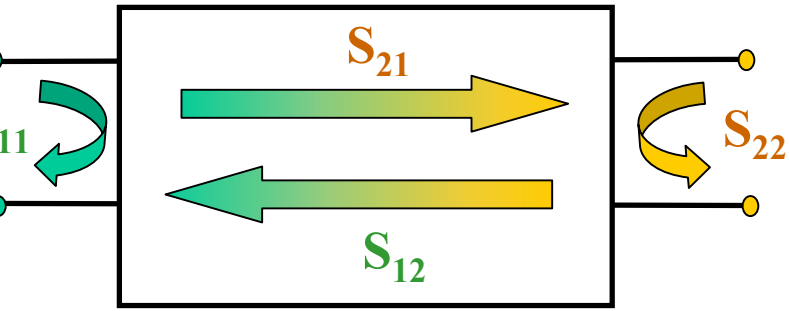
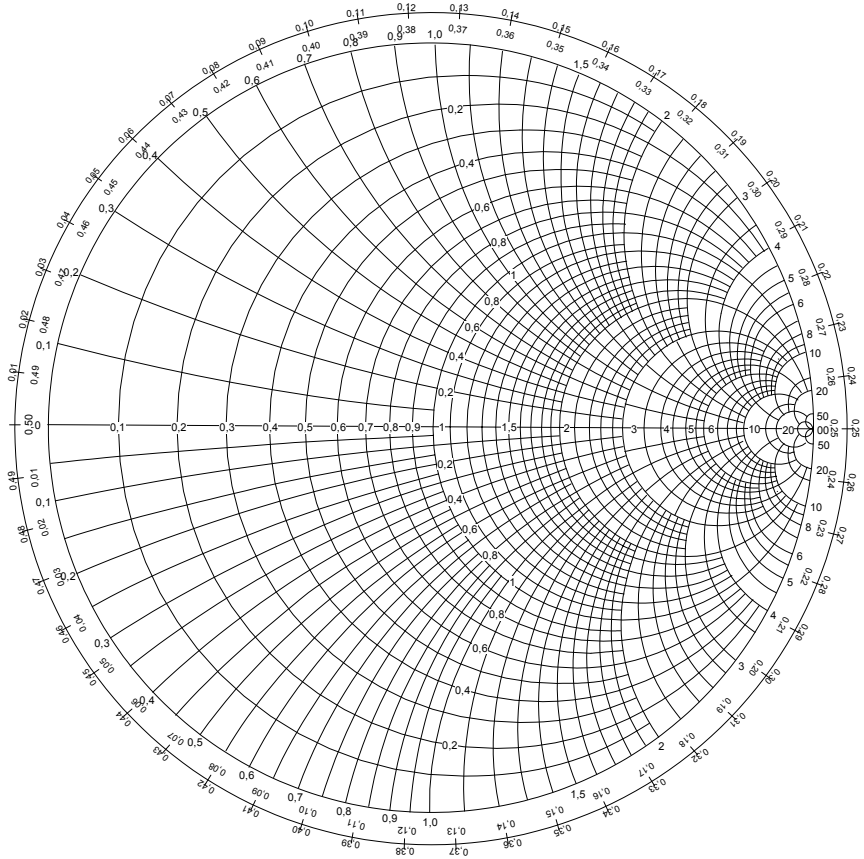
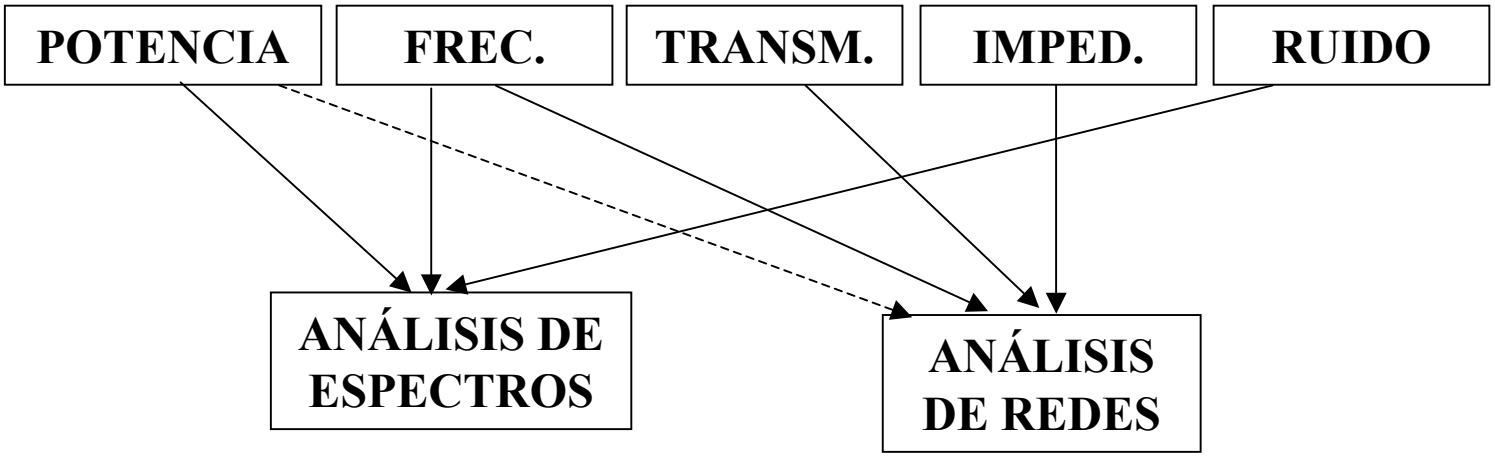
Analizadores de redes vectoriales

