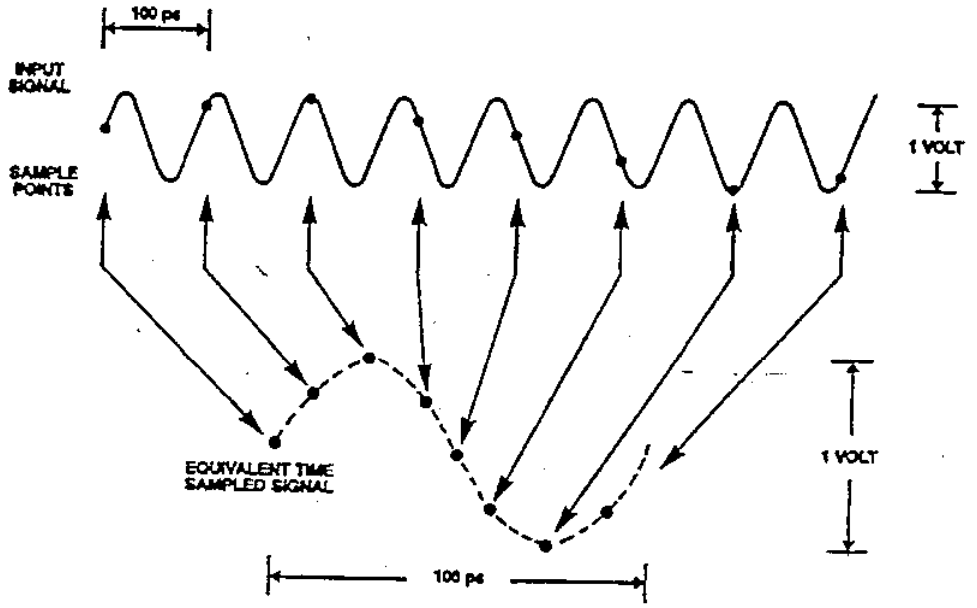
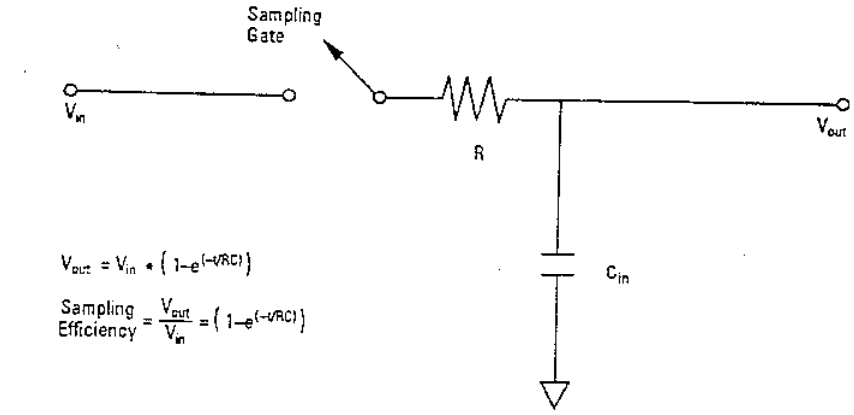
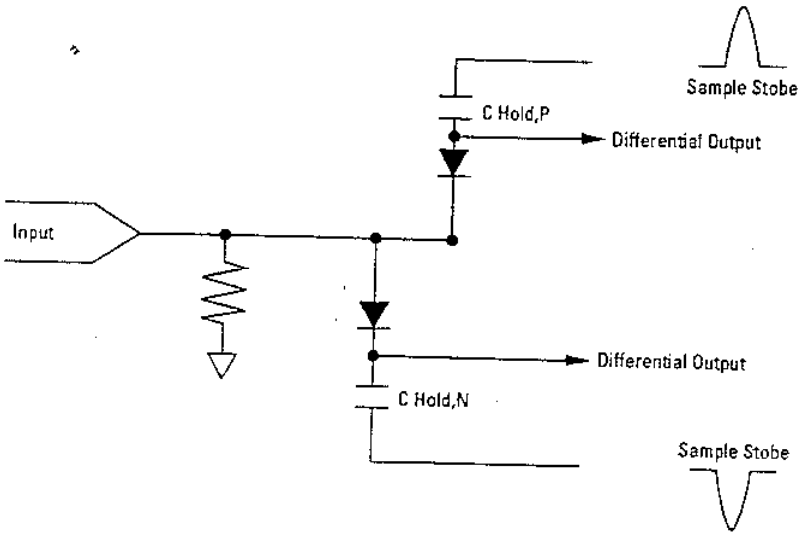
Sampling Oscilloscope



