pg no-1

ASSIGNMENT-5

19BD1A0472
D. Jahnavi

① Draw block diagrams of following

a. AM low level and high level transmitter

b. FM direct and indirect transmitter

c. Radio receivers

i. TRF receiver

ii. super hetrodyne reciever

d. super hetrodyne tracking

e. padder, Trimmer and 3 point tracking along with respective graphs.

f. IF Amplifiers.

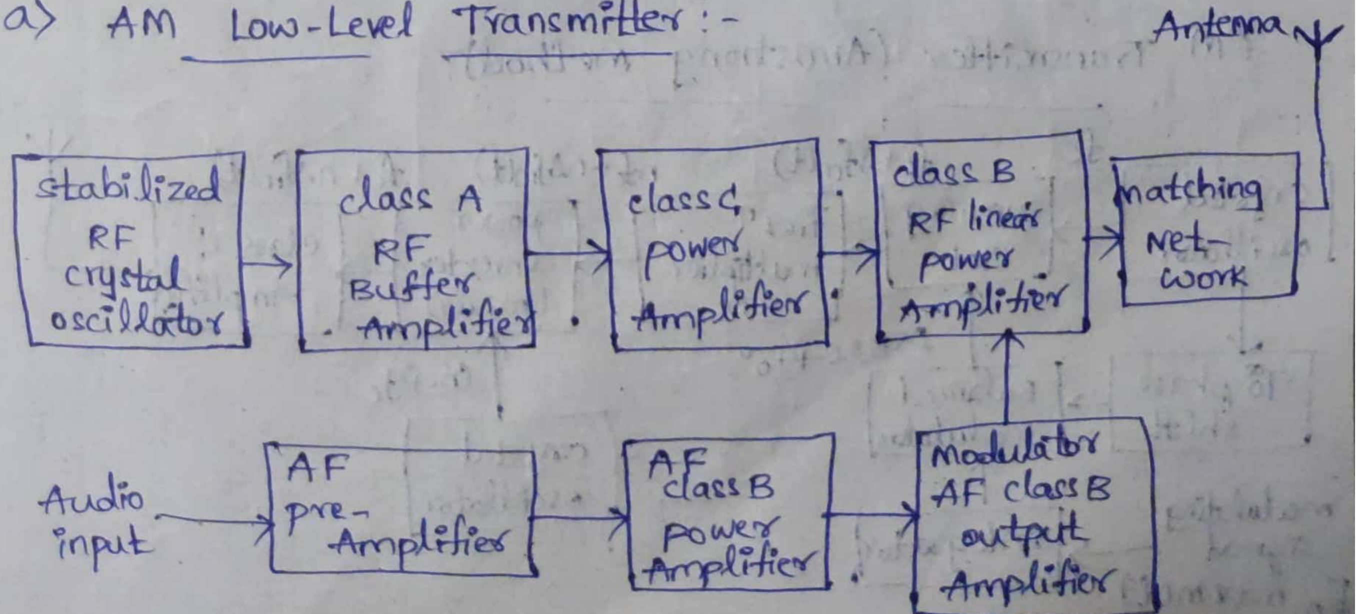
g. simple and practical diode detector diagrams.

h. Amplitude limiter diagram along with Amplitude limiter characteristics and typical response characteristics.

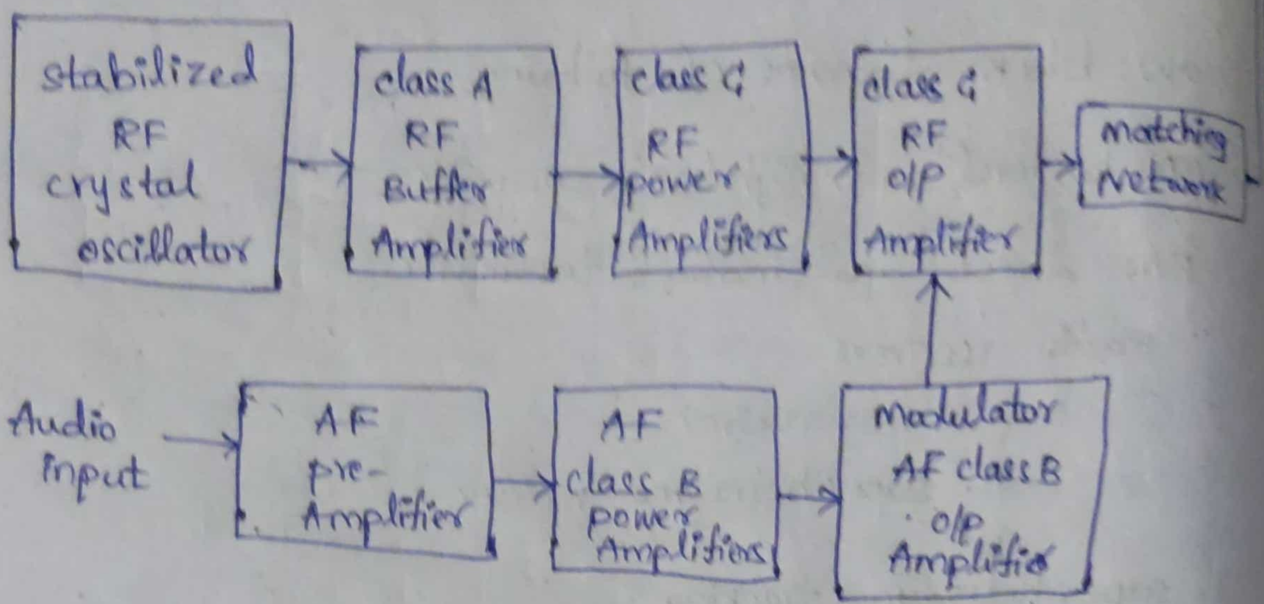
i. FM superhetrodyne receiver.

