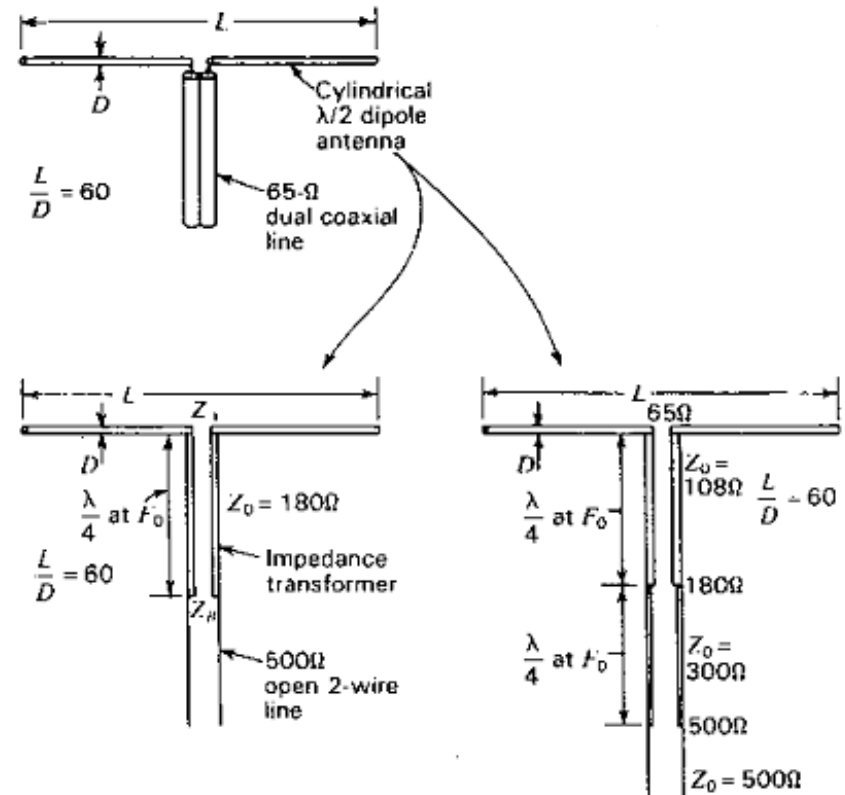
OMEGA MATCH

Matching Impedance

Contoh : (Kraus hal 734-738)

Antenna dipole $\lambda/2$ (silindrical dipole dengan $L/D = 60$) dengan impedansi yang terukur pada terminal sebagai berikut

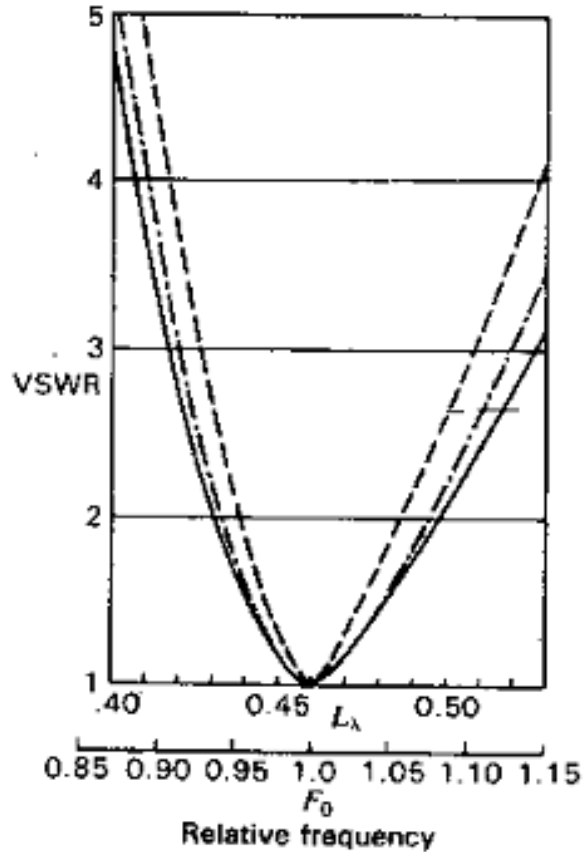
Frequency	Antenna length, λ	Terminal impedance, Ω
$1.15F_0$	$L = 0.53$	$110 + j90$
$1.07F_0$	$L = 0.49$	$80 + j40$
$F_0 = \text{center frequency}$	$L = 0.46$	$65 + j0$
$0.93F_0$	$L = 0.43$	$52 - j40$
$0.85F_0$	$L = 0.39$	$40 - j100$



