某单位负反馈系统的开环传函为：

$$G(s)=\frac{20}{s(s+2)(s+50)}$$

1、画出系统的对数频率特性图

2、用Nyquist判据判断系统稳定性

$$G(s)=\frac{20}{s(s+2)(s+50)}=\frac{\frac{1}{5}}{s(0.5s+1)(0.02s+1)}$$

四个典型环节，包含一个积分环节；首先确定交接频率：

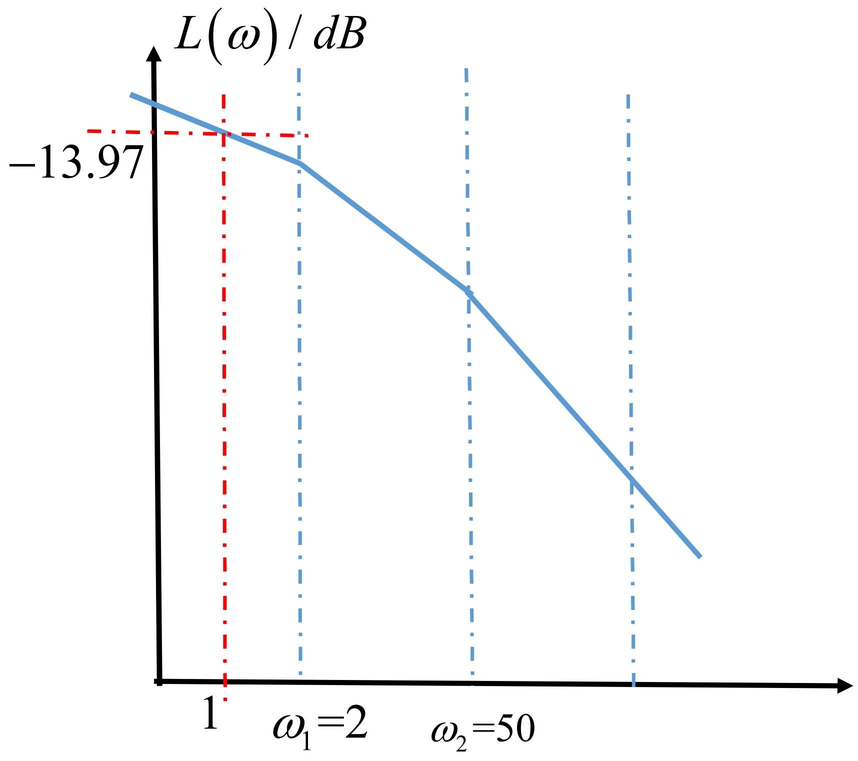
$\omega_1=2$ 最小相位一阶惯性环节，斜率较小20dB/dec

$\omega_2=50$ 最小相位一阶惯性环节，斜率较小20dB/dec

最小交接频率为2，现绘制交接频率小于2的低频段渐进特性曲线

$$\nu=1,\qquad 20\lg K=20\lg(1/5)=-13.97dB$$

故低频渐进线斜率为-20dB，且过点（1，-13.97dB）



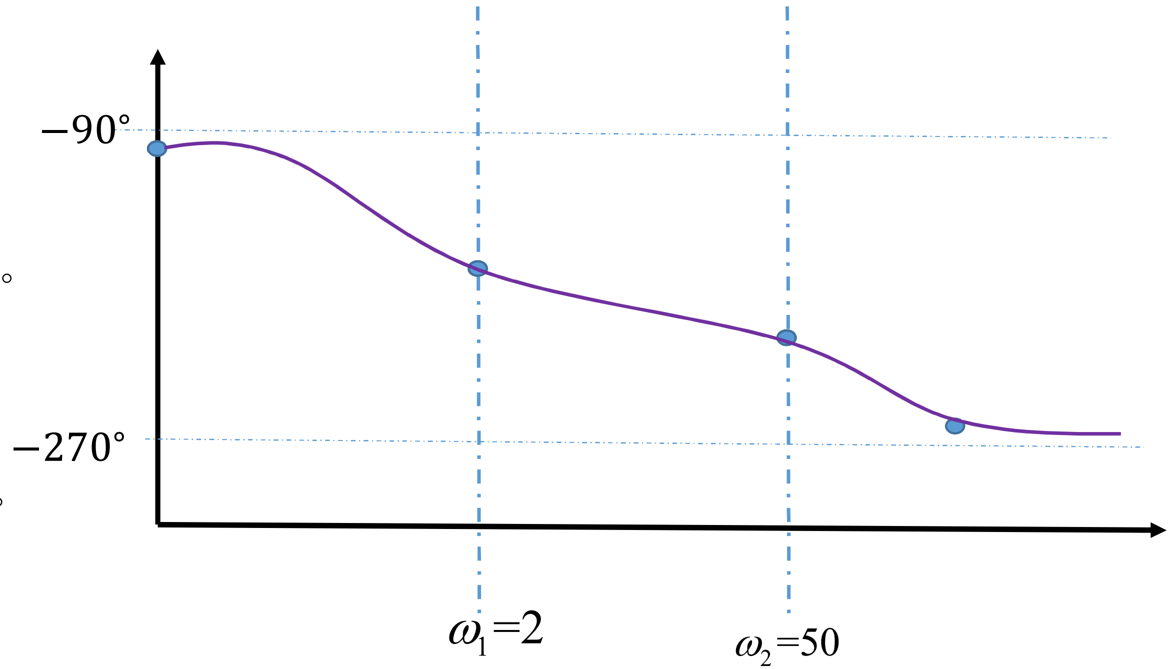
$$\varphi(\omega) = -90^\circ - \arctan\frac{\omega}{2} - \arctan\frac{\omega}{50}$$

