SSBRC - Single Sideband with Reduced Carrier ①

(Pilot Carrier S.S.B System)

An attenuated carrier is reinserted into S.S.B signal so that demodulation and receiver tuning is easy.

Requires less transmission power and minimum transmission bandwidth.

It is well suited for long-distance transmission of voice signals over metallic ccts, because it permits longer spacing b/n the repeaters.

Here first unwanted sideband is removed, then pilot carrier (reduced carrier) is reinserted.

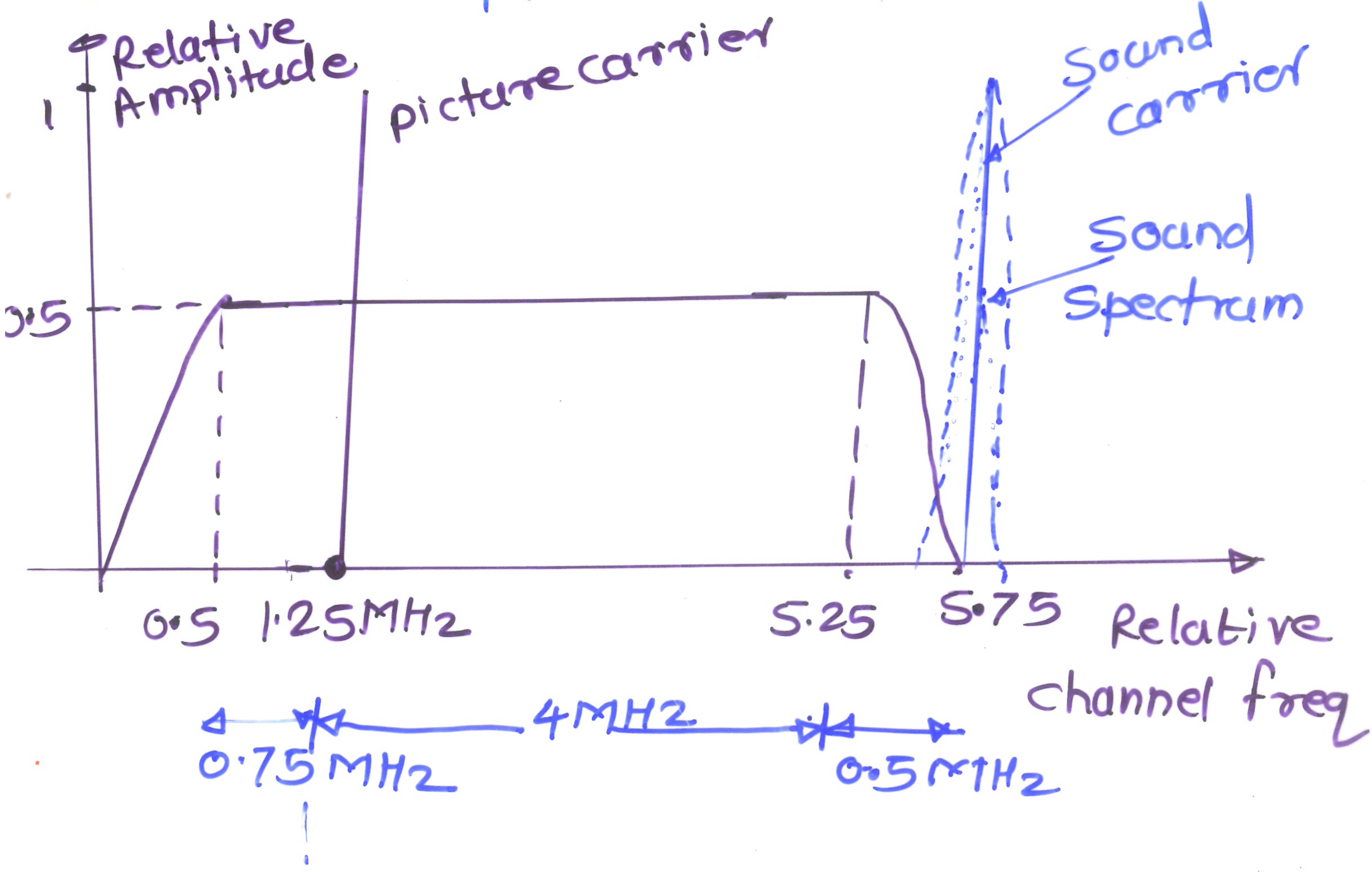
This reinserted carrier is at very low power level, 16 to 20 dB below the normal carrier level before suppression.

