

Gain & Phase Margin

Mechanical Engineering

How much extra gain or lag the loop can absorb before it oscillates.

Stability margin is how much extra gain or phase lag a loop can take before it starts to oscillate.

Gain margin at 180 degrees lag · phase margin at 0 dB

Phase margin 45 to 60

The usual aim.

Well-damped response

Phase margin below 30

Reduce the gain.

Ringling, poor margin

Rule of thumb

Up to about 0.6.

Margin $\approx 100 \times$ damping

THE COMMON MISTAKE

× **Trusting Bode margins on any plant**

✓ **Check it is stable and minimum phase**

Bode margins assume a stable, minimum-phase open loop. For an unstable or non-minimum-phase plant, the Nyquist encirclement count is the correct test.

A slope of minus 20 dB per decade through the crossover frequency is the classic sign of a healthy loop.