4.2) (a) THE GAIN-CIRCLES ARE THE CONSTANT-GAIN G_A CIRCLES.

FROM FIG. P.2(a): $F_{min} = 3.3$ dB, $\Gamma_{opt} \approx 0.56\angle -155^\circ$.

r_n IS EVALUATED BY READING A VALUE OF F AND ITS ASSOCIATED Γ_s, AND USING (4.3.4). FROM FIG. P.2(a) WE READ:

$F = 4.5$ dB AT $\Gamma_s \approx 0.56\angle -94^\circ$. THEN

$$10^{0.45} = 10^{0.33} + \frac{4 r_n \left|0.56\angle -94^\circ - 0.56\angle -155^\circ\right|^2}{(1-(0.56)^2)\left|1+0.56\angle -155^\circ\right|^2} \Rightarrow r_n = 0.108$$

FROM FIG. P.2(b): $F_{min} = 1.7$ dB, $\Gamma_{opt} \approx 0.215\angle 149^\circ$.

USING: $F = 3$ dB AT $\Gamma_s = 0.445\angle 26^\circ$ WE OBTAIN $r_n = 0.202$

(b) FOR THE $G_A = 10.7$ dB CIRCLE IN FIG. 4.3.4:

$g_a = 4.158$, $C_a = 0.574\angle -154^\circ$, $r_a = 0.423$

4.4) (a) $K = 2.25$ AND $\Delta = 0.246\angle 112.8^\circ$ ∴ UNCONDITIONALLY STABLE

(b) $G_{A,max} = \frac{|S_{21}|}{|S_{12}|}\left(K - \sqrt{K^2-1}\right) = 9.36$ OR 9.71 dB

(c) $G_A = 9.71 - 3 = 6.71$ dB

FOR THE $G_A = 6.71$ dB CIRCLE: $g_a = 1.173$,

$C_a = 0.42\angle 174.5^\circ$, $r_a = 0.515$

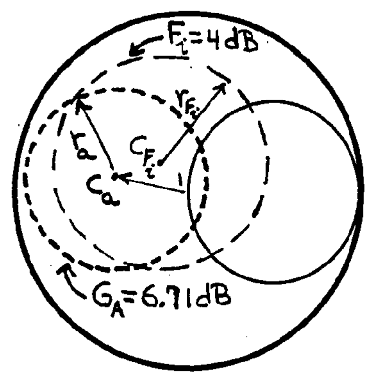
(d) FOR THE 3 dB NOISE CIRCLE:

$C_{F_i} = 0.405\angle 145^\circ$, $r_{F_i} = 0.388$

FOR THE 4 dB NOISE CIRCLES:

$C_{F_i} = 0.279\angle 145^\circ$, $r_{F_i} = 0.616$

THE $F_i = 4$ dB CIRCLE IS DRAWN ON THE SMITH CHART.



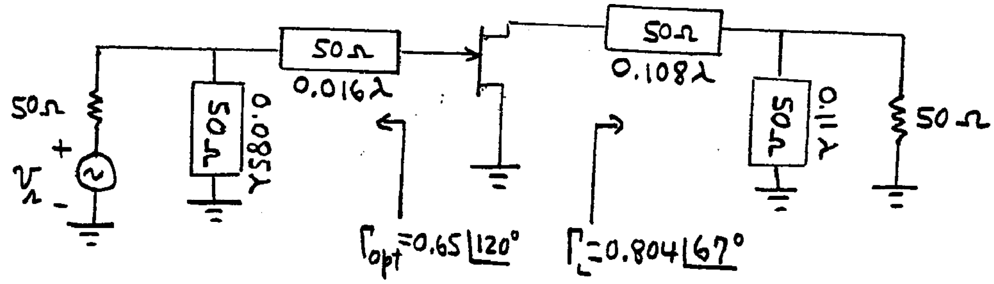
Γ_s PLANE

(e) FOR $G_{A,max}$: $\Gamma_s = \Gamma_{Ms} = 0.667\angle 174.5^\circ$, $\Gamma_L = \Gamma_{ML} = 0.587\angle 102.2^\circ$.

$$\therefore F = 10^{0.25} + \frac{4\left(\frac{5}{50}\right)\left|0.667\angle 174.5^\circ - 0.5\angle 145^\circ\right|^2}{(1-(0.667)^2)\left|1+0.5\angle 145^\circ\right|^2} = 1.97 \text{ OR } 2.95 \text{ dB}$$

4.6) $K = 2.18$, $\Delta = 0.555\angle{-178.3^\circ}$ ∴ UNCONDITIONALLY STABLE

DESIGN WITH $\Gamma_s = \Gamma_{opt} = 0.65\angle{120^\circ}$ AND $\Gamma_L = \Gamma_{OUT}^* = 0.804\angle{67^\circ}$



