Bridged Tee Dissipation

By Terry Cisco – Microwaves101.com
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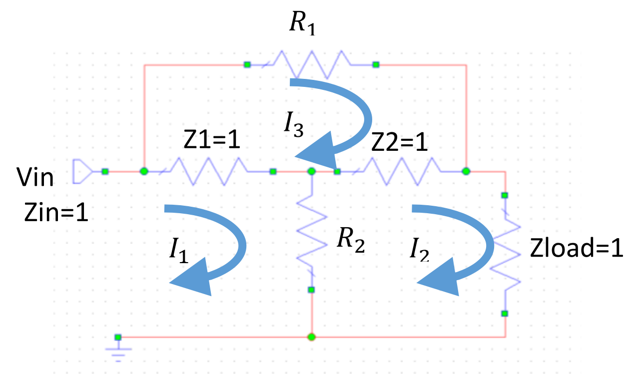

$P_{in} = 1 = (I_1)^2 * Z_{in} \quad \therefore \quad I_1 = 1$
$P_{out} = (I_2)^2 * Z_{load} \quad \therefore \quad P_{out} = (I_2)^2$
$(G)^2 \equiv P_{out}/P_{in} \quad \therefore \quad G = I_2$
(1) $-I_1 * 1 + (I_1 - I_3) * 1 + (I_1 - I_2) * R_2 = 0$
(2) $(I_2 - I_3) * 1 + I_2 * 1 + (I_2 - I_1) * R_2 = 0$
(3) $I_3 * R_1 + (I_3 - I_2) * 1 + (I_3 - I_1) * 1 = 0$

Eq (1) becomes $\quad I_3 = (1 - G) * R_2$
Eq (2) becomes $\quad I_3 = (2 + R_2) * G - R_2$

Hence:
$\boldsymbol{I_1 = 1}$
$\boldsymbol{I_2 = G}$
$\boldsymbol{I_3 = (1 - G) * R_2}$

Combining Eqs 1 & 2 yields
(4) $\boldsymbol{R_2 = G/(1 - G)}$ **where** $\boldsymbol{G = 10^{-attenuation/20}}$ **and** $attenuation$ **is in dB**

For R_1: $\quad I_3 = \frac{V_{in} - V_{out}}{R_1} = \frac{I_1 * 1 - I_2 * 1}{R_1} \quad \therefore$
(5) $I_3 = (1 - G)/R_1$

Combining Eqs 1 & 5 yields $\quad I_3 = (1 - G)/R_1 = (1 - G) * R_2 \quad \therefore$
(6) $\boldsymbol{R_1 * R_2 = 1}$

For dissipation
(7) $\boldsymbol{P_D^{R_1} = (1 - G)^2 * R_2}$
$P_D^{R_2} = (1 - G)^2/R_1 \quad \therefore$
(8) $\boldsymbol{P_D^{R_1} = P_D^{R_2}}$ because $R_2 = 1/R_1$

For Z1 and Z2 dissipation
$P_D^{Z_1} = (I_1 - I_3)^2 * 1 \quad \therefore \quad \boldsymbol{P_D^{Z_1} = (1 - G)^2}$
$P_D^{Z_2} = (I_2 - I_3)^2 * 1 \quad \therefore \quad \boldsymbol{P_D^{Z_2} = 0}$

Assumptions:

1. All resistances are normalized to Zo
2. Pin is 1 Watt
3. The circuit is designed to be matched.
4. Z1=Z2=Zo=1 by normalization