FM TRANSMISSION

Mono, Stereo, Surround, Radio Data Service (RDS)

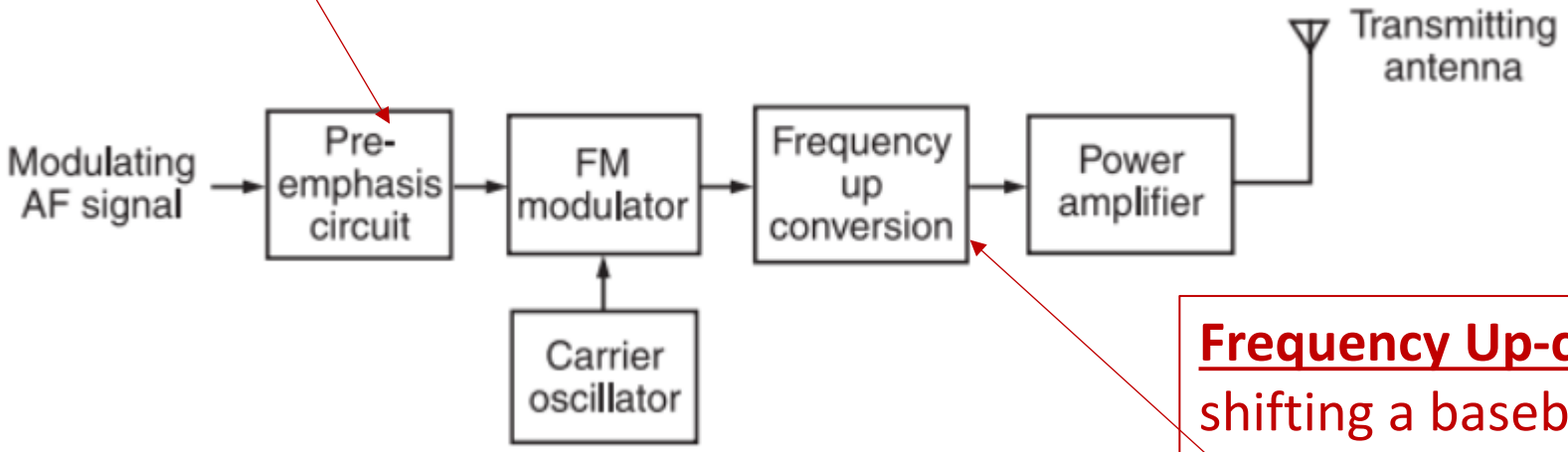
EEEN 462 – ANALOGUE COMMUNICATION SYSTEMS

Friday, 21 November 2025

BLOCK DIAGRAM OF A MONO FM TRANSMITTER

Pre-emphasis

Boost the amplitude of higher frequency modulating signals to improve the noise immunity at higher modulating frequencies.



Frequency Up-conversion

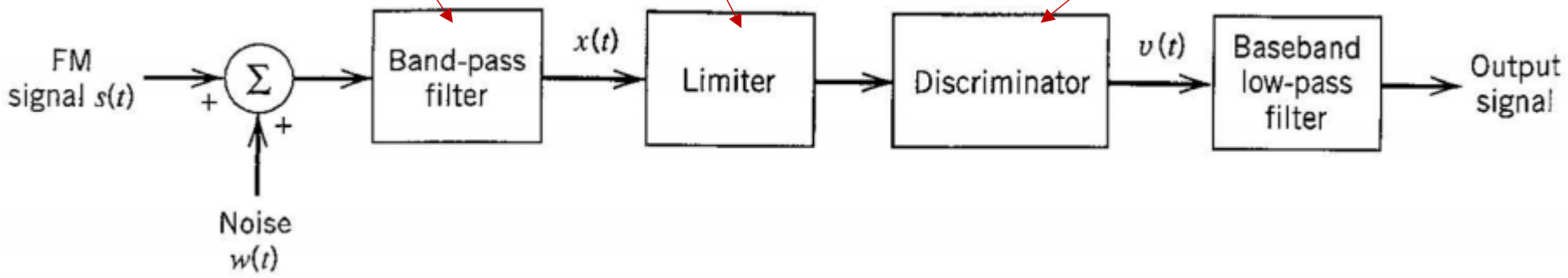
shifting a baseband signal's frequency, often modulated at a lower intermediate frequency (IF), to a much higher radio frequency (88 – 108 MHz) for transmission.