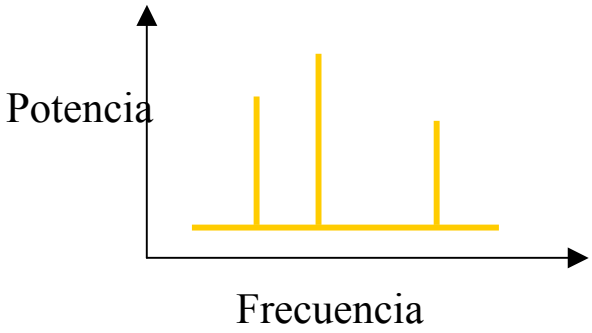


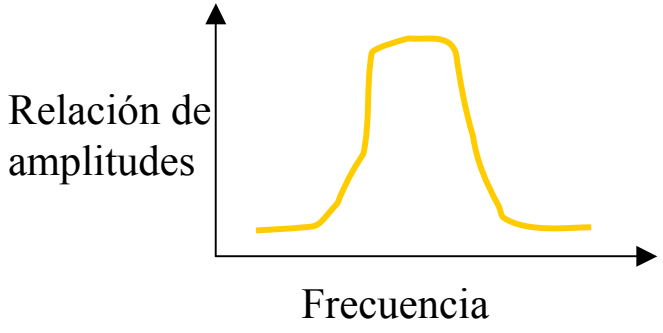


Introducción

Medidas básicas en microondas

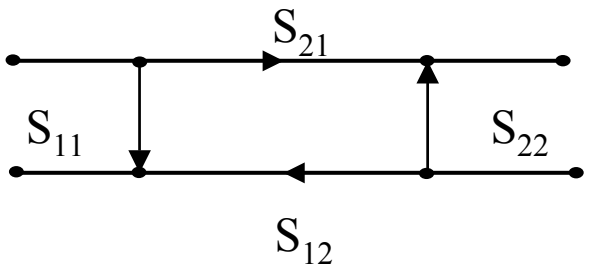




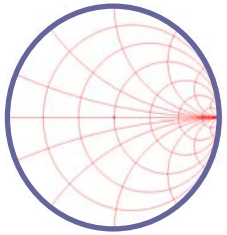


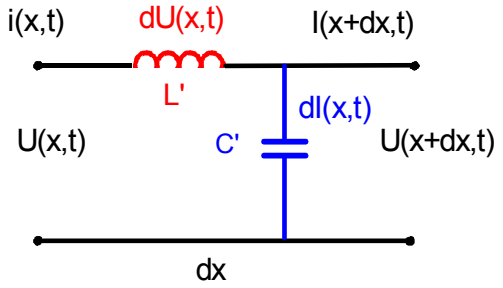
Necesidad de medir amplitud y fase

1. Caracterización completa de redes lineales



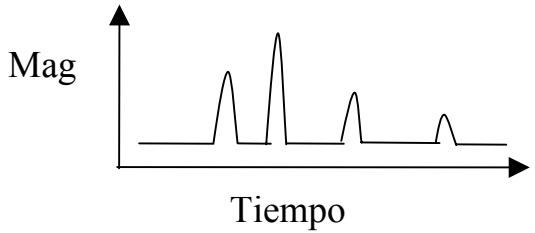
2. Necesidad de impedancia compleja para adaptaciones



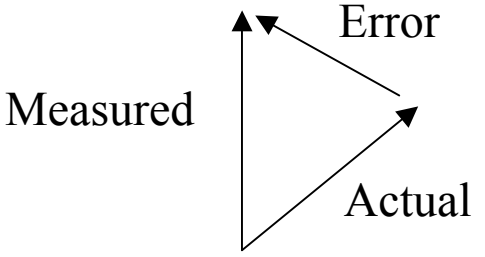


3. Valores complejos para el modelado de dispositivos

4. Caracterización en el dominio del tiempo



5. Mejora de precisión



Parámetros de reflexión

Coeficiente de reflexión

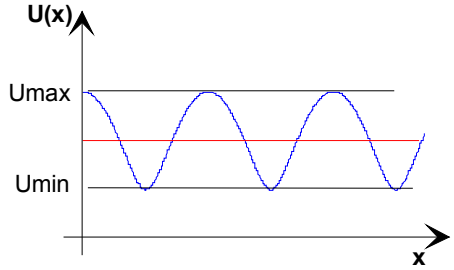
$$r = \frac{V_{reflejada}}{V_{incidente}} \qquad \underline{r} = \frac{\underline{Z}_L - \underline{Z}_0}{\underline{Z}_L + \underline{Z}_0}$$

