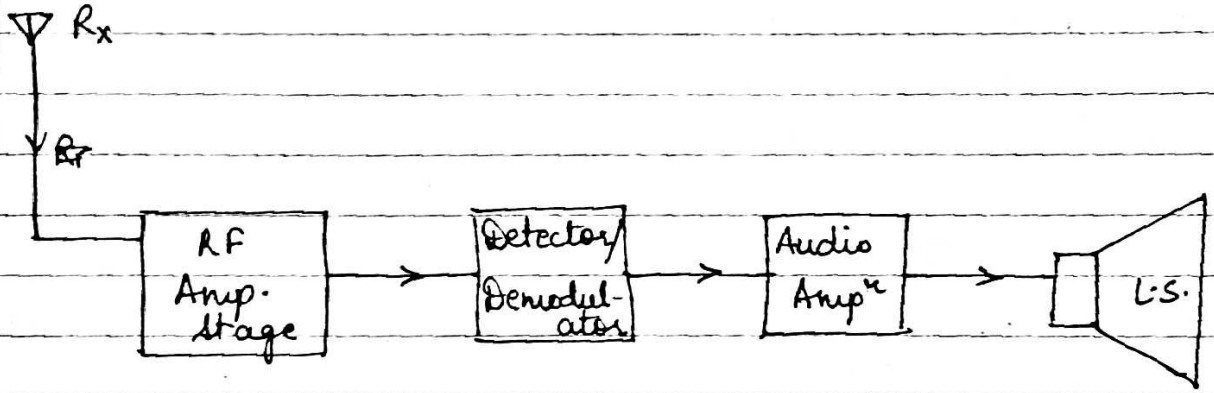
Receivers (R_x)

1. Tuned Radio Frequency R_x (TRF)
2. Superhetrodyne R_x

TRF R_x : The block diagram of TRF R_x is shown in the fig. The function of RF- Amplifier is to provide amplification of weak received signals at the frequency of carrier. The RF amplifier stage generally consist of 2/3 R-F amp^r. Each R-F amp^r proceeds by a separate tuned circuit. This unit have a low noise characteristics.



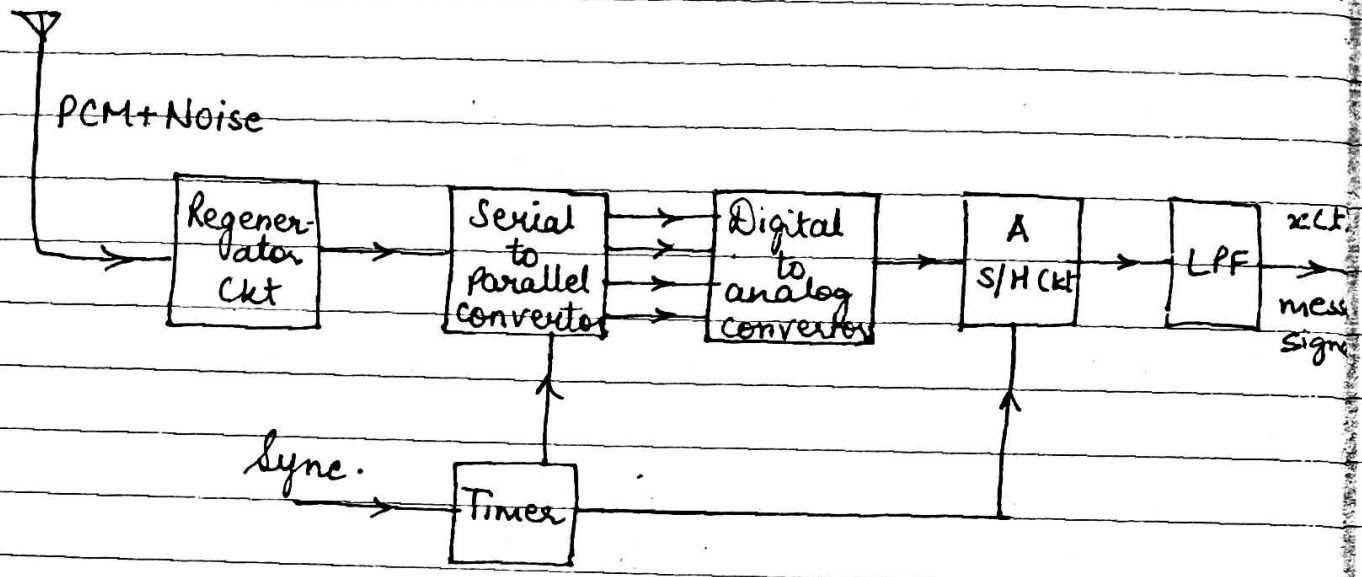
The major of limitation of TRF R_x arises from the variation of bandwidth over the tuning range. The variation of bandwidth has a direct effect on the frequency contents of the received signal. Hence, the TRF R_x are suffer from selectivity problems because the selectivity of R_x depends on the bandwidth.