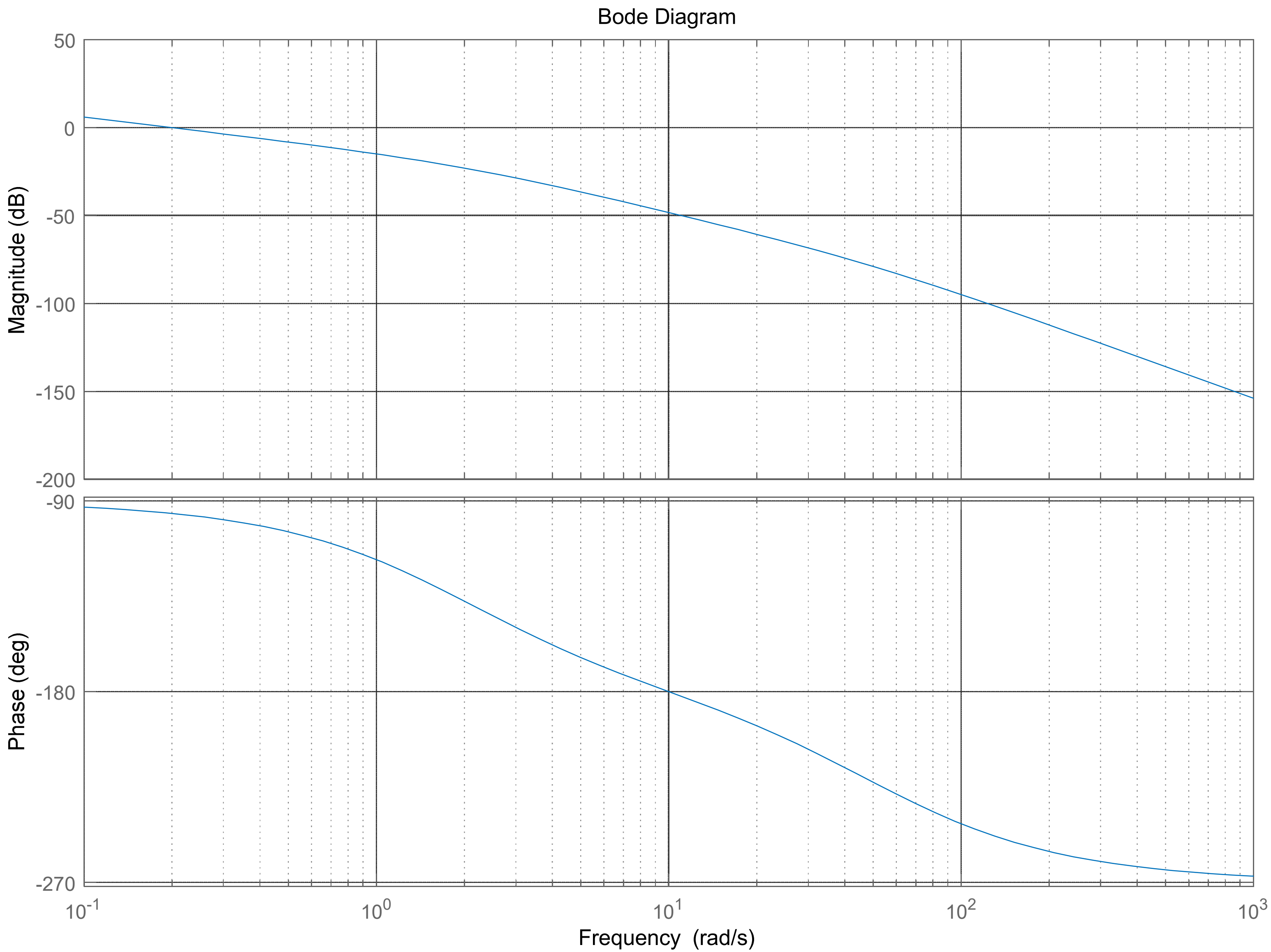
$$\varphi(0) = -90^\circ$$

$$\varphi(\infty) = -270^\circ$$

$$\varphi(\omega=2) = -90^\circ - 45^\circ - 2.3^\circ = -137.3^\circ$$

$$\varphi(\omega=50) = -90^\circ - 87^\circ - 45^\circ = -222^\circ$$





Bode Diagram
Magnitude (dB)
50
0
-50
-100
-150
-200
Phase (deg)
-90
-180
-270
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (rad/s)