Pérdidas de retorno

$$a = -20 \log r$$

VSWR

$$S = \frac{U_{max}}{U_{min}} = \frac{1+r}{1-r}$$

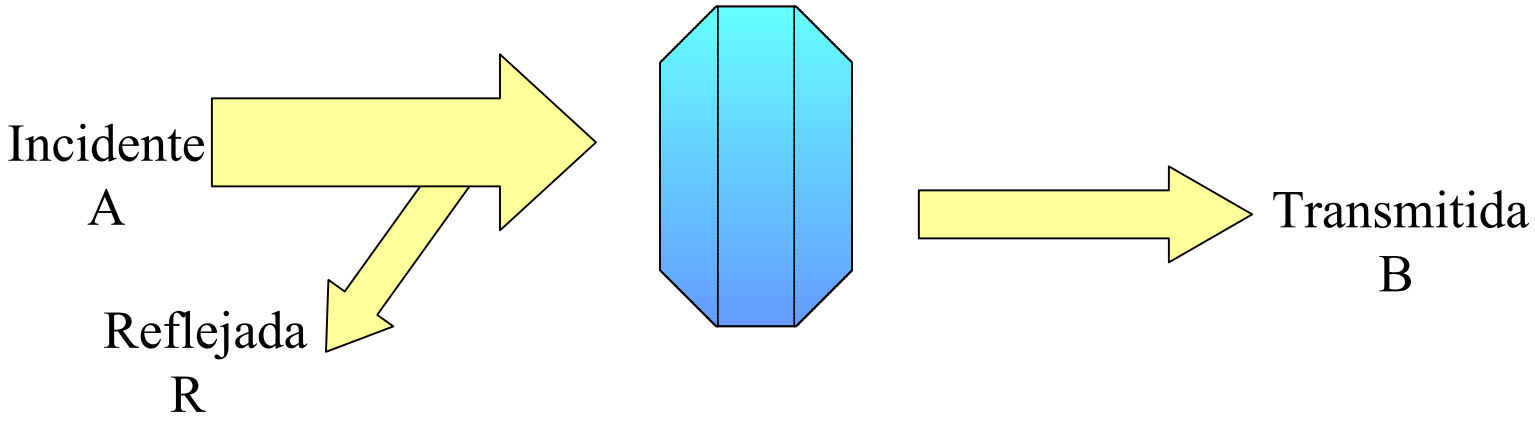


No reflexión
$Z_L = Z_0$

Reflexión total
Z_L = abierto, corto

0	r	1
∞ dB	a	0 dB
1	s	∞

Caracterización dispositivos en HF



Reflexión

$$\frac{\text{Reflejada}}{\text{Incidente}} = \frac{R}{A}$$

SWR

S11, S22

Pérdidas de retorno

Transmisión

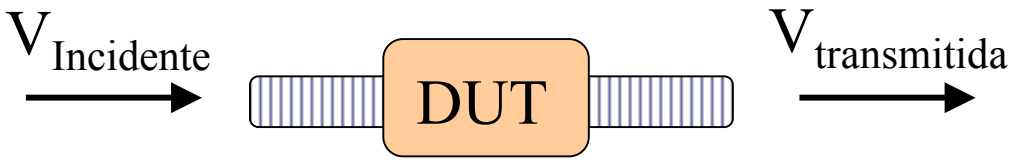
$$\frac{\text{Transmitda}}{\text{Incidente}} = \frac{B}{A}$$

