Modul #05

TE3113
SISTEM KOMUNIKASI 1

RECEIVER FM & AGC:

Superheterodyne, Demodulator FM,

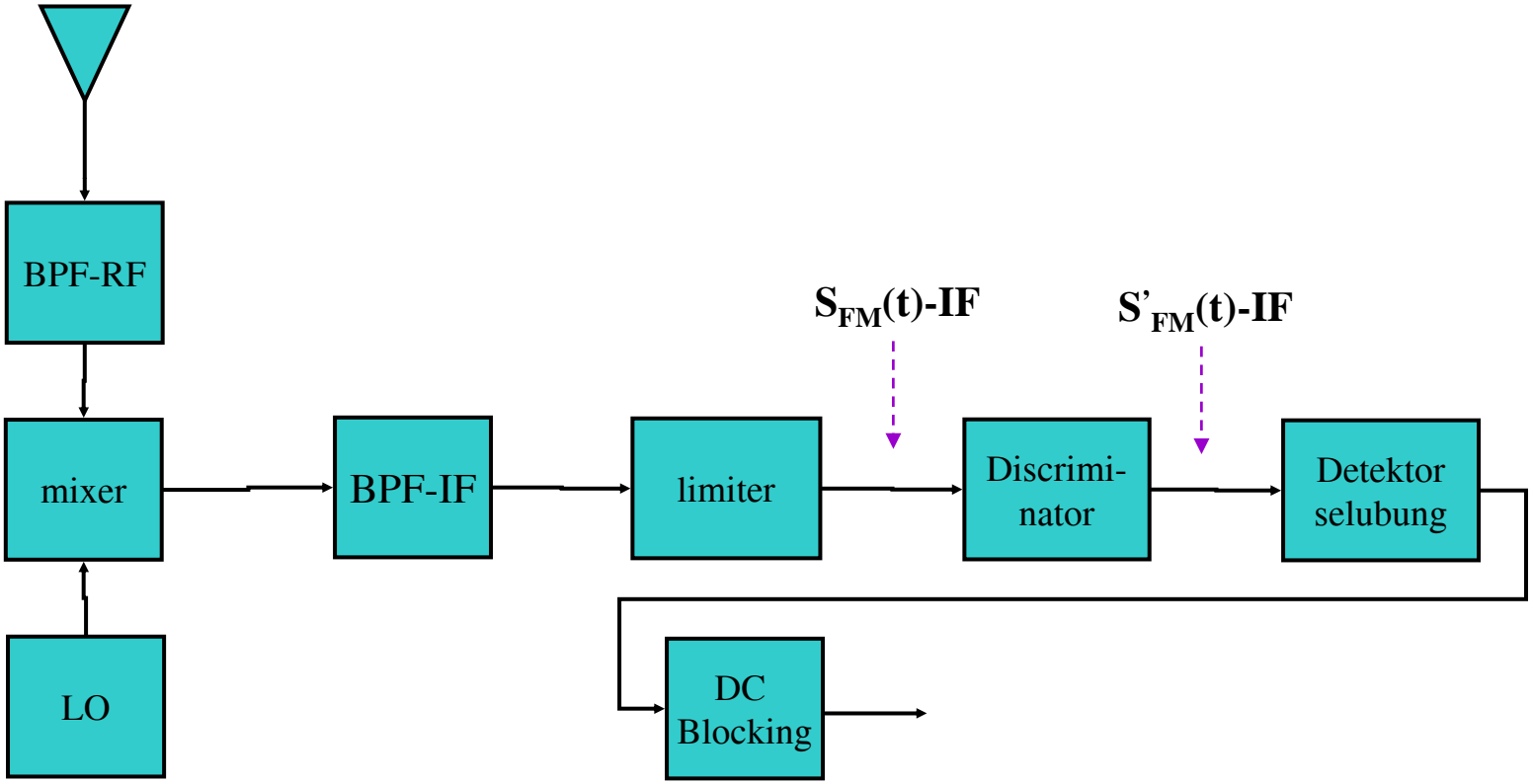
FM Stereo, AGC

Kelas TE-29-02

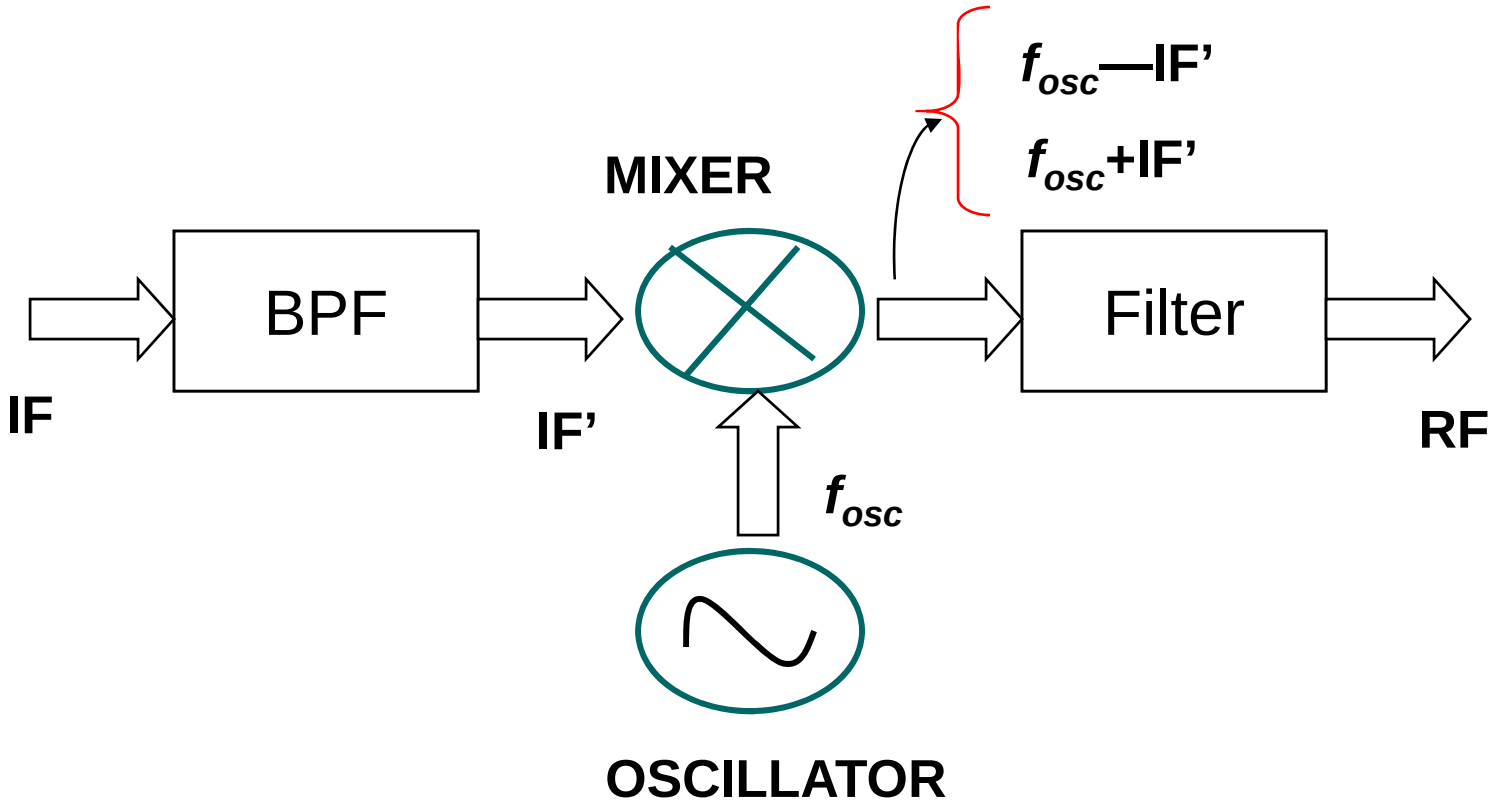
Program Studi S1 Teknik Telekomunikasi
Departemen Teknik Elektro - Sekolah Tinggi Teknologi Telkom
Bandung – 2007

