Electronics II

Feedback

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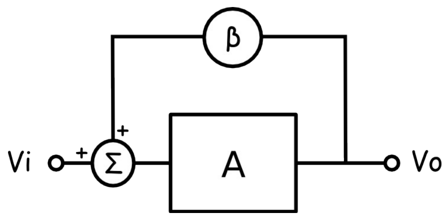

- For the (positive) feedback system of Figure 1, determine the relation between V_i and V_o.

$$A_f = \frac{A}{(1 - A\beta)}$$

- Fill out the table below with gain values $A_f \equiv V_o/V_i$ for combinations A-β.

β \ A	∞	10^5	10^4	1000	100	10	1
−1	1	1	1	1	0.99	0.91	0.05
−0.1	10	10	9.99	9.9	9.09	5	0.91
−0.01	100	99.9	99.01	90.91	50	9.09	0.99
-10^{-3}	10^3	990.1	909.09	500	90.91	9.9	1
-10^{-4}	10^4	9090.91	5000	909.09	99.01	9.99	1
0	∞	10^5	10^4	1000	100	10	1
+0.1	−10	−10	−10.01	−10.1	−11.11	∞	1.11
+1	−1	−1	−1	−1	−1.01	−1.11	∞

- For an open-loop gain, $A = 10^5$ with a variation (tolerance) of 5%. Calculate the variation of closed-loop gain for the following betas:

β = 0	β = −0.001	β = −0.01	β = −0.1	β = −1
5%	0.0495%	0.005%	0.0005%	0.00005%

- The amplifier A ($A = 10^5$) has a single pole at 10 Hz. Determine the bandwidth of the circuit with feedback of $\beta = -10^{-3}$.

The gain-bandwidth product is constant. Without feedback A_v x Δf = 10^5 x 10 Hz = 1 MHz. With feedback of $\beta = -10^{-3}$, the gain becomes (see the table above) 990.1. The bandwidth therefore is Δf = 1 MHz/ 990.1 = 1.01 kHz. Another way of calculating is: $\Delta f = \Delta f_0\,(1 - A\beta)$ = 10 Hz x (1 + 10^5 x 10^3) = 1010 Hz.