

TIME DOMAIN REFLECTOMETRY

PROBLEMA

MISURA DI IMPEDENZA DI UNA LINEA

METODO TRADIZIONALE

$$\Gamma(\omega) \leftrightarrow Z$$

DISCONTINUITA' ?

TRATTI CON IMPEDENZA
DIVERSA ?

MISURE IN FREQUENZA

NON POSSONO RISOLVERE
POSIZIONI.

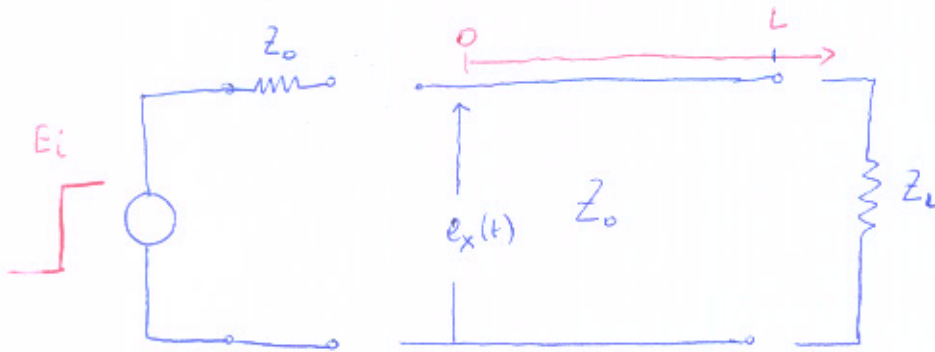
L'INFORMAZIONE E' CONTENUTA NELLA RISPOSTA IN FREQUENZA

SOLUZIONE

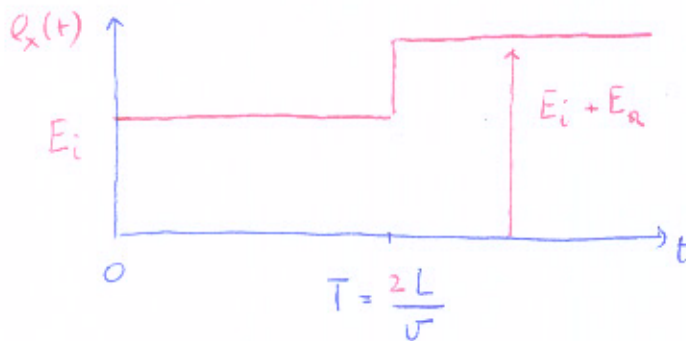
MISURA DI ECO (COME UN RADAR)

MISURE IN TEMPO

\neq ISTANTI $\Rightarrow \neq$ POSIZIONI



$$\frac{E_r}{E_i} = \Gamma = \frac{Z_L - Z_0}{Z_L + Z_0}$$



I APPLICAZIONE

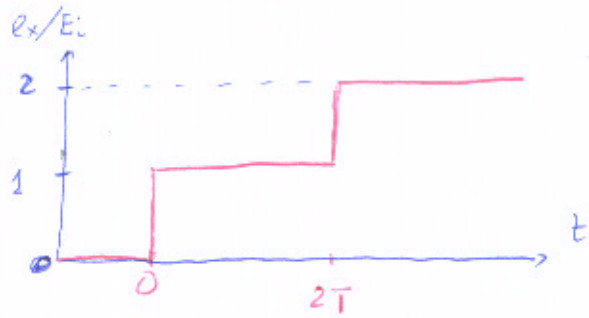
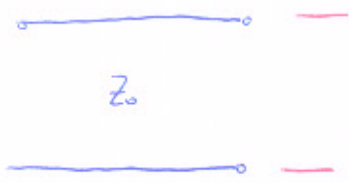
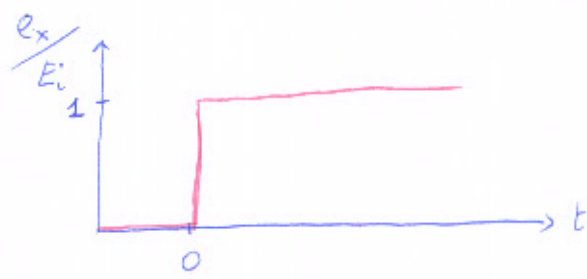
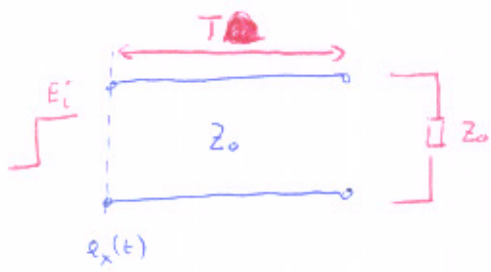
LOCALIZZARE DISACCOPIAMENTI