Ans:

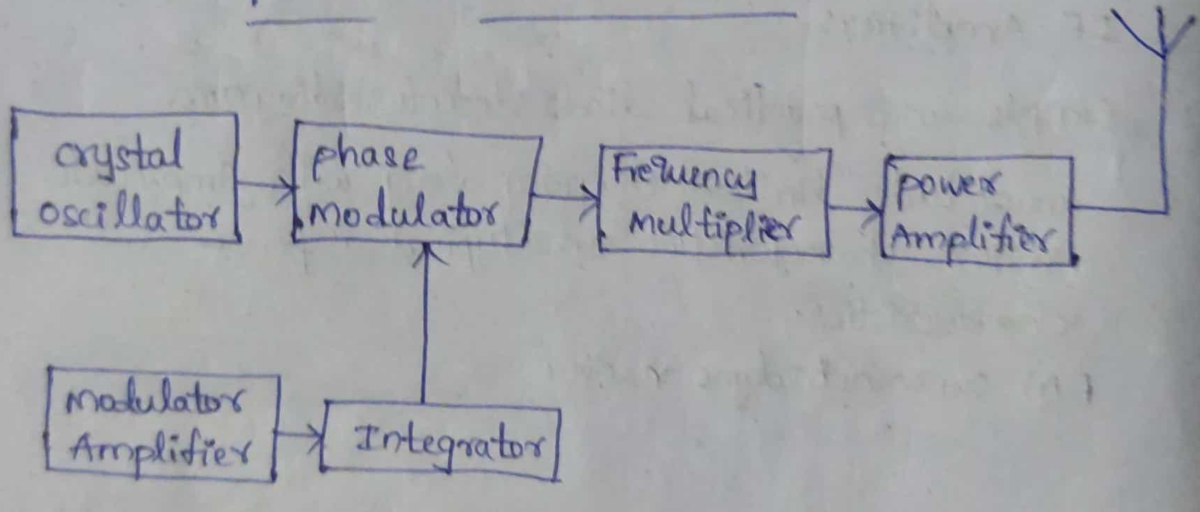
a) AM Low-Level Transmitter :-



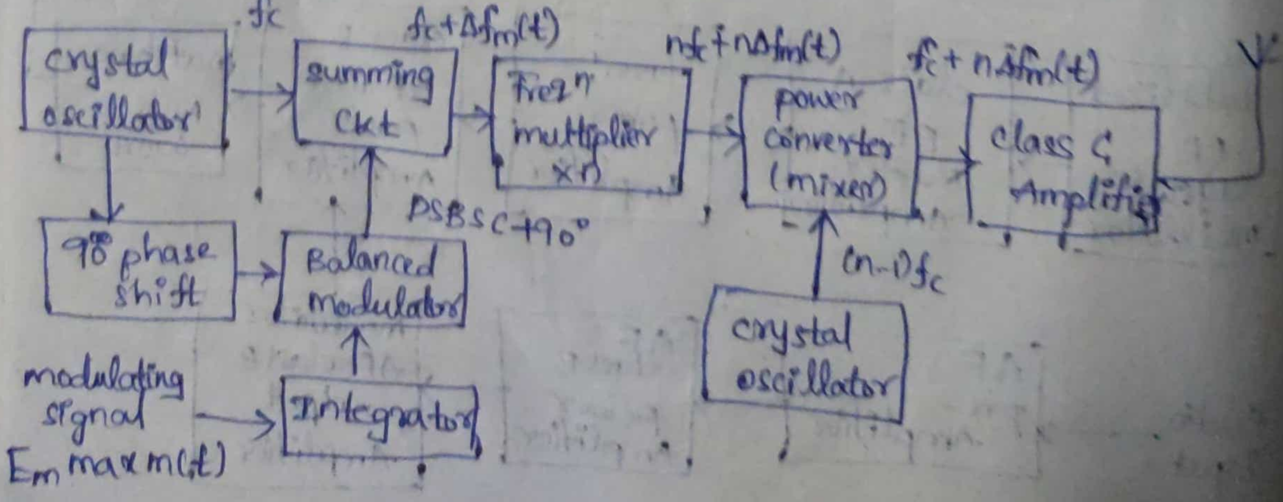
(2) AM High-Level Transmitter:-



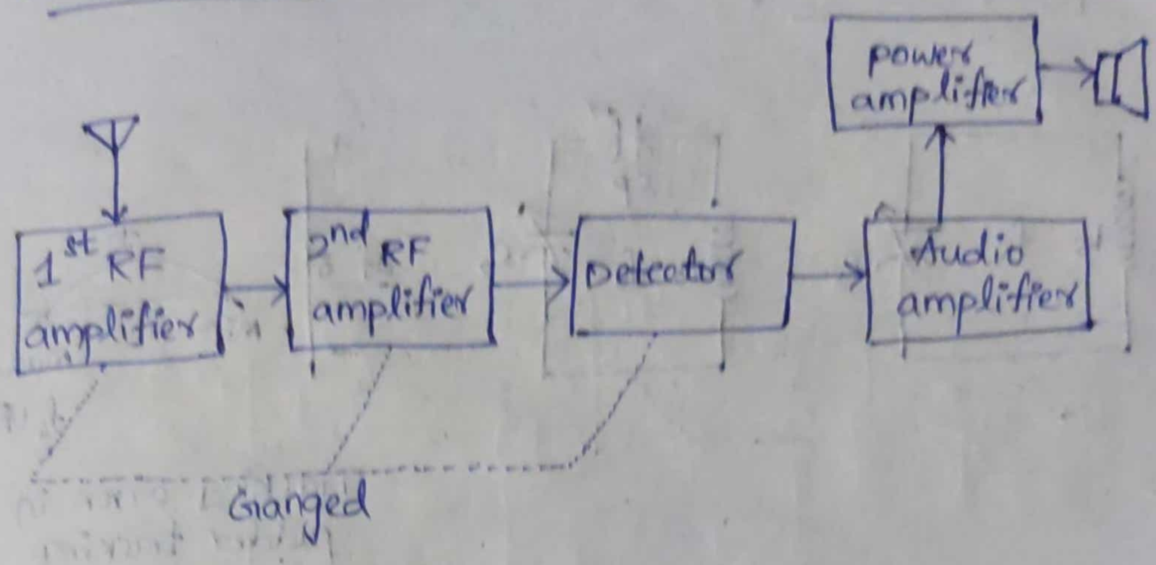
b) Indirect (phase) Modulated FM Transmitter:



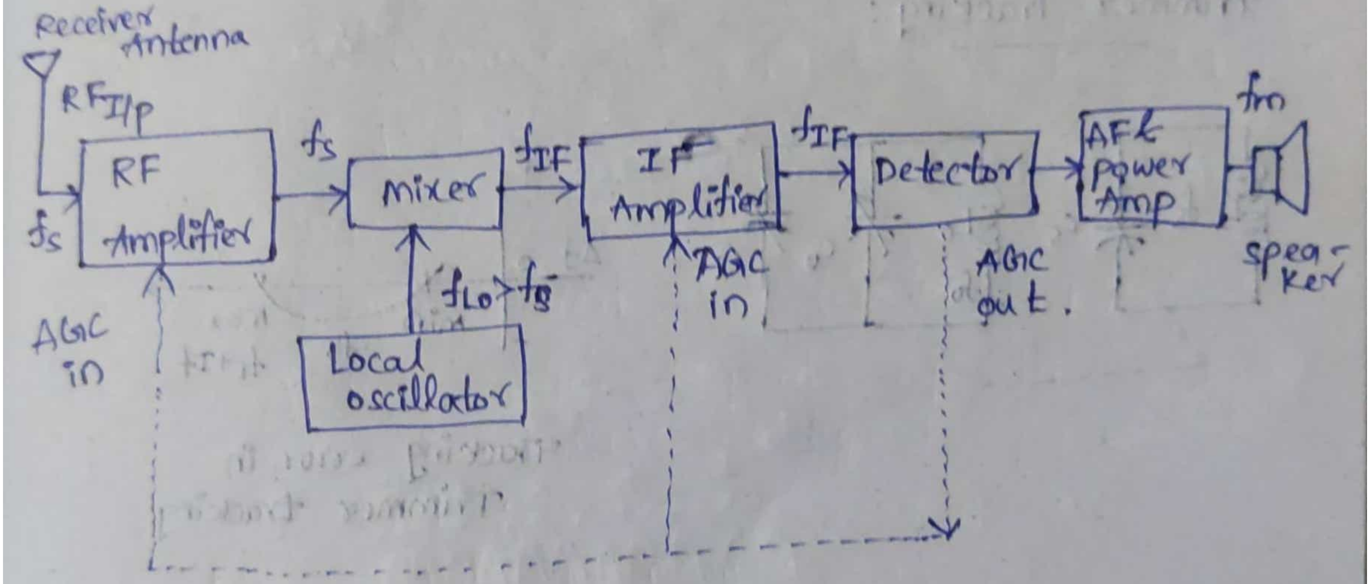
FM Transmitter (Armstrong method):



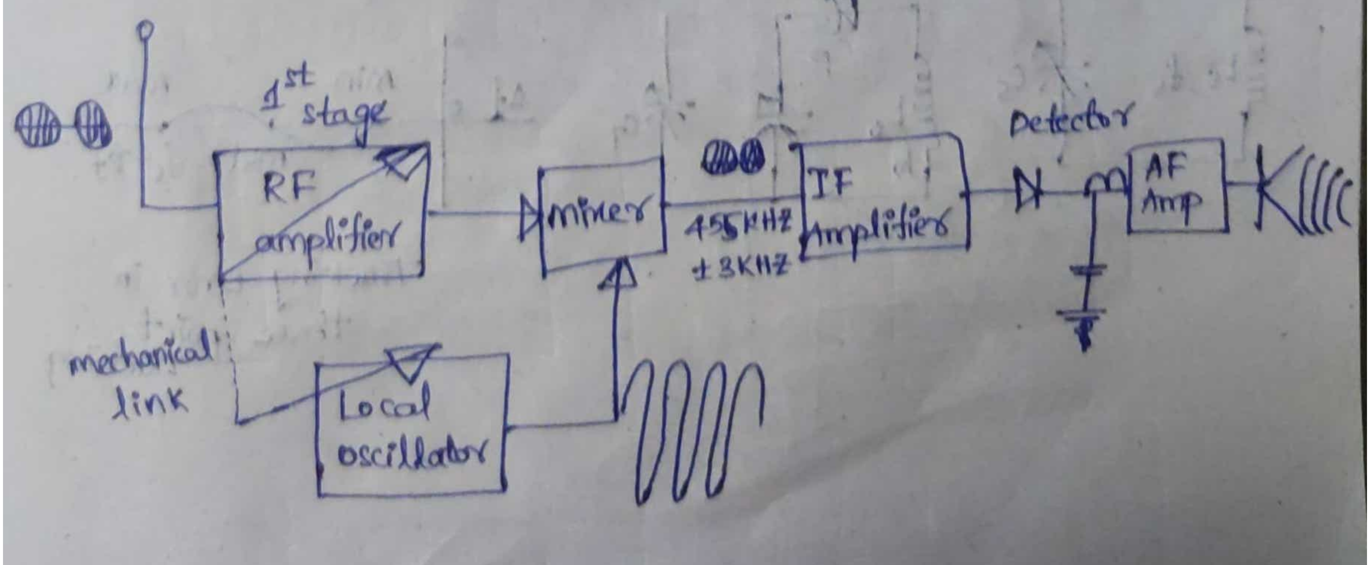
③ c) TRF Receiver :



