

Introductory Control Systems

Summary of Terms for Bode Diagrams

| Term | Low Frequency Asymptote for M and φ (dB and deg) | High Frequency Asymptote for M and φ (dB and deg) | Corner Frequency (rad/s) |
|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------|
| Constant, K $K > 0$ $K < 0$ | $M = +20 \log(K)$ $\varphi = 0$ (deg) $\varphi = 180$ (deg) | same | none |
| Poles at Origin (Order N) | $M = -20 N \log(\omega)$ $\varphi = -90 N$ (deg) | same | none |
| Zeros at Origin (Order N) | $M = +20 N \log(\omega)$ $\varphi = +90 N$ (deg) | same | none |
| Real Pole $s = -p$ $s = +p$ | $M = -20 \log(p)$ $\varphi = 0$ (deg) $\varphi = -180$ (deg) | $M = -20 \log(\omega)$ $\varphi = -90$ (deg) $\varphi = -90$ (deg) | $\omega = p$ |
| Real Zero $s = -z$ $s = +z$ | $M = +20 \log(z)$ $\varphi = 0$ (deg) $\varphi = +180$ (deg) | $M = +20 \log(\omega)$ $\varphi = +90$ (deg) $\varphi = +90$ (deg) | $\omega = z$ |
| Complex Conjugate Poles (ζ, ω_n) Left-Half Plane Right-Half Plane | $M = -40 \log(\omega_n)$ $\varphi = 0$ (deg) $\varphi = -360$ (deg) | $M = -40 \log(\omega)$ $\varphi = -180$ (deg) $\varphi = -180$ (deg) | $\omega = \omega_n$ |
| Complex Conjugate Zeros (ζ, ω_n) Left-Half Plane Right-Half Plane | $M = +40 \log(\omega_n)$ $\varphi = 0$ (deg) $\varphi = 360$ (deg) | $M = +40 \log(\omega)$ $\varphi = +180$ (deg) $\varphi = +180$ (deg) | $\omega = \omega_n$ |