BLOCK DIAGRAM OF A MONO FM RECEIVER

Bandpass filter allows only the signals in the passband through

Limiter removes any amplitude variation

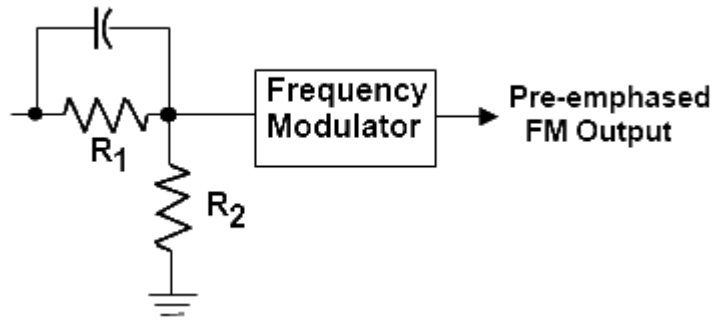
Discriminator gives an output that is proportional to the frequency deviation.



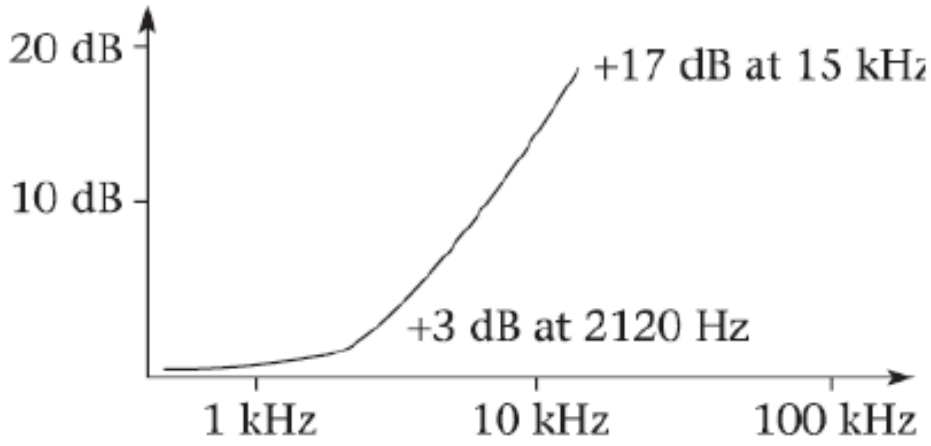
1. In FM, the noise level increases with the modulation frequency.
2. To compensate for this effect, FM communication systems incorporate a noise-combating system of **pre-emphasis and de-emphasis**.

FM PRE-EMPHASIS

1. **Pre-emphasis** provides increased amplitude to the higher modulating frequencies prior to modulation under a well-defined pre-emphasis (high-pass filter) curve.
2. This added amplitude makes the higher frequencies more immune to noise by increasing their index of modulation.