Resonant frequency of tuned circuit :

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

PCM

Commercial circuit of receiver (R_x)



Q. 10 side band analog signals each 100Hz bandwidth are to be transmitted by a single binary PCM system in such a way that quantisation error for each signal does not exceed 0.1% of the peak amplitude of each signal. The sampling rate is higher 50% of it's Nyquist rate for each signal. Cal ~~of~~ bit transmission rate and minimum bandwidth of system.

Sol. Signal power = S

Quantisation error = 0.1% S

$$= \frac{0.1 \times S}{100} = 0.001S$$

$$\frac{S}{N} = \frac{S}{0.001S} = 1000$$

$$\left(\frac{S}{N}\right)_{\text{in dB}} = 10 \log 1000$$

$$= 30 \text{ dB}$$

SQNR $= (1.76 + 6.02 \times N)\ dB = 30$

$\therefore N = 5$

f_s = Nyquist rate + 50% of Nyquist rate

$= 2f_m + 2f_m \times 50\%$

$= 3f_m$

$= 300\ Hz$

Bit Transmission Rate $= (f_s \times N) \times 10$.

$= 300 \times 5 \times 10$

$= 15000$

Minimum bandwidth $= \frac{f_s \times N}{2}$

$= 7500$

Q. A carrier of frequency 10^6 Hz and amplitude 3V is frequency modulated by a sinusoidal modulating signal frequency 500 Hz and of peak amp. 1V. The freq. deviation is 1KHz. The level of modulating waveform is changed to 5V peak and mod. freq. is changed to 2KHz. Write the corresponding expression for the new modulated wave.

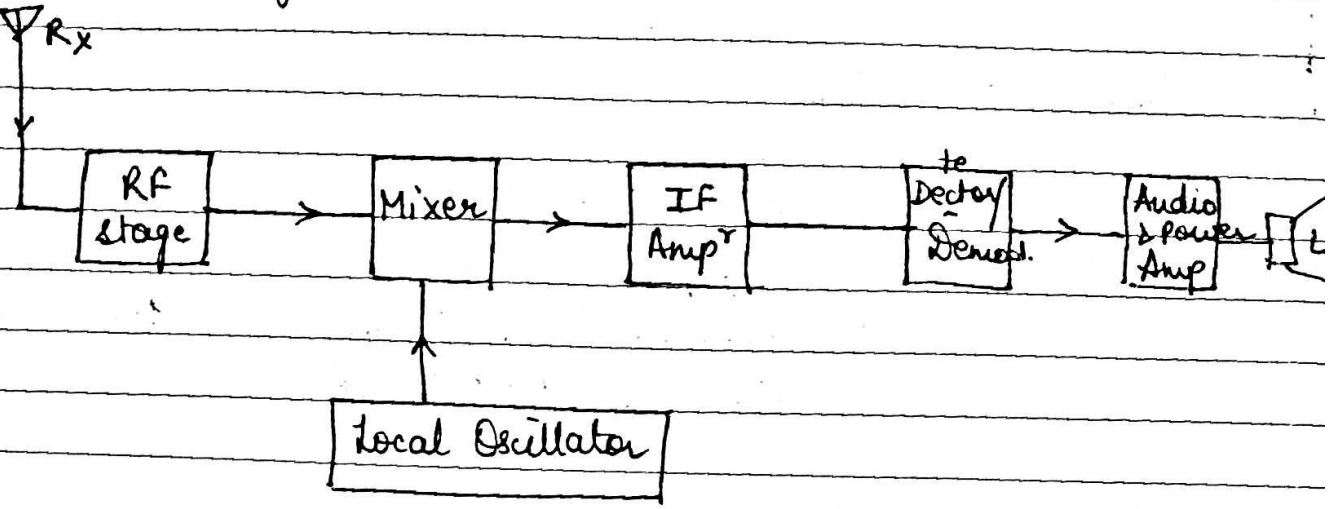
$f_c = 10^6 Hz$

$V_c = 3V$

$f_m = 500\ Hz$

$m_f = \frac{\delta}{f_m} = \frac{1KHz}{500} = 2$

Superhetrodyne Rx



The block diagram of superhetrodyne R_x is shown in the fig. Superhetrodyne R_x are frequently used in televisions and radar systems. In this receiver the received RF signal combine with the L.O. generated signal and converted into a signal of low frequency fixed frequency. These frequency components are called intermediate frequency.

Assignment - Block diagram of TV transmitter ckt and receiver ckt.

Image frequency $= f_t + 2f_I$

f_t = signal freq or tuned freq.

f_I = intermediate f

Image rejection ratio (α):

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

$$Y = \frac{f_{image}}{f_t} - \frac{f_t}{f_{image}}$$