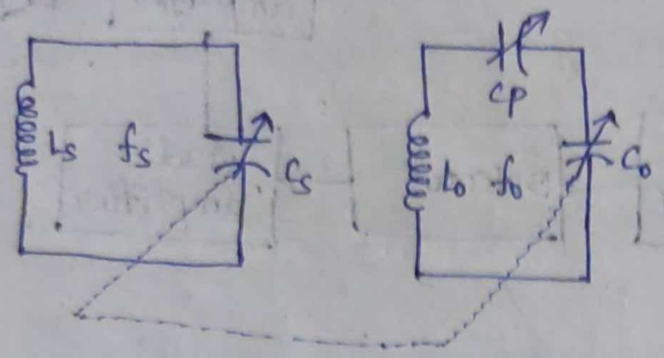
superhetrodyne Receiver :-

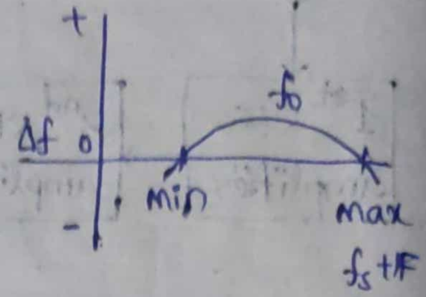


d) superheterodyne Tracking :-



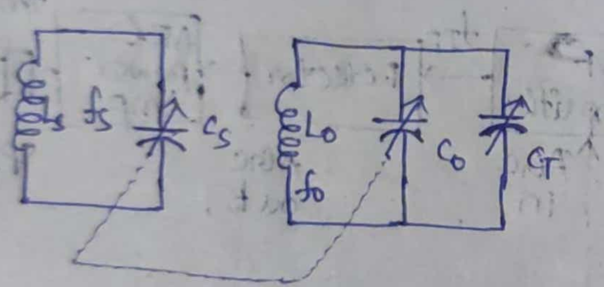
e) padder Tracking :-

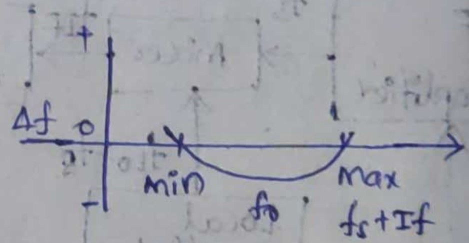




Tracking erron in padder tracking

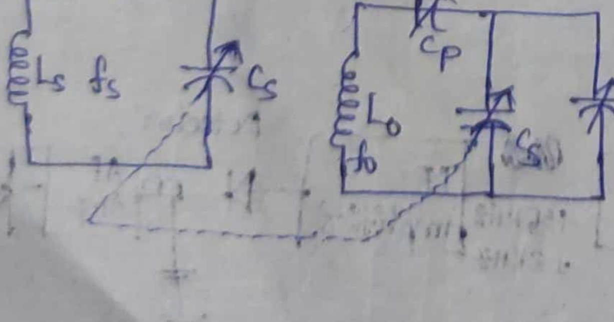
Trimmer Tracking :

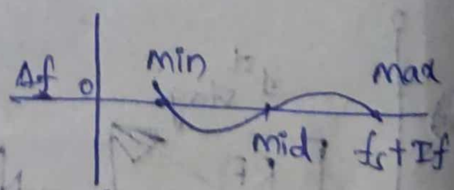




Tracking error in Trimmer tracking

Three point Tracking :

