

Block Diagram Algebra

Mechanical Engineering

Four moves that reduce any single-loop diagram to one transfer function.

Reduce from the inside out, one loop at a time.

Arrangement	Equivalent transfer function
Two blocks in series	$G_1 G_2$
Two blocks in parallel	$G_1 + G_2$
Negative feedback loop	$G \div (1 + G H)$
Positive feedback loop	$G \div (1 - G H)$
Unity negative feedback	$G \div (1 + G)$

Setting $1 + GH = 0$ gives the characteristic equation. Its roots are the closed-loop poles, and they decide stability.