FM receiver

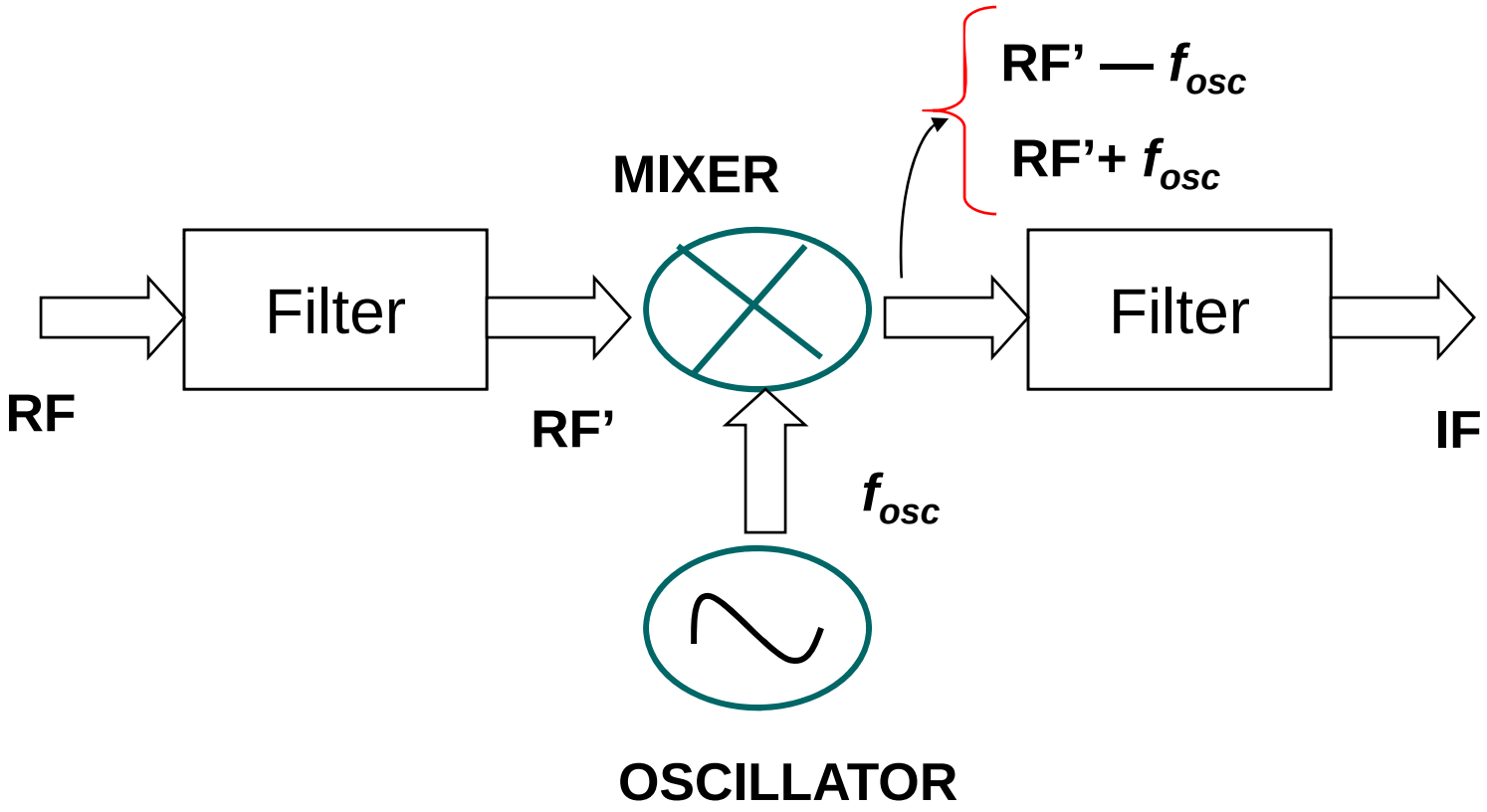
- FM receiver is similar to the superheterodyning (down converting) layout:



Up Converter (di Pemancar)

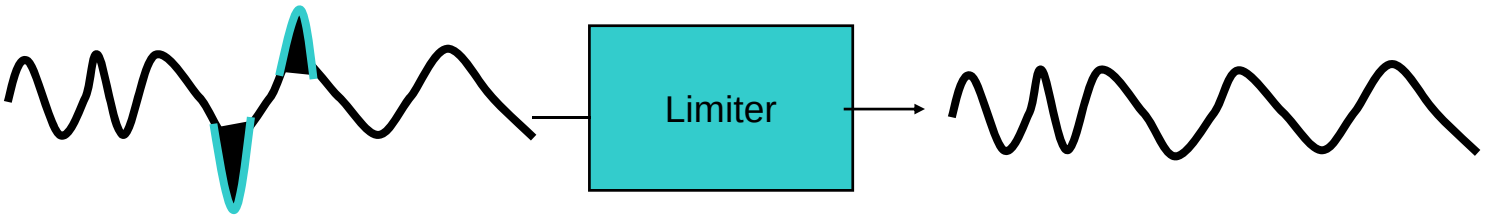


Down Converter (di Penerima)