This pilot carrier acts as a reference signal to help the demodulation process in the receiver.

Uses - Transmarine point to point radio - telephony
mobile communication.

Vestigial Side Band Transmission (VSB)

In VSB carrier signal, one full sideband and only some part or vestige of another sideband is transmitted.



1) Carrier is sent undiminished.
① To simplify demodulation in the Rx^r cct

② Received signal would have harmful effect near the edges of flat passband because of phase response of filters used when simply SSB transmission is used.

Hence Carrier + some part of other

other sideband is transmitted alongwith required sideband.

For DSBFC - minimum BW = 9 MHz.

For VSB

Total BW for VSB = 4 MHz + 0.5 MHz
$\downarrow$
filter ckt

= 4.5 MHz

Total BW = 4.5 + 1.25 + ~~0.25~~ 0.25
$\downarrow$ vestige
$\downarrow$ Guard Band

= 6 MHz

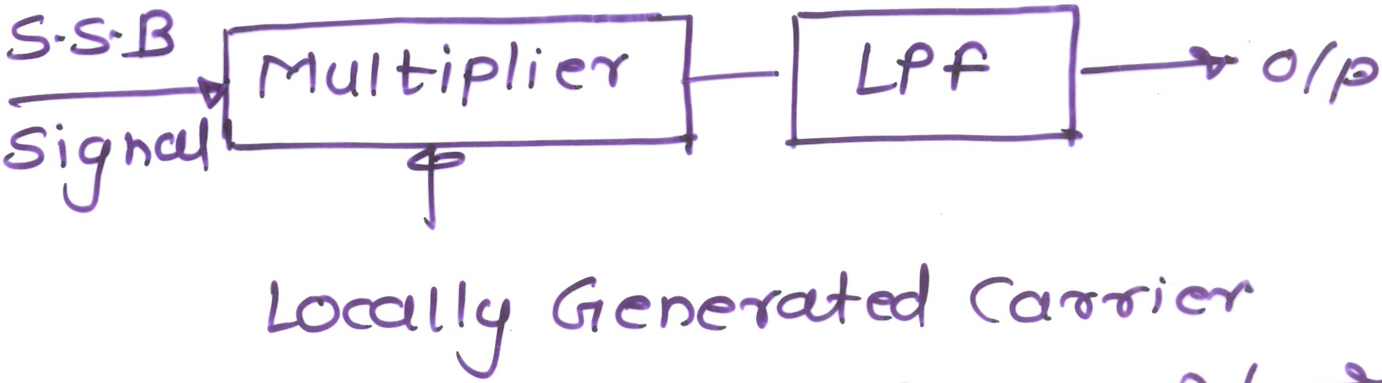
sound spectrum of 50 KHz is shown with dotted line

AM $\rightarrow$ for picture signal
FM $\rightarrow$ for sound signal.