$G_A = G_T = 75.6$ OR 18.8 dB

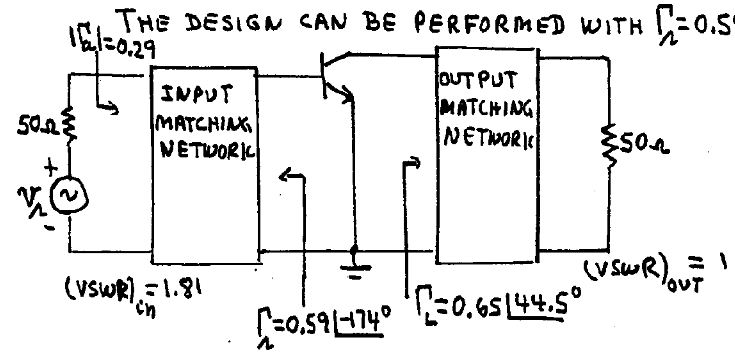
ALSO: $\Gamma_{IN} = 0.806\angle{-119.6^\circ}$, $|\Gamma_a| = 0.327$, $(VSWR)_{in} = 1.97$, $(VSWR)_{OUT} = 1$

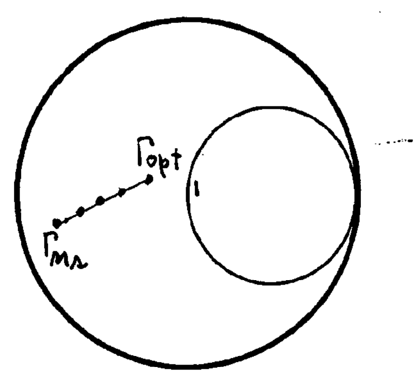
4.7) $K = 1.235$, $\Delta = 0.175\angle{166.2^\circ}$ ∴ UNCONDITIONALLY STABLE

$G_{A,max} = 43.07$ OR 16.3 dB, $\Gamma_{Ms} = 0.787\angle{-170.1^\circ}$, $\Gamma_{ML} = 0.749\angle{44.8^\circ}$

Γ_s	$\Gamma_L = \Gamma_{OUT}^*$	Γ_{IN}	$\lvert\Gamma_a\rvert$	$(VSWR)_{in}$	G_A(dB)	F(dB)
$0.2\angle{155^\circ}$	$0.528\angle{41.7^\circ}$	$0.704\angle{170.8^\circ}$	0.62	4.27	13.75	1.6
$0.32\angle{172^\circ}$	$0.559\angle{42.9^\circ}$	$0.715\angle{170.8^\circ}$	0.535	3.30	14.5	1.66
$0.43\angle{180^\circ}$	$0.592\angle{43.7^\circ}$	$0.726\angle{170.7^\circ}$	0.446	2.61	15.1	1.82
$0.59\angle{-174^\circ}$	$0.650\angle{44.5^\circ}$	$0.747\angle{170.6^\circ}$	0.290	1.81	15.8	2.30
$0.787\angle{-170.1^\circ}$	$0.749\angle{44.8^\circ}$	$0.787\angle{170.1^\circ}$	0	1	16.3	3.76

THE DESIGN CAN BE PERFORMED WITH $\Gamma_s = 0.59\angle{-174^\circ}$ AND $\Gamma_L = 0.65\angle{44.5^\circ}$.





$G_A = 15.8$ dB

$F = 2.3$ dB

4.10) TRANSISTOR #1: $K = 0.869$, $\Delta = 0.348 \angle -39.2^\circ$ $\therefore$ POTENTIALLY UNSTABLE

$G_{MSG} = 44$ OR $16.4\,dB$.

