Esercizi di Elettronica

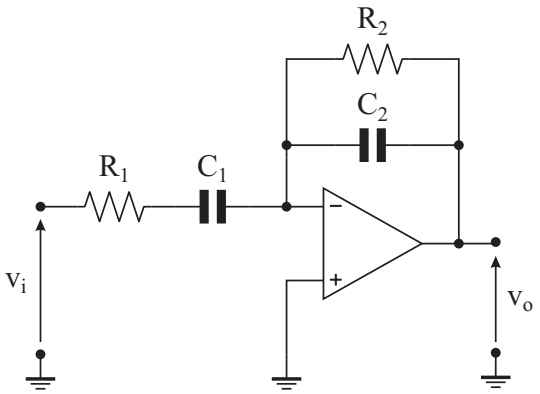
Amplificatori operazionali

Parte 2

www.die.ing.unibo.it/pers/mastri/didattica.htm

(versione del 28-5-2014)

Esercizio n. 1



$R_1 = 3\ k\Omega$
$C_1 = 50\ nF$
$R_2 = 12\ k\Omega$
$C_2 = 100\ pF$

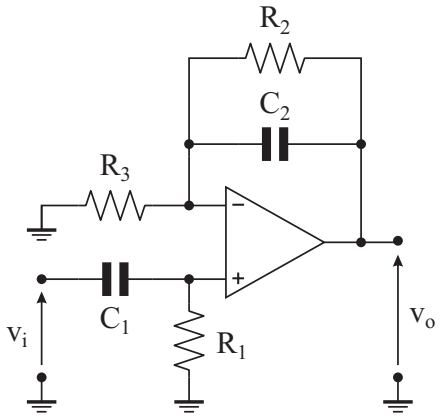
Determinare il guadagno di tensione ($\mathbf{A}_V = \mathbf{V}_o/\mathbf{V}_i$), indicare i valori delle frequenze corrispondenti ai poli e agli zeri e tracciare i diagrammi di Bode del modulo e della fase.

Risultati

$$A_V(s) = -\frac{6\cdot 10^{-4}\,s}{(1+1.5\cdot 10^{-4}\,s)(1+1.2\cdot 10^{-6}\,s)}$$

$f_z = 0$ Hz $f_{p1} = 1.061$ kHz $f_{p2} = 132.6$ kHz

Esercizio n. 2



$R_1 = 45\ k\Omega$
$C_1 = 100\ nF$
$R_2 = 450\ k\Omega$
$C_2 = 22\ pF$
$R_3 = 50\ k\Omega$

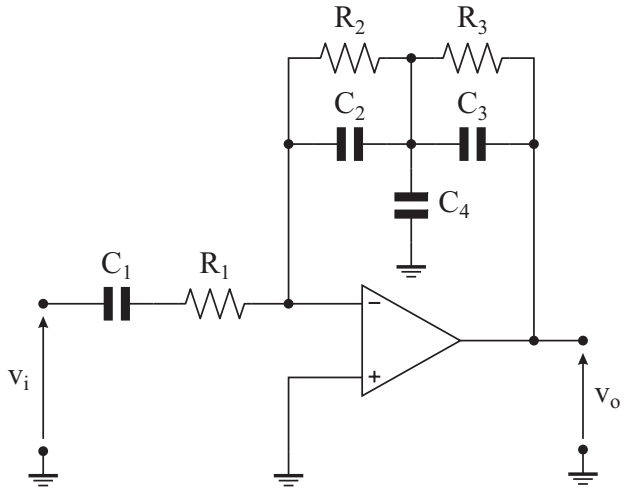
Determinare il guadagno di tensione ($\mathbf{A}_V = \mathbf{V}_o/\mathbf{V}_i$), indicare i valori delle frequenze corrispondenti ai poli e agli zeri e tracciare i diagrammi di Bode del modulo e della fase.

Risultati

$$A_V(s) = \frac{45\cdot 10^{-3}\,s(1+9.9\cdot 10^{-7}\,s)}{(1+9.9\cdot 10^{-6}\,s)(1+4.5\cdot 10^{-3}\,s)}$$

$f_{z1} = 0$ Hz $f_{z2} = 161$ k Hz $f_{p1} = 35.4$ Hz $f_{p2} = 16.1$ kHz

Esercizio n. 3



$R_1 = 10\ k\Omega$
$R_2 = 10\ k\Omega$
$R_3 = 10\ k\Omega$
$C_1 = 1\ \mu F$
$C_2 = 1\ nF$
$C_3 = 1\ nF$
$C_4 = 10\ nF$

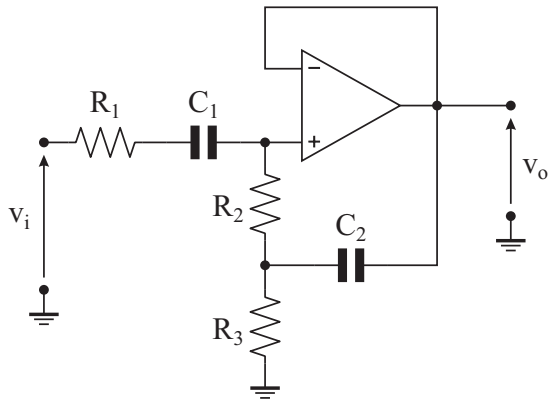
Determinare il guadagno di tensione ($\mathbf{A}_V = \mathbf{V}_o/\mathbf{V}_i$), indicare i valori delle frequenze corrispondenti ai poli e agli zeri e tracciare i diagrammi di Bode del modulo e della fase.

Risultati

$$A_V(s) = -\frac{2\cdot 10^{-2}\,s\,(1+6\cdot 10^{-5}\,s)}{(1+10^{-5}\,s)^2(1+10^{-2}\,s)}$$

$f_{z1} = 0$ Hz $f_{z2} = 2.65$k Hz $f_{p1} = 15.9$ Hz $f_{p2} = 15.9$ kHz $f_{p3} = 15.9$ kHz

Esercizio n. 4



$R_1 = 9\ k\Omega$
$R_2 = 4\ k\Omega$
$R_3 = 4\ k\Omega$
$C_1 = 100\ nF$
$C_2 = 100\ nF$

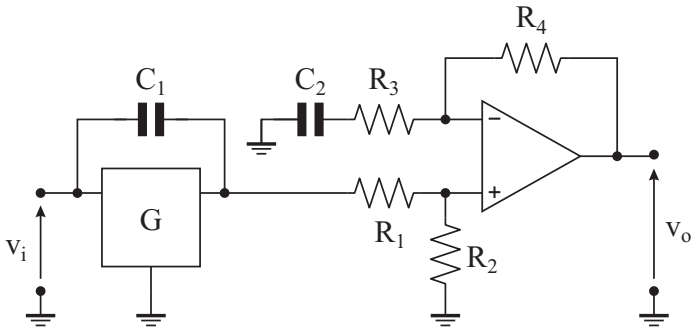
Determinare il guadagno di tensione ($\mathbf{A}_V = \mathbf{V}_o/\mathbf{V}_i$), indicare i valori delle frequenze corrispondenti ai poli e agli zeri e tracciare i diagrammi di Bode del modulo e della fase.

Risultati

$$A_V(s) = -\frac{8\cdot 10^{-4}\,s\,(1+2\cdot 10^{-4}\,s)}{(1+10^{-4}\,s)^2(1+1.6\cdot 10^{-3}\,s)}$$

$f_{z1} = 0$ Hz $f_{z2} = 796$ Hz $f_{p1} = 99.5$ Hz $f_{p2} = 1.59$ kHz

Esercizio n. 5



$R_1 = 1\ k\Omega$
$R_2 = 2\ k\Omega$
$R_3 = 1\ k\Omega$
$R_4 = 3\ k\Omega$
$C_1 = 10\ nF$
$C_2 = 1\ \mu F$

$$\mathbf{G} = \begin{bmatrix} 10^{-4} & 0 \\ 10^{-2} & 10^{-3} \end{bmatrix} \text{ S}$$

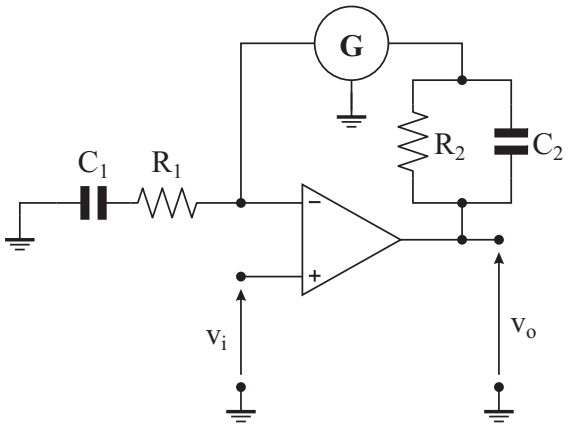
Determinare il guadagno di tensione ($\mathbf{A}_V = \mathbf{V}_o/\mathbf{V}_i$), indicare i valori delle frequenze corrispondenti ai poli e agli zeri e tracciare i diagrammi di Bode del modulo e della fase.