$$G(s)H(s)=\frac{20}{s(s+2)(s+50)}$$

$$G(j\omega)H(j\omega)=\frac{20}{j\omega(j\omega+2)(j\omega+50)}$$

$\omega\to 0$，$A(\omega)=\infty$，$\varphi(\omega)=-90^\circ$

$\omega\to\infty$，$A(\omega)=0$，$\varphi(\omega)=-270^\circ$

1、计算与实轴交点

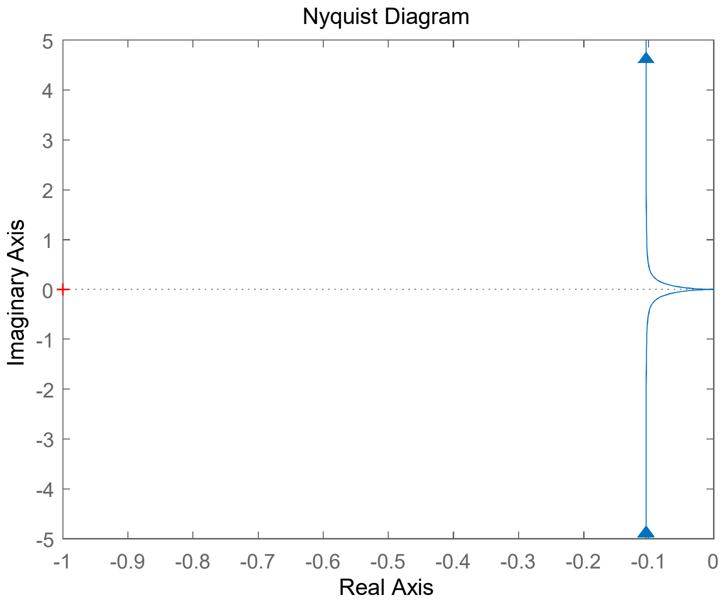
2、计算低频曲线渐近线的实部

$G(j\omega)H(j\omega)=$

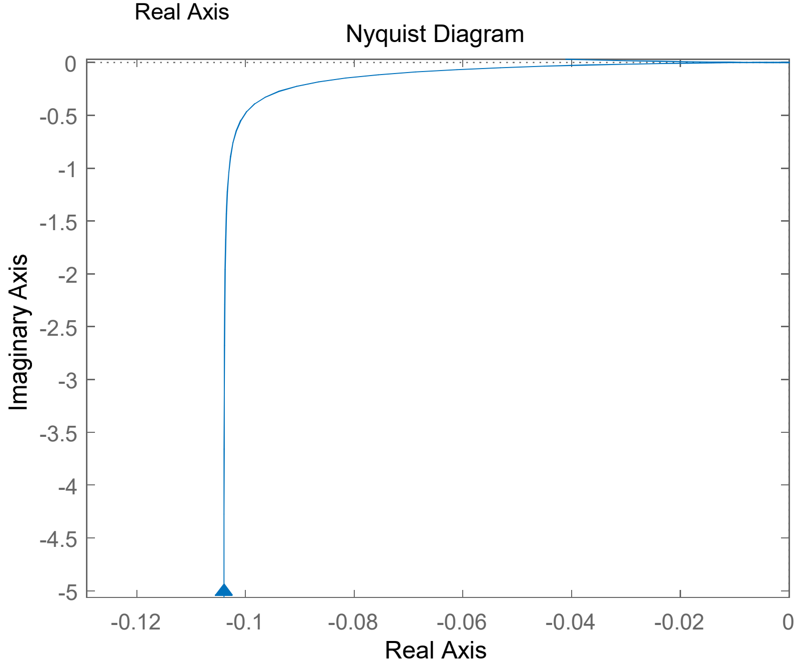
$$G(j\omega)H(j\omega)=-\frac{1040}{(w^2+4)(w^2+2500)}+i\left(\frac{20\,w}{(w^2+4)(w^2+2500)}-\frac{2000}{w\,(w^2+4)(w^2+2500)}\right)$$

ω=10 $\quad\mathrm{Re}\left[G(j\omega)H(j\omega)\right]=-0.0038$