Limiter

- A limiter is a circuit whose output is constant for all input amplitudes above a threshold
- Limiter's function in an FM receiver is to remove unwanted amplitude variations of the FM signal



Demodulasi Sinyal FM

Dengan menggunakan diskriminator/differensiator

- Pada sinyal FM, informasi terkandung pada frekuensi sinyal FM

$$S_{FM}(t) = A_c \cos\left[2\pi f_{IF} t + 2\pi k_f \int_0^t m(t)dt\right]$$

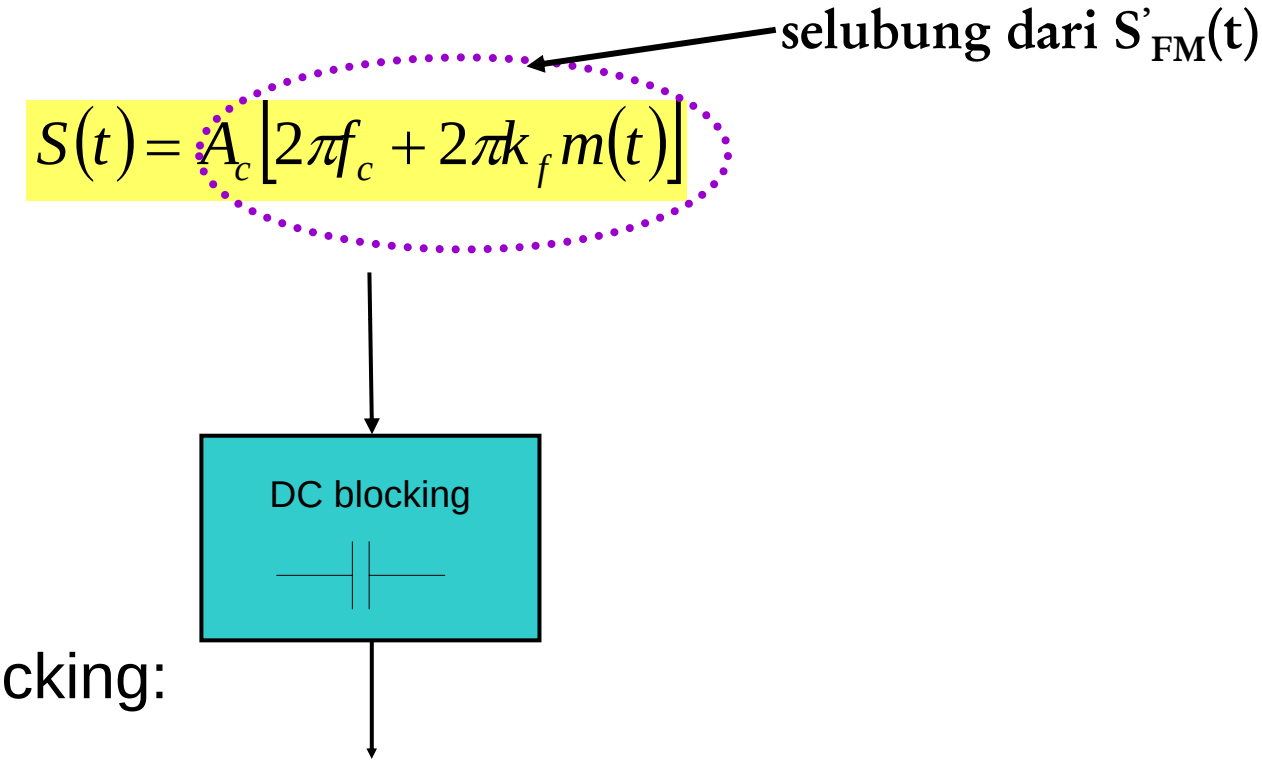
- Jika dilakukan diferensiasi terhadap $S_{FM}(t)$ ($\Rightarrow$keluaran discriminator) didapat :

$$S'_{FM}(t) = A_c\left[2\pi f_{IF} + 2\pi k_f m(t)\right]\sin\left(2\pi f_{IF} t + 2\pi k_f \int_{-\infty}^t m(t)dt\right)$$

Informasi terkandung pada bagian selubung dari $S'_{FM}(t)$

Demodulasi Sinyal FM

- Keluaran detektor selubung (masukan DC blocking):



- Keluaran DC blocking:

$$\hat{m}(t) = A_c 2\pi k_f m(t) = C.m(t)$$

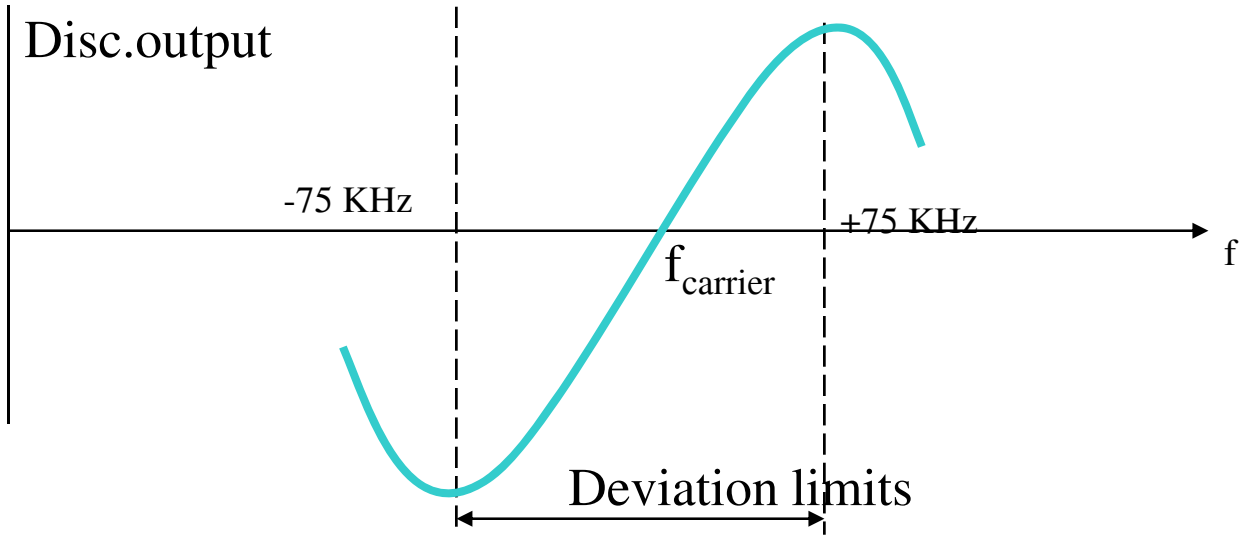
Discriminator

- The heart of FM is this relationship

$$f_i(t) = f_c + k_f m(t)$$

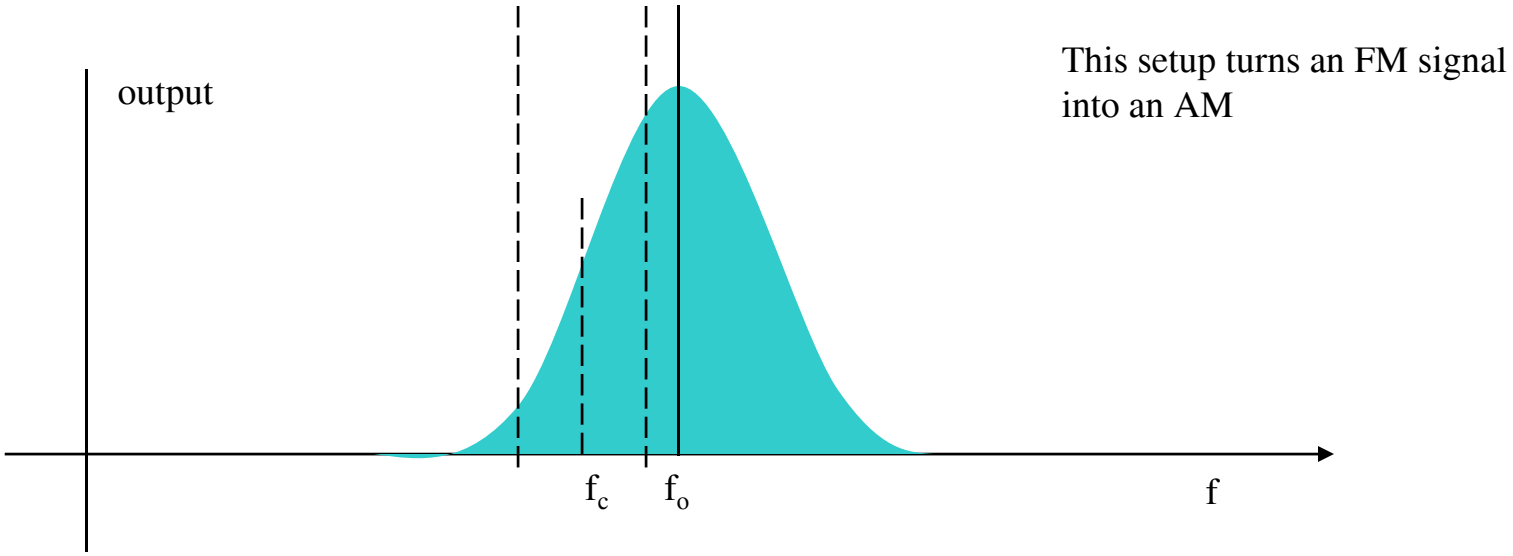
- What we need is a device that linearly follows inst. frequency

$f_{carrier}$ is at the IF frequency
Of 10.7 MHz



Examples of discriminators

- Slope detector - simple LC tank circuit operated at its most linear response curve

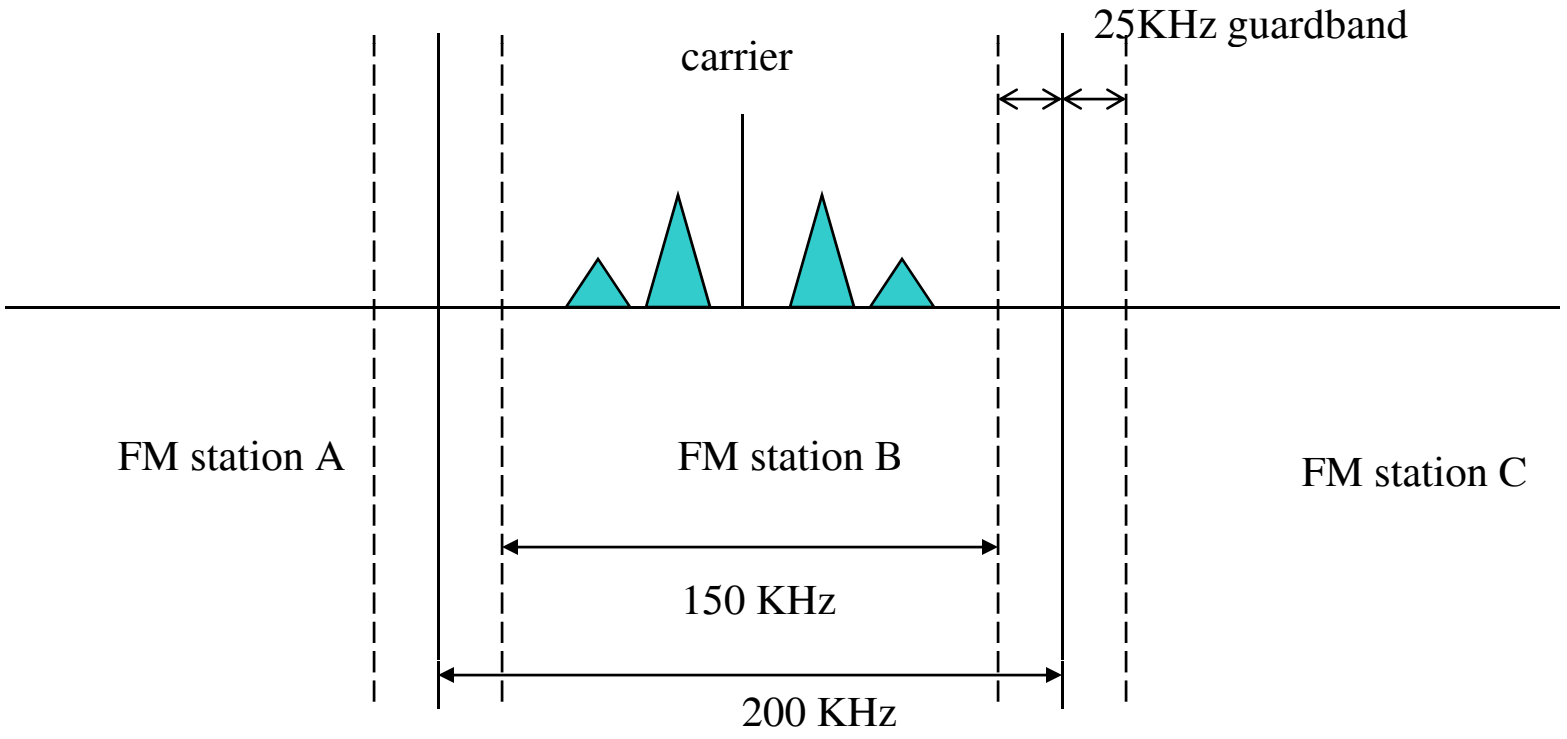


Commercial FM

- Commercial FM broadcasting uses the following parameters
  - Baseband:15KHz = W = fm
  - Deviation ratio:5
  - Peak freq. Deviation=75KHz
    - ➡ $B_{FM}=2(\beta+1)W=2x6x15=180KHz$