Ganancia/ Pérdidas

S21, S12

Retardo de grupo

Parámetros de transmisión

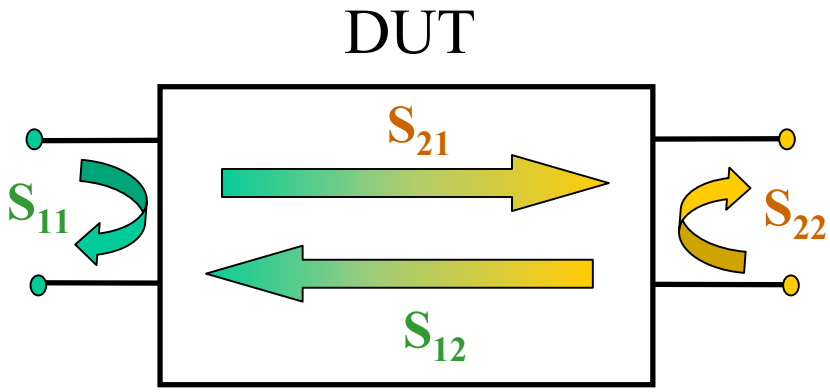


Coeficiente transmisión $$T = \frac{V_{Trans}}{V_{Inc}}$$

Pérdidas insección (dB) $$= -20 \log \left| \frac{V_{Trans}}{V_{Inc}} \right|$$

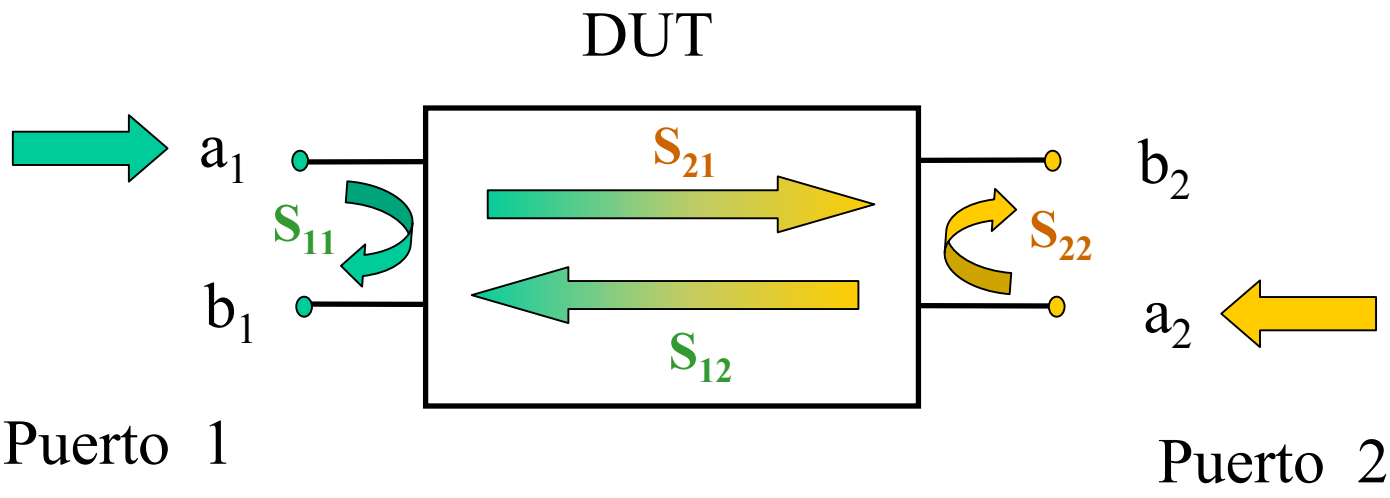
Ganancia (dB) $$= 20 \log \left| \frac{V_{Trans}}{V_{Inc}} \right|$$

Porqué usar los parámetros S



- Respuesta del DUT
- Relacionar medidas familiares (ganancia, pérdidas, coeficiente reflexión)
- Conexión en casacada de múltiples dispositivos
- Evaluación de los parámetros Y / Z a partir de los S
- Posibilidad de importar ficheros de parámetros S para simulació

Medida de los parámetros S



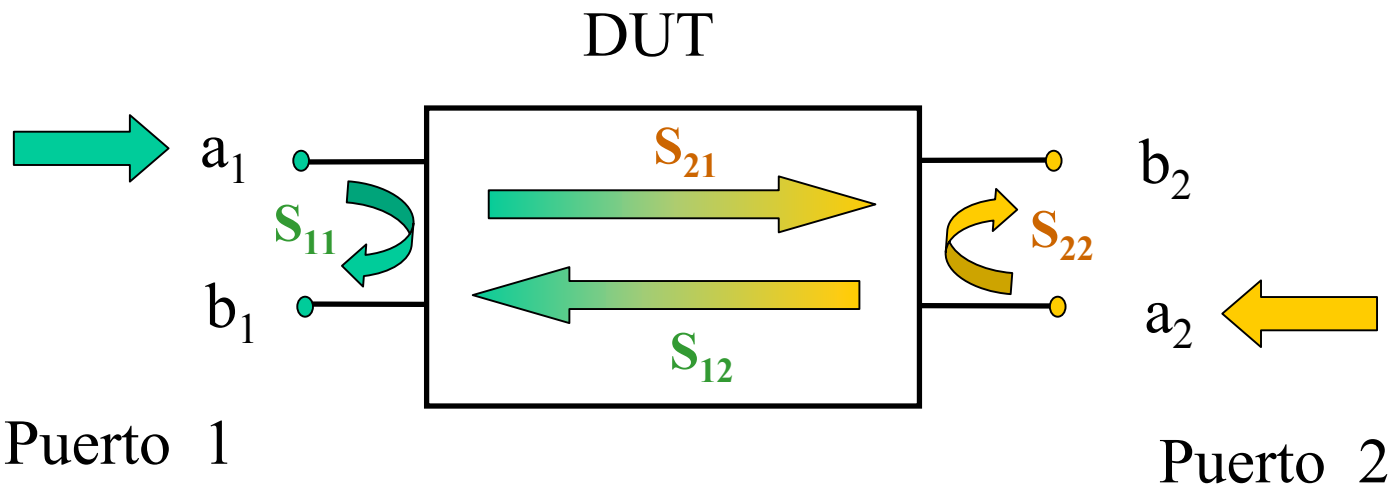
$$S_{11} = \frac{Reflejada}{Incidente} = \frac{b_1}{a_1}\Big|_{a_2=0}$$

