

Maximum Power Transfer

Electrical Engineering

When matching the load to the source maximises power, and what it costs in efficiency.

A load draws the most power when its resistance equals the source's Thevenin resistance.

$$R_L = R_{Th} \cdot P_{max} = V_{Th}^2 / (4 R_{Th})$$

V_{Th} 12 V, R_{Th} 50 Ω

At $R_L = 50 \Omega$.

$P_{max} = 0.72 \text{ W}$

Efficiency when matched

50%

Half heats the source.

AC version

Reactance cancels.

$Z_L = \text{conjugate of } Z_{Th}$

THE COMMON MISTAKE

✗ **Matching load to source in a power supply**

✓ **Keeping source resistance far below the load**

Matched transfer throws half the energy away inside the source. Efficiency, not peak power, is what a supply is designed for.

Maximum power and maximum efficiency are different goals, and only one of them can be met at a time.