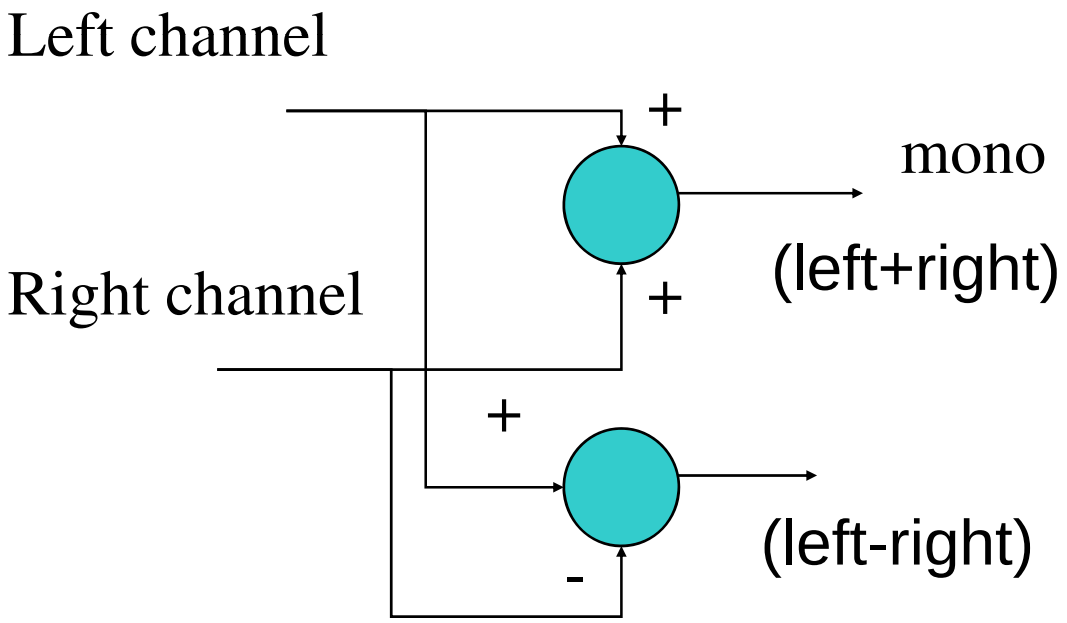
Commercial FM spectrum

- The FM landscape looks like this



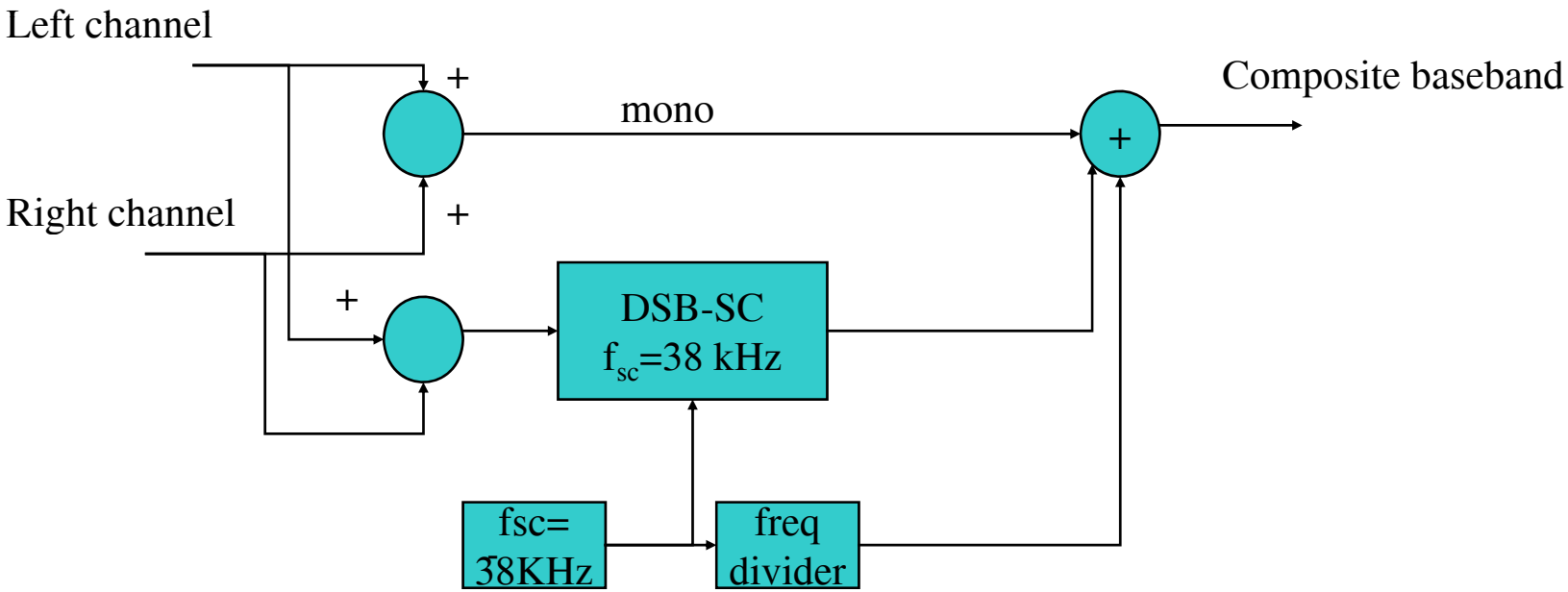
FM stereo:multiplexing

- First, two channels are created; (left+right) and (left-right)
- Left+right is useable by monaural receivers