Risultati

$$A_V(s) = -\frac{5(1-10^{-6}\,s)(1+4\cdot10^{-3}\,s)}{(1+10^{-3}\,s)(1+7.5\cdot10^{-6}\,s)}$$

$f_{z1} = 39.8$ Hz $f_{z2} = 159$ kHz $f_{p1} = 159$ Hz $f_{p2} = 21.2$ kHz

Esercizio n. 6



$R_1 = 10\ k\Omega$
$C_1 = 300\ nF$
$R_2 = 10\ k\Omega$
$C_2 = 15\ nF$

$$\mathbf{G} = \begin{bmatrix} 10^{-4} & -10^{-4} \\ -5\cdot10^{-4} & 10^{-4} \end{bmatrix} \text{ S}$$

Determinare il guadagno di tensione ($\mathbf{A}_V = \mathbf{V}_o/\mathbf{V}_i$), indicare i valori delle frequenze corrispondenti ai poli e agli zeri e tracciare i diagrammi di Bode del modulo e della fase.

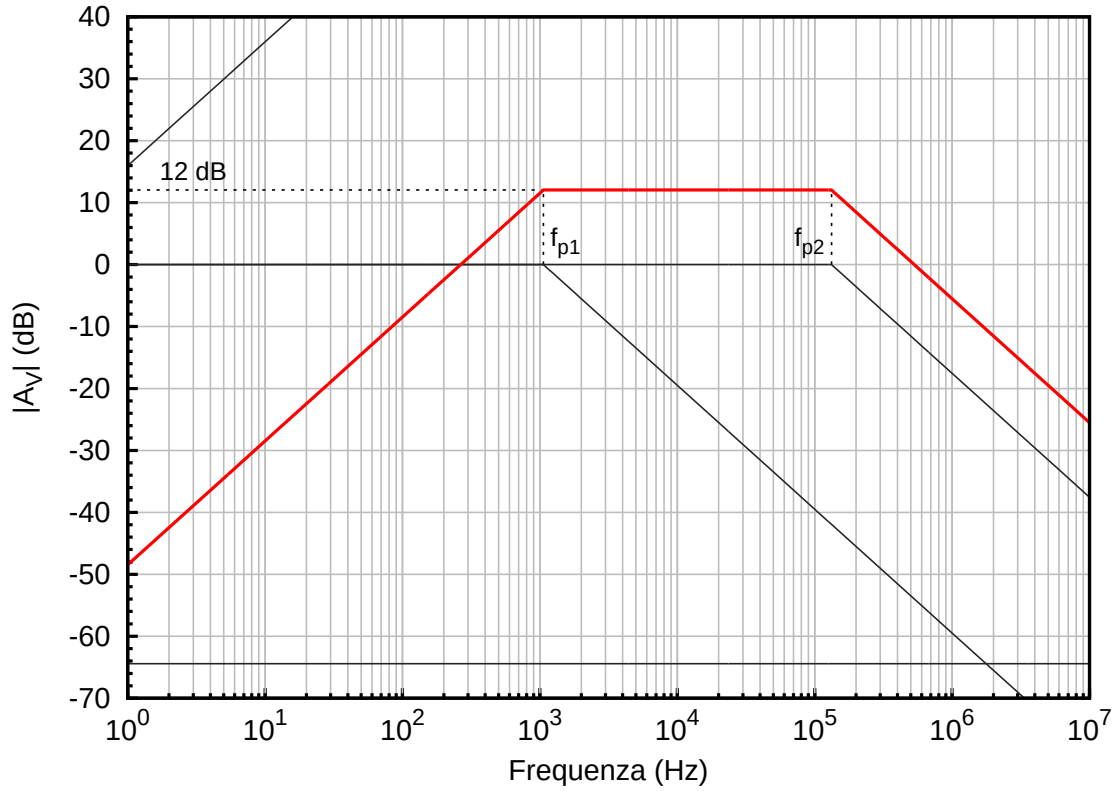
Risultati

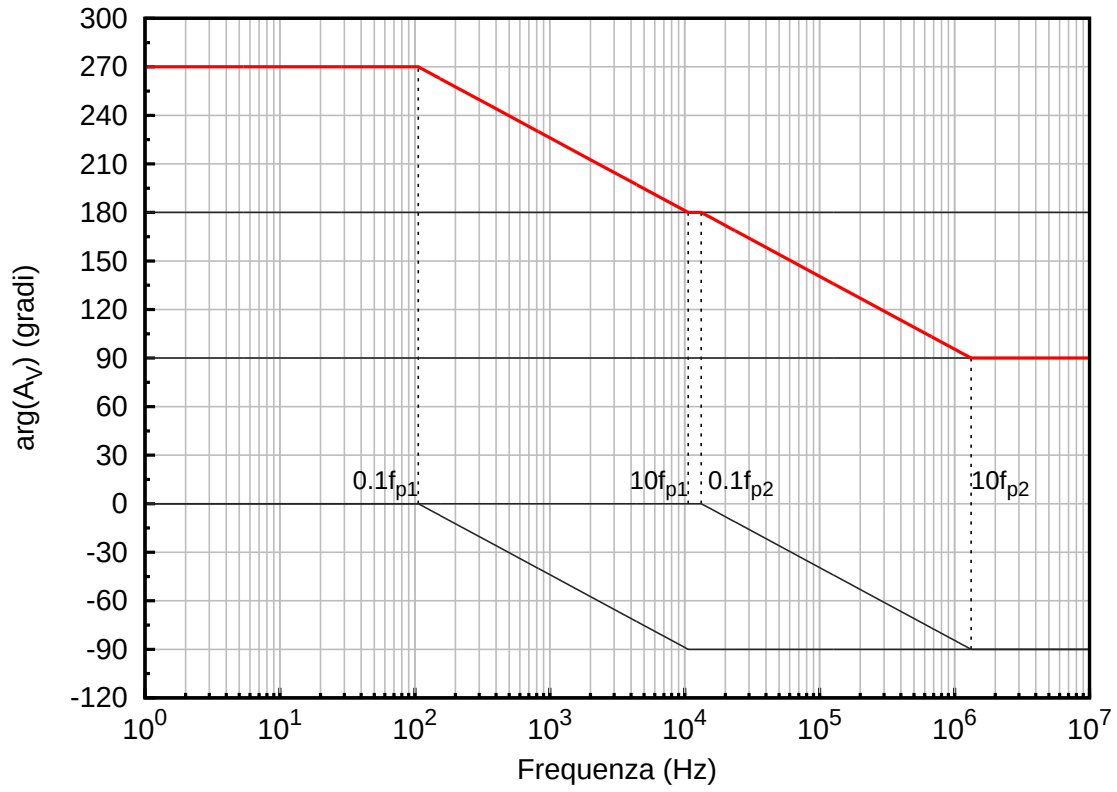
$$A_V(s) = -\frac{3(1-2.5\cdot10^{-4}\,s)(1+1.2\cdot10^{-3}\,s)}{(1+3\cdot10^{-3}\,s)(1+1.5\cdot10^{-4}\,s)}$$

$f_{z1} = 132.6$ Hz $f_{z2} = 636.6$ kHz $f_{p1} = 53.05$ Hz $f_{p2} = 1.061$ kHz