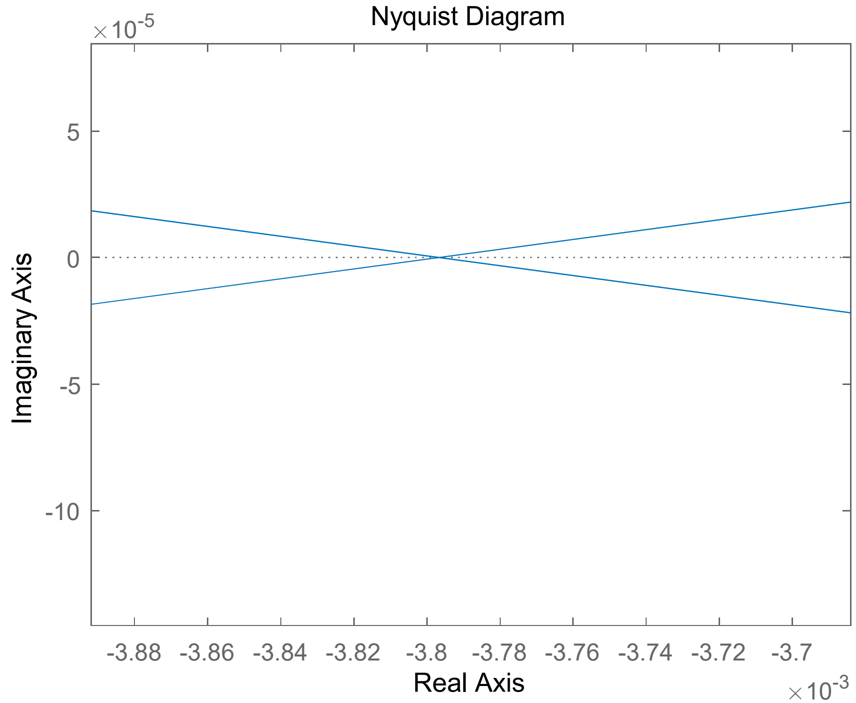
$$\lim_{\omega\to 0^+}\mathrm{Re}\left[G(j\omega)H(j\omega)\right]=-0.104$$



Nyquist Diagram
Imaginary Axis
Real Axis
5
4
3
2
1
0
-1
-2
-3
-4
-5
-1
-0.9
-0.8
-0.7
-0.6
-0.5
-0.4
-0.3
-0.2
-0.1
0



Nyquist Diagram
Imaginary Axis
Real Axis
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
-0.12
-0.1
-0.08
-0.06
-0.04
-0.02
0



Nyquist Diagram
$\times 10^{-5}$
Imaginary Axis
Real Axis
$\times 10^{-3}$
5
0
-5
-10
-3.88
-3.86
-3.84
-3.82
-3.8
-3.78
-3.76
-3.74
-3.72
-3.7