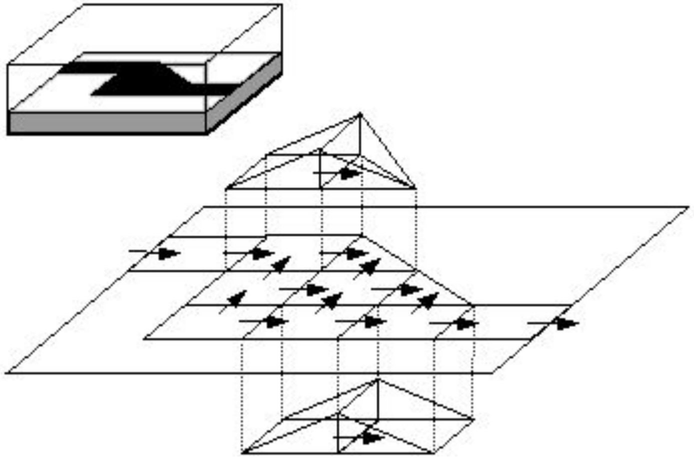
TEMA **6**

СОДЕРЖАНИЕ

- **Основы теории МОМ метода**
- **Настройка параметров ЕМ симулятора на основе метода МОМ**
- **Анализ моделирования устройства на основе технологии МОМ**

МЕТОД МОМЕНТОВ



$$\iint dS\,\overline{\overline{G}}(r,r')\cdot \boldsymbol{J}(\boldsymbol{r}) = \boldsymbol{E}(\boldsymbol{r})$$

$$\boldsymbol{J}(\boldsymbol{r}) \approx \sum_{j=1}^{N} I_j \boldsymbol{B}_j(\boldsymbol{r})$$

МЕТОД МОМЕНТОВ

$$\sum_{i=1}^{N} Z_{i,j} I_j = V_i \quad \text{or} \quad [Z] \cdot [I] = [V]$$

$$Z_{i,j} = \iint_S dS \boldsymbol{B}_i(\boldsymbol{r}) \cdot \iint_{S'} dS' \overline{\overline{\mathbf{G}}}(\boldsymbol{r}, \boldsymbol{r}') \cdot \boldsymbol{B}_j(\boldsymbol{r})$$

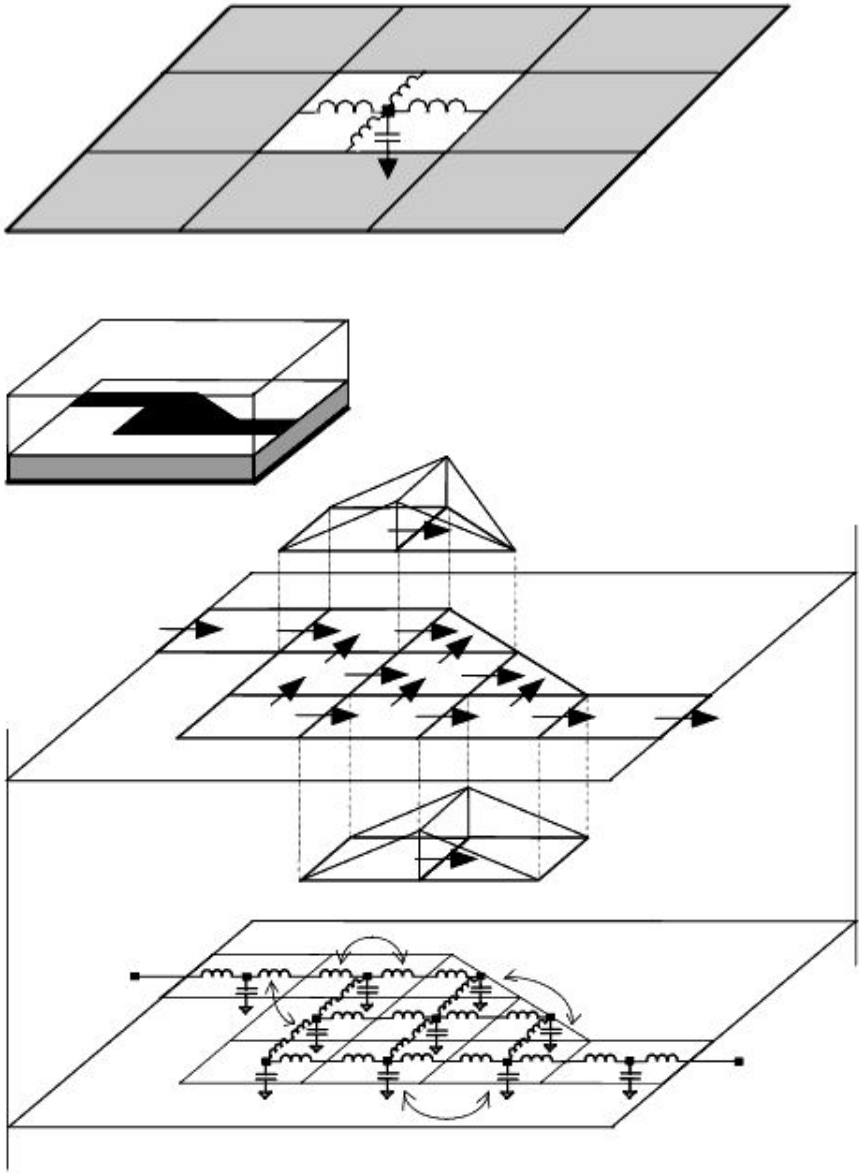
$$V_i = \iint_S dS \boldsymbol{B}_i(\boldsymbol{r}) \cdot \boldsymbol{E}(\boldsymbol{r})$$

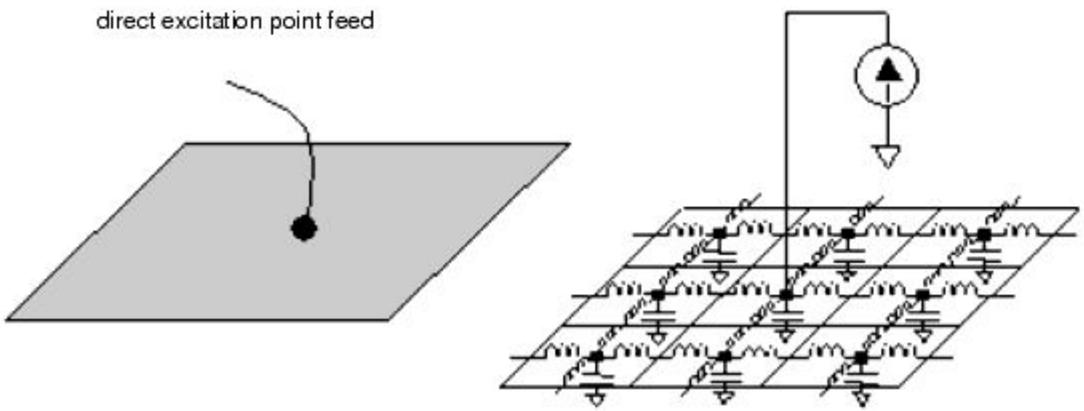
$$\overline{\overline{\mathbf{G}}}(\boldsymbol{r}, \boldsymbol{r}') = j\omega G^A(\boldsymbol{r}, \boldsymbol{r}')\overline{\overline{I}} - \frac{1}{j\omega}\nabla[G^V(\boldsymbol{r}, \boldsymbol{r}')\nabla']$$

$$Z_{i,j} = j\omega L_{i,j} + \frac{1}{j\omega C_{i,j}}$$

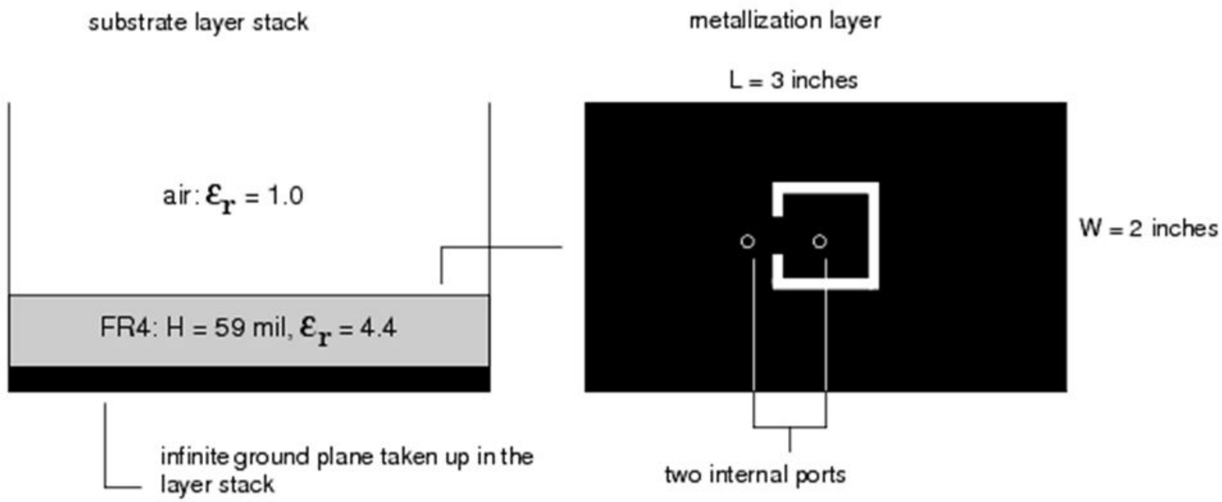
$$L_{i,j} = \iint_S dS \boldsymbol{B}_i(\boldsymbol{r}) \cdot \iint_{S'} dS' G^A(\boldsymbol{r}, \boldsymbol{r}') \boldsymbol{B}_j(\boldsymbol{r}')$$

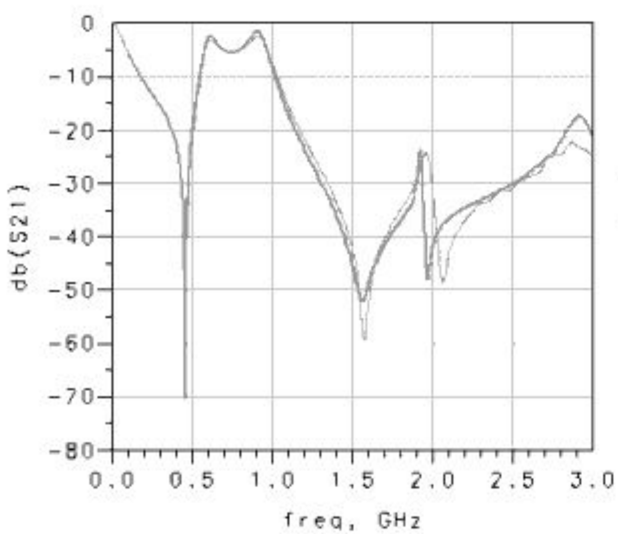
$$\frac{1}{C_{i,j}} = \iint_S dS \nabla \cdot \boldsymbol{B}_i(\boldsymbol{r}) \iint_{S'} dS' G^V(\boldsymbol{r}, \boldsymbol{r}') \nabla \cdot \boldsymbol{B}_j(\boldsymbol{r}')$$

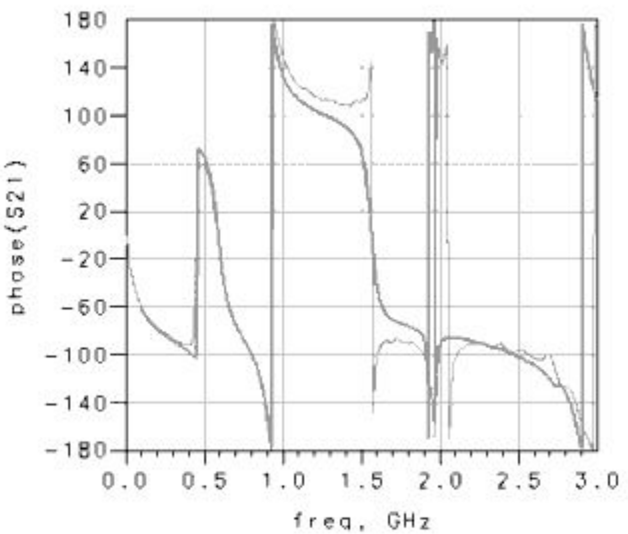



direct excitation point feed

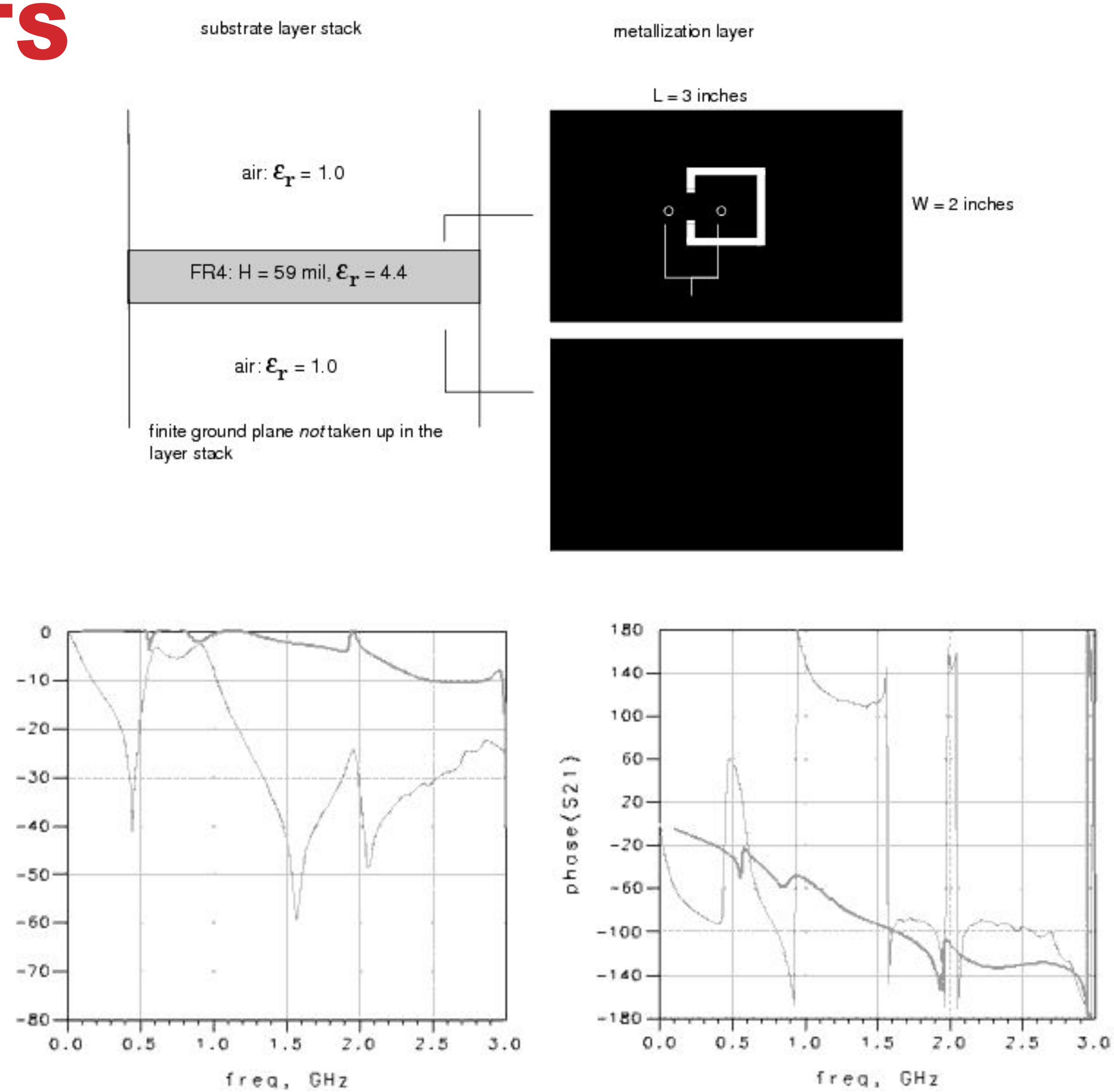
INFINITE GROUND PLANE



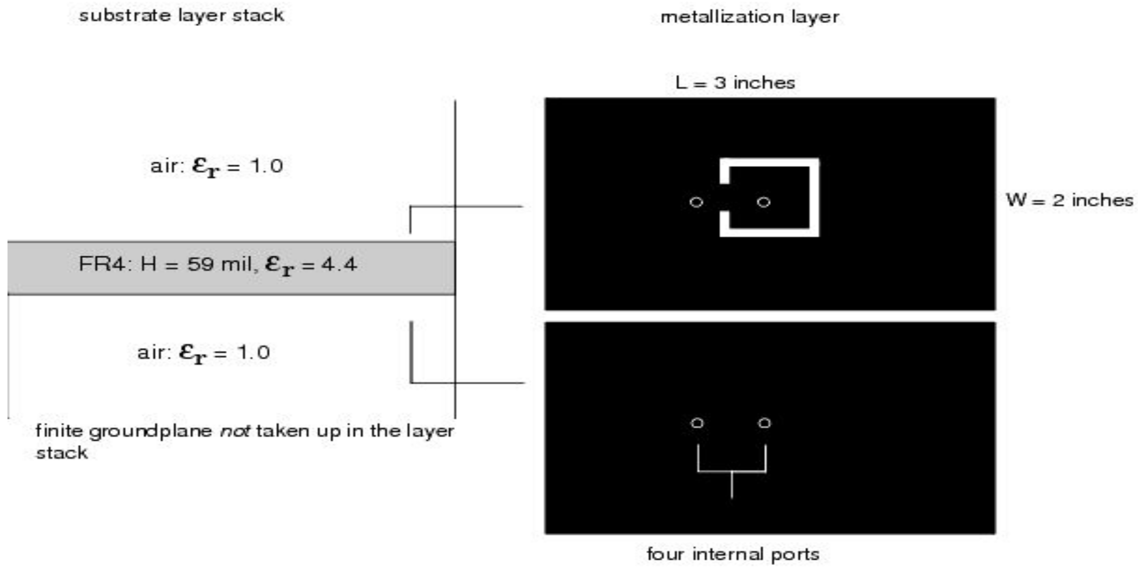


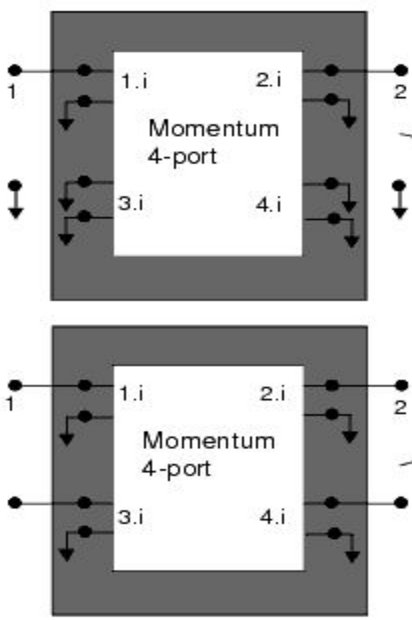


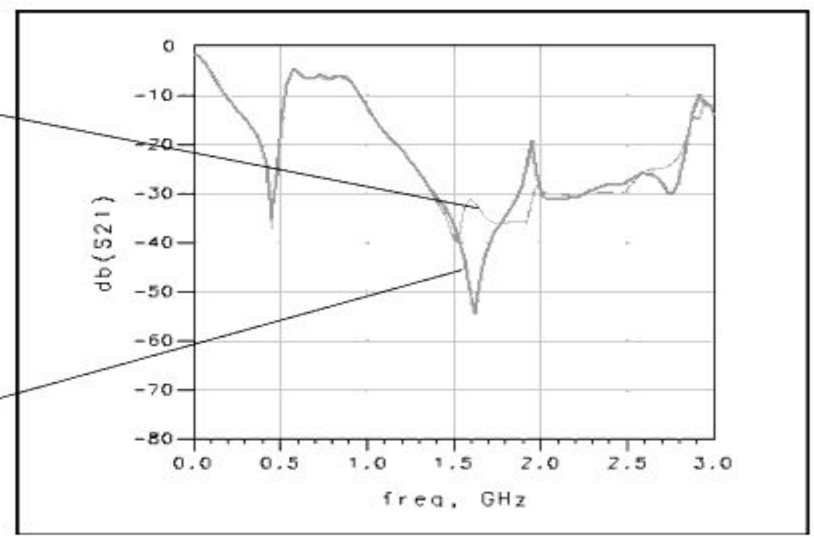
FINITE GROUND PLANE/NO GROUND PORTS



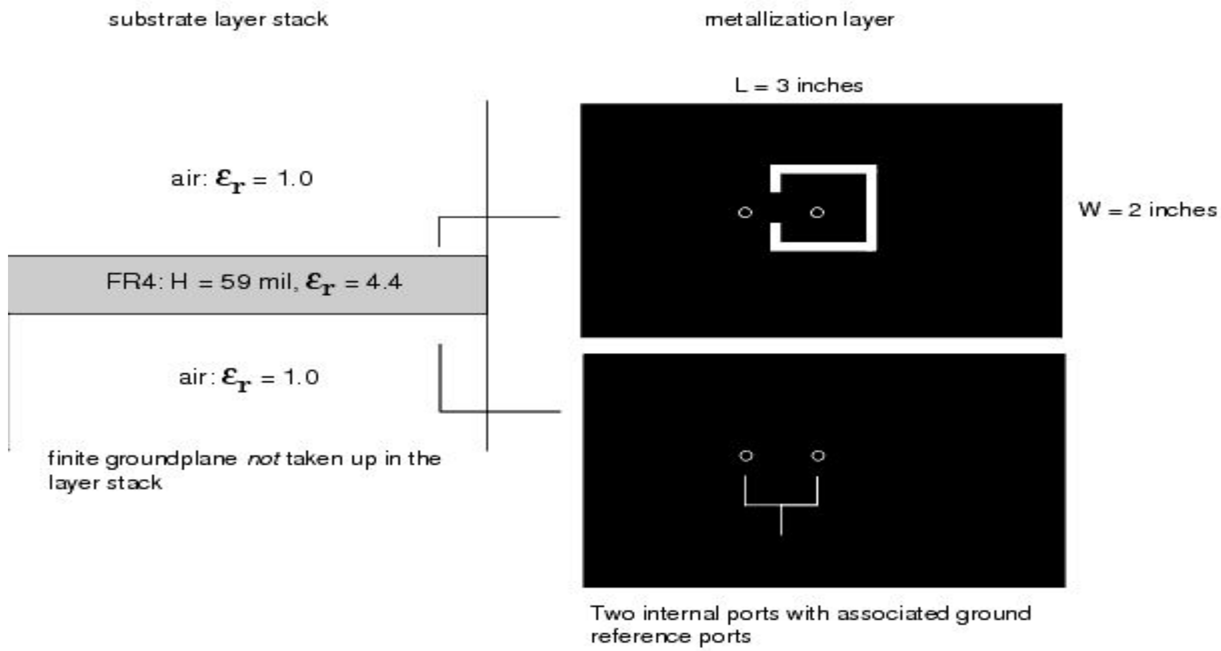
FINITE GROUND PLANE/PORTS IN THE GROUND PLANE

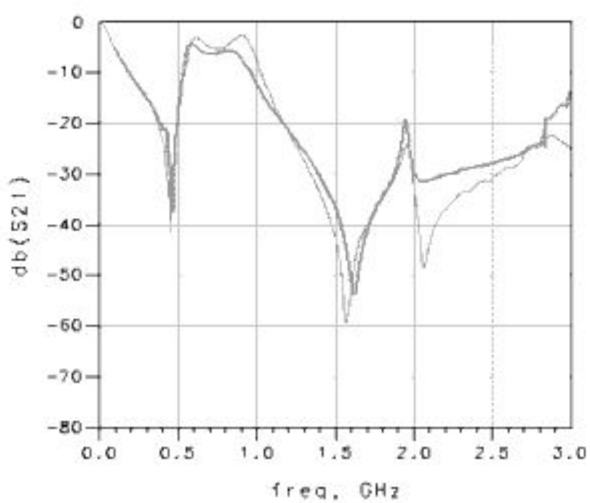


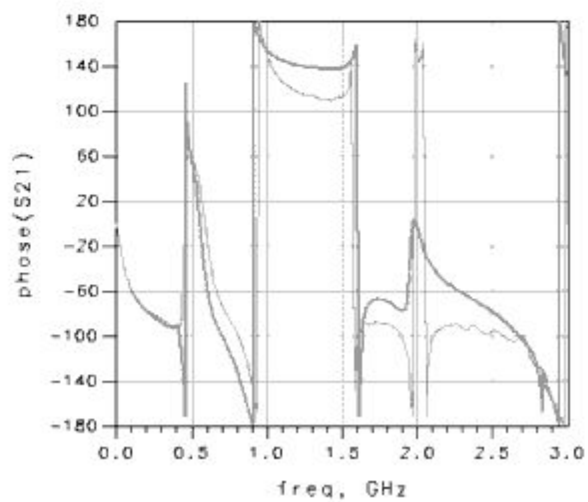




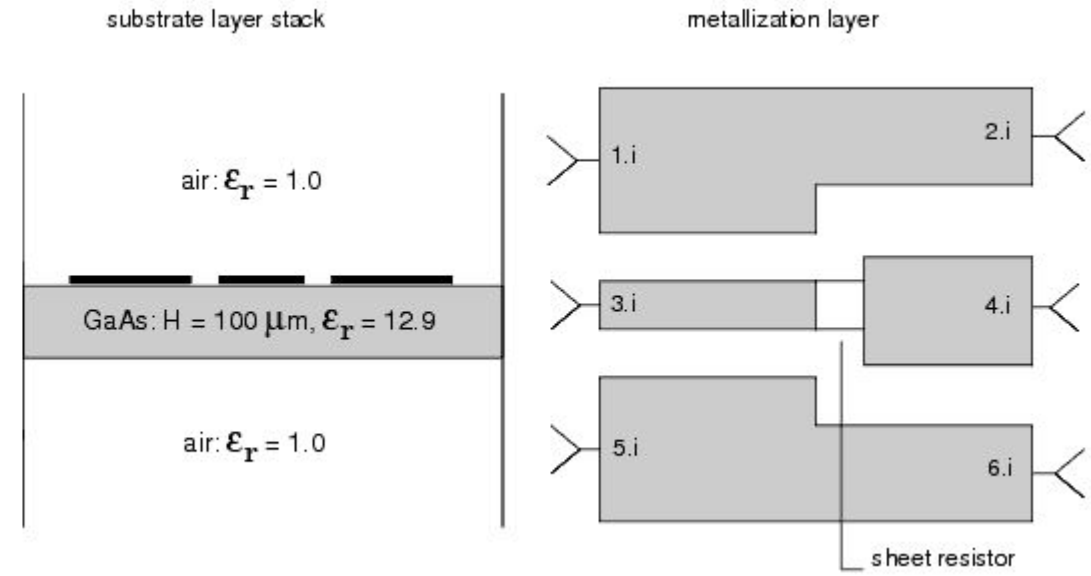
FINITE GROUND PLANE/GROUND REFERENCE

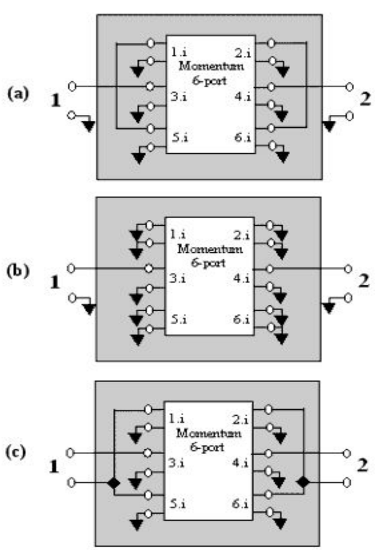


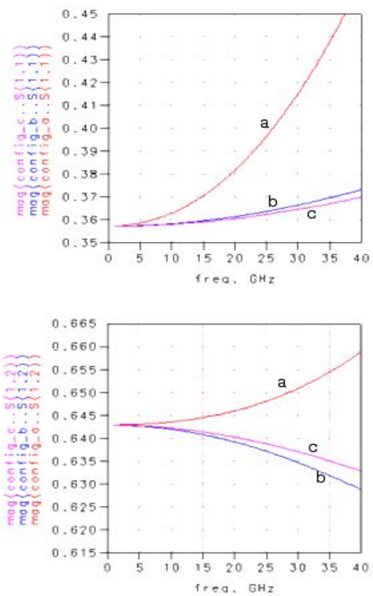


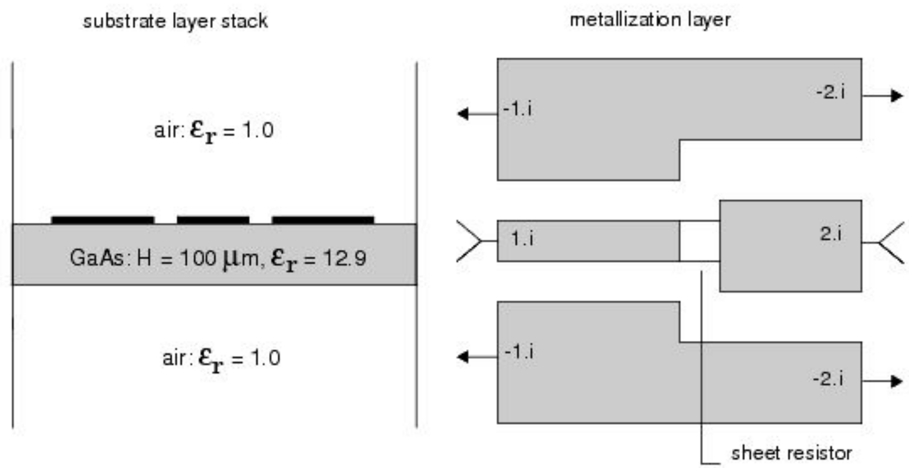


INTERNAL PORTS WITH CPW STRUCTURE

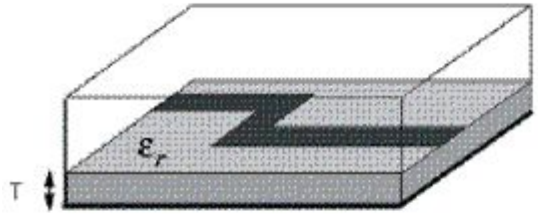








ЭЛЕКТРИЧЕСКИ МАЛЫЕ СХЕМЫ



$\alpha = 20$ (with groundplane)
$\alpha = 10$ (without groundplane)

$$Thickness < \frac{WaveLength}{\alpha\sqrt{(\varepsilon_r - 1)}}$$

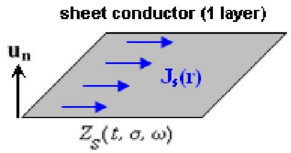
$$Freq[GHz] < \frac{300}{\alpha\sqrt{(\varepsilon_r - 1)}\ T[mm]}$$

$$F < \frac{150}{D}$$

$$D < \frac{150}{F}$$

КОНДУКТИВНЫЕ ПОТЕРИ

Sheet Conductor



- model 0: DC resistance

$$Z_s(t, \sigma, \omega) = \frac{1}{\sigma t}$$

- model 1: single sided skin effect

$$Z_S(t, \sigma, \omega) = Z_C \coth(jk_C t)$$

- model 2 (default): double sided skin effect

$$Z_s(t, \sigma, \omega) = \frac{1}{2} Z_c \coth(jk_c \tfrac{t}{2})$$

With

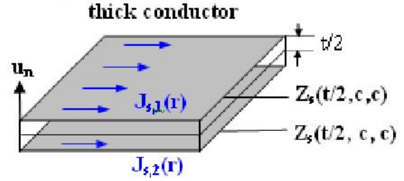
$$Z_c = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\varepsilon}}$$

$$jk_c = \sqrt{j\omega\mu(\sigma + j\omega\varepsilon)}$$

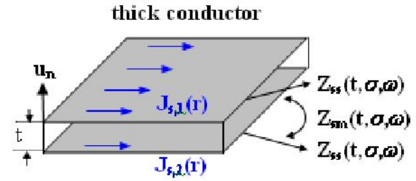
Thick Conductor (2D Distributed Model)

No horizontal currents on the conductor sides are allowed. Deprecated setting.

- model 0: 2-layer sheet conductor
  - each layer has half the conductor thickness
  - each layer is modeled with DC resistance sheet model



- model 1: 2-layer sheet conductor *Note: this is default in ADS 2003C*
  - each layer has half the conductor thickness
  - each layer is modeled with single-sided skin effect sheet model
- model 2 (default): 2-layer sheet conductor
  - 2 surface current layers at top and bottom
  - both modeled with coupled skin effect



$$Z_{s,s}(t, \sigma, \omega) = \frac{1}{2}(Z_1 + Z_2)$$

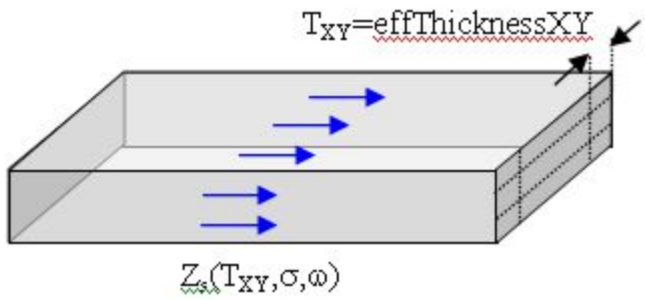
$$Z_{s,m}(t, \sigma, \omega) = \frac{1}{2}(Z_1 - Z_2)$$

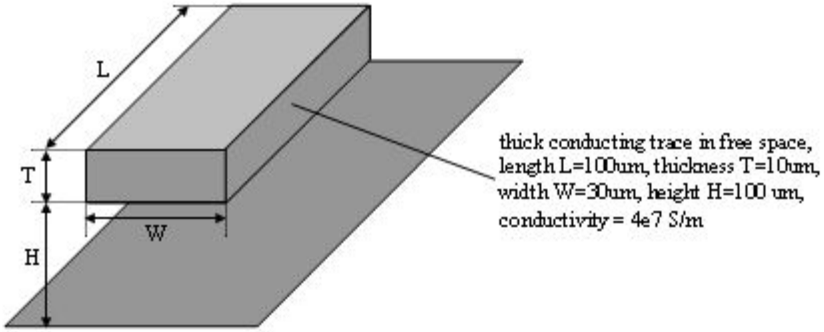
$$Z_1 = \frac{Z_{c,1} Z_{c,2}}{Z_{c,1} \tanh(jk_{c,2} \frac{t}{2}) - Z_{c,2} \tanh(jk_{c,1} \frac{t}{2})}$$

$$Z_2 = \frac{Z_{c,1} Z_{c,2}}{Z_{c,1} \coth(jk_{c,2} \frac{t}{2}) - Z_{c,2} \coth(jk_{c,1} \frac{t}{2})}$$

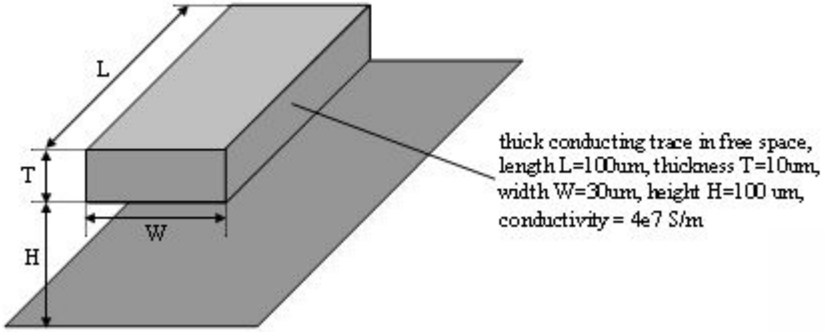
medium 1 = background layer, medium 2 = conductor

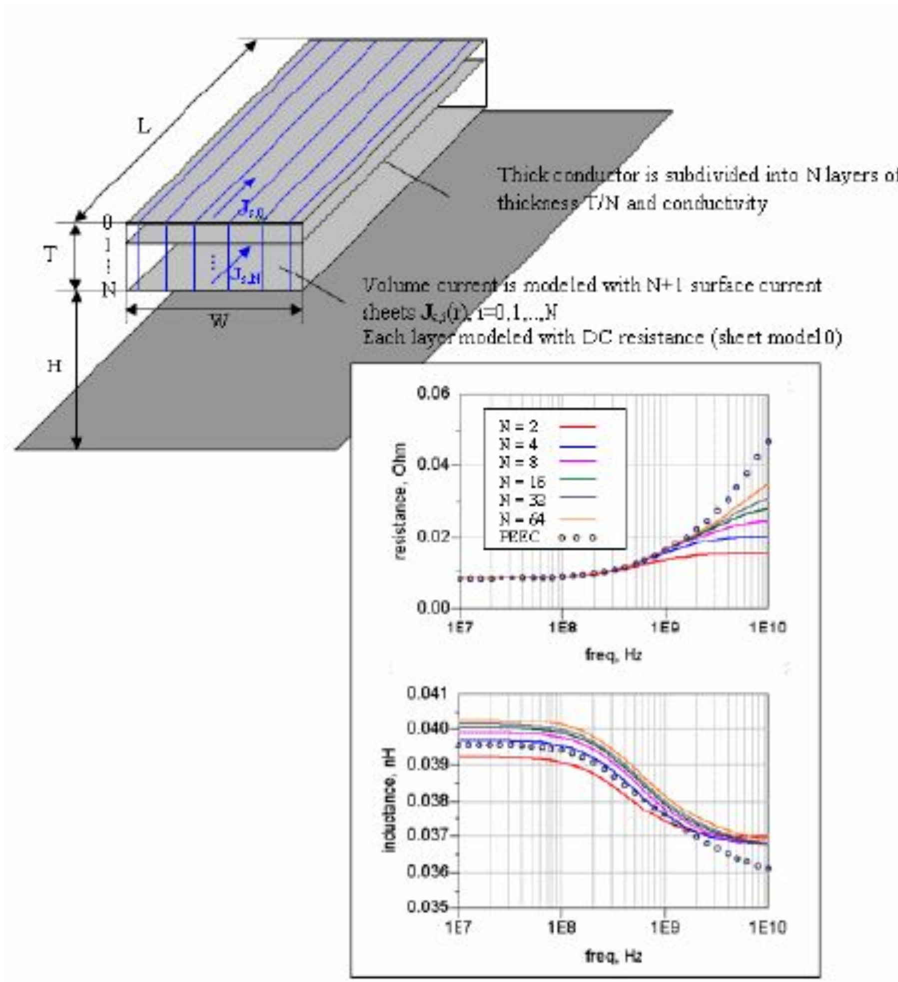
Thick Conductor (3D Distributed Model)



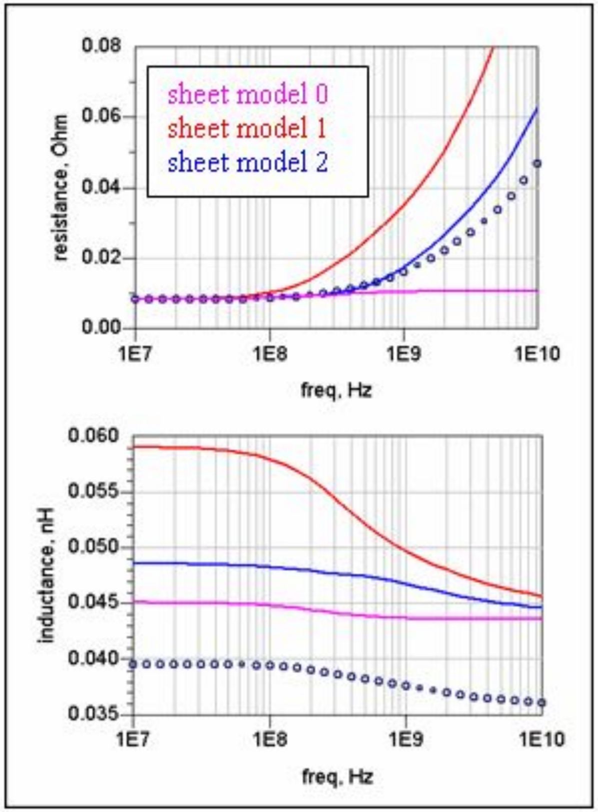


Example: Single Trace in Free Space

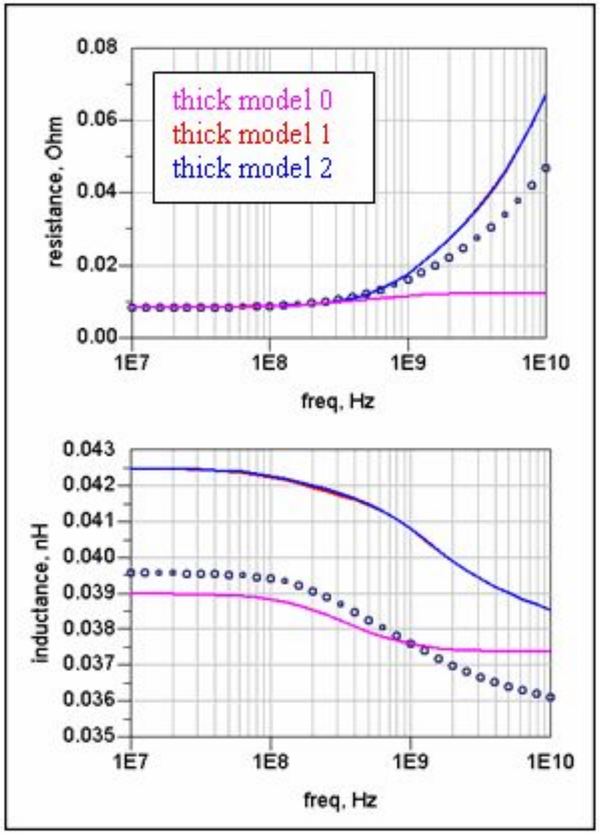




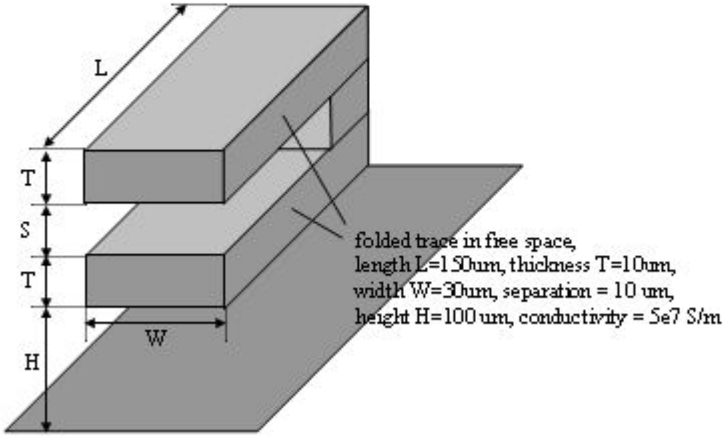
Results Using Sheet Conductor Models



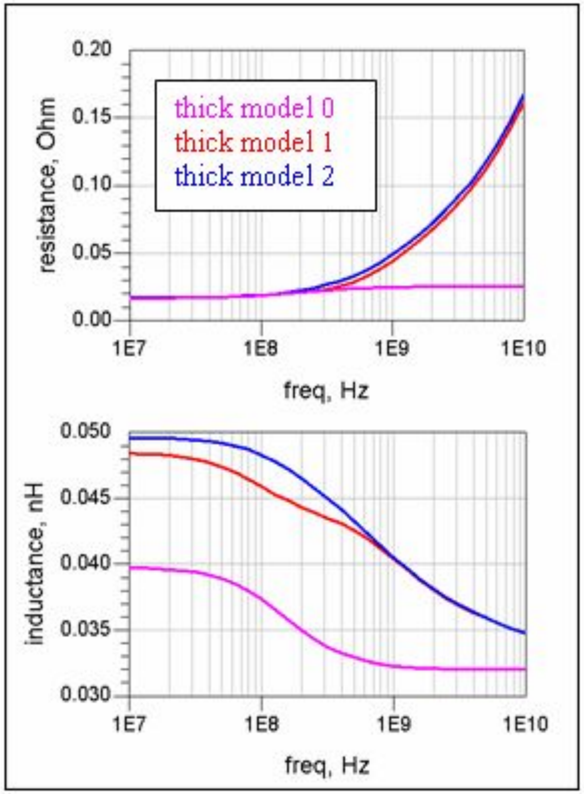
Results Using Thick Conductor Models



Example: Folded Trace in Free Space



Results Using Thick Conductor Models



РЕЖИМ МОДЕЛИРОВАНИЯ