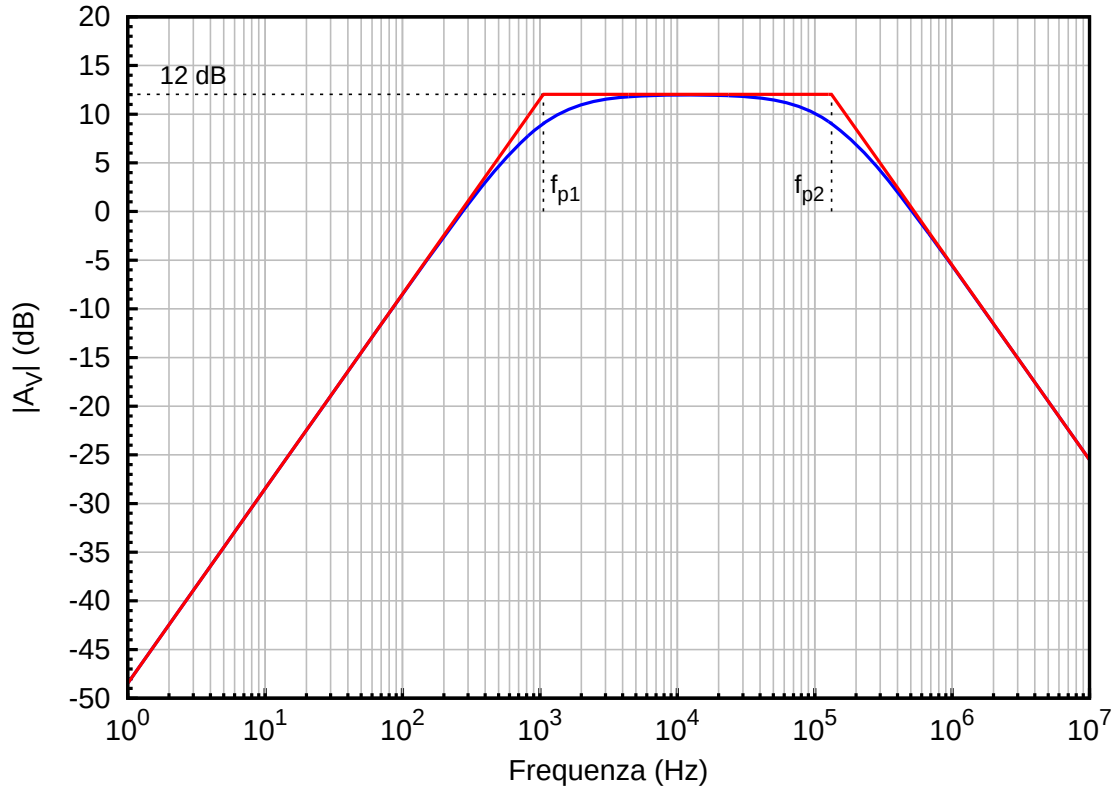
Esercizio n. 1

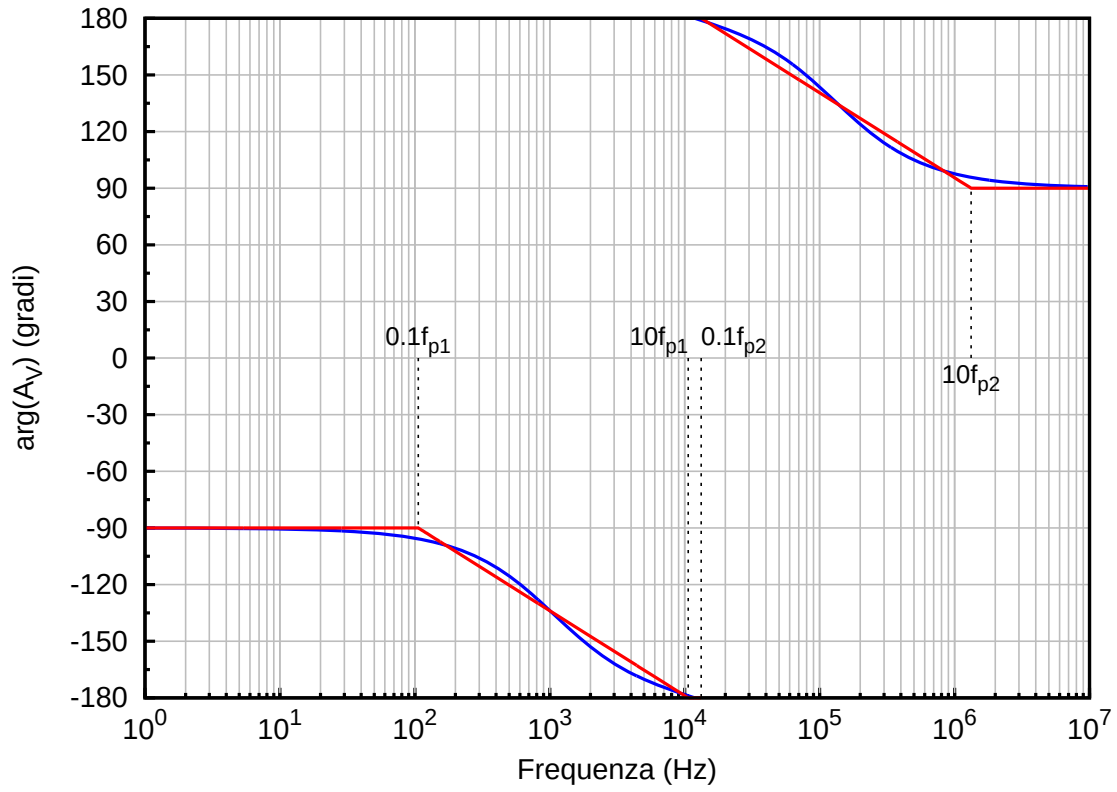
Costruzione dei diagrammi di Bode





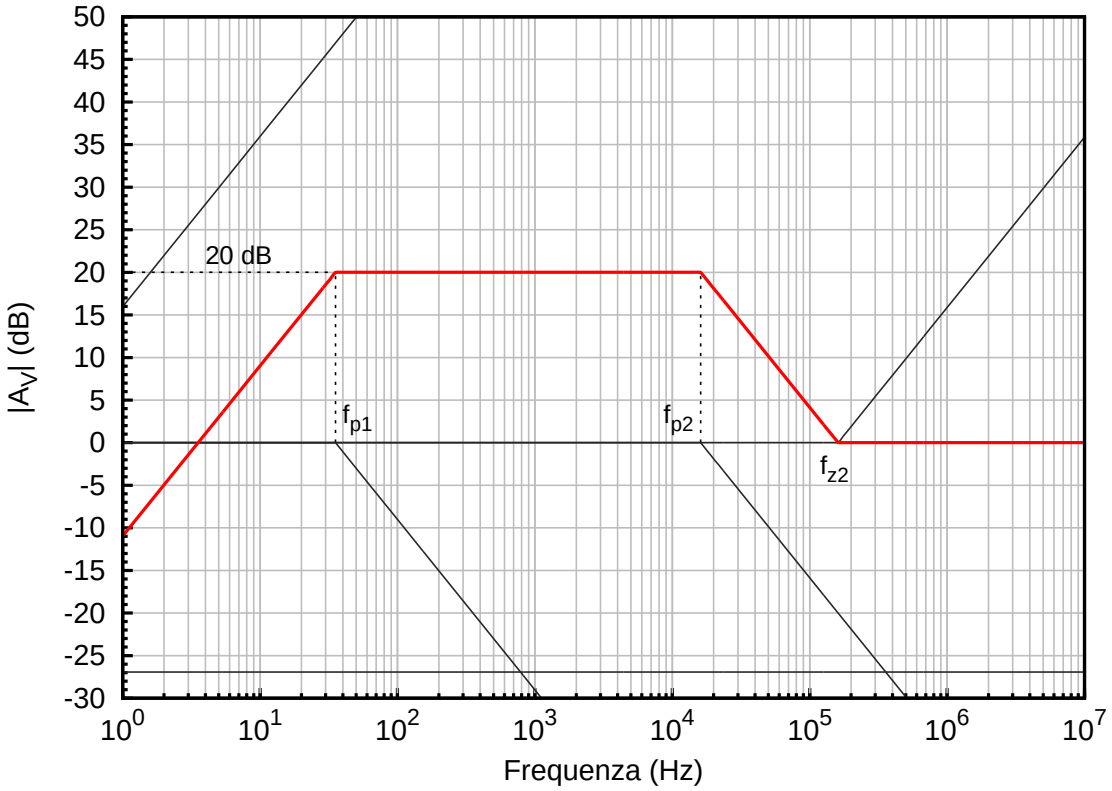
Confronto tra diagrammi asintotici e andamento reale