INPUT STABILITY CIRCLE: $C_s = 16.75 \angle -37.3^\circ$, $r_s = 17.61$

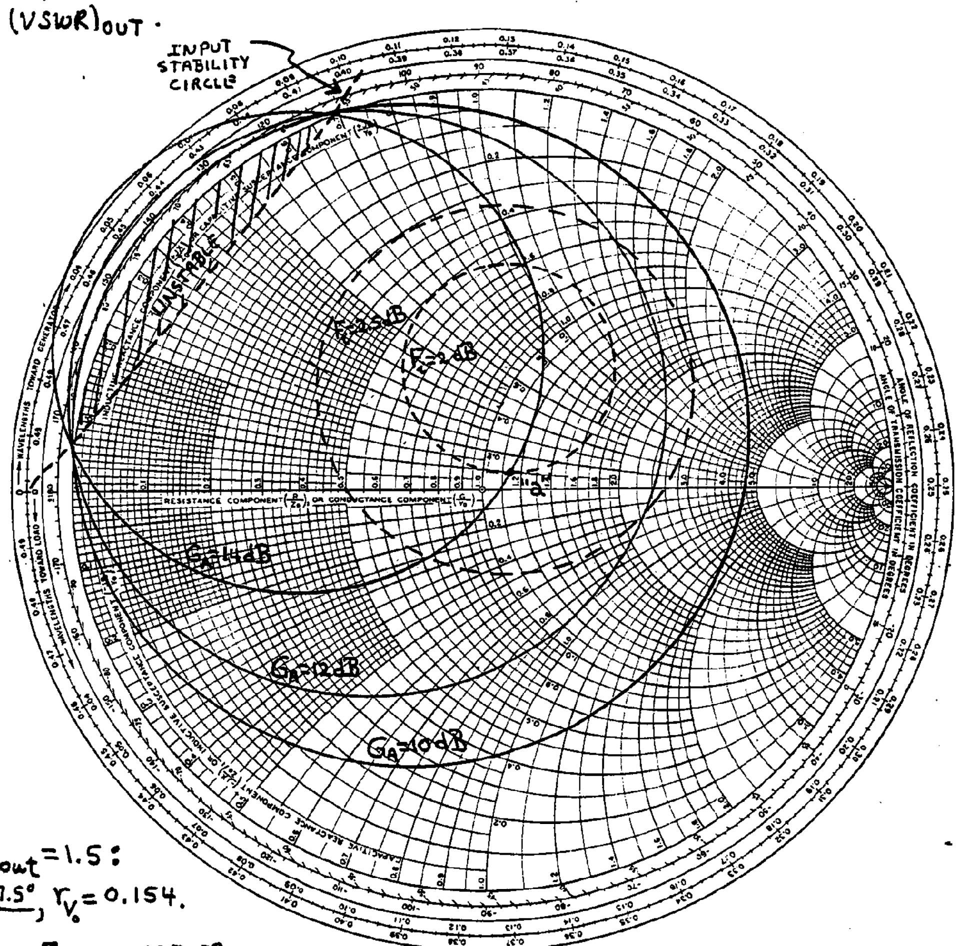
OUTPUT STABILITY CIRCLE: $C_L = 4.06 \angle 44.5^\circ$, $r_L = 3.16$

THE $G_A = 14\,dB$, $12\,dB$, AND $10\,dB$ CIRCLES, THE $F_i = 2\,dB$, AND $2.5\,dB$ CIRCLES, AND THE INPUT STABILITY CIRCLE ARE DRAWN IN THE SMITH CHART.

G_A(dB)	C_a	r_a
14	$0.561 \angle 142.7^\circ$	0.597
12	$0.35 \angle 142.7^\circ$	0.724
10	$0.219 \angle 142.7^\circ$	0.821

F_i(dB)	C_{F_i}	r_{F_i}
2	$0.306 \angle 77^\circ$	0.258
2.5	$0.254 \angle 77^\circ$	0.458

LET US TRY A DESIGN WITH Γ_s AT POINT "a": $\Gamma_s = 0.08 \angle 31^\circ$. WITH THIS VALUE OF Γ_s WE FIND: $\Gamma_L = \Gamma_{OUT}^* = 0.485 \angle 37.5^\circ$, $\Gamma_{IN} = 0.555 \angle -140^\circ$, $|\Gamma_a| = 0.577$, AND $(VSWR)_{in} = 3.7$. THE VALUE OF $(VSWR)_{in}$ CAN BE IMPROVED IF WE DESIGN FOR A HIGHER $(VSWR)_{OUT}$.



FOR $(VSWR)_{out} = 1.5$:

$C_{V_o} = 0.47 \angle 37.5^\circ$, $r_{V_o} = 0.154$.

SELECTING $\Gamma_L = 0.32 \angle 37.5^\circ$ IT FOLLOWS THAT

$\Gamma_{IN} = 0.449 \angle -134.7^\circ$, $|\Gamma_a| = 0.47$, AND $(VSWR)_{in} = 2.78$

TRANSISTOR #2 : THE DESIGN PROCEDURE IS SIMILAR TO THE ONE USED WITH TRANSISTOR #1. ONLY THE CALCULATIONS FOR THE G_A CIRCLES AND FOR THE NOISE CIRCLES ARE GIVEN.

$K = 0.244$, $\Delta = 0.263\angle 56.2°$ ∴ POTENTIALLY UNSTABLE

$G_{MSG} = 22.5$ dB

INPUT STABILITY CIRCLE: $C_s = 2.04\angle 172.2°$, $r_s = 1.55$

OUTPUT STABILITY CIRCLE: $C_L = 1.63\angle 21.9°$, $r_L = 1.07$

THE CALCULATIONS FOR THE $G_A = 18$ dB AND 16 dB CIRCLES, AND FOR THE $F_i = 1.2$ dB AND 1.5 dB CIRCLES ARE:

G_A(dB)	C_a	r_a
18	$0.376\angle 172.2°$	0.796
16	$0.255\angle 172.2°$	0.849

F_i(dB)	C_{F_i}	r_{F_i}
1.2	$0.39\angle 32°$	0.246
1.5	$0.35\angle 32°$	0.378