note: Tc is in Material properties

```
function [Det] = TES_Dynamics_Simple(Det);
% Let's calculate the TES bias point characteristics:
%
% Assumptions:
% 1) beta = 0;
% 2) L -> 0 ... L/R << tau_etf
%
% Calculated:
% 1) Tbias -> bias temperature
% 2) alpha
% 3) C -> total TES heat capacity
% 4) Gep -> TES electron/phonon coupling
% 5) tau_etf -> TES fall time
% 6) w_etf -> TES bandwidth
%
% 12/9/13 MCP
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%

%\\\\\\\\\\\\ Physical Constants and Invariant Characteristics \\\\\\\\\\\\\\
pc=PhysicalConstants();

%------- Bias Point Temperature ------------------------------------
zeta_bias= log(Det.TES.fOp/(1-Det.TES.fOp))/2;

%Test Design
```

```
Det.TES.Tbias = zeta_bias * Det.TES.wTc + Det.TES.Tc; %K

%------- Alpha/Beta/Loop Gain ------------------------------------------------
% let's calculate bias location along the normalized transition curve

%let's also calculate alpha
Det.TES.alpha= 2.*Det.TES.Tbias/Det.TES.wTc ./ exp(zeta_bias) ./ (exp(zeta_bias)+exp(-zeta_bias));
Det.TES.beta = 0.1;

%and the loop gain
Det.TES.LG= Det.TES.alpha/Det.TES.nPep*(1- (Det.fridge.T_MC/Det.TES.Tbias).^Det.TES.nPep);
if Det.TES.LG<0
Det.TES.LG=0;
end

%------ Tau0 Calculation ------------------------------------------------
%Let's calculate the thermal conductivity for the e/p system when there is
%no voltage bias

Det.TES.C = (Det.TES.fCsn*Det.TES.gC_v.* Det.TES.Tbias)*(Det.TES.vol); %J/K
Det.TES.Gep = Det.TES.nPep*Det.TES.gPep_v*(Det.TES.vol).* Det.TES.Tbias.^(Det.TES.nPep-1); %W/K
Det.TES.Po = Det.TES.gPep_v*(Det.TES.vol).* (Det.TES.Tbias.^(Det.TES.nPep)-
Det.fridge.T_MC.^(Det.TES.nPep)); %W
Det.TES.Io = sqrt(Det.TES.Po/Det.TES.Ro);%[A]
Det.TES.tau0= Det.TES.C./Det.TES.Gep; %[s]

%------ Sensor Bandwidth ------------------------------------------------
%Let's calculate the sensor bandwidth
Det.TES.tau_etf= Det.TES.tau0./(1+Det.TES.LG.*(1-Det.elec.Rl./Det.TES.Ro)./(1+Det.TES.beta+Det.elec.Rl./
Det.TES.Ro));
Det.TES.w_etf= 1./Det.TES.tau_etf;
```

$G = K$

$\alpha \frac{T_{bias}^{n_p} - T_{MC}^{n_p}}{n_p T_{bias}^{n_p}} = \frac{\alpha P_0}{G T_{bias}}$

missing $(1+\beta+R_L/R_0)$

$\tau_{eff} = \tau_0 \frac{(1+\beta+R_L/R_0)}{\ldots}$

$$1 + \mathcal{L}\left(1 - \frac{R_L}{R_0}\right)$$

$$= \tau_0 \frac{R_L + R_0(1+\beta)}{(1+\mathcal{L})R_0 - R_L \mathcal{L}}$$

$$\tau_{eff} = \tau \cdot \frac{\{R_L + (1+\beta)R_0\}}{(1-\mathcal{L}_i)R_L + (1+\beta+\mathcal{L}_i)R_0} \neq$$

missing a β

missing R_L

not important for large $\mathcal{L}$ but could be important

due to threshold

22
10

$\mathcal{L} = 2$

$R_L = 0.3 R_0$

$\beta = 0$

$(1+2) - 0.3 \times 2 = 2.4$

$- 0.3 + 3 = 2.7$

$\frac{3}{24} = \underline{12\%}$