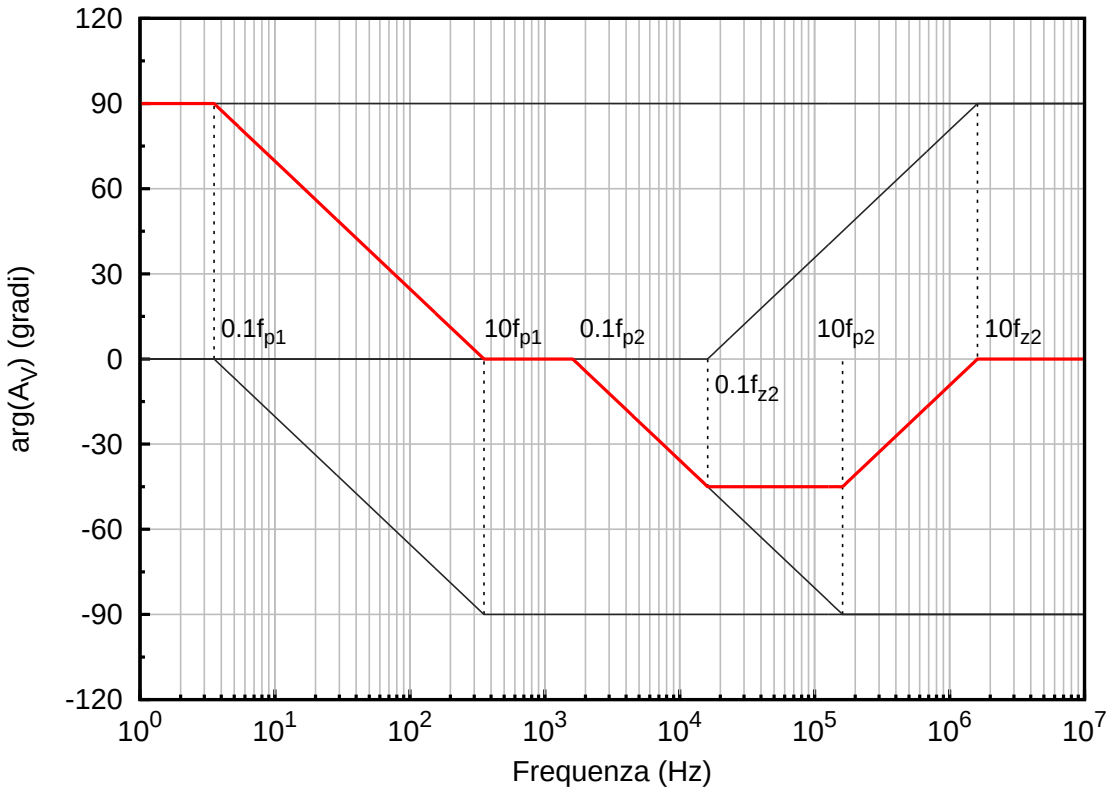




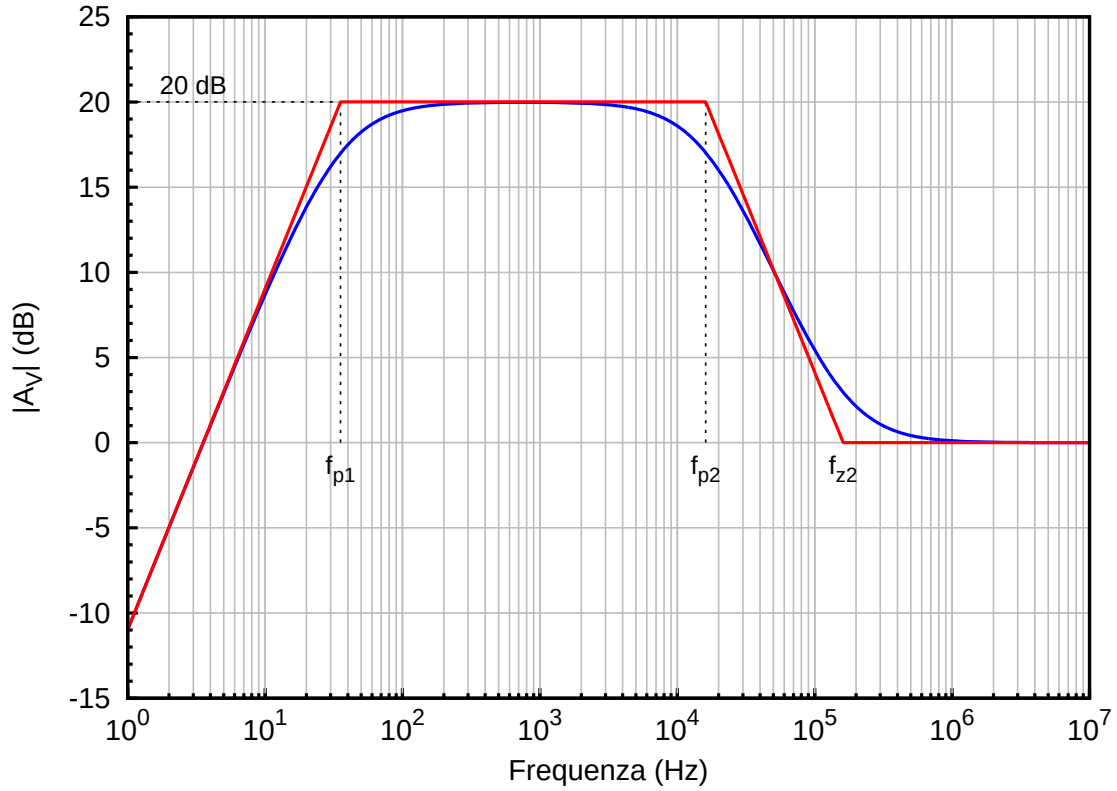
Esercizio n. 2

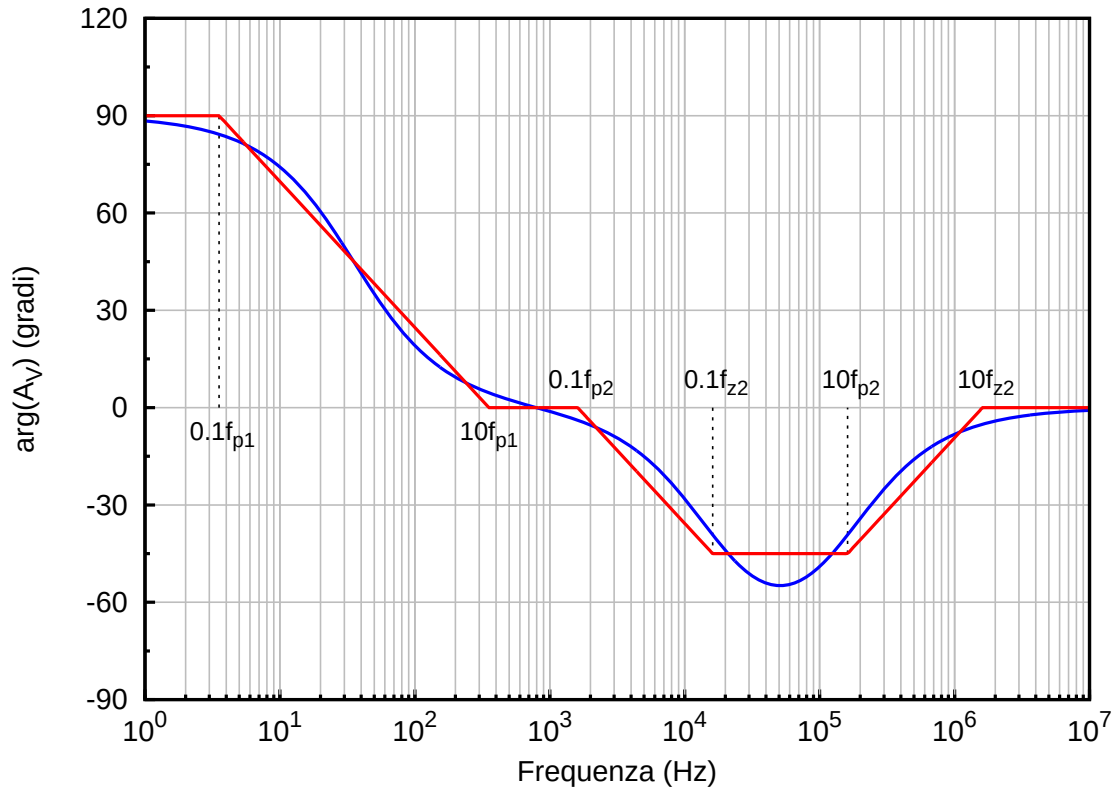
Costruzione dei diagrammi di Bode





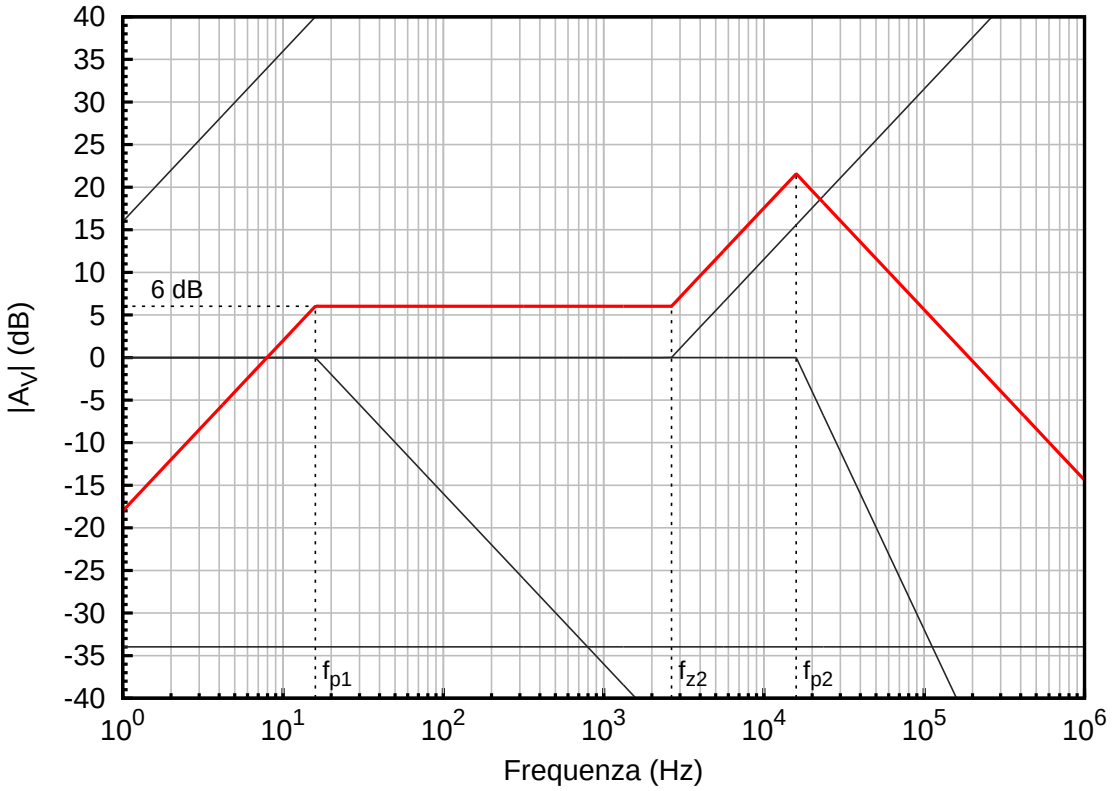
Confronto tra diagrammi asintotici e andamento reale