Use

Thus B.W for single channel is 6 MHz so more channels can be introduced

SSB Demodulation



Let $e_1 = USB = E_m \cos(\omega_c + \omega_m)t \rightarrow (1)$

$e_2 = E_c \sin \omega_c t = \text{carrier} \rightarrow (2)$

$e_o = e_1 \times e_2$

$= E_m \cos(\omega_c + \omega_m)t \times E_c \sin \omega_c t \rightarrow (3)$

$= E_c E_m \cos(\omega_c + \omega_m)t \sin \omega_c t$

$2 \cos A \sin B = \sin(A+B) - \sin(A-B)$

$$e_o = \frac{E_c E_m}{2} \left[\sin(2\omega_c + \omega_m)t - \sin \omega_m t \right]$$

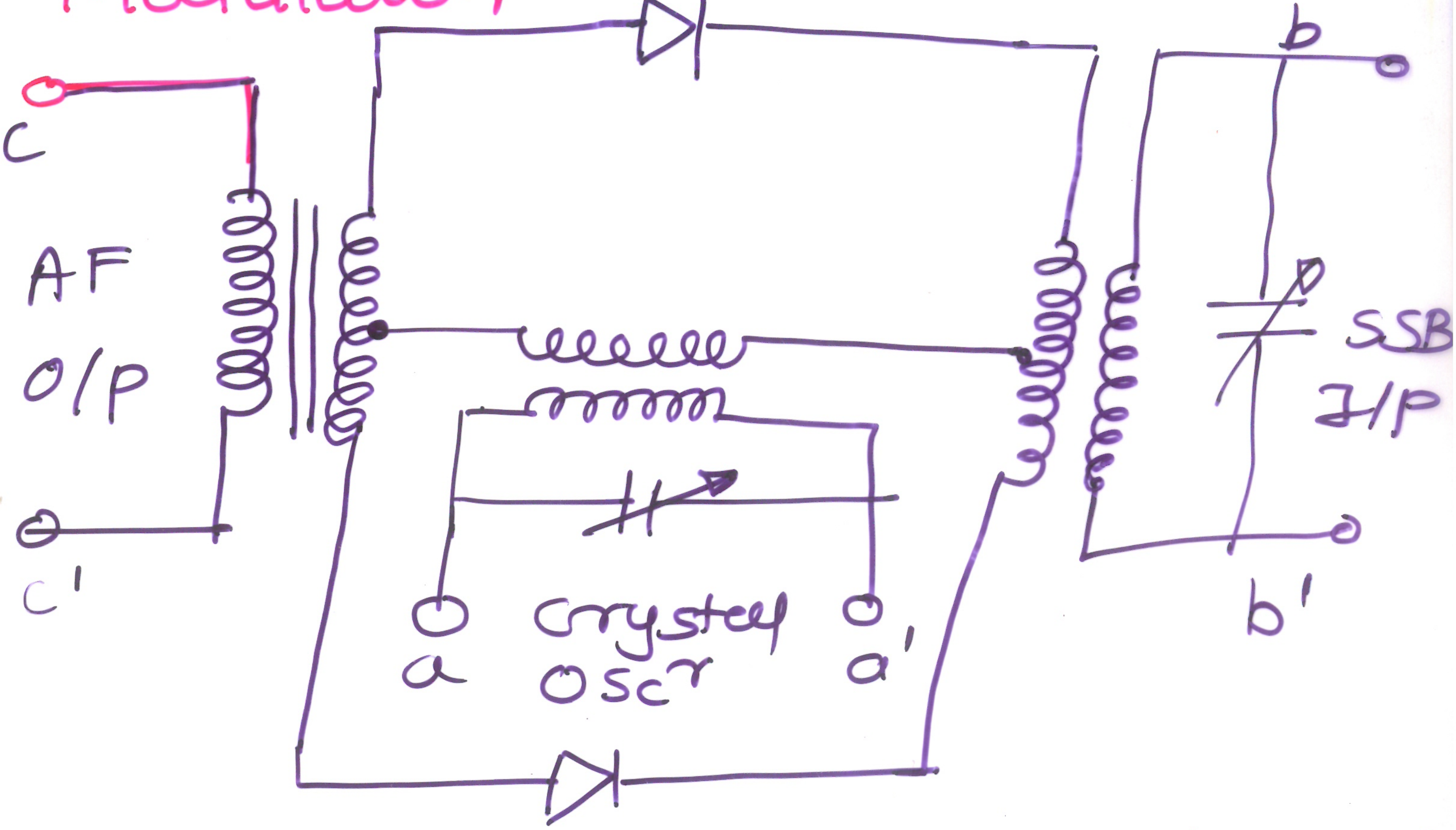
e_o is given to LPF which gives only modulating signal at o/p.