$$L = \frac{vT}{2}$$

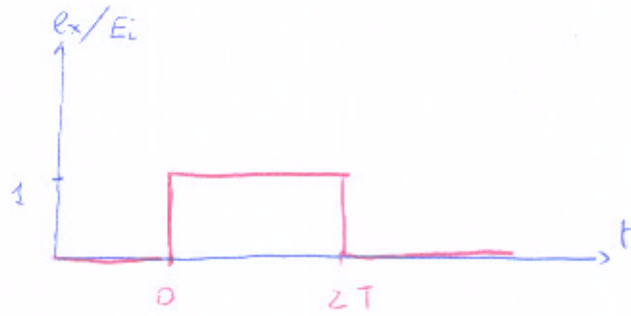
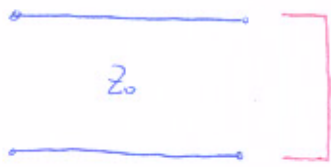
II APPLICAZIONE

NATURA E QUANTITA' DEL DISACCOPIAMENTO

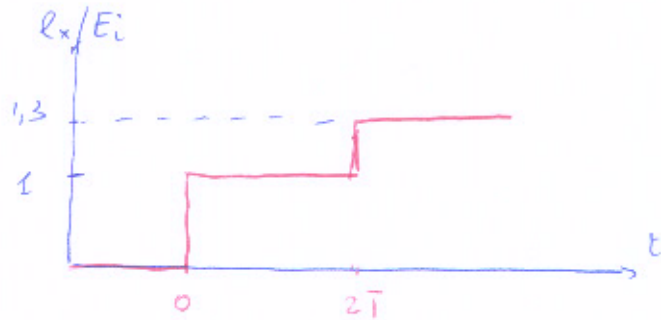
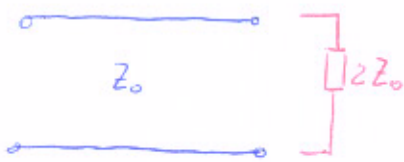
A RIGORE: TRASFORMATA DI LAPLACE (CASI SEMPLICI INTUITIVI)