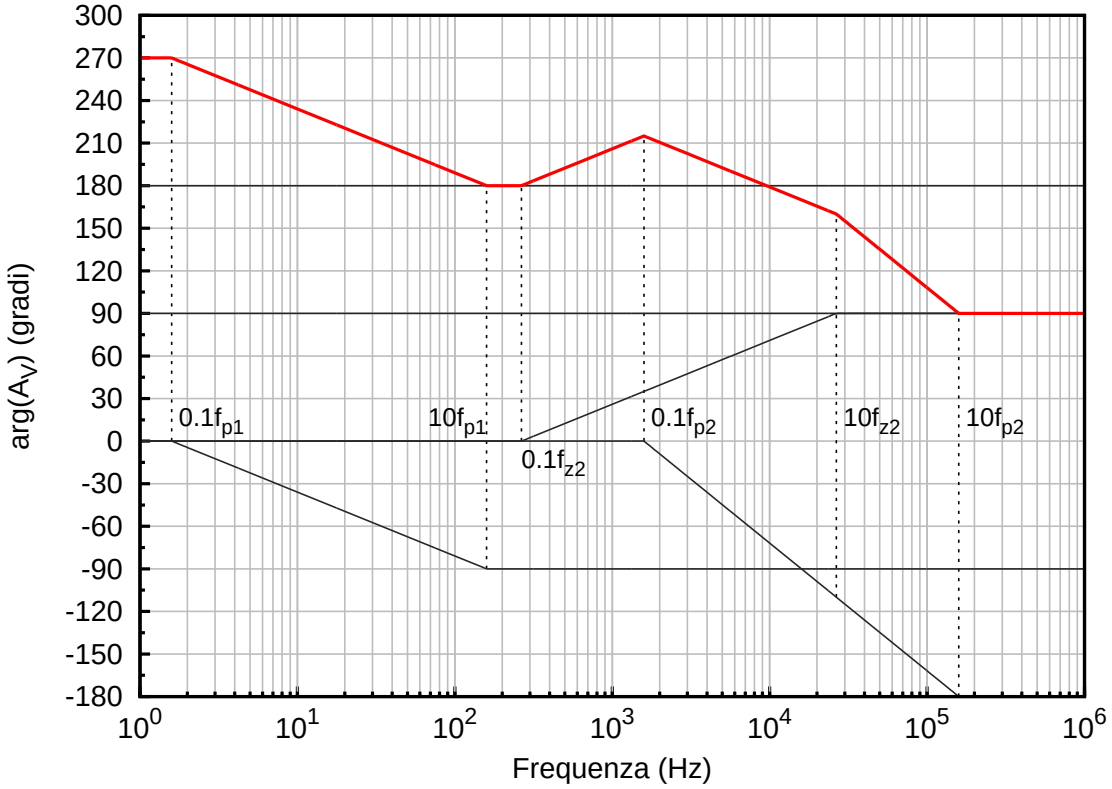




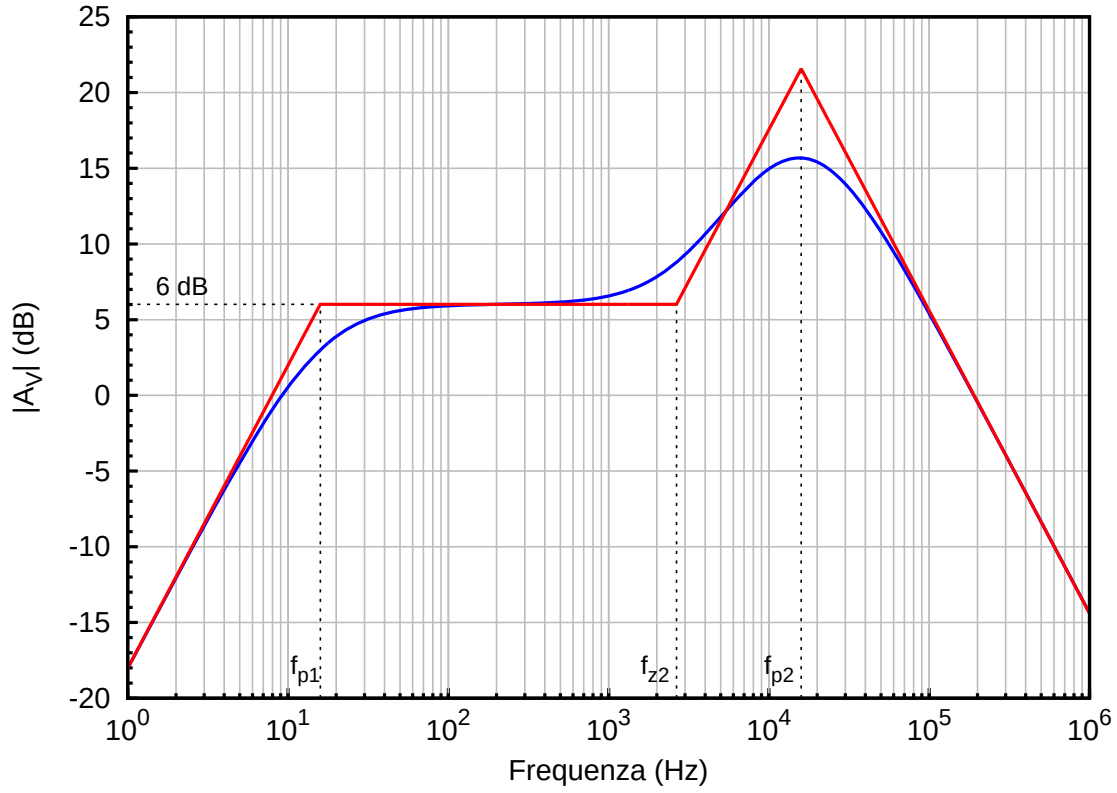
Esercizio n. 3

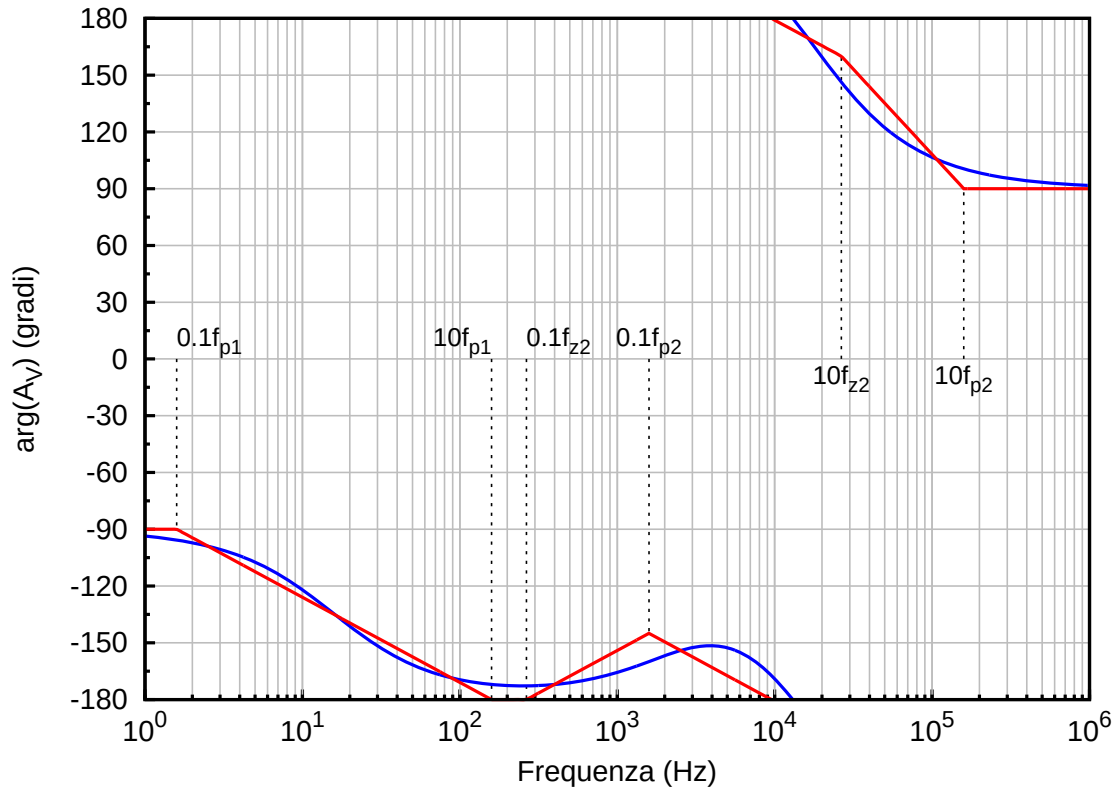
Costruzione dei diagrammi di Bode





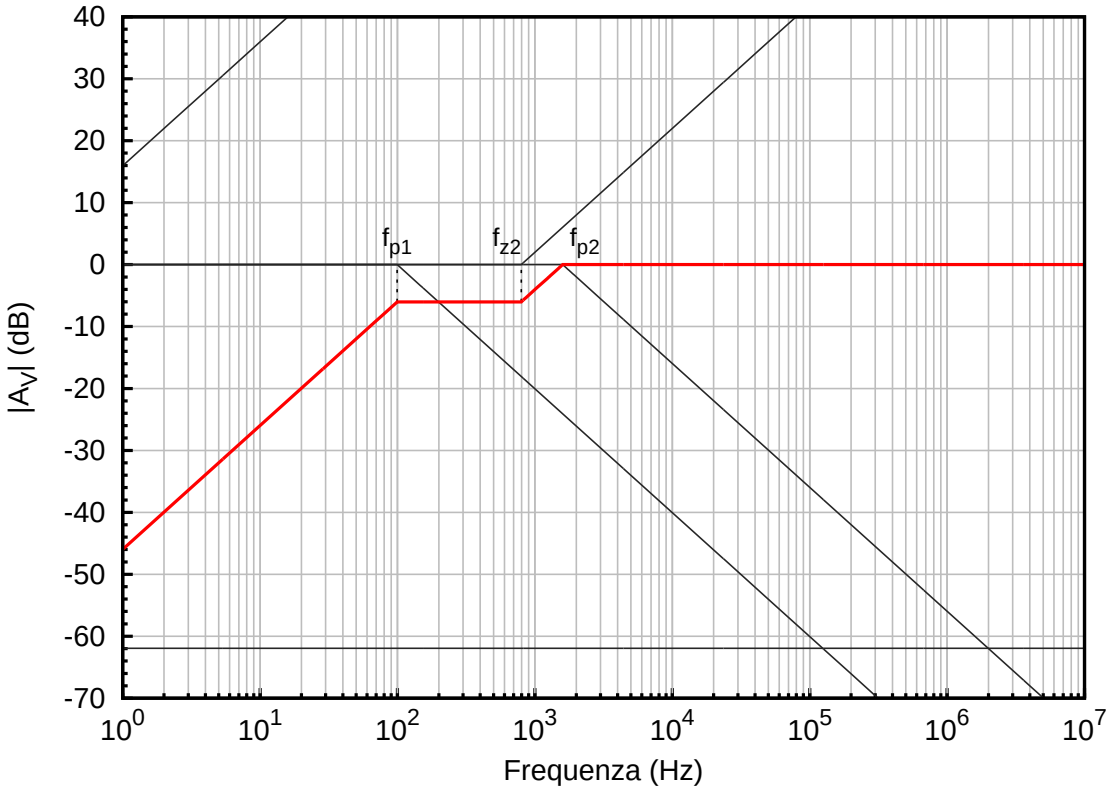
Confronto tra diagrammi asintotici e andamento reale

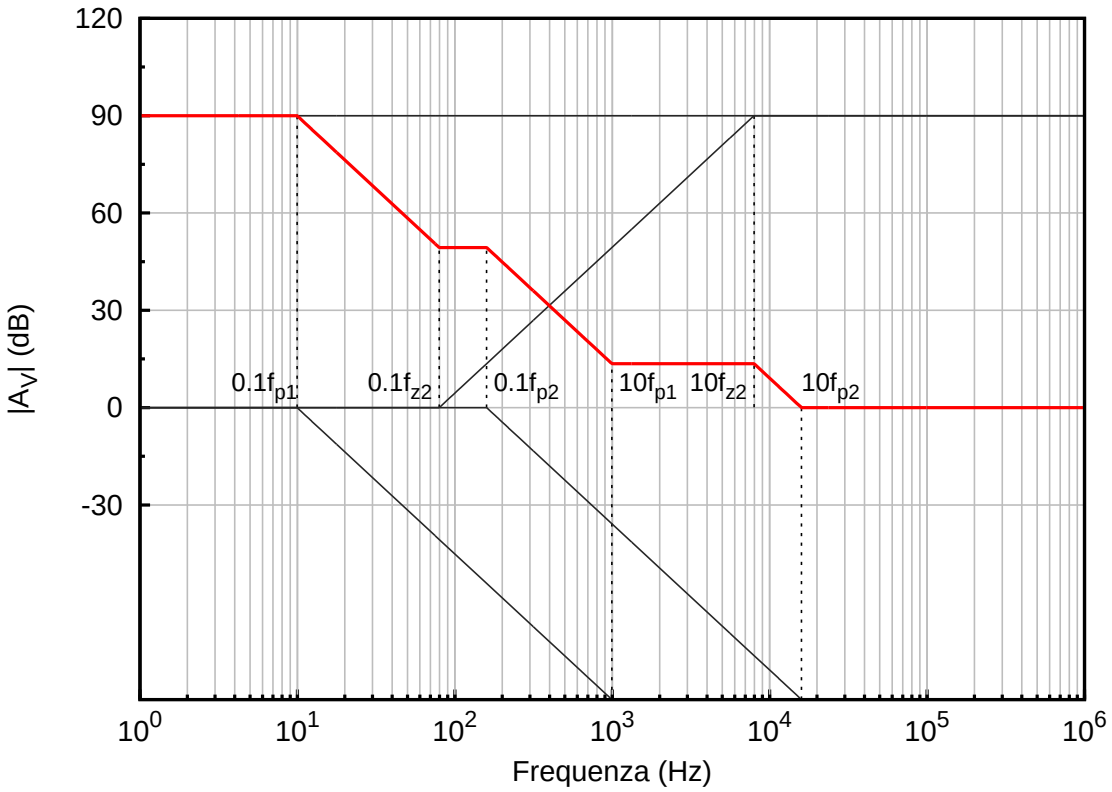




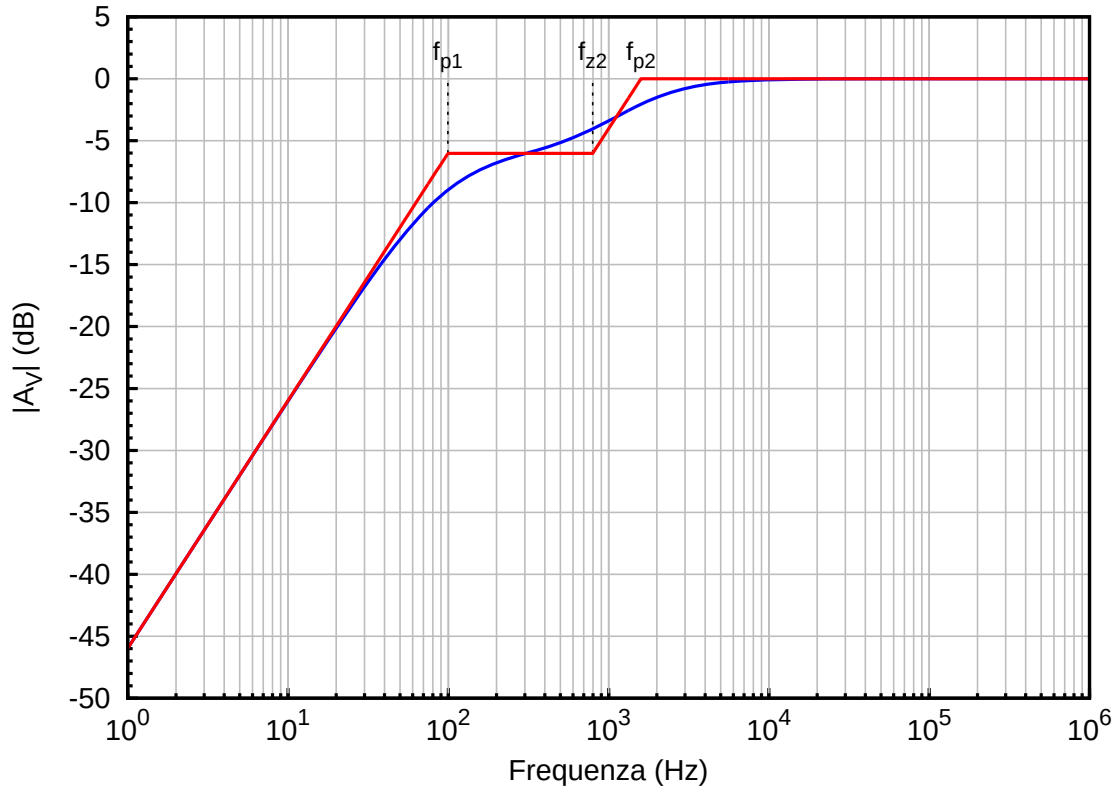
Esercizio n. 4

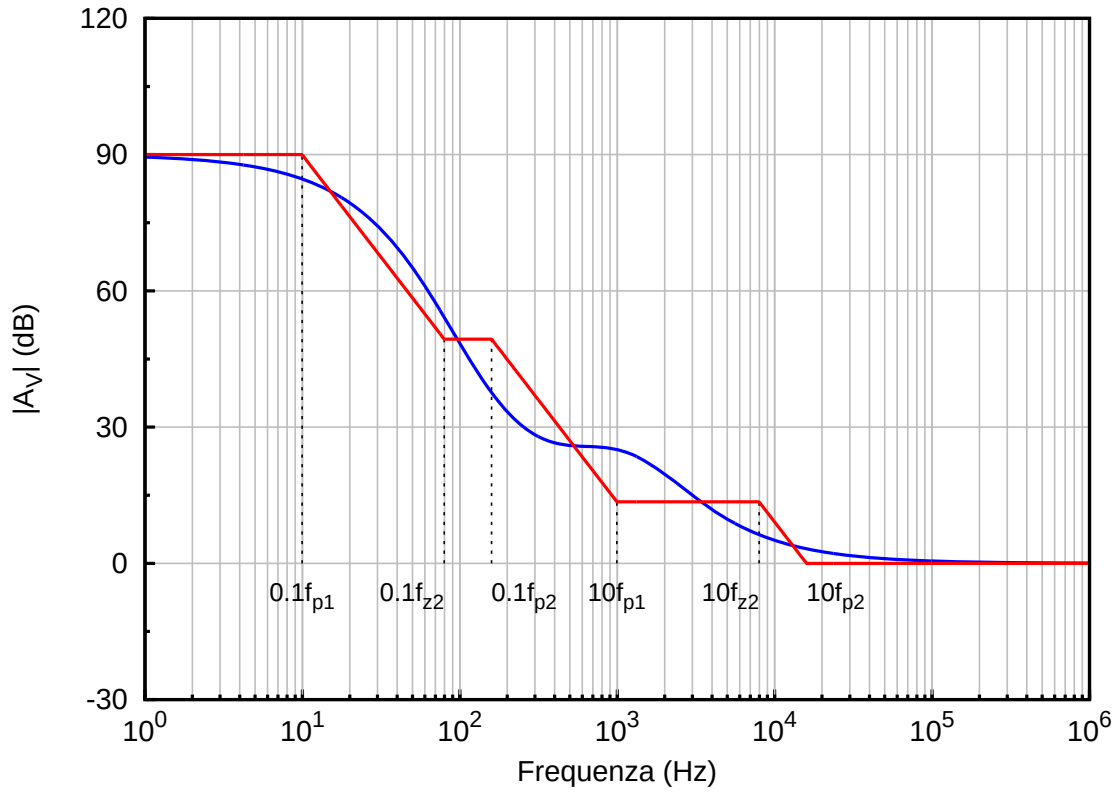
Costruzione dei diagrammi di Bode





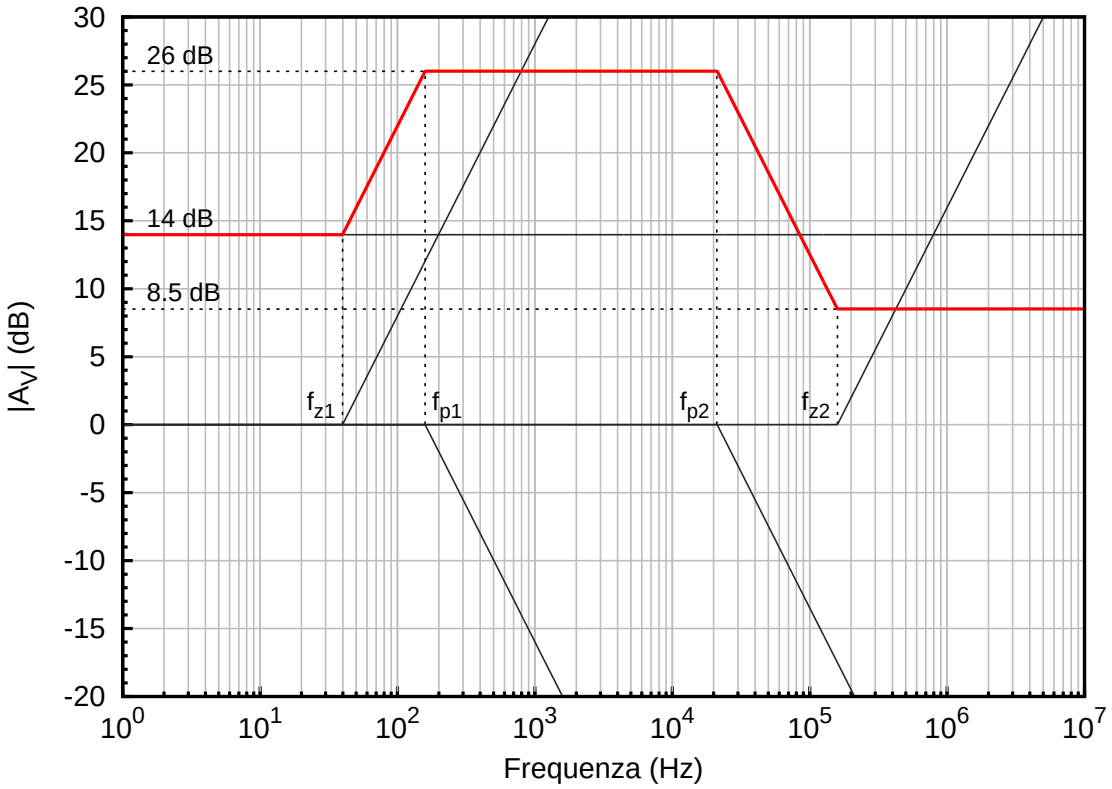
Confronto tra diagrammi asintotici e andamento reale

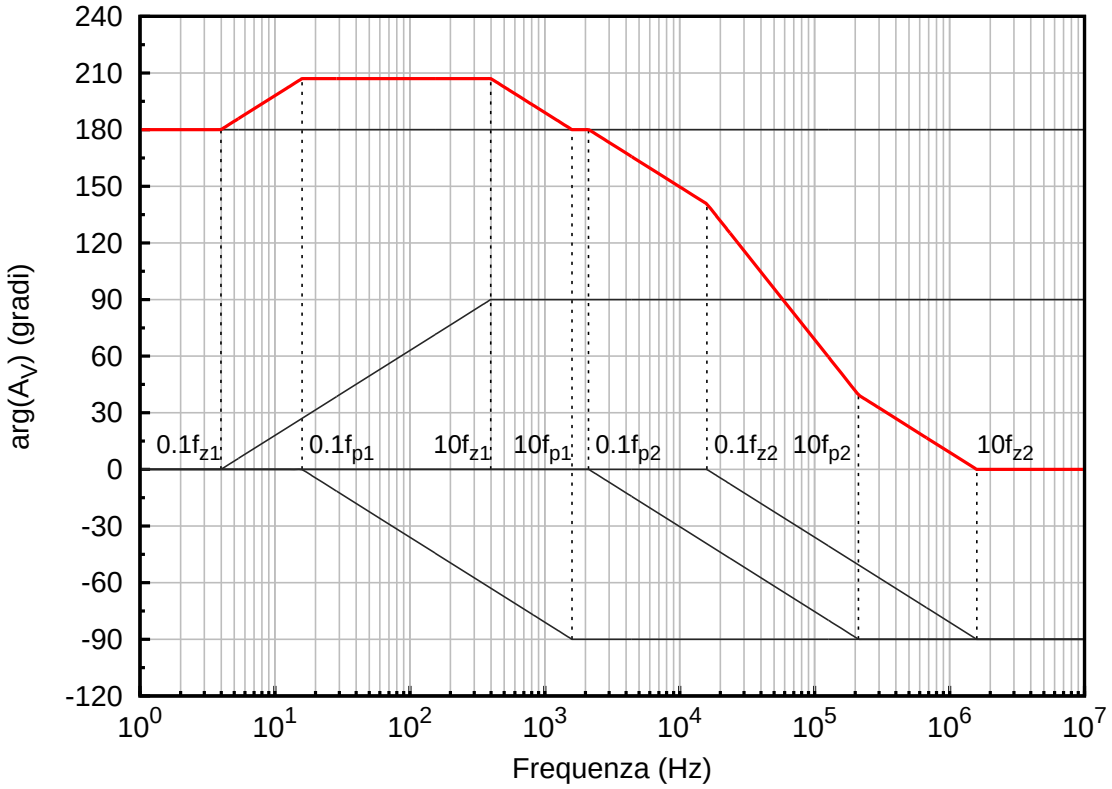




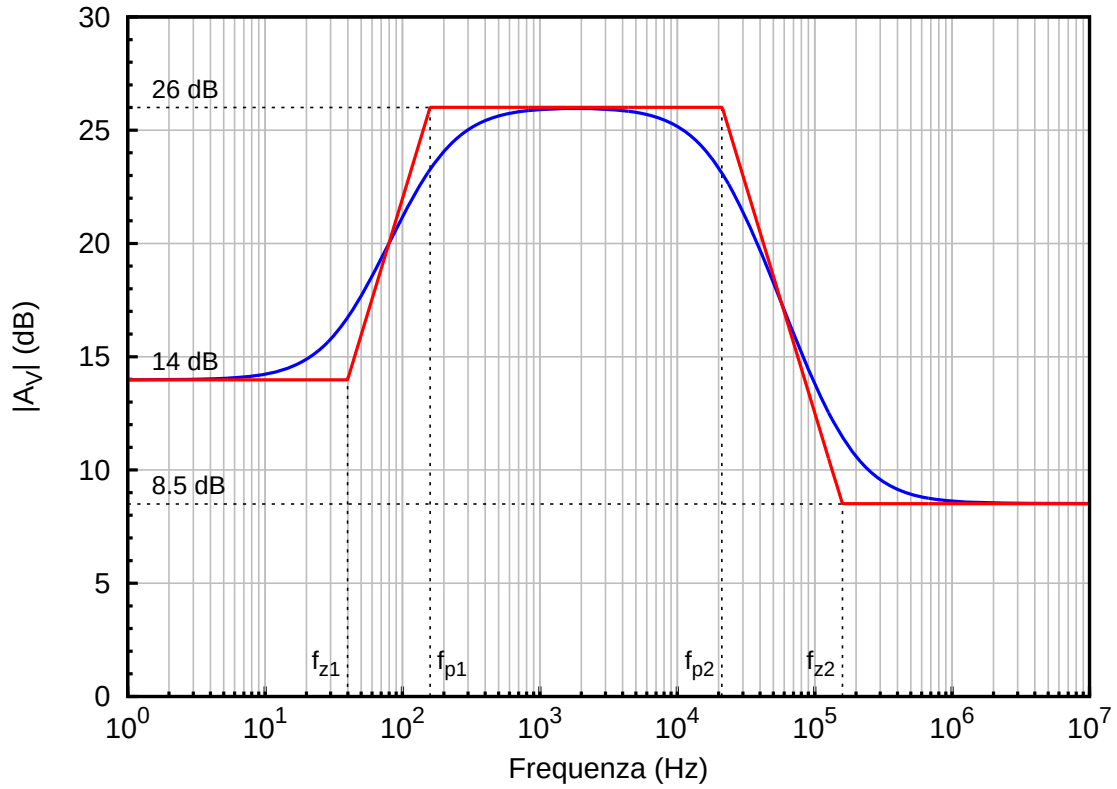
Esercizio n. 5

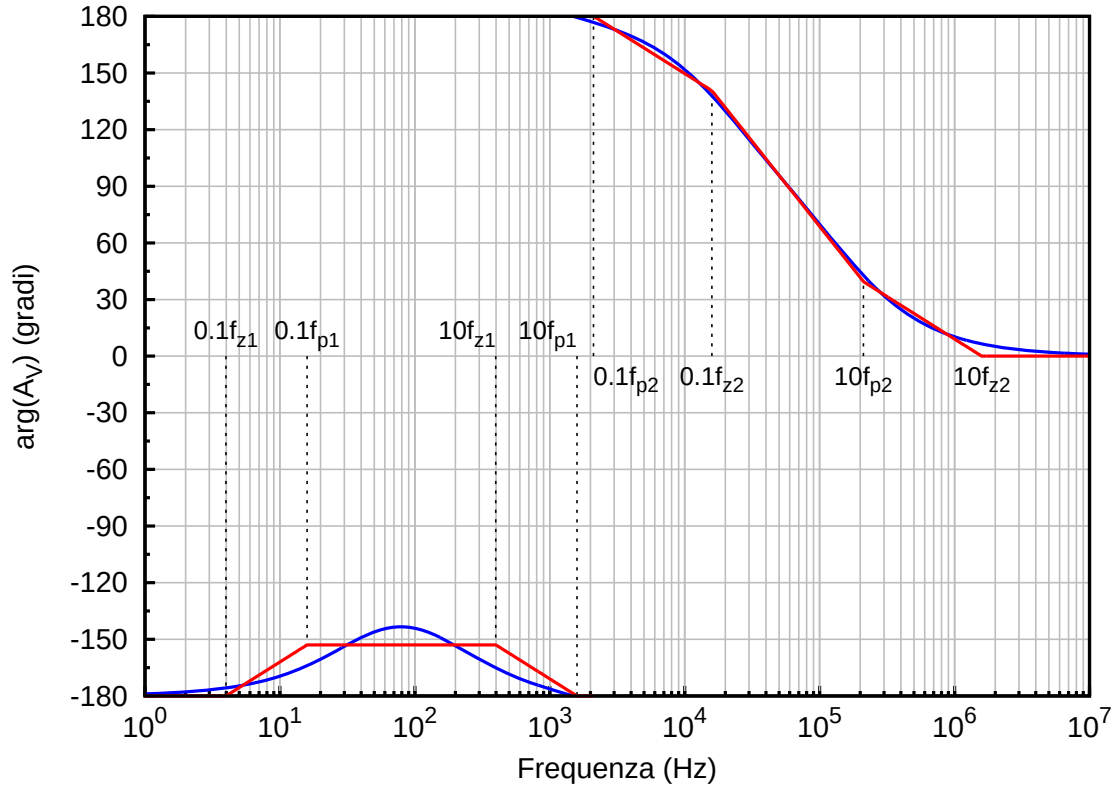
Costruzione dei diagrammi di Bode





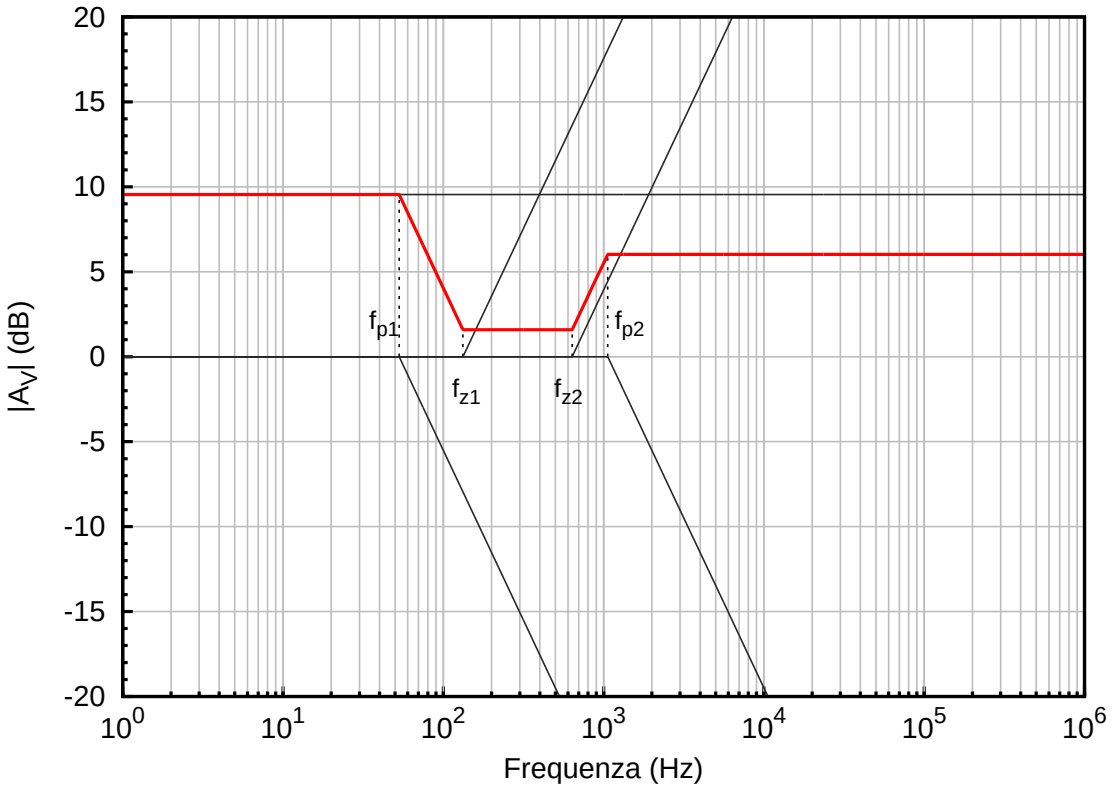
Confronto tra diagrammi asintotici e andamento reale

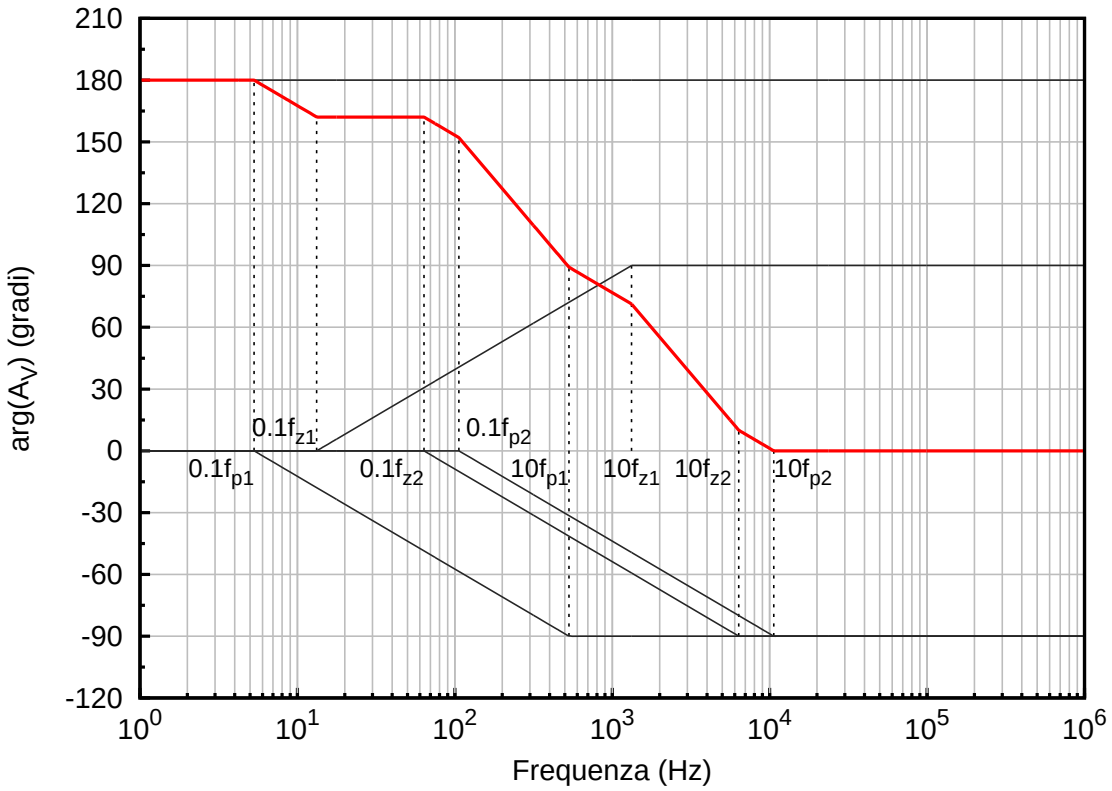




Esercizio n. 6

Costruzione dei diagrammi di Bode





Confronto tra diagrammi asintotici e andamento reale