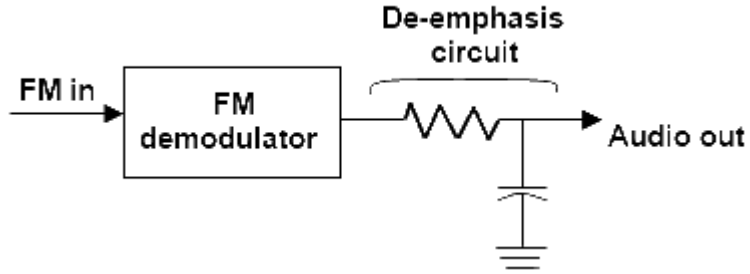


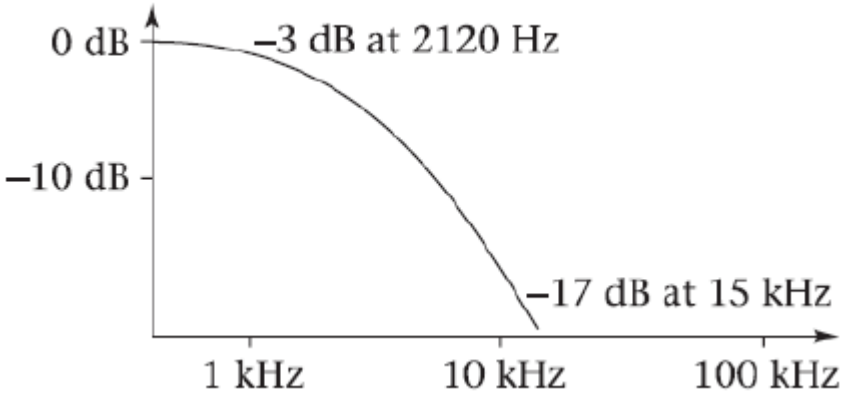
Simple Pre-emphasis Circuit



FM DE-EMPHASIS

- A de-emphasis circuit is designed to un-do the effect of the emphasis filter.