Similarly for LSB, $E_m \cos(\omega_c - \omega_m)t$

$$e_o = \frac{E_c E_m}{2} \left[\sin(2\omega_c - \omega_m)t + \sin \omega_m t \right]$$

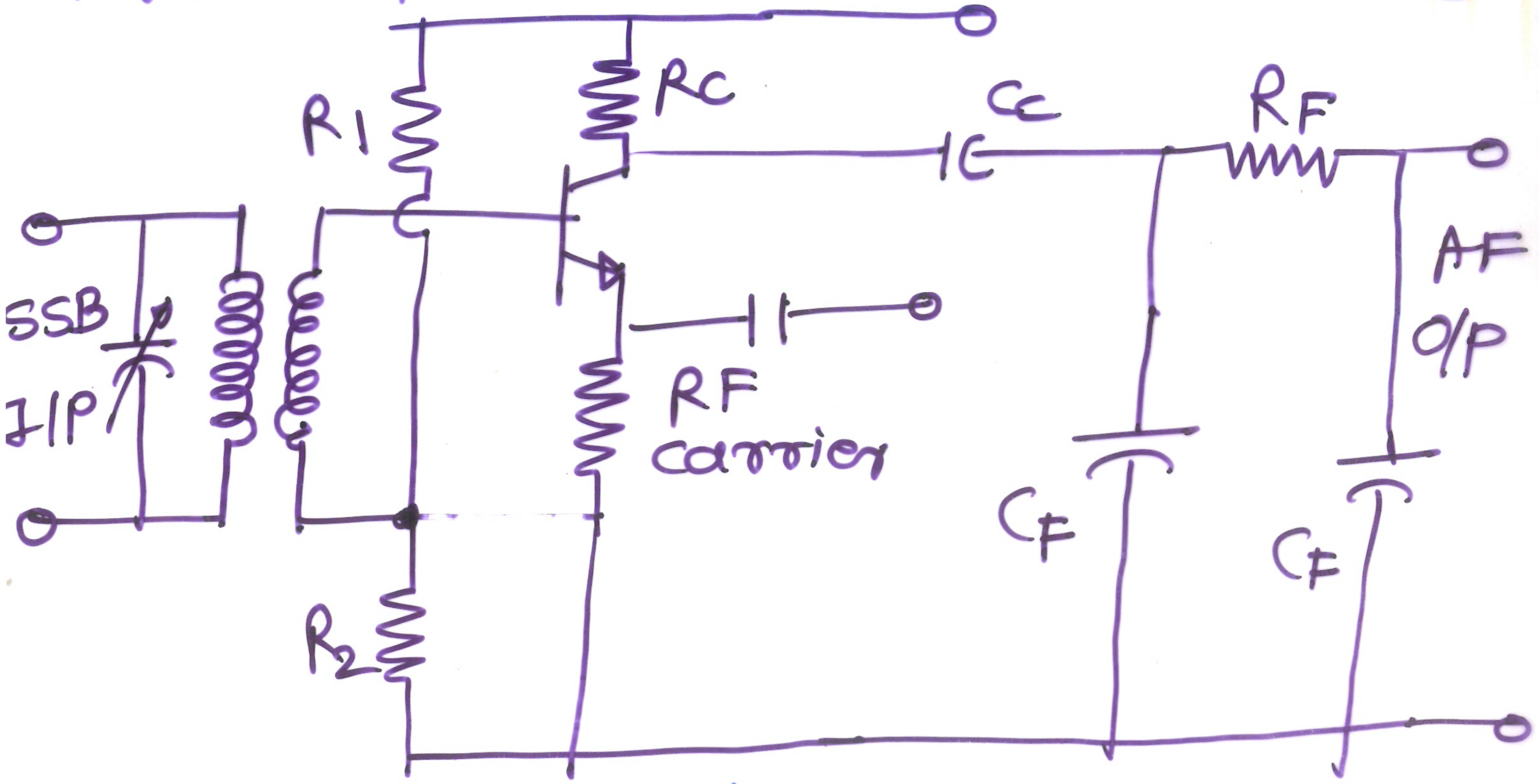
By giving this to LPF ~~we~~ get modulating signal at o/p