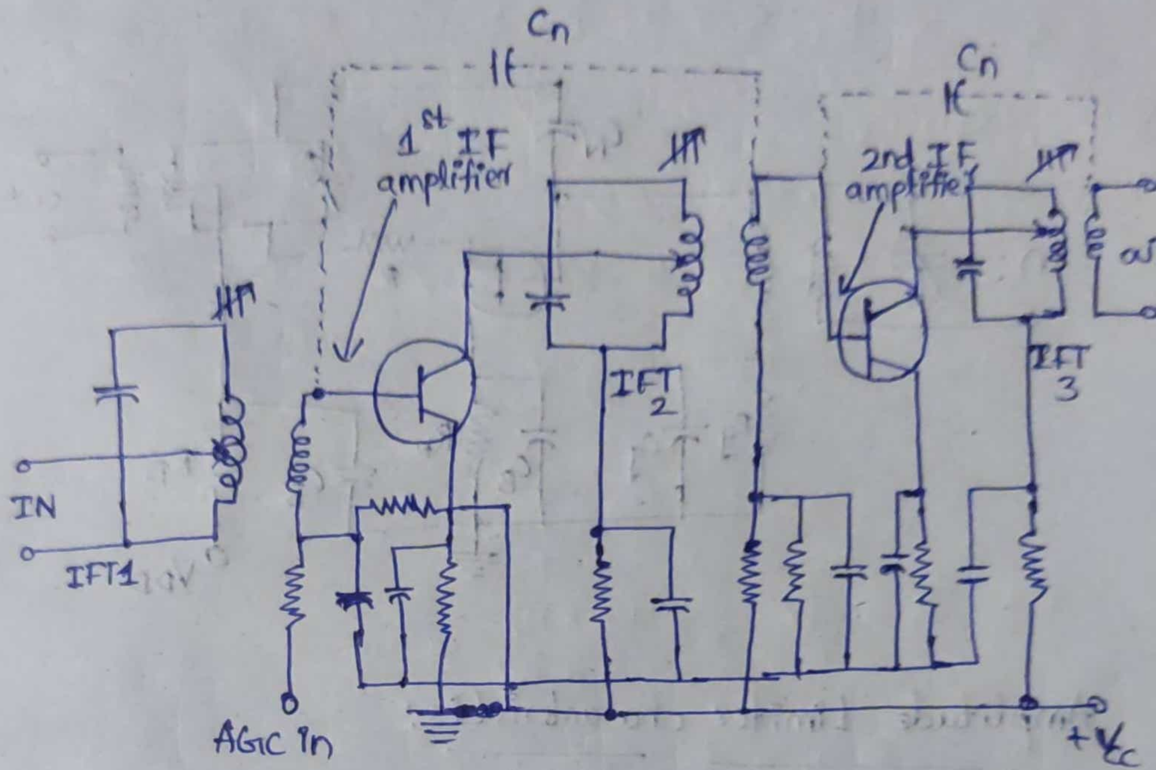




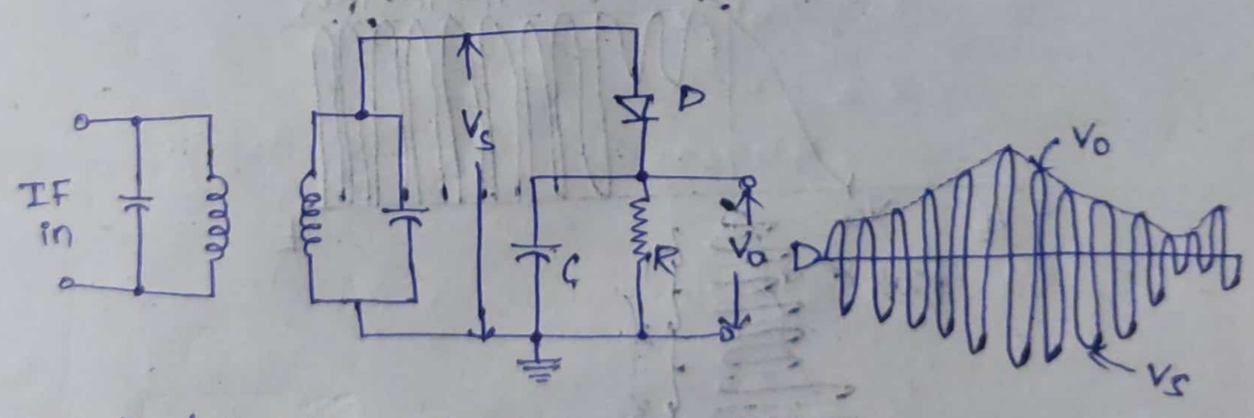
Tracking Error in three point tracking

5

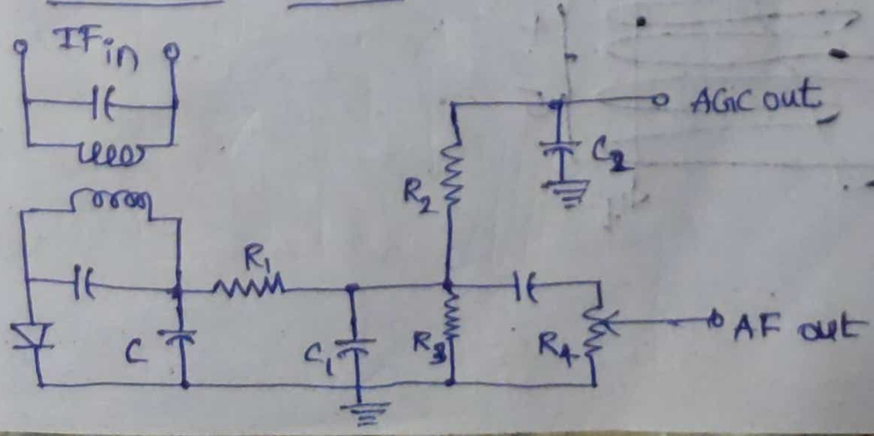
f) IF Amplifiers (FYI):



g) simple Diode Detector :-

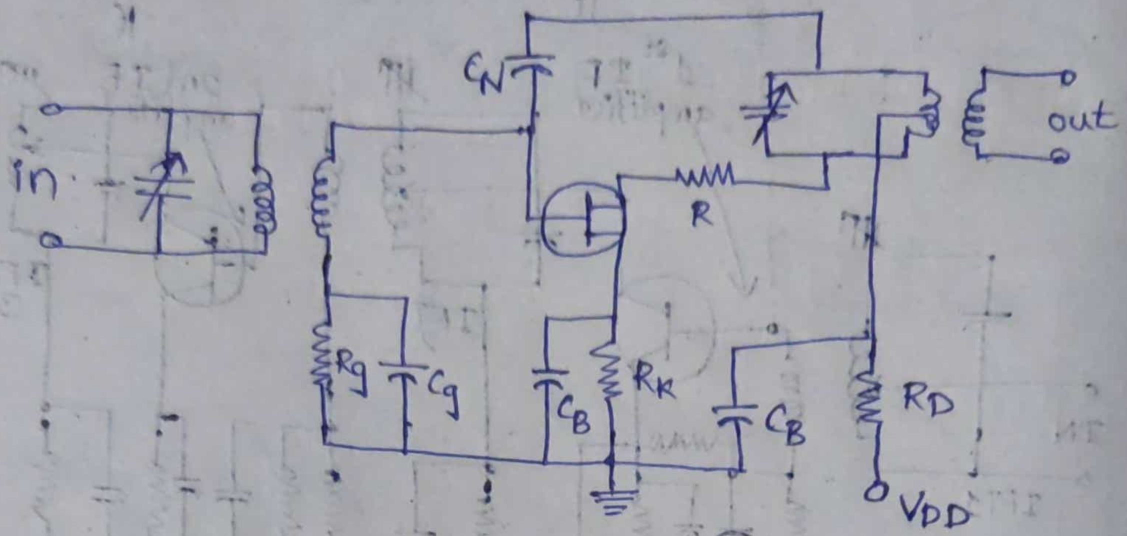


practical Diode Detector:

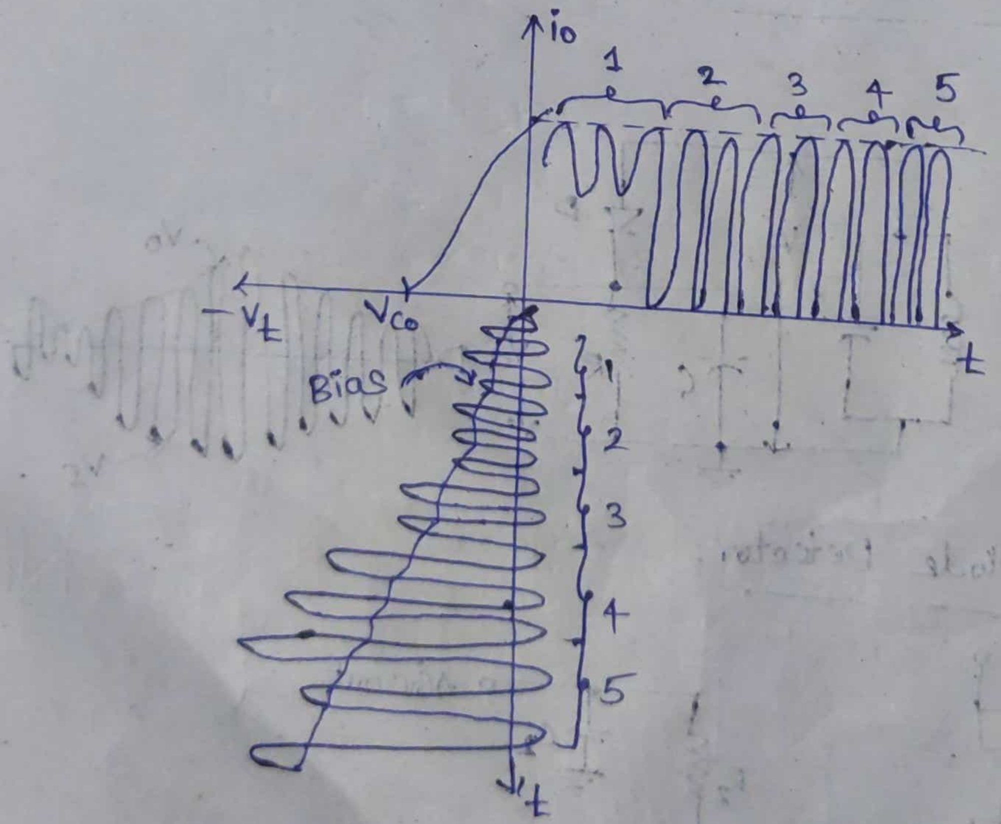


⑥

h) Simple Amplitude Limiter ckt (using FET) :-

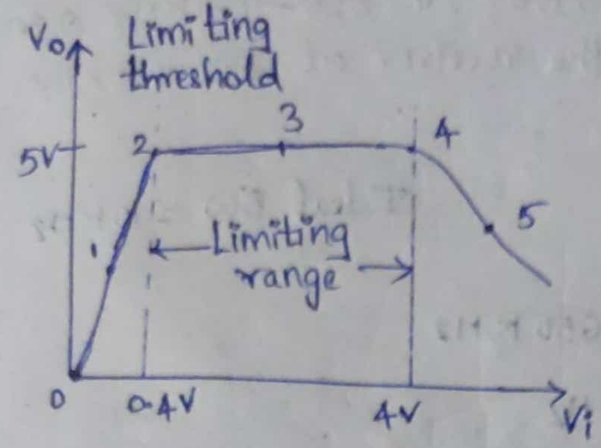


Amplitude Limiter characteristics :

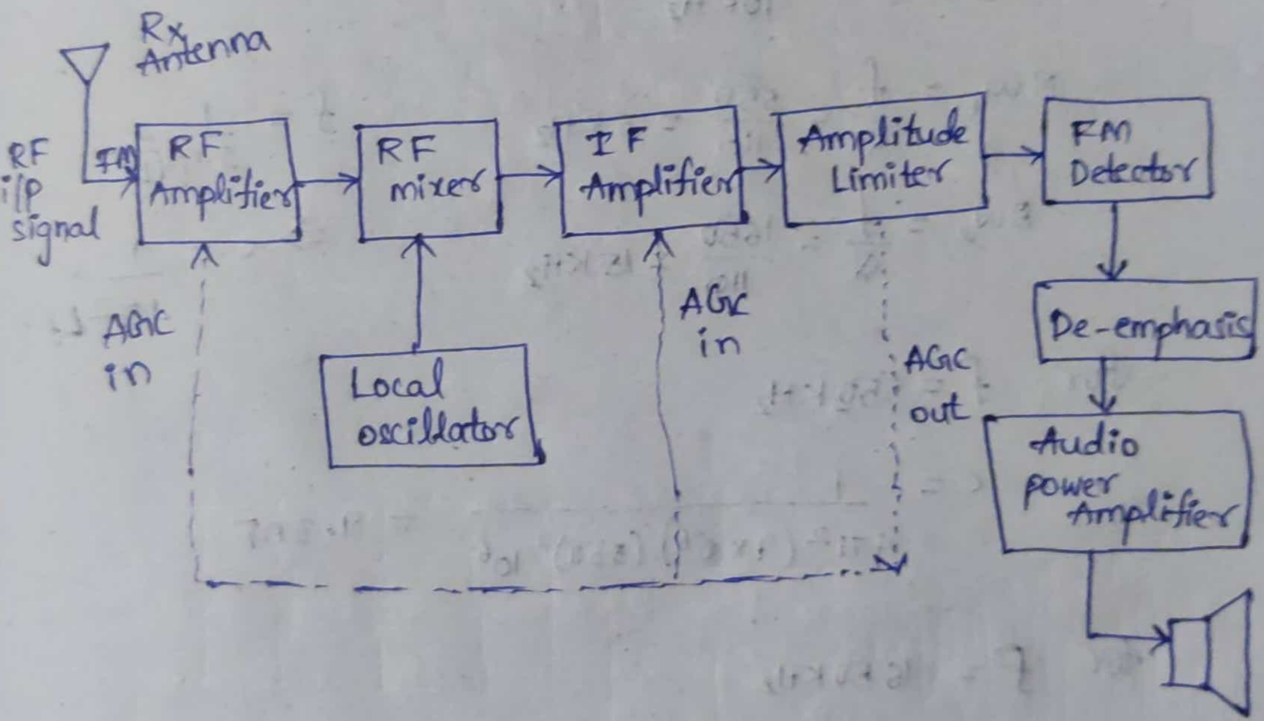


7

typical Limiter response characteristics:



i) FM superheterodyne Receiver:



(2) (8) A TRF Receiver is to be designed with single tuned ckt using 9μH inductor. The capacitance range of the variable capacitance in LC Tank ckt require to tend the receiver in 550–1650 KHZ range. Calculate the B.W of the receiver at 550–1650 KHz.

Sol: Given,

Ideal BW = 10 KHz

$L = 9\mu H$

$f_r = 550$ to 1650 KHZ

$f_r = 1100$ KHz

$C = ?$

Bandwidth = ?

(a) $Q = \frac{f_r}{BW} = \frac{1100\,KHz}{10\,KHz} = 110$

$BW_1 = \frac{f}{Q} = \frac{550}{110} = 5\,KHz$

$BW_2 = \frac{f}{Q} = \frac{1650}{110} = 15\,KHz$

$f = \frac{1}{2\pi\sqrt{LC}}$

$\Rightarrow C = \frac{1}{4\pi^2 L f^2}$

for $f = 550$ KHz

$$C = \frac{1}{4\pi^2 (9\times10^{-6})(550)^2 10^6} = 9.3\,nF$$

for $f = 1650$ KHz

$$C = \frac{1}{4\pi^2 (9\times10^{-6})(1650)10^6} = 1.03\,nF$$

(9)

(3) calculate Q.F of LC tuned ckt having resonant frequency of 2MHZ with internal resistance of coil 60ohms and capacitance value is 50pF.

sol!

Given,

$f_r = 2MHz$

$R = 60\Omega$

$C = 50pF$

$Q.F = ?$

$Q = \frac{f_r}{BW}$ (or) $R = \frac{X_L}{Q} \Rightarrow Q = \frac{X_L}{R}$

$f_r = \frac{1}{2\pi\sqrt{LC}}$

$\Rightarrow L = \frac{1}{4\pi^2 f_r^2 C} = \frac{1}{4\pi^2 \times 4 \times 10^{12} \times 50 \times 10^{-12}}$

$= \frac{1}{16 \times \pi^2 \times 50}$

$= 126.6\mu H$

$Q = \frac{X_L}{R} = \frac{2\pi f_r L}{R}$

$= \frac{2\pi \times 2 \times 10^6 \times 126.6 \times 10^{-6}}{60}$

$= \frac{4\pi \times 126.6}{60}$

$= 26.51$

$\therefore$ quality factor $= 26.51$

(5) (10) In a broad cast superhetrodyne receiver, having no RF amplifier, the loaded QF of antenna Coupling ckt is 50. If the image frequency is 2MHZ and IF is 455KHZ. calculate the signal frequency and IFRR.

Sol:

given,

$QF = 50$

$f_{si} = 2 \times 10^6 Hz$

$IF = 455 \times 10^3 Hz$

$f_s = ?$ $IFRR = ?$

$f_{si} = f_s + 2IF$

$\Rightarrow f_s = (-2I.F + f_{si})$

$= 2 \times 10^6 - 2(455 \times 10^3)$

$= 2 \times 10^3 (10^3 - 455)$

$= 1090 \text{ KHZ}$

$$\rho = \frac{f_{si}}{f_s} - \frac{f_s}{f_{si}}$$

$$= \frac{2 \times 10^6}{1090 \times 10^3} - \frac{1090 \times 10^3}{2 \times 10^6}$$

$$= \frac{200}{109} - \frac{109}{200} = 1.29$$

$\therefore \rho = 1.29$

$$\alpha = \sqrt{\rho^2 Q^2 + 1} = \sqrt{(1.29)^2 (50)^2 + 1}$$

$$= 64.4$$

$\therefore f_s = 1090 kHz$, $IFRR = 64.4$

4 A tuned ckt is having a $20\mu H$ coil connected in parallel with a 100 pF capacitor. calculate the desired coil resistances for 200 kHz BW

Sol: Given,

$L = 20\mu H$

$C = 100pF$

$BW = 200KHz$

$R = ?$

$$R = \frac{X_L}{Q} = \frac{2\pi f L}{f} \times BW$$

$$= 2\pi L BW$$

$$R = 2\pi L BW$$

$$= 2\pi \times 20 \times 10^{-6} \times 200 \times 10^{3}$$

$$= 8 \times \pi \times 10^{-6} \times 10^{6}$$

$$= 8 \times \pi$$

$$= 25.13\Omega$$

$$\boxed{R = 25.1\Omega}$$

6 A broadcast superheterodyne receiver, has IF 465KHz and it is tuned to 1500 KHz. Calculate the IF and QF of tuned ckt having IRR=75.