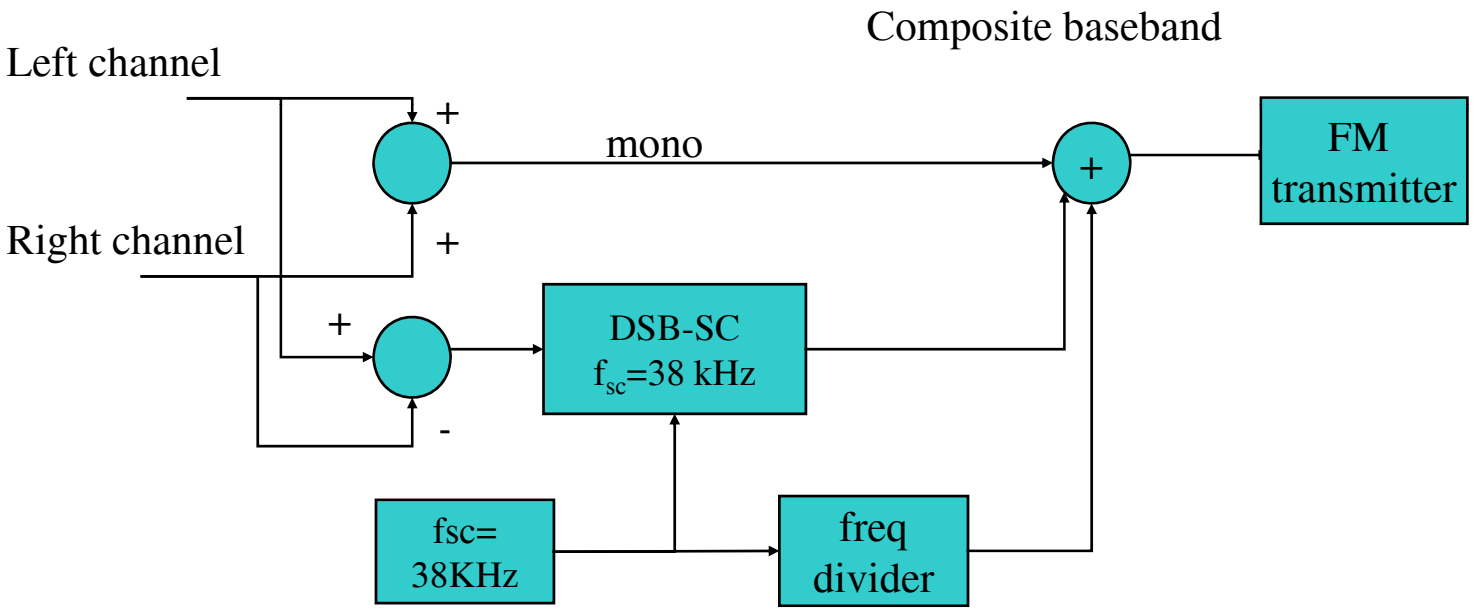
Subcarrier modulation

- The mono signal is left alone but the difference channel is amplitude modulated with a 38 KHz carrier