$$S_{21} = \frac{Transmitida}{Incidente} = \frac{b_2}{a_1}\Big|_{a_2=0}$$

$$S_{22} = \frac{Reflejada}{Incidente} = \frac{b_2}{a_2}\Big|_{a_1=0}$$

$$S_{12} = \frac{Transmitida}{Incidente} = \frac{b_1}{a_2}\Big|_{a_1=0}$$

Medida de los parámetros S



S11=Coeficiente de reflexión directo (entrada adaptada)

S22=Coeficiente de reflexión inverso (salida adaptada)

S21=Coeficiente de transmisión directo (ganancia/pérdida)

S12=Coeficiente de transmisión inverso (aislamiento)

Otras caracterizaciones

$$\begin{pmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{pmatrix} \Leftrightarrow \begin{pmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{pmatrix} \Leftrightarrow \begin{pmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{pmatrix}$$

$$Z_{11} = Z_0 \frac{(1+S_{11})(1-S_{22})+S_{12}S_{21}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

$$Z_{21} = Z_0 \frac{2S_{21}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

$$Z_{12} = Z_0 \frac{2S_{12}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

$$Z_{22} = Z_0 \frac{(1-S_{11})(1+S_{22})+S_{12}S_{21}}{(1-S_{11})(1-S_{22})-S_{12}S_{21}}$$

Fórmula para parámetros Z

Otras caracterizaciones

$$\begin{pmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{pmatrix} \Leftrightarrow \begin{pmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{pmatrix} \Leftrightarrow \begin{pmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{pmatrix}$$

$$Y_{11} = Y_0 \frac{(1-S_{11})(1+S_{22})+S_{12}S_{21}}{(1+S_{11})(1+S_{22})-S_{12}S_{21}}$$

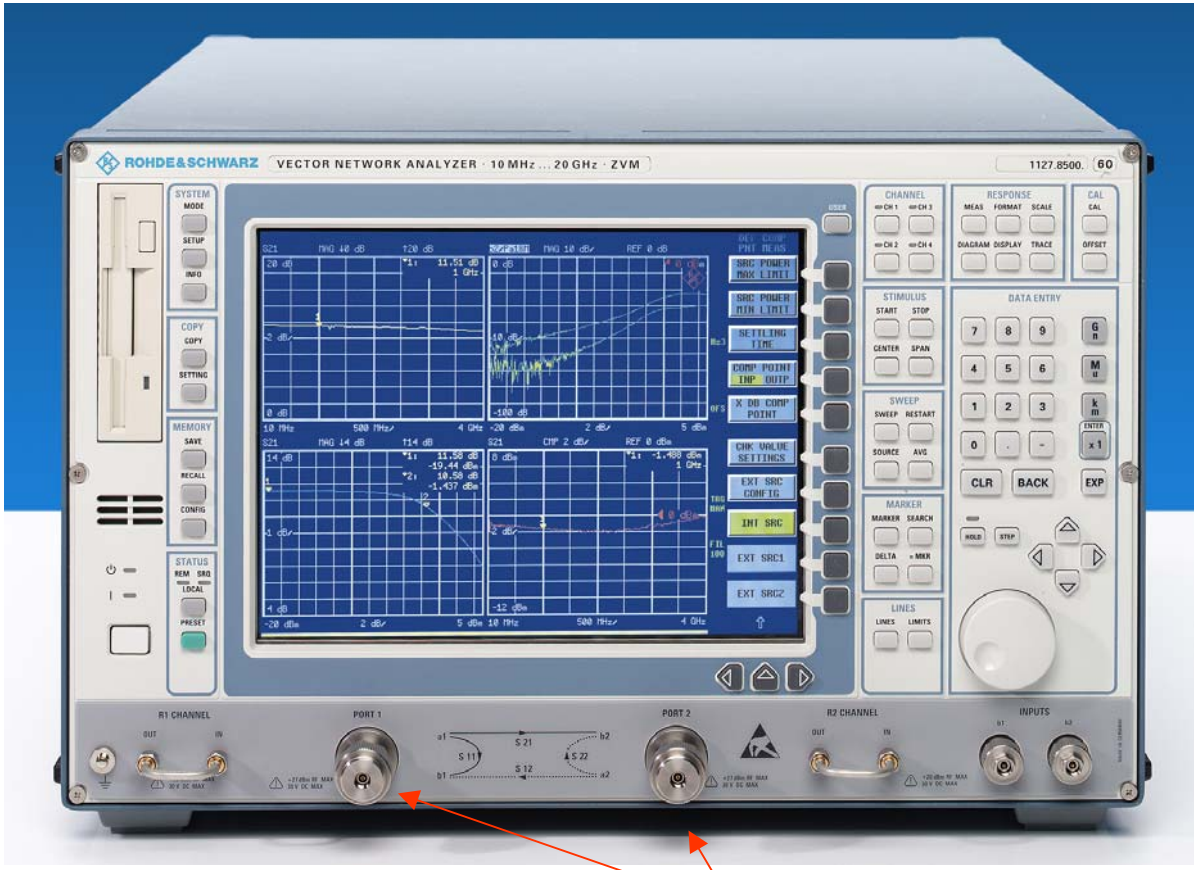
$$Y_{21} = Y_0 \frac{-2S_{21}}{(1+S_{11})(1+S_{22})-S_{12}S_{21}}$$