Sol: Given,

$IF = 455 KHz$

$f_s = 1500 KHz = 1.5 MHz$

$IRR = 75$

$IF = ?$ $QF = ?$

$$f_{si} = f_s + 2IF$$

$$= 1500 + 2(455)$$

$$= 1500 + 910$$

$$= 2410\ KHz$$

$$= 2.41 MHz$$

$$\rho = \frac{f_{si}}{f_s} - \frac{f_s}{f_{si}} = \frac{2.41}{1.5} - \frac{1.5}{2.41} = 0.98$$

$$\alpha = \sqrt{\rho^2 Q^2 + 1}$$

$$\Rightarrow Q = \sqrt{\frac{\alpha^2 - 1}{\rho^2}} = \sqrt{\frac{(75)^2 - 1}{(0.98)^2}}$$

$$= \sqrt{\frac{5624}{(0.98)^2}}$$

$$= \sqrt{5835.8}$$

$$= 76.5$$

$\therefore$ QF $= 76.5$, $f_{si} = 2.41 MHz$

7) when a superheterodyne receiver is tuned to 555 KHz Its LO provides the mixer with a input at 1010 KHz. what is the IF? If the antenna of this receiver is connected to mixer via a tuned ckt whose load Q is 40. what will be the rejection ratio of calculated IF.

(13)

Sol! Given,

$f_s = 555\ KHz$

$f_l = 1010\ KHz$

$Q = 40$, $IF = ?$, $\alpha = ?$

$I.F = f_l - f_s$

$= 1010 - 555$

$= 455\ KHz$

$f_{si} = f_s + 2\ I.F$

$= 555 + 2(455)$

$= 910 + 555$

$= 1465\ KHz$

$\alpha = \sqrt{\rho^2 Q^2 + 1}$

$\rho = \frac{f_{si}}{f_s} - \frac{f_s}{f_{si}}$

$= \frac{1465}{555} - \frac{555}{1465}$

$= 2.63 - 0.37$

$= 2.26$

$\rho = 2.26$

$\alpha = \sqrt{(40)^2 (2.26)^2 + 1}$

$= \sqrt{1600 (5.1) + 1}$

$= 90.3$

$\therefore \boxed{\alpha = 90.3}$

$\therefore IF = 455\ KHz$

$\alpha = 90.3$

(8) In a broadcast superheterodyne receiver, having no RF amplifier, the loaded QF of antenna coupling ckt is 100. If the IF used is 455 KHz. calculate the image frequency. calculate the IRR at 1000 KHz.

Sol:

Given,

$Q = 100$

$IF = 455\ KHz$

at $f_s = 1000\ KHz$

$IRR = ?$ $f_{si} = ?$

$f_{si} = 1000 + 2(455)$

$= 1910\ KHz$

$IRR = \sqrt{\rho^2 Q^2 + 1}$

$\rho = \frac{f_{si}}{f_s} - \frac{f_s}{f_{si}}$

$= \frac{1910}{1000} - \frac{1000}{1910}$

$= 1.910 - 0.323$

$= 1.387$

$IRR = \sqrt{(1.38)^2 (100)^2 + 1}$

$= \sqrt{1.92 (10000) + 1}$

$= 138.7$

$\therefore f_{si} = 1910\ KHz$

$I_{RR} = 138.7$

5

(a) calculate the IRR of receiver having RF amplifier with IF of 450 KHz. If Q.F of relevant coil are 65 at incoming frequency of 1200 KHz and 20 MHz.

Ans: Given,

$IF = 450 KHz = 0.45 MHz$

$Q = 65$

$f_{s1} = 1200 KHz$

$f_{s2} = 20 MHz$

$IRR = ?$

Formulas:-

$IRR = \sqrt{\rho^2 Q^2 + 1}$

$\rho = \frac{f_{si}}{f_s} - \frac{f_s}{f_{si}}$

$f_{si} = f_s + 2IF$

i> $f_s = 1200 KHz$

$f_{si} = f_s + 2IF$

$= 1200 + 2(450)$

$= 2100 KHz$

$\rho = \frac{f_{si}}{f_s} - \frac{f_s}{f_{si}} = \frac{2100}{1200} - \frac{1200}{2100}$

$= 1.17$

$\alpha = \sqrt{1 + (65)^2 (1.17)^2} = \sqrt{578 + 36}$

$= 76.05$

$\therefore \alpha_1 = 76.05$

$\alpha_2 = 5.29$

ii> $f_s = 20 \times 10^6 Hz$

$= 20 MHz$

$f_{si} = 20 + 2(0.45)$

$= 20.9 MHz$

$\rho = \frac{20.9}{20} - \frac{20}{20.9}$

$= 0.08$

$\alpha = \sqrt{(0.08)^2 65^2 + 1}$

$= \sqrt{28.04}$

$= 5.29$

10. The RF Lo freq and IF of AM receiver are 800 KHZ, 1255 KHZ, 455 KHZ respectively. Determine image freq, IRR for a loaded Q of 120.

Sol: Given,

$f_L = 1255$ KHZ

IF = 455 KHZ

Q = 120

$f_s = 800$ KHZ

$f_{si} = f_s + 2IF$

$= 800 + 2(455)$

$= 1710$ KHZ

$IRR = \sqrt{\rho^2 Q^2 + 1}$

$\rho = \frac{1710}{800} - \frac{800}{1710}$

$= 2.13 - 0.46$

$\rho = 1.67$

$IRR = \sqrt{(2.78)(120)^2 + 1}$

$= \sqrt{14400(2.78) + 1}$

$= 200.08$

$\therefore \boxed{IRR = 200.08}$

(11) For a receiver with IF, QF & Lo Frez of 455 KHz, 1100 KHz, 1555 KHz respectively. Determine image frequency, IRR for a loaded Q of 50.

Sol:-

given,

$IF = 455 KHZ$

$f_s = 1100 KHz$

$f_l = 155 KHz$

$Q = 50$

$f_{si} = ?$ $IRR = ?$

$f_{si} = f_s + 2 * IF$

$f_{si} = 1100 + 2(455) = 1100 + 910$

$= 2010 KHZ$

$\rho = \frac{2010}{1100} - \frac{1100}{2010} = 1.82 - 0.54$

$= 1.28$

$IRR = \sqrt{(0.28)^2 (50)^2 + 1}$

$= \sqrt{1.63(2500) + 1}$

$= \sqrt{4076}$

$= 63.84$

$\therefore f_{si} = 2010 KHZ$

$IRR = 63.84$