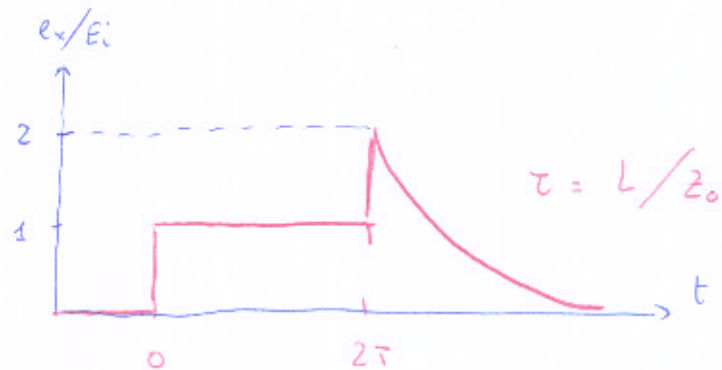
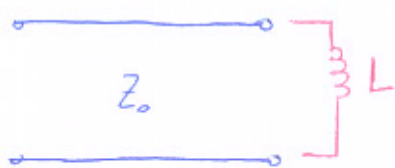
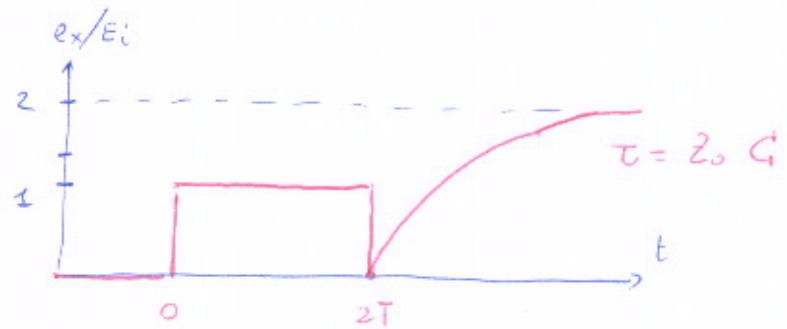
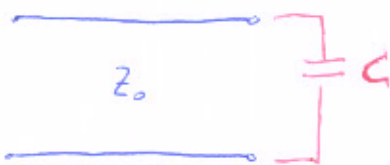
$$\Gamma = 1$$



$$\Gamma = -1$$



$$\Gamma = 1/3$$



PIU' CASI → AGILENT
AM

IMPULSO SIMTETICO CON VNA

(TIME DOMAIN)

