Figure 12-1. (a) Simple resistance and (b) small thermal random noise voltage appearing across it.
Figure 12-2. (a) Thevenin and (b) Norton equivalent circuits for thermal noise sources associated with resistance.
Figure 12-3. Series combination of two resistors and equivalent models that represent the effect of thermal noise.

\[ \overline{v_1^2} = 4R_1kTB \]

\[ \overline{v_2^2} = 4R_2kTB \]

\[ R = R_1 + R_2 \]

\[ v^2 = 4(R_1 + R_2)kTB \]

\[ = 4RkTB \]
Figure 12-4. Circuit of Example 12-3.
Figure 12-5. Concept of available power from source.
Figure 12-6. Circuit used to establish available noise power from resistance.
Figure 12-7. Power spectral density of unfiltered white noise on a one-sided basis.

\[ S(f) \]

\[ \eta = kT \text{ W/Hz} \]
Figure 12-8. Illustration of equivalent noise bandwidth.

\[ A^2(f) = |H(f)|^2 \]
Figure 12-9. System of Example 12-9.
Figure 12-10. Block diagram used in defining noise temperature.
Figure 12-11. Block diagram used in defining noise figure.

\[ P_i = \frac{N_i}{i} = kT_iB \]

\[ P_o = N_o \]

Available Source Power

MATCHED LOAD
Figure 12-12. Three amplifiers in cascade whose total noise effects are to be determined.
\[ R_{in} = R \]
\[ R_{out} = R \]
Figure 12-14. Matched attenuator at a physical temperature $T_p$ excited by a noise input source with effective temperature $T_i$. 
Figure 12-15. Circuit of Example 12-14.
TRANSMISSION LINE
Loss = 6.02 dB
Physical Temperature = 290 K

Figure 12-16. Circuit of Example 12-16.
Figure 12-17. Circuit of Example 12-17.
Figure P12-17
Figure P12-18
Figure P12-27
Figure P12-28