SSB detection with diode Balanced Modulator



Nonlinear resistance principle used
This Balanced modulator gives sum & difference frequencies at the primary winding of AF Transformer. It will not pass radio frequencies & therefore acts as a LPF and we get modulating signal at o/p.
(same proof already done)

Practical S.S.B Demodulator.



SSB is applied at base. carrier is applied to unbypassed emitter by crystal osc^r.

Due to nonlinear action of transistor we get the same modulating freq (by product term) (difference freq) and higher freq (sum freq)

LPF formed by RF and CF allows only modulating signal at O/P

$V_C = V_{CC} - i_C R_C$

$e_b = e_1 + e_2$

$i_C = a + b e_b + c e_b^2$

$= a + b(e_1 + e_2) + c\,(e_1 + e_2)^2$

Let $e_1 = E_m \sin(\omega_c + \omega_m)t$

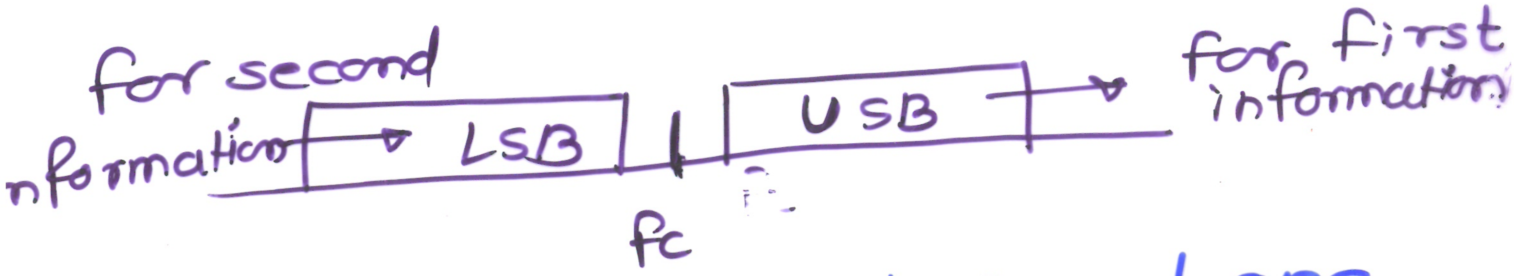
$e_2 = E_c \sin \omega_c t$

- - - - - - - -

$$i_c = bE_m \sin(\omega_c + \omega_m)t + bE_c \sin \omega_c t + cE_m^2 \sin^2(\omega_c + \omega_m)t + cE_c^2 \sin \omega_c t + \underline{2cE_cE_m \sin(\omega_c + \omega_m)t \sin \omega_c t}$$