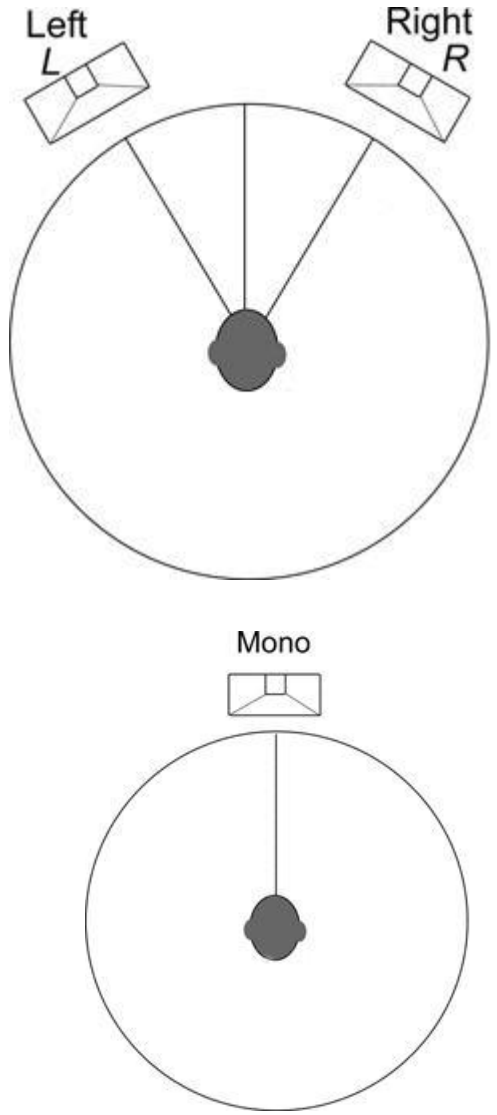


Further Reading

https://electronicspost.com/what-is-pre-emphasis-and-de-emphasis/

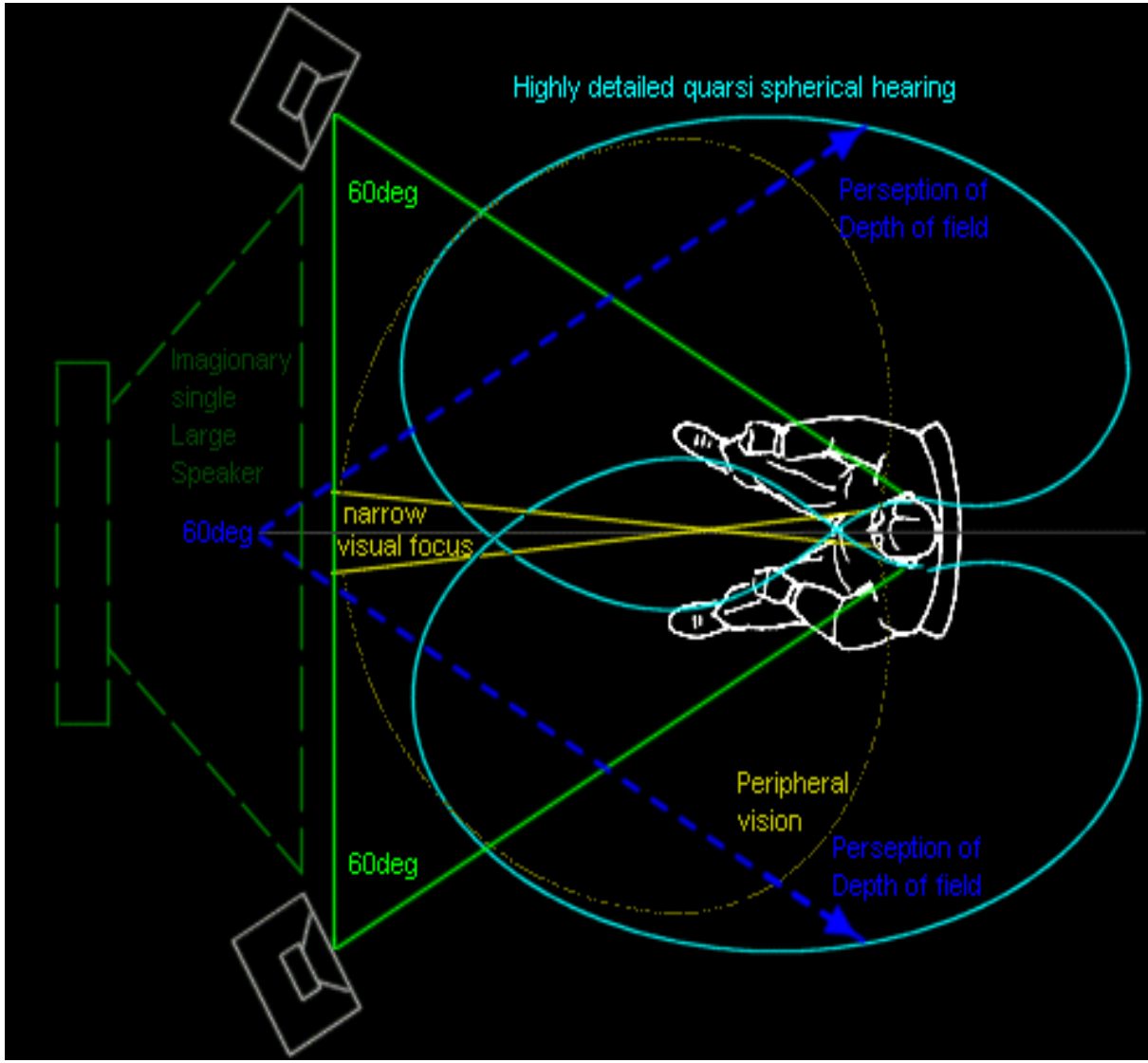
DEFINITION OF STEREO

1. **Stereophonic sound** or, more commonly, stereo, is a method of sound reproduction that creates an illusion of directionality and audible perspective.
2. Stereo production uses two or more independent audio channels through a configuration of two or more loudspeakers (or stereo headphones) in such a way as to create the impression of sound heard from various directions, as in natural hearing.
3. Modern stereophonic technology was invented in the 1931 by British engineer Alan Blumlein who patented stereo records, stereo films, and also surround sound.
4. The word stereophonic derives from the Greek words:
   a) stereos meaning "firm, solid," and
   b) Phone meaning “sound, tone, voice".



EVENTS LEADING TO THE INVENTION

1. Blumlein and his wife were at a local cinema.
2. **The sound reproduction systems had a single set of speakers** which led to the somewhat disconcerting effect of the actor being on one side of the screen whilst his voice appeared to come from the other.
3. Blumlein declared to his wife that he had found a way to make the sound follow the actor across the screen.