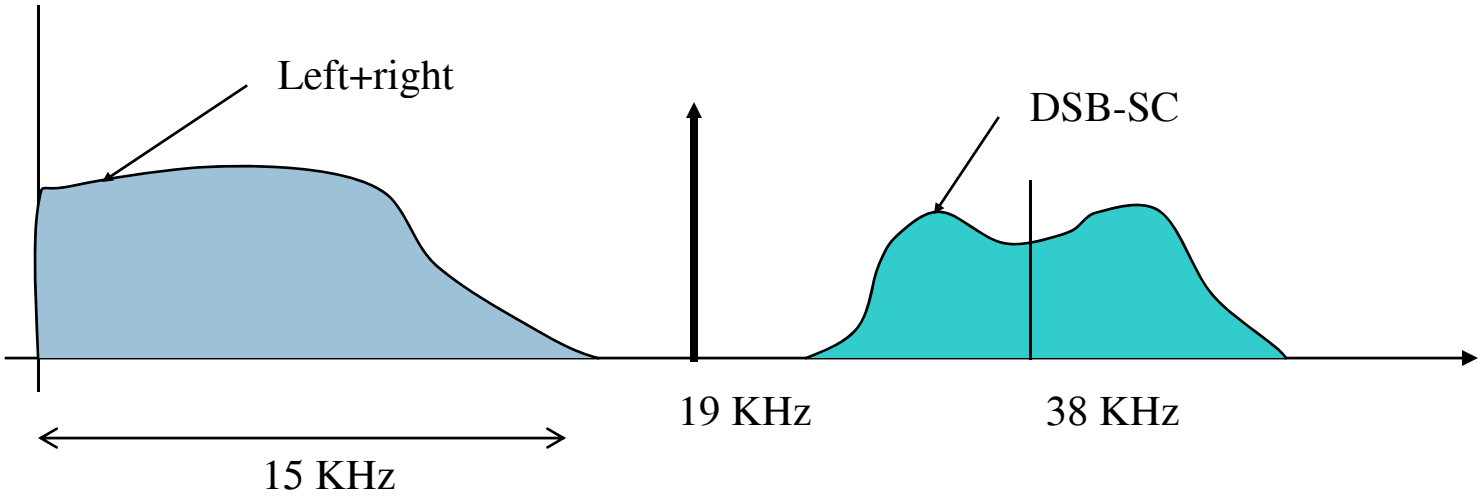
Stereo signal

- Composite baseband signal is then frequency modulated



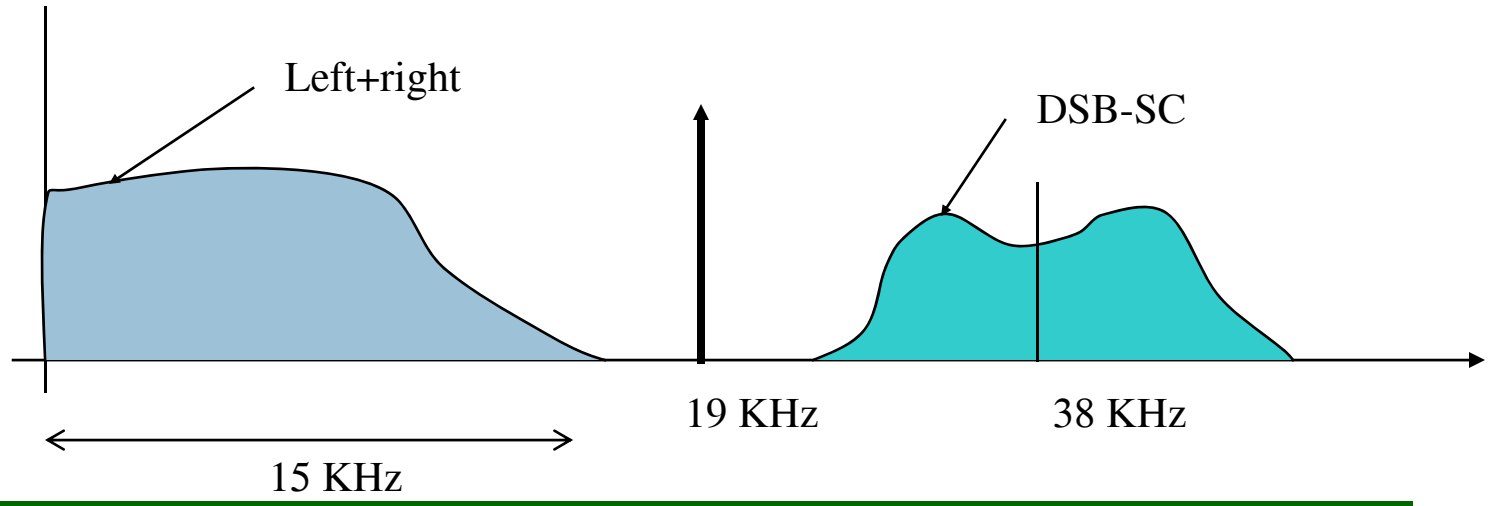
Stereo spectrum

- Baseband spectrum holds all the information. It consists of composite baseband, pilot tone and DSB-SC spectrum

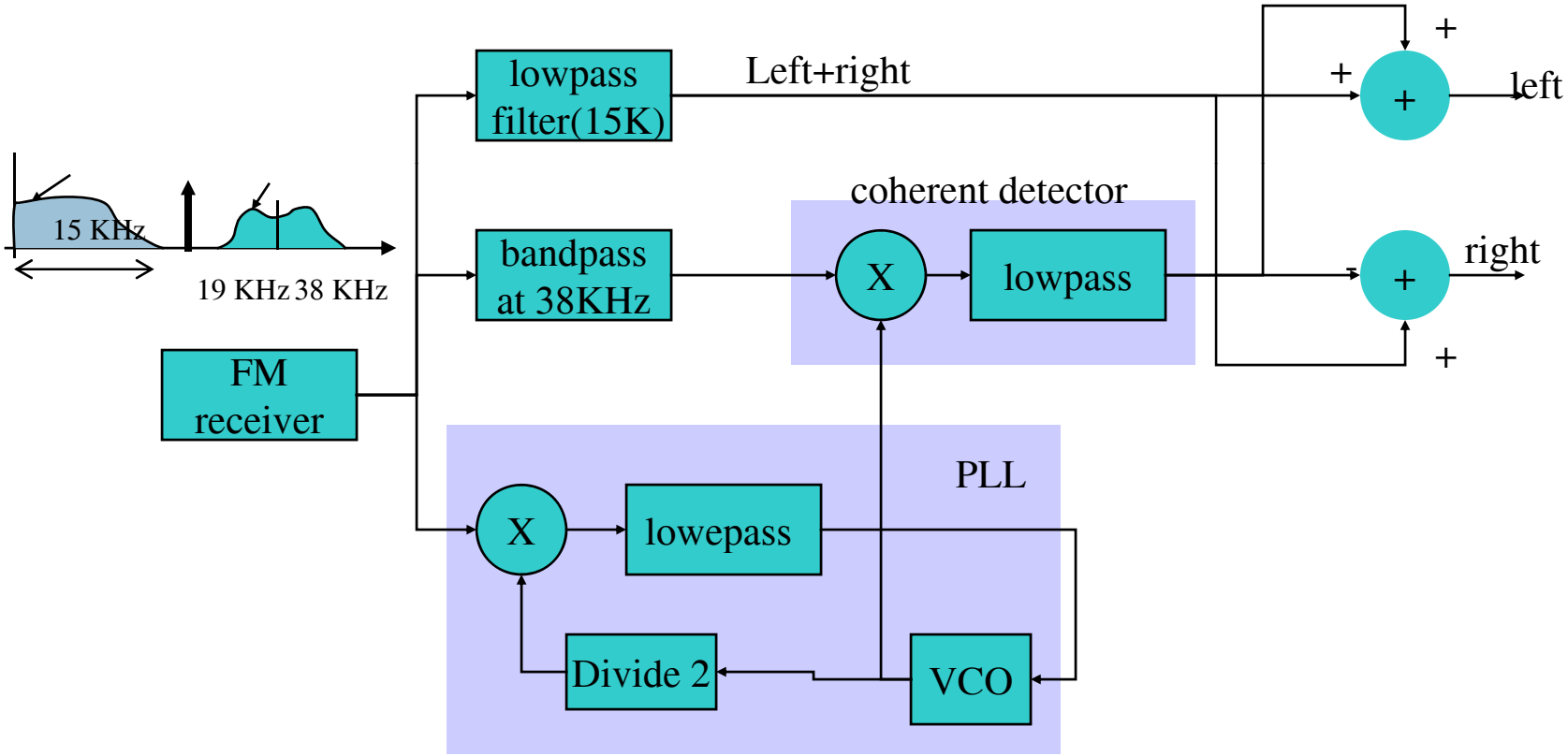


Stereo receiver

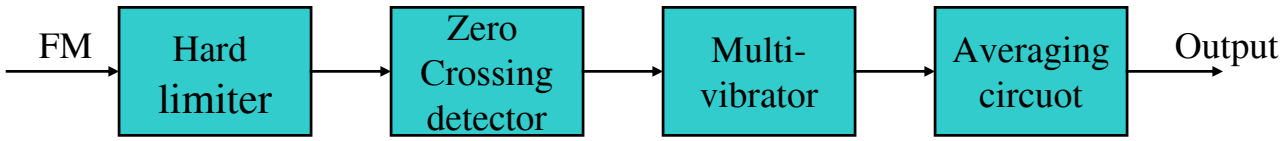
- First, FM is stripped, i.e. demodulated
- Second, composite baseband is lowpass filtered to recover the left+right and in parallel amplitude demodulated to recover the left-right signal

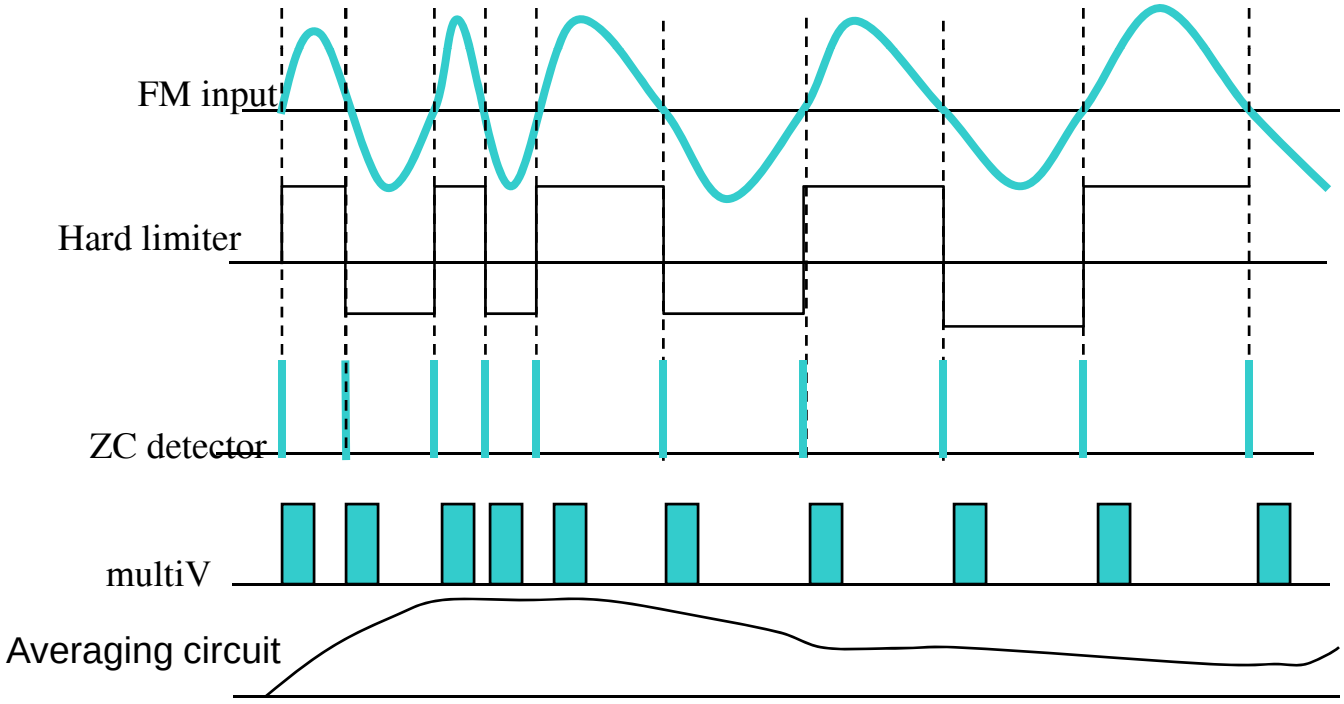


Stereo receiver diagram



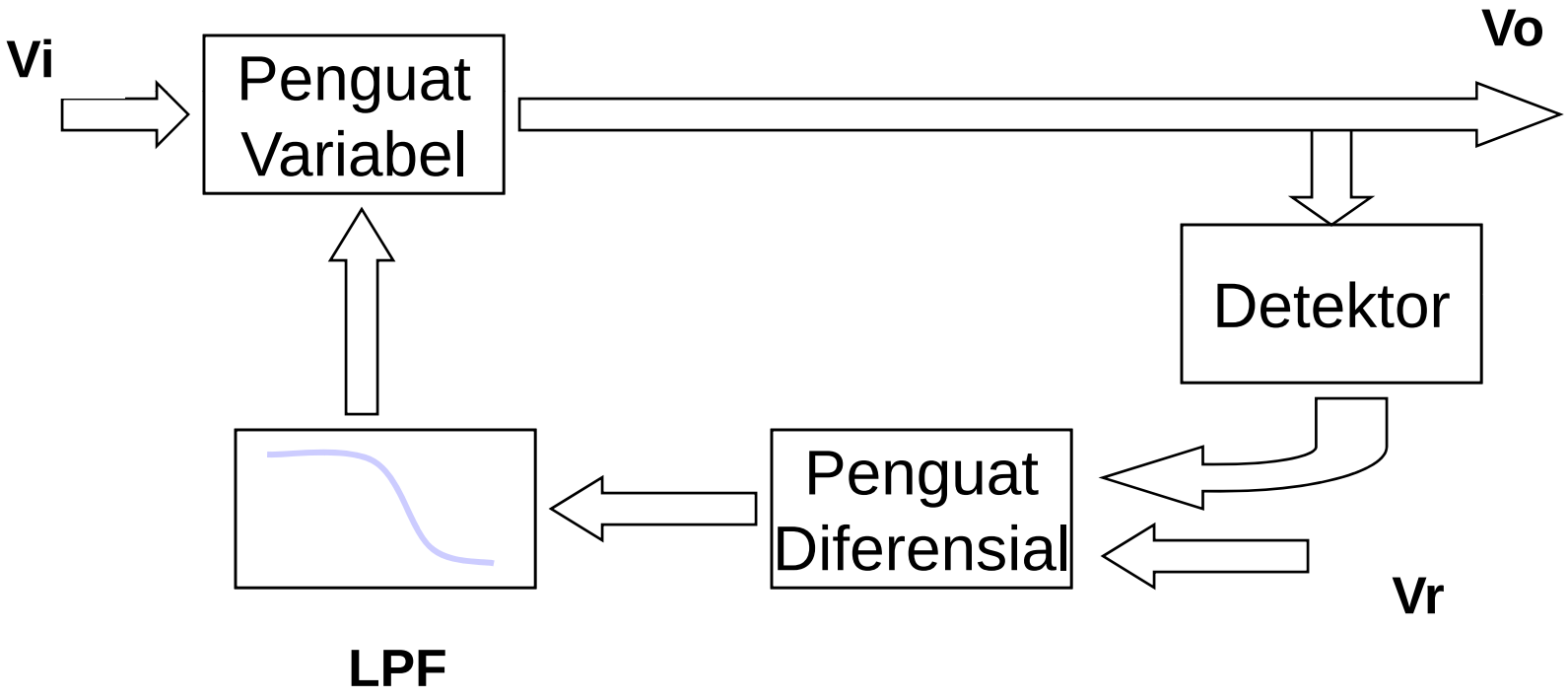
Zero crossing detector





more frequent ZC's means higher inst freq in turn means Larger message amplitudes

AGC (Automatic Gain Control)



AGC (Automatic Gain Control)