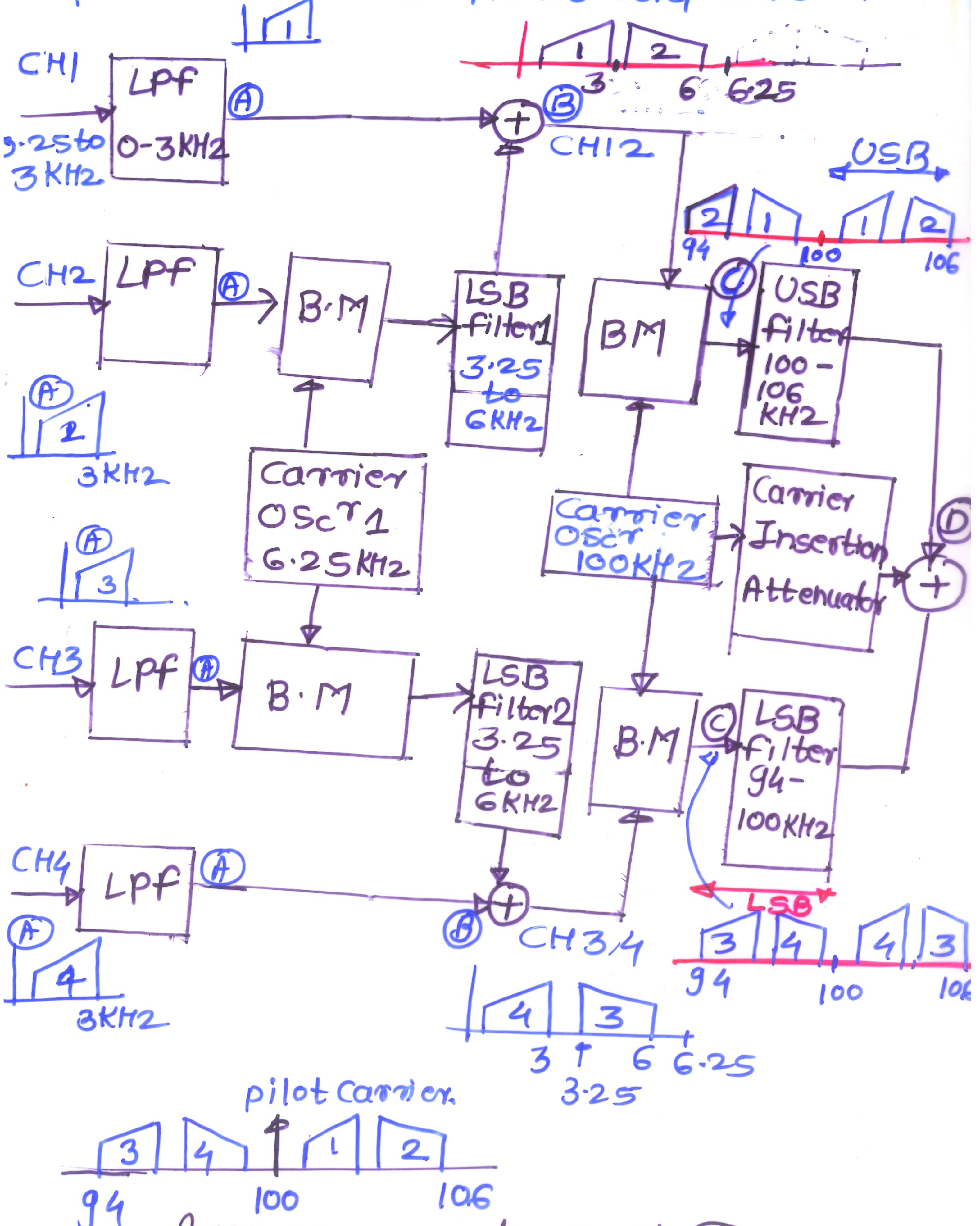
same proof already done.