Ralph J. Pasquinelli
Fermilab

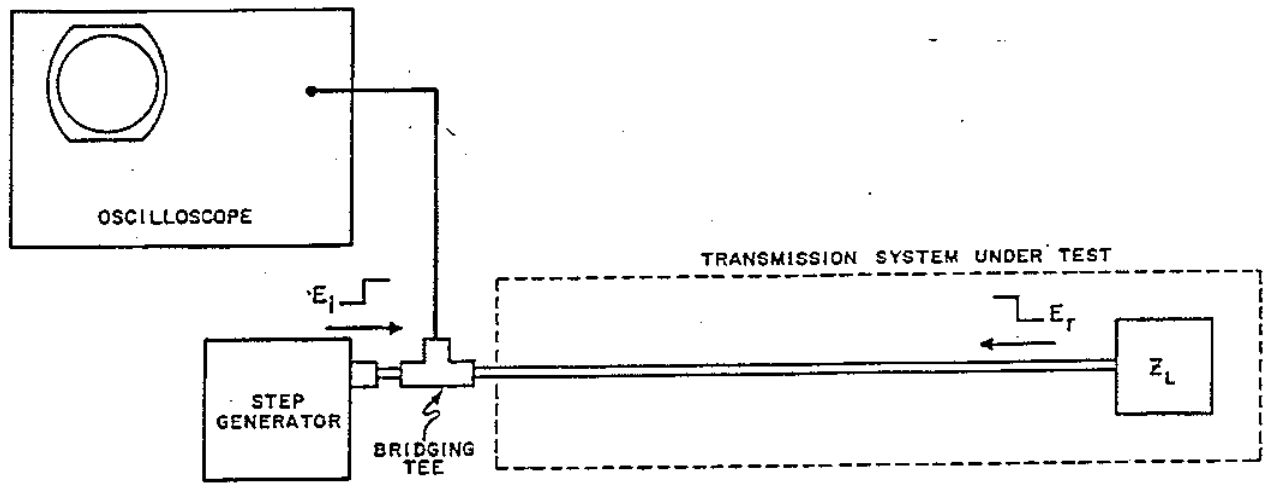
Sampling Scope Front End



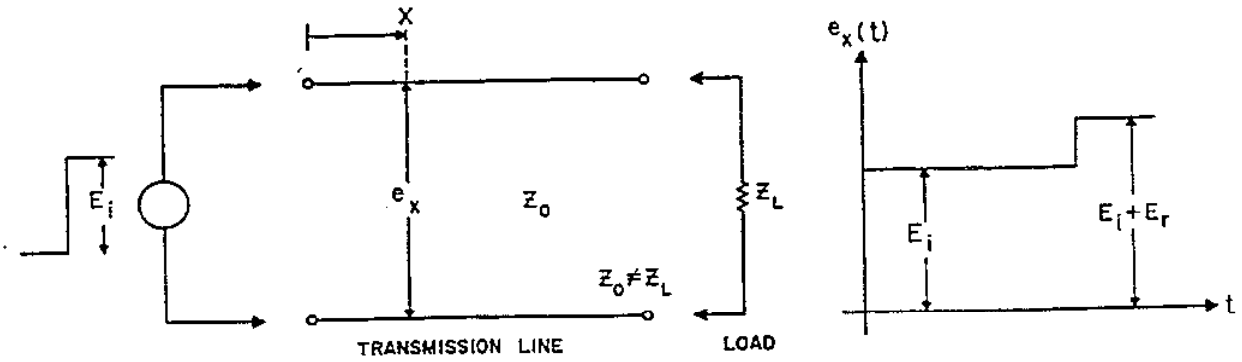


Ralph J. Pasquinelli
Fermilab

Time Domain Reflectometer (TDR)



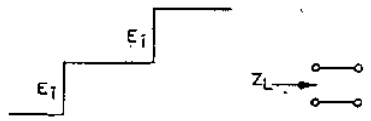
Once the incident and reflected voltages are measured on the oscilloscope, the reflection coefficient and impedance of the mismatch may be calculated.