$$Y_{12} = Y_0 \frac{-2S_{12}}{(1+S_{11})(1+S_{22})-S_{12}S_{21}}$$

$$Y_{22} = Y_0 \frac{(1+S_{11})(1-S_{22})+S_{12}S_{21}}{(1+S_{11})(1+S_{22})-S_{12}S_{21}}$$

Fórmula para parámetros Y

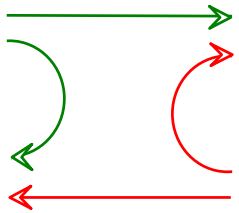
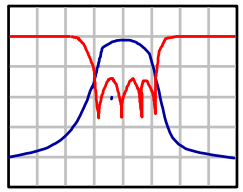
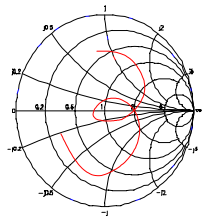
ZVx Concepto hardware



ZVx Concepto hardware

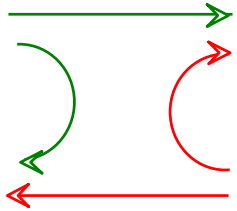
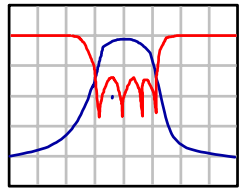
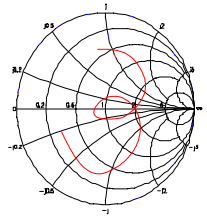
ZVR, ZVC, ZVM, ZVK: 4 canales de referencia

- Bidireccional
- Métodos de calibración estándar más...
  ... R&S calibration methods
  for test fixtures, on circuit boards