ISB - Independant Side Band

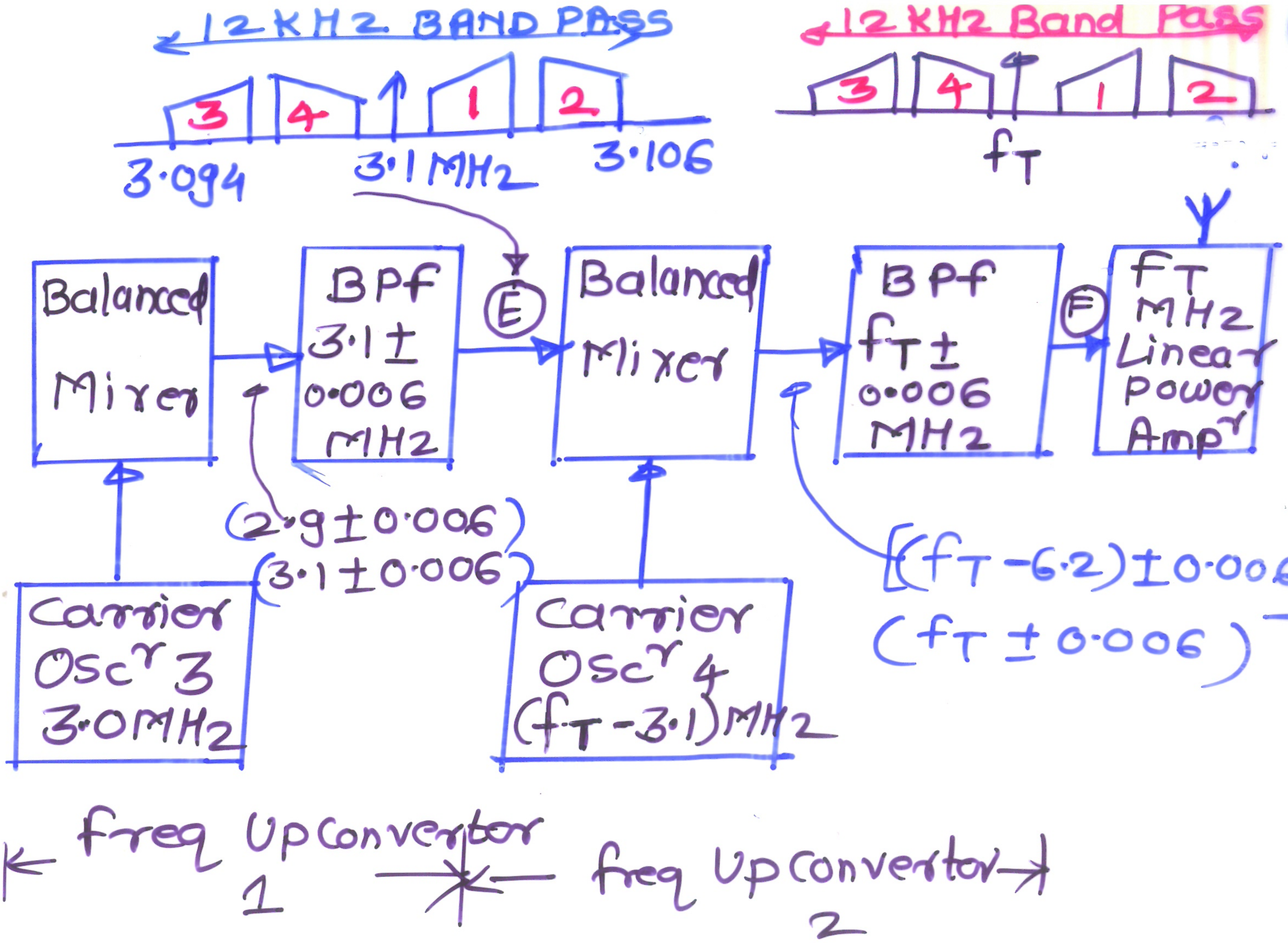


In SSB the carrier and one sideband are removed from AM signal. It is possible to replace the removed sideband with another sideband of information created by modulating a different input signal on the same carrior. Such type of transmission is known as Independant sideband Transmission

4 Channel ISB Radio-Telephone Tx^r



Frequency spectrum at D


12 KHz BAND PASS
3
4
1
2
3.094
3.1 MHz
3.106
12 KHz Band Pass
3
4
1
2
f_T
Balanced Mixer
BPF 3.1 ± 0.006 MHz
E
Balanced Mixer
BPF f_T ± 0.006 MHz
F
f_T MHz Linear Power Amp^r
(2.9 ± 0.006)
(3.1 ± 0.006)
Carrier Osc^r 3 3.0 MHz
Carrier Osc^r 4 (f_T − 3.1) MHz
[(f_T − 6.2) ± 0.006]
(f_T ± 0.006)
freq Up convertor 1
freq Up convertor 2