FSK MODEM MODEL

CIRCUIT BLOCK DIAGRAM 3/12/99

WE WANT THE TRANSFER FUNCTION OF THE MODEM:

\[ H(s) = \frac{V_{or}(s)}{T_x(s)} \]

THE SYSTEM \( H(s) \) IS LINEAR IF THE PLL IS ALWAYS LOCKED.

MODEL

\[ \omega_i = 2\pi f_i \quad , \quad \omega_i = \frac{\Delta f_i}{\Delta T_x} \]

MODEL

\[ T_x(s) \rightarrow 2\pi K_{0T} \rightarrow \omega_i(s) \rightarrow \frac{1}{s} \rightarrow \phi_i(s) \rightarrow K_D = \frac{V_{dd}}{\pi} \rightarrow U_D(s) \rightarrow F(s) \rightarrow V_{or}(s) \]

\[ \phi_i = \omega_i t + \phi_0 \rightarrow \omega_i = \frac{d\phi_i}{dt} \]

\[ \phi_i(s) = \left(\frac{1}{s}\right)\omega_i(s) \]
Now, solve the model

\[ \phi_i(s) = \left( \frac{2\pi K_{oi}}{s} \right) T_x(s) \]

\[ U_{ir}(s) = F(s) U_{\phi}(s) \]

\[ U_{\phi}(s) = K_D (\phi_i(s) - \phi_{osc}(s)) \]

\[ U_{\phi}(s) = K_D \left( \phi_i(s) - \left( \frac{2\pi K_{or}}{s} \right) U_{ir}(s) \right) \]

\[ U_{ir}(s) = F(s) K_D \left[ \left( \frac{2\pi K_{oi}}{s} \right) T_x(s) - \left( \frac{2\pi K_{or}}{s} \right) U_{ir}(s) \right] \]

\[ H(s) = \frac{U_{ir}(s)}{T_x(s)} = \frac{K_{oi}}{K_{or}} \left( \frac{1}{1 + \frac{s}{\omega_p}} \right) \]

\[ \text{for} \quad F(s) = \frac{1}{1 + \frac{s}{\omega_p}} \]

\[ \therefore \text{The FSK modem is a 2nd Order Dynamic System} \]

Let's look at the step response:

\[ T_x(t) \]

\[ \Delta V \]

\[ \Delta V \left( \frac{K_{oi}}{K_{or}} \right) \text{ since } H(s) \bigg|_{s=0} = \frac{K_{oi}}{K_{or}} \]
THE TRANSFER FUNCTION CAN BE WRITTEN AS

$$H(s) = \frac{K_{0T}}{K_{0R}} \left( 1 + \frac{s}{Q \omega_0} + \left(\frac{s}{\omega_c}\right)^2 \right)^{-1}$$

WHERE

$$\omega = \sqrt{\omega_p^2 - 2\pi K_D K_{0R}}$$

$$Q = \sqrt{\frac{K_{0R} K_D}{f_p}}$$

A LARGE Q RESULTS IN AN UNDERDAMPED RESPONSE (NOT GOOD)

$$f < \frac{1}{2}$$ RESULTS IN NO OVERSHEET OR RINGING

Q GOES UP: (BAD)

TRY TO USE THIS RESULT IN YOUR DESIGN!