VANTAGGIO

RISPETTO ALLA TDR TRADIZIONALE, HA UN ELEVATO RANGE DINAMICO

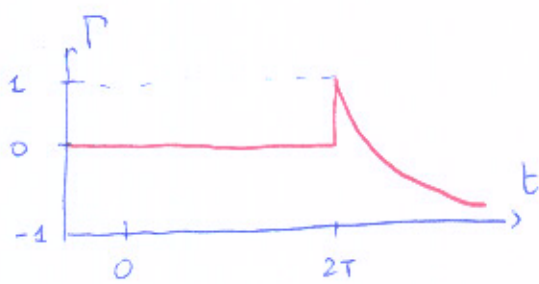
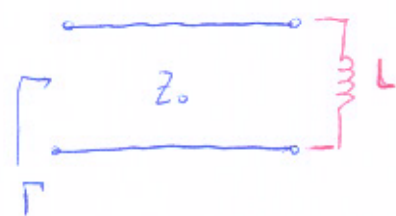
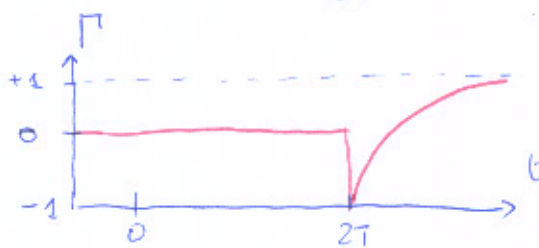
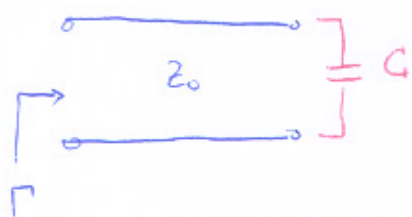
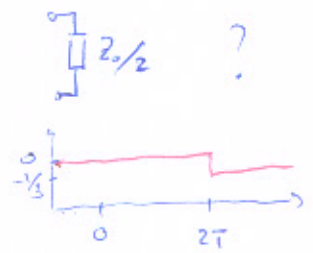
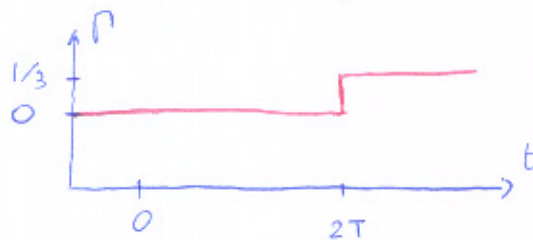
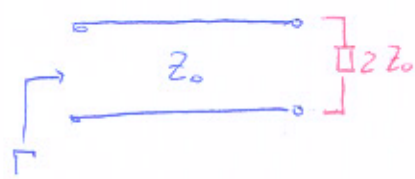
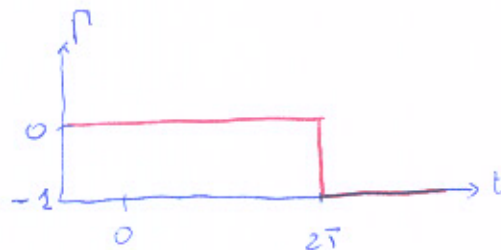
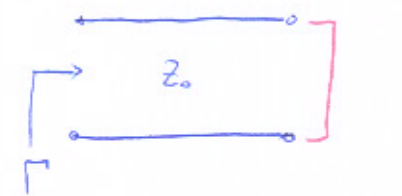
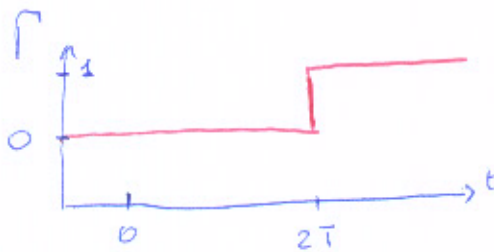
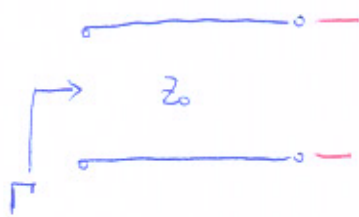
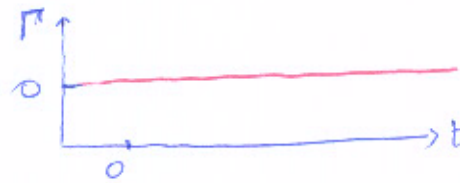
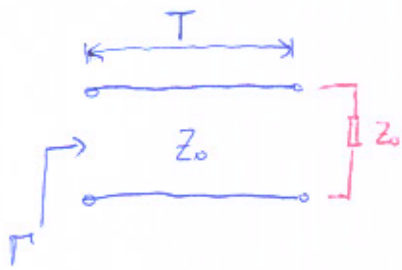
RISPOSTA IN TEMPO

← FOURIER →

FUNZIONE DI TRASFERIMENTO

IL VNA FA LA FFT DELLA F. DI TRASFERIMENTO

STEP. RESPONSE



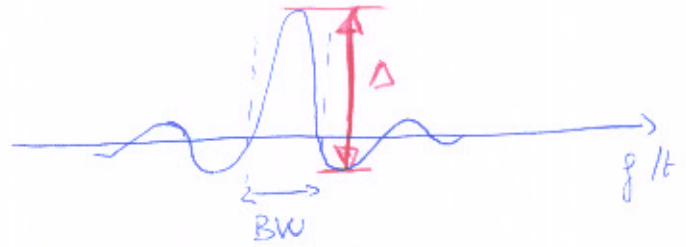
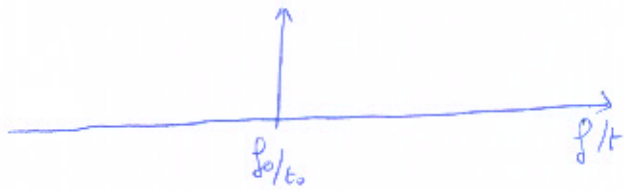
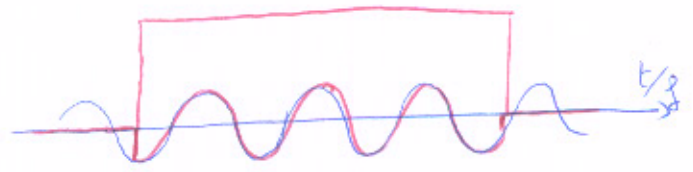
IV CONSEQUENZA

TIME DOMAIN
(SINTETICO)

← FFT

FREQUENCY DOMAIN
(MISURA)

LA FFT E' INFLUENZATA DAL NUMERO LIMITATO DI CAMPIONI



FINESTRA RETTANGOLARE: $\Delta = -13 \text{ dB}$, BW... DA # CAMPIONI

LA FINESTRA RETTANGOLARE NON E' L'UNICA POSSIBILE, SI PUO' FARE UN PROFILO DIVERSO



LE DIVERSE FINESTRE ~~VARIANO~~ Δ HA A SPESE DI BW

FINESTRA RETTANGOLARE

$\Delta = -13 \text{ dB}$

WINDOW

MINIMUM

FINESTRA DI HANNING

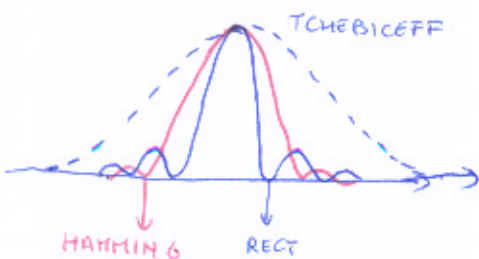
$\Delta = -44 \text{ dB}$

NORMAL

FINESTRA DI TCHEBICEFF
COSENO RIALZATO

$\Delta = -75 \text{ dB}$

MAXIMUM



ESERCIZIO

PULSE RESPONSE SU APERTO

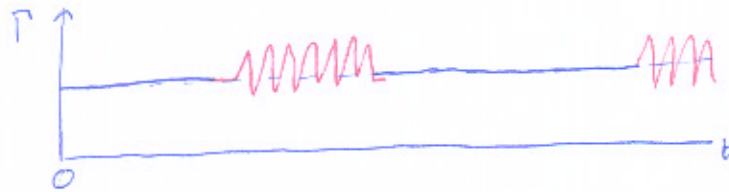
FA VISUALIZZARE LE FINESTRE

V CONSEGUEZZA

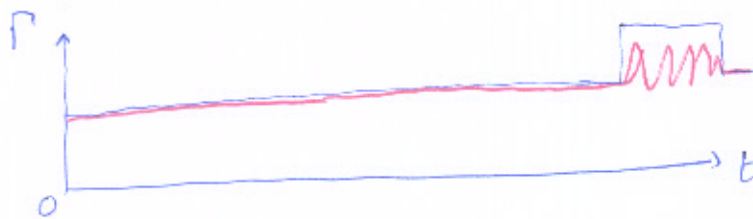
POSSO DISCRIMINARE IN TEMPO
LA PARTE DI RISPOSTA CHE
MI INTERESSA

⇒ GATING
(FILTRO NEL
DOMINIO DEL TEMPO)

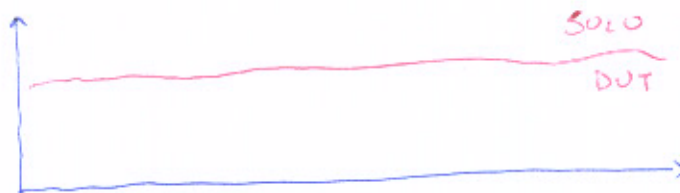
ESEMPIO



TIME DOMAIN
(PULSE RESPONSE)



GATING



FREQUENCY
DOMAIN

PROBLEMA IL GATING TOGLIE POTENZA AL SEGNALE

⇒ SNR + BASSO (⇒ e.g. ATTENUATORE DI PIU' ATZEMUA)

LOW PASS STEP

LOW PASS PULSE

BAND PASS

→ USATO PER DISPOSITIVI PASSA BANDA

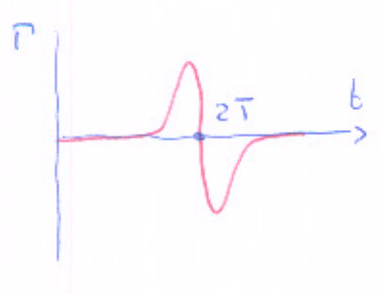
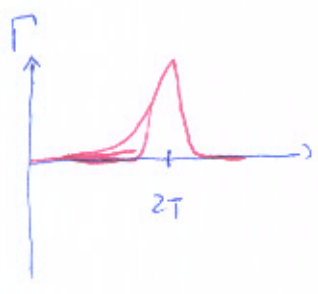
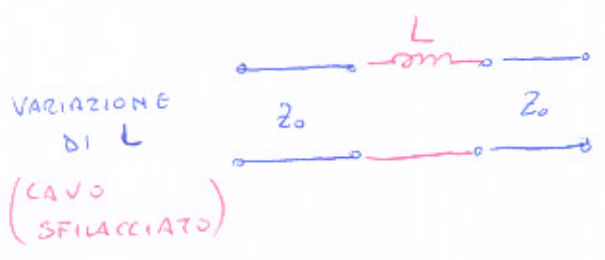
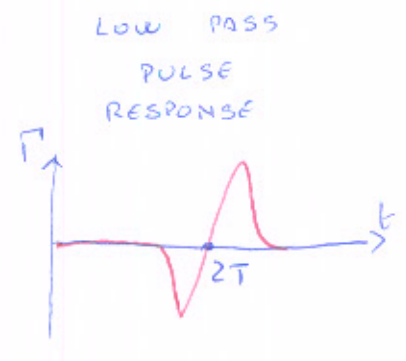
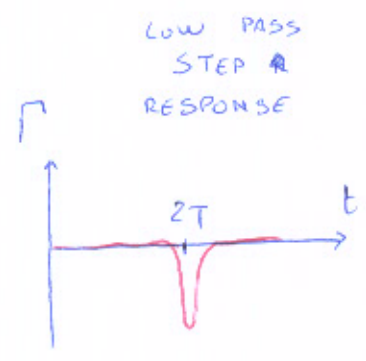
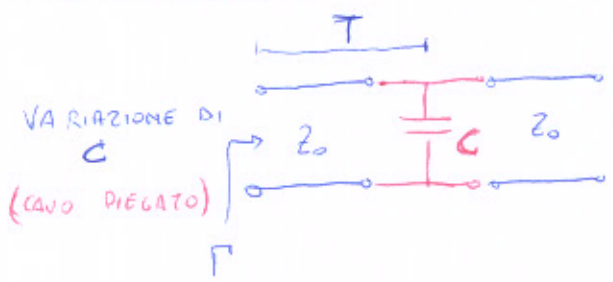
→ SEGNO E AMPIEZZA DI f NON SEMPRE

DI FACILE INTERPRETAZIONE

→ USATO PER IL GATING

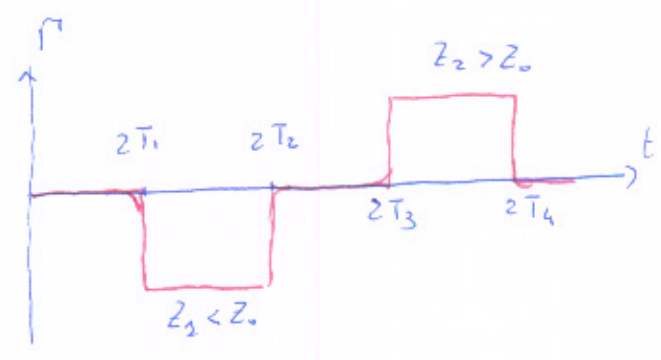
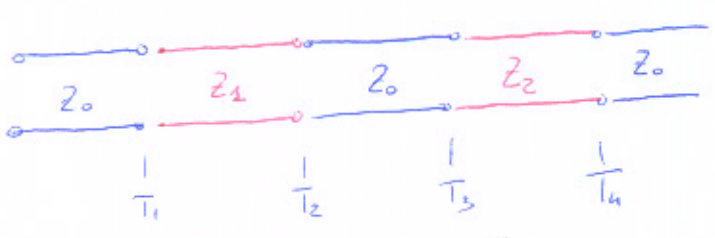
ESERCIZI

FAULT LOCATION



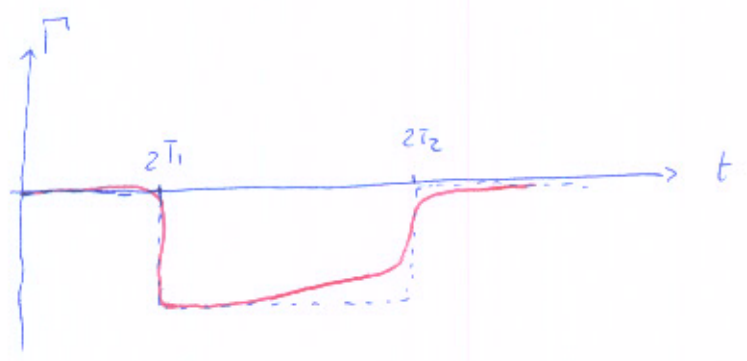
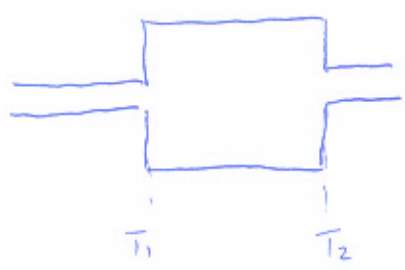
MISURA DI IMPEDENZA IN FUNZIONE DI Z

MICROSTRISCE



$$Z(t) = Z(x) = Z_0 \frac{1 + \Gamma}{1 - \Gamma}$$

ESEMPIO: MICROSTRISCE



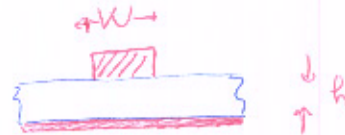
- NON IDEALITÀ:
- Ⓘ NON TORNA A ZERO (ATTENUAZIONE, PERDITA DI ENERGIA, RIFLESSIONI)
 - Ⓜ IL SECONDO TEMPO DI SALITA' È PIÙ LENTO → DISPERSIONE

PER FARE Z(x) BISOGNA CALCOLARSI J

GATING



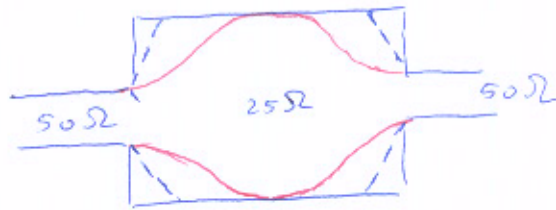
MICROSTRIP



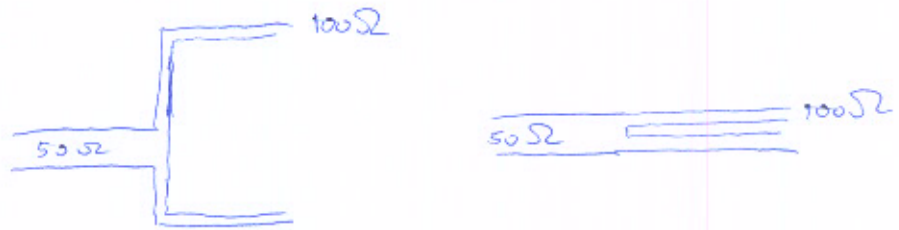
IMPEDANCE

VARI $\frac{W}{h}$

TAPER



CROSS-TALK



DIVERSE ?