$$\rho = E_r/E_i = (Z_L - Z_0)/(Z_L + Z_0)$$

Ralph J. Pasquinelli
Fermilab

TDR Displays for Resistive Loads

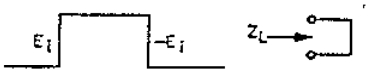


(A) OPEN CIRCUIT TERMINATION ($Z_L = \infty$)

(A) $E_r = E_i$ THEREFORE $\frac{Z_L - Z_o}{Z_L + Z_o} = +1$

WHICH IS TRUE AS $Z_L \to \infty$

$\therefore Z$ = OPEN CIRCUIT



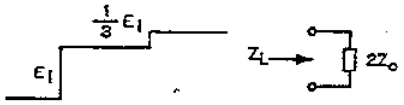
(B) SHORT CIRCUIT TERMINATION($Z_L = 0$)

(B) $E_r = E_i$ THEREFORE $\frac{Z_L - Z_o}{Z_L + Z_o} = -1$

WHICH IS ONLY TRUE (FOR FINITE Z_o)

WHEN $Z_L = 0$

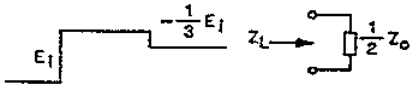
$\therefore Z$ = SHORT CIRCUIT



(C) LINE TERMINATED IN $Z_L = 2Z_o$

(C) $E_r = +\frac{1}{3}E_i$ THEREFORE $\frac{Z_L - Z_o}{Z_L + Z_o} = +\frac{1}{3}$

AND $Z_L = 2Z_o$



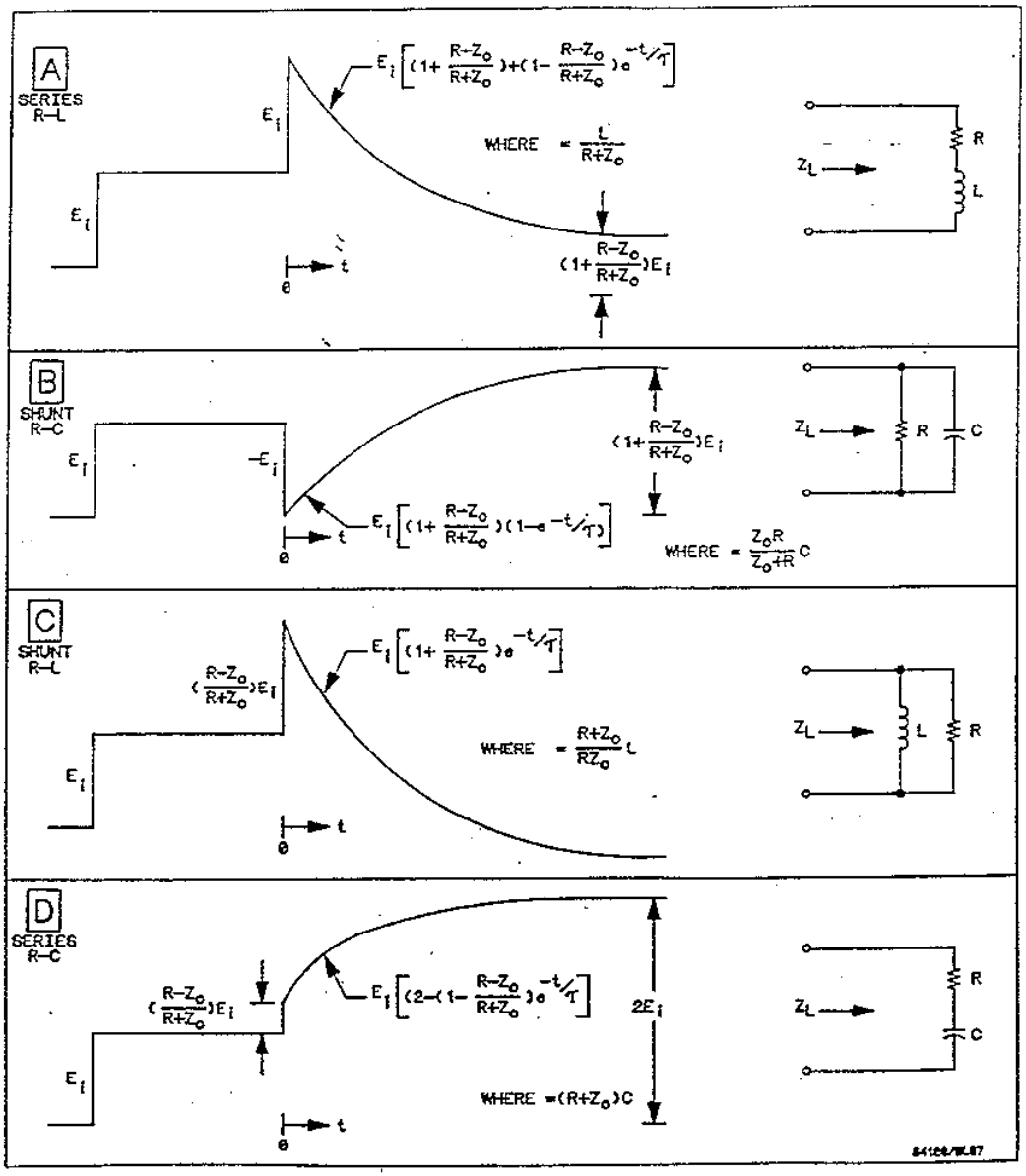
(D) LINE TERMINATED IN $Z_L = \frac{1}{2}Z_o$

(D) $E_r = -\frac{1}{3}E_i$ THEREFORE $\frac{Z_L - Z_o}{Z_L + Z_o} = -\frac{1}{3}$

AND $Z_L = \frac{1}{2}Z_o$

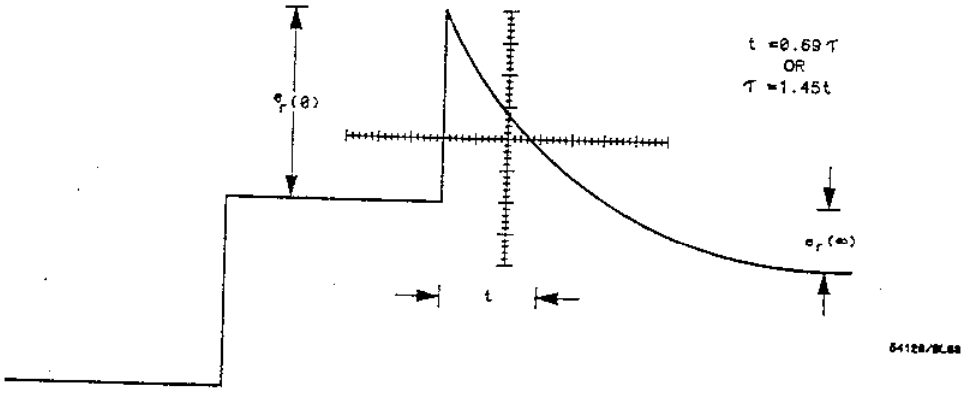
Ralph J. Pasquinelli
Fermilab

TDR Displays for Complex Loads



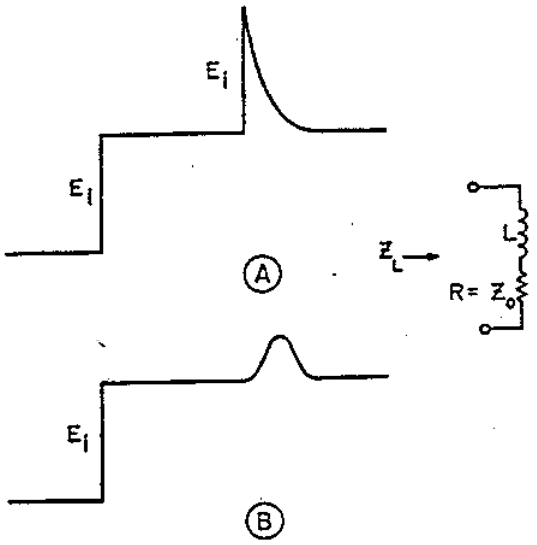
Ralph J. Pasquinelli
Fermilab

TDR Measurement of Time Constants



Ralph J. Pasquinelli
Fermilab

TDR Displays with Limited Bandwidth



Ralph J. Pasquinelli
Fermilab

References

TDR Fundamentals, Hewlett Packard App. Note 62

HP teaching tools WWW page, http://www.tmo.hp.com/tmo/iia/edcorner

High Bandwidth Oscilloscope Sampling Architectures, HP product note 54120-3, August 1989

Ralph J. Pasquinelli
Fermilab