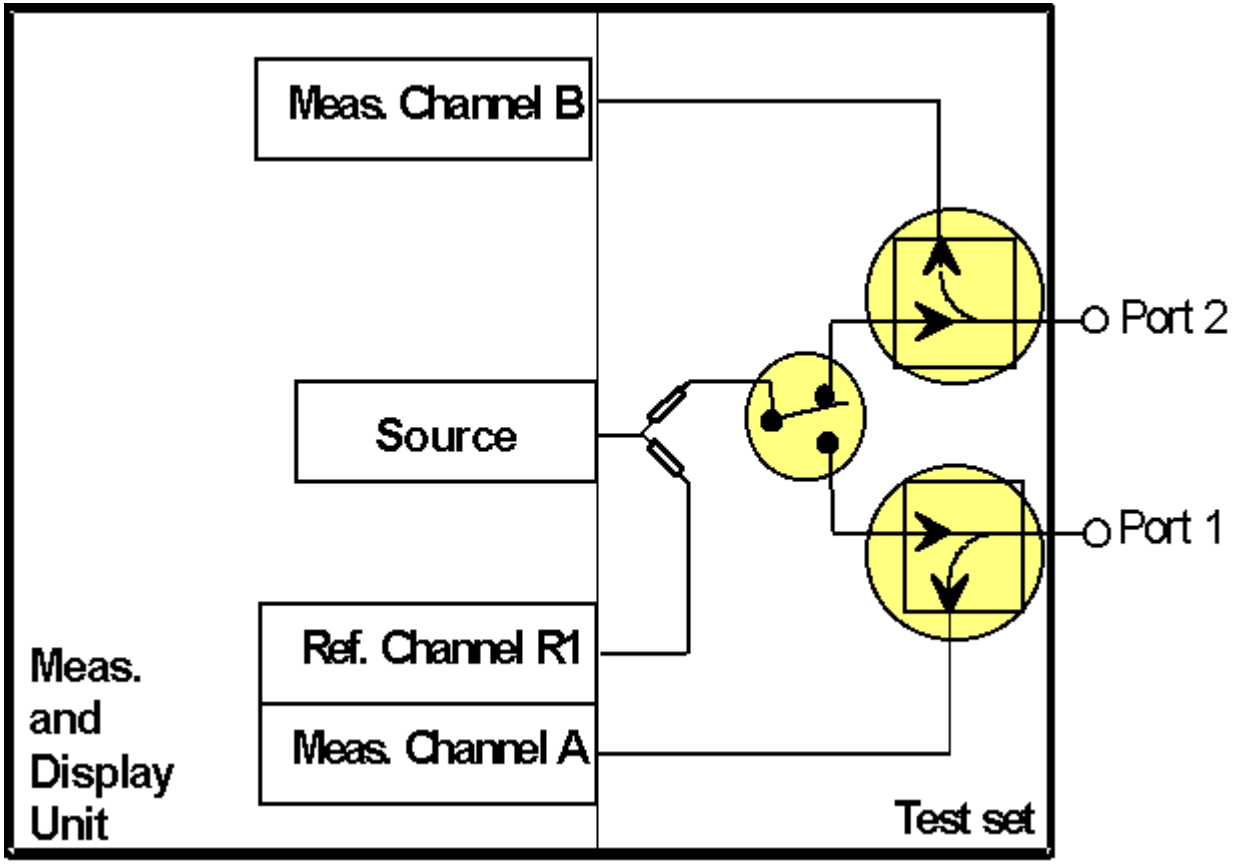
ZVRE, ZVCE: 3 canales de referencia

- Bidireccional
- Métodos de caliración estándar

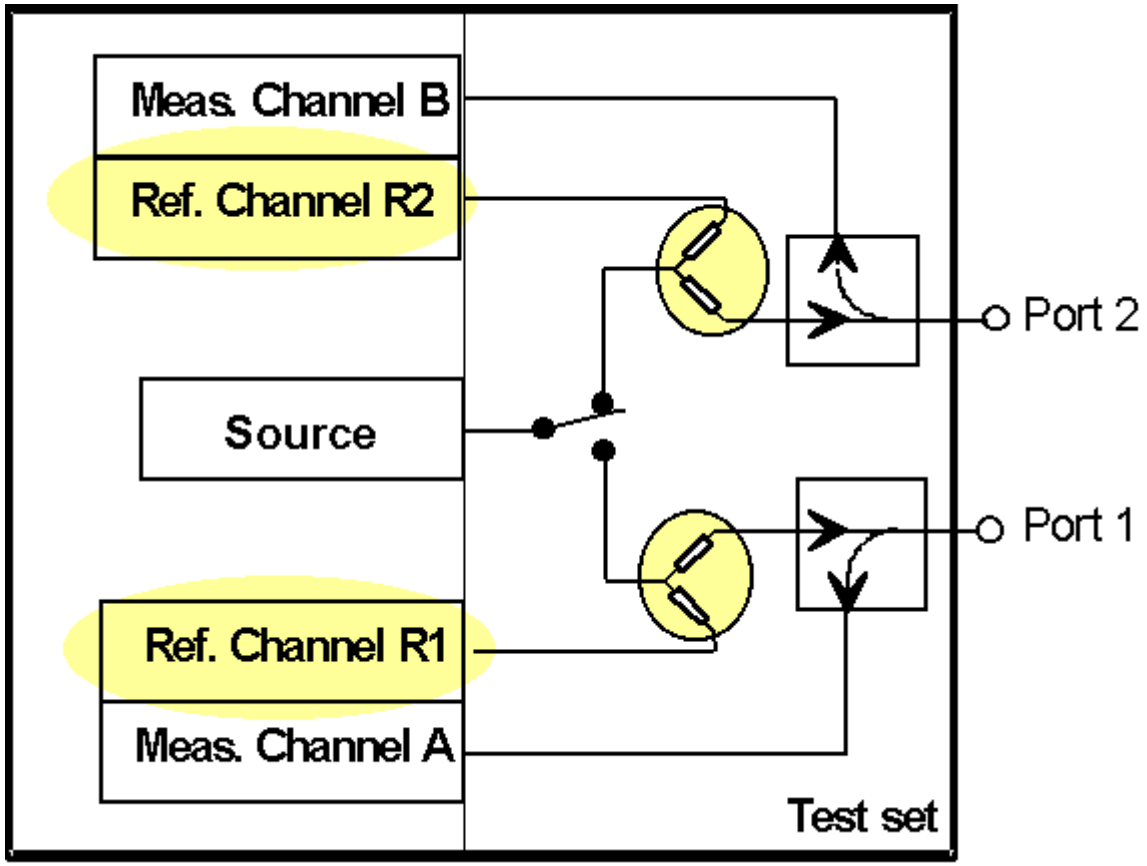
ZVx- Test Sets

Test set de 3 canales para ZVRE y ZVCE

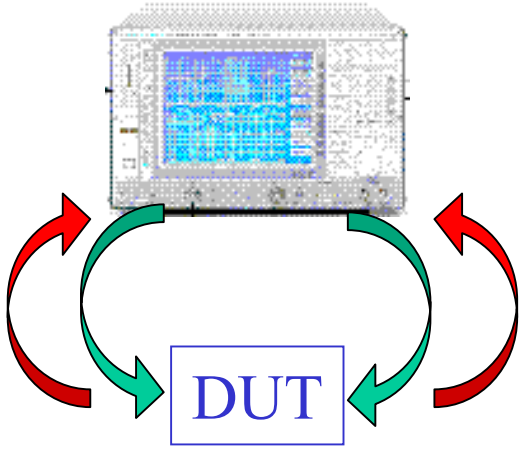


ZVx- Test Sets

Test set de 4 canales para ZVR y ZVC

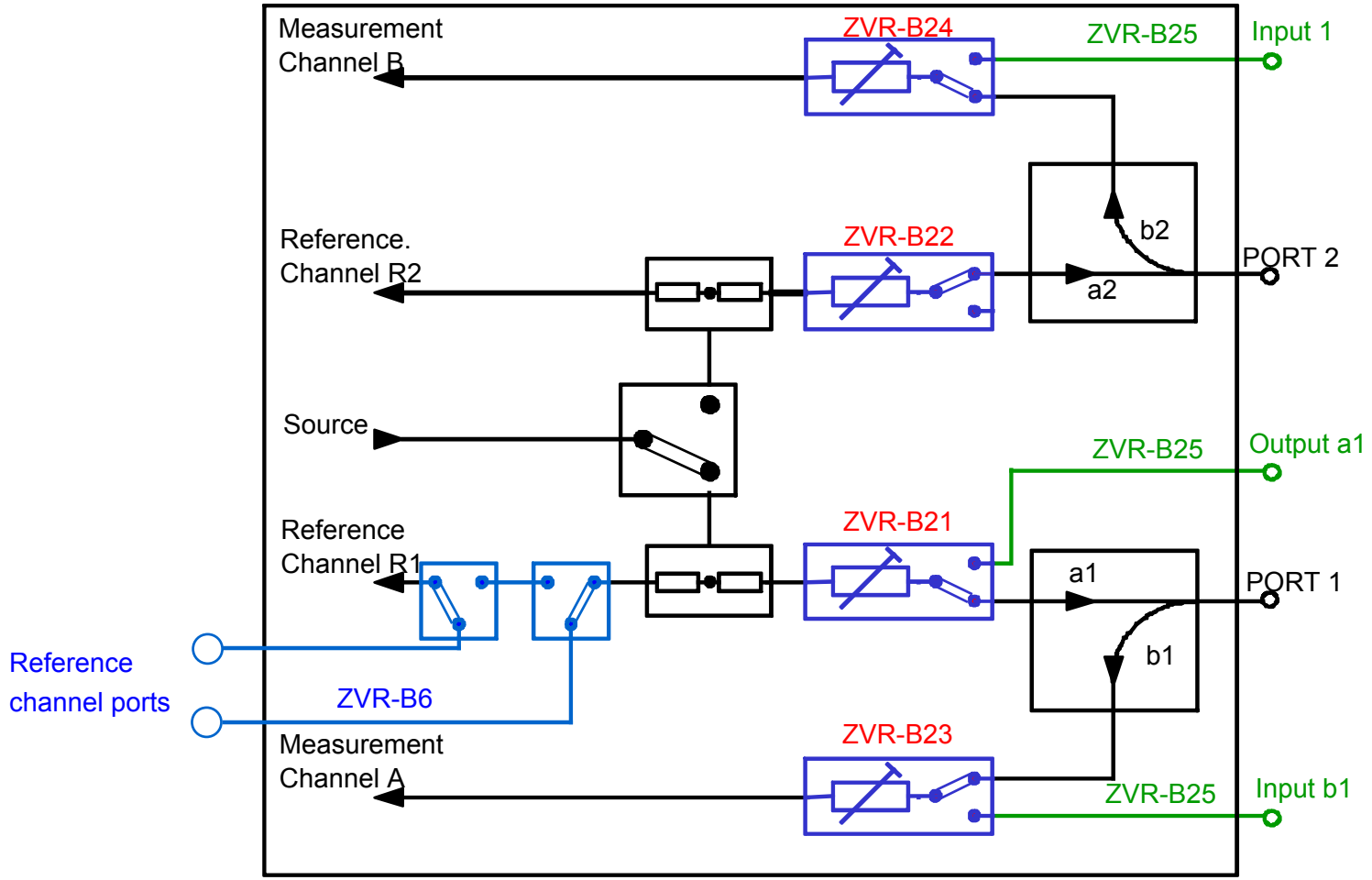


Fuente de señal



- La fuente proporciona estímulo para el DUT
- Se puede barrer en frecuencia y potencia
- La fuente sintetizada está integrada en el analizador

ZVx Concepto Hardware



Aplicaciones típicas

- Multitone
- Hot S-Parameter
- Intermodulation
- Compr. Point
- One Tone
- Measurement
- Harmonics
- Gain / Conv. Loss
- Spurious
- Up- and Down Convert.
- Phase / GD
- Return Loss / VSWR
- Impedance
- S-Parameter
- Attenuation, ...