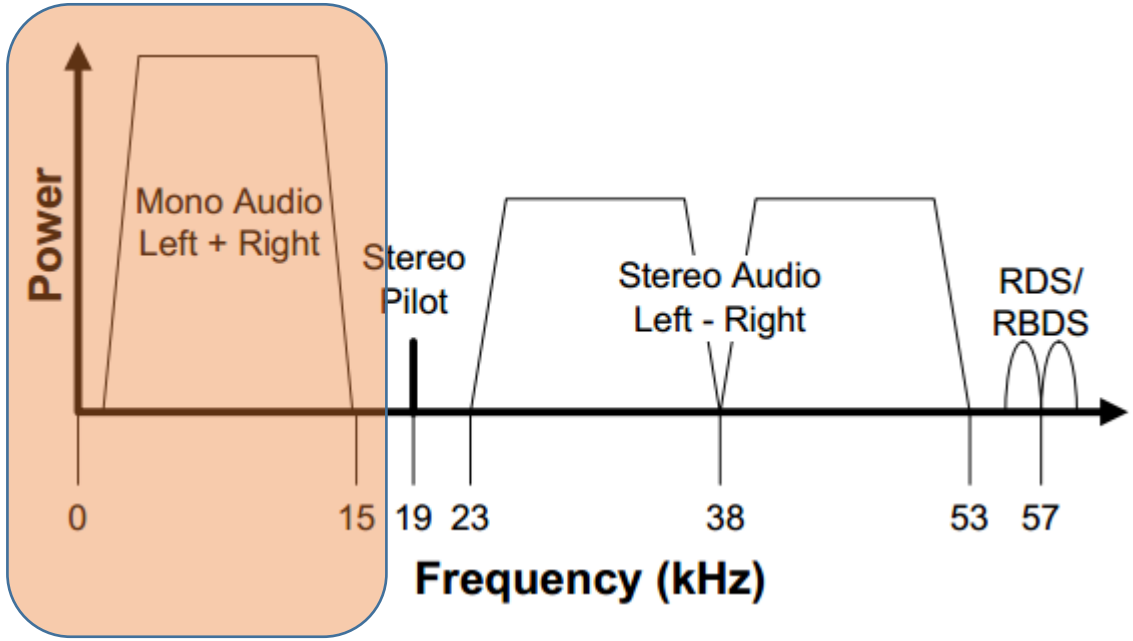


SURROUND SOUND

1. **Surround sound** is a technique for enriching the sound reproduction quality of an audio source with additional audio channels from speakers that surround the listener providing sound from a 360° radius in the horizontal plane (2D).
2. The first documented use of surround sound was in 1940, for the Disney studio's animated film Fantasia.
3. Surround sound is used in:
   a) Cinemas,
   b) Home Entertainment Systems, and
   c) Sound Recording.

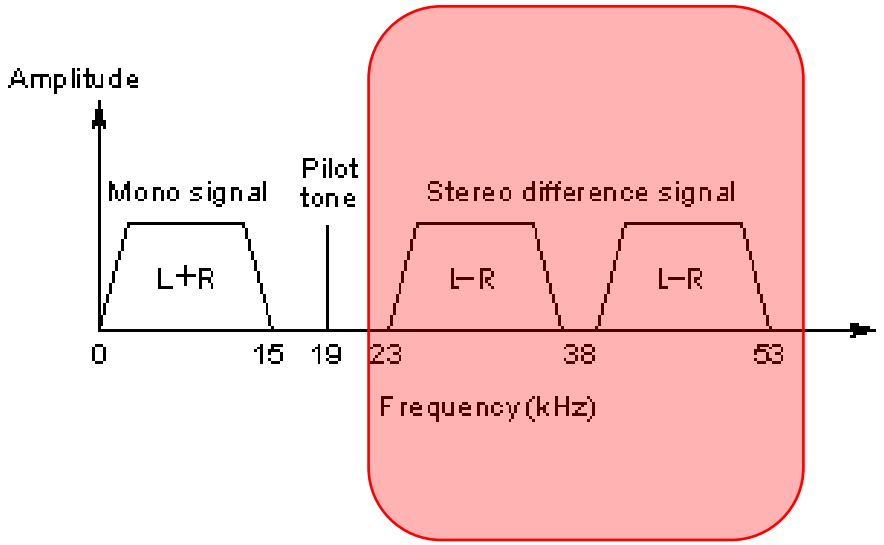
FREQUENCY SPECTRUM OF FM SIGNAL

1. **Mono signal (0-15KHz)** is serves mono receivers (backward compatibility)
2. **Stereo pilot (19 KHz)** is transmitted to:
    1. Notify the receiver that the transmission is stereo.
    2. enable the receiver to reconstruct 38KHz which it uses to demodulate the stereo signal .
3. **RDS** transmits the Time and program details in digital form. Uses the frequency band 57±2KHz.