3 teknik pencatutan (matching impedance) :

- Dicatu langsung dengan dual coaxial dengan impedansi karakteristik 65 Ω
- Dicatu dengan 2-wire line dengan impedansi 500 Ω dengan menambah trafo $\lambda/4$ dengan impedansi karakteristik trafo $Z_0 = 180\Omega$ (single section trafo $\lambda/4$)
- Dicatu dengan 2-wire line dengan impedansi 500 Ω dengan menambah 2 buah trafo $\lambda/4$ dengan impedansi karakteristik trafo $Z_{01} = 108\Omega$ dan $Z_{02} = 300\Omega$ (multi section trafo $\lambda/4$)

Matching Impedance



Grafik perbandingan VSWR terhadap fungsi dari frequency pada 3 kasus pencatuan diatas

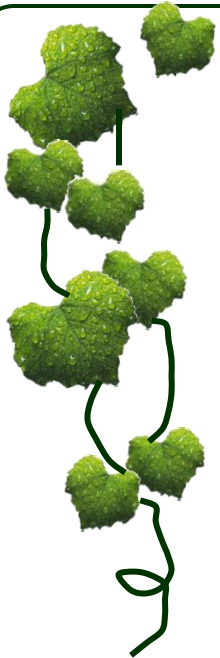
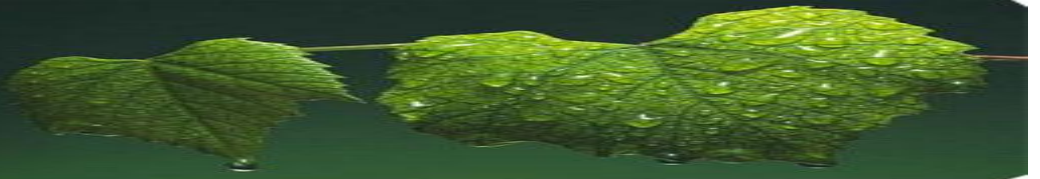
- $\lambda/2$ antenna and 65- Ω line
- - - - $\lambda/2$ antenna and 500- Ω line with one $\lambda/4$ transformer
- · - · $\lambda/2$ antenna and 500- Ω line with two $\lambda/4$ transformers

Matching Impedance

Latihan

1. sebuah impedansi antena $100 + j 100 \Omega$ akan disambungkan ke saluran transmisi dengan impedansi karakteristik $= 50 \Omega$. Untuk itu digunakan sebuah transformator $\lambda/4$ dengan impedansi Z_{0T} dan frequency kerja 500 Mhz, Tentukan :
 - a. Jarak pemasangan transformator $\lambda/4$ dari antena
 - b. Berapa besar Z_{0T}
2. Gunakan diagram Smith untuk mendesain sebuah rangkaian matching stub, yang akan mentransformasikan sebuah impedansi antena $Z_A = 35 - j 47.5 \Omega$ ke saluran transmisi dengan impedansi karakteristik $Z_0 = 50 \Omega$.

Where are We ?



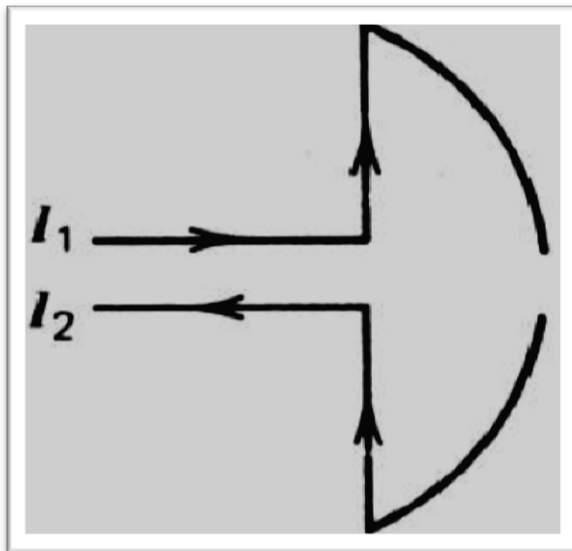
- 1 ✓ PENDAHULUAN 😊
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Balun

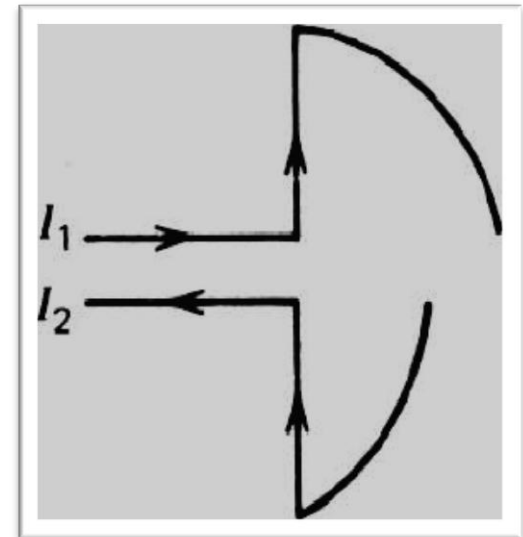
Balun ...

Selain transformasi impedansi, sering juga diperlukan transformasi dari balans ke tidak-balans, atau sebaliknya.

Alat transformator seperti ini disebut BALUN (*Balancing-Unbalancing Unit*)



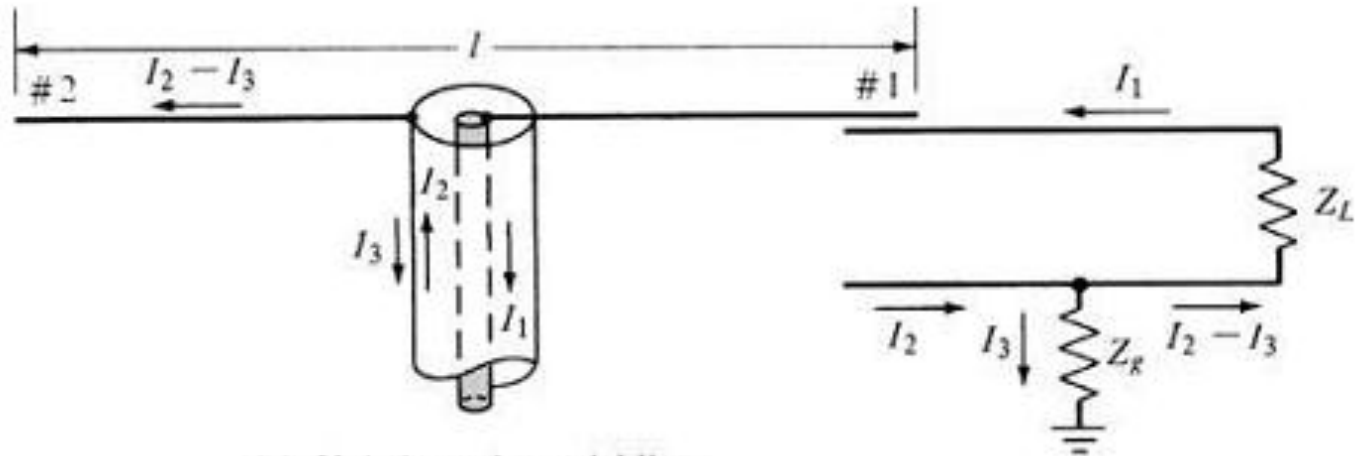
Arus balanced $I_1 = I_2$



Arus unbalanced $I_1 > I_2$

Balun

Arus Unbalance



(a) Unbalanced coaxial line

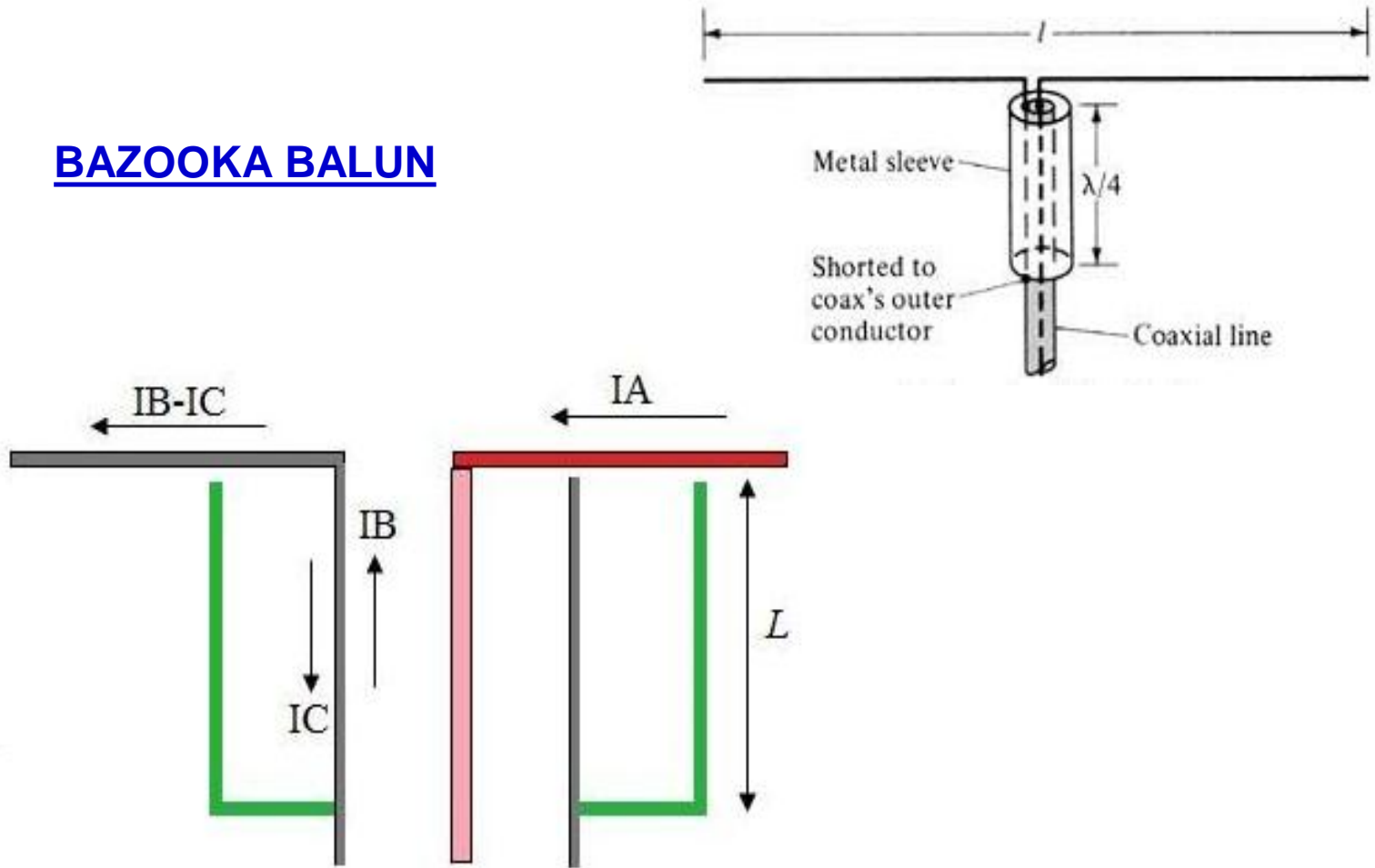
Example:

Cross section of a coaxial transmission line feeding a dipole at its centre

Balun : Balanced to UNbalanced



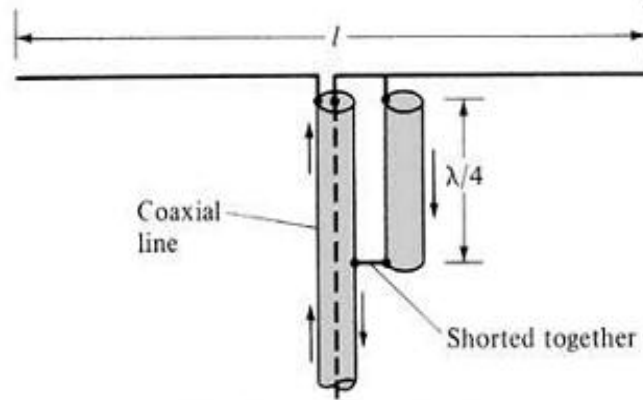
BAZOOKA BALUN



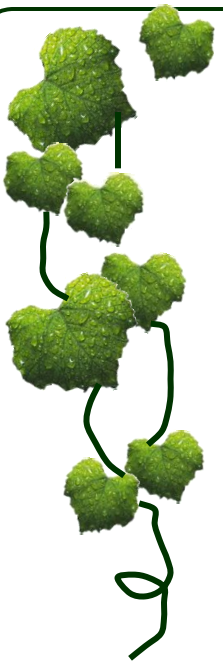
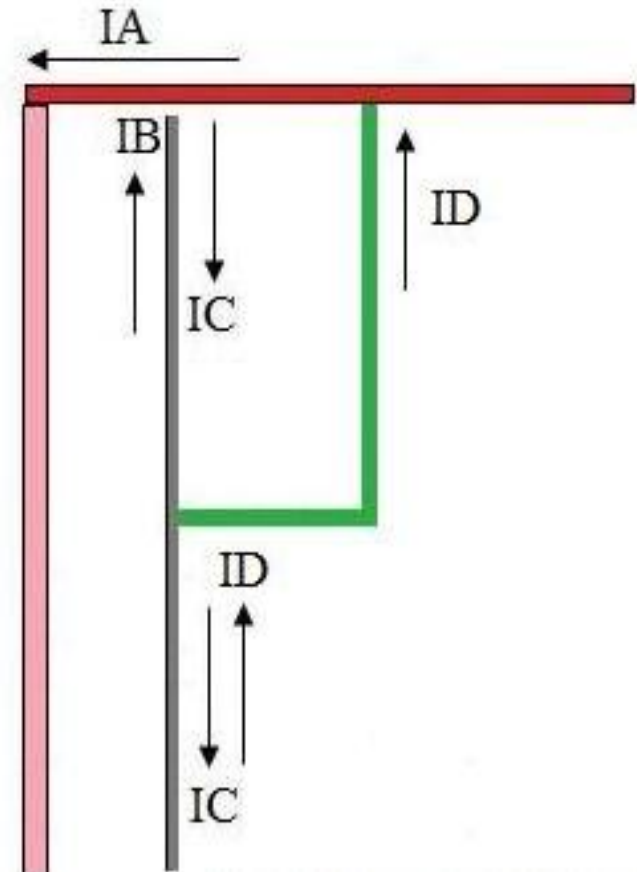
Cross section of a sleeve balun (Bazooka balun)

Balun : Balanced to UNbalanced

Folded Balun/Balun $\lambda/4$

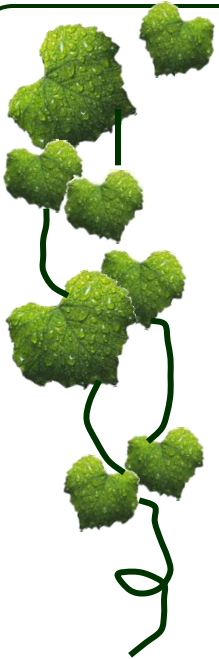
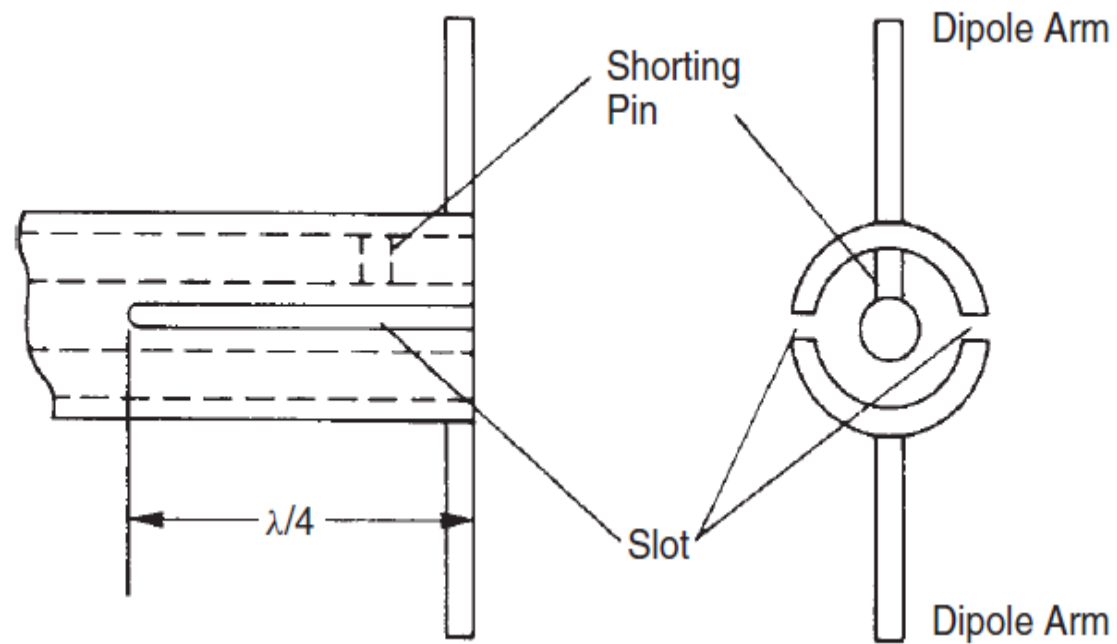


(c) $\lambda/4$ coaxial balun (1 : 1)



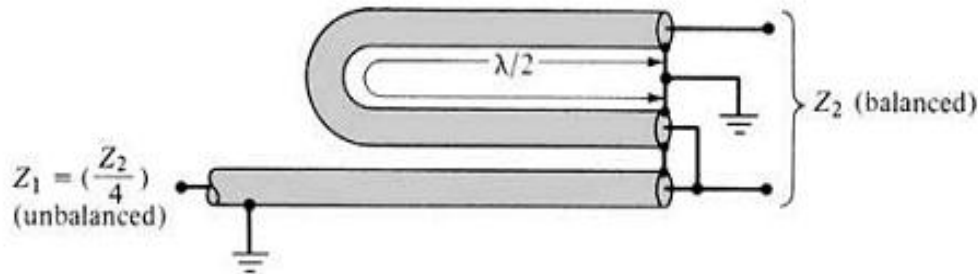
Balun : Balanced to UNbalanced

Split Coax Balun

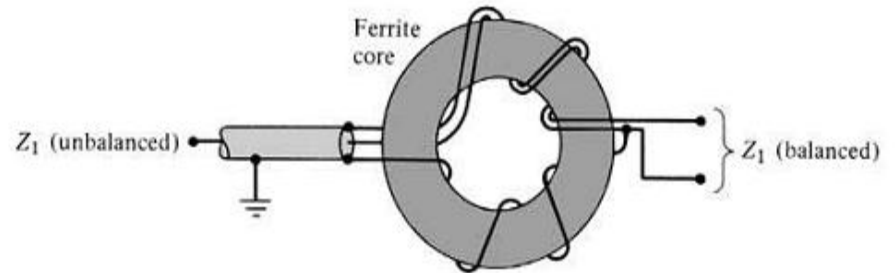


Balun : Balanced to UNbalanced

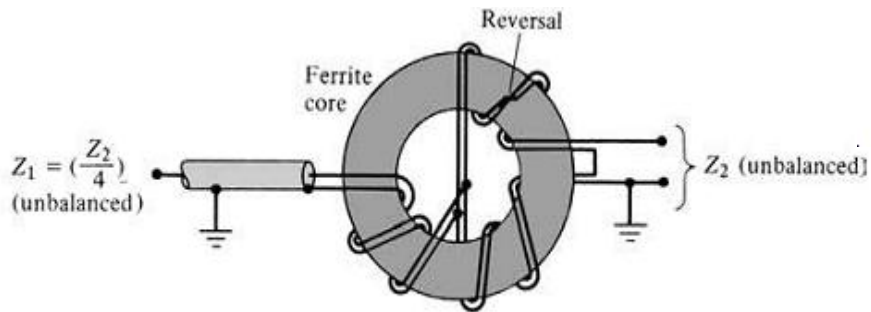
Contoh balun lainnya :



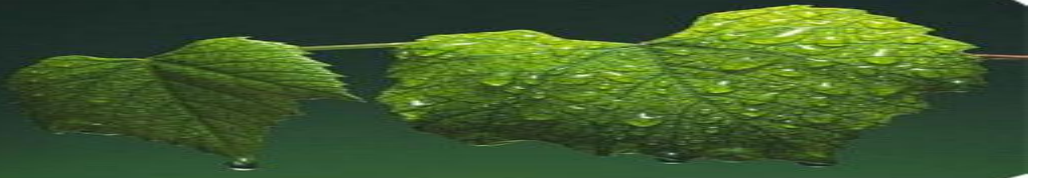
(a) $\lambda/2$ coaxial balun (4 : 1 or 1 : 4)



(c) Ferrite core balun (1 : 1)



(b) Ferrite core transformer (4 : 1 or 1 : 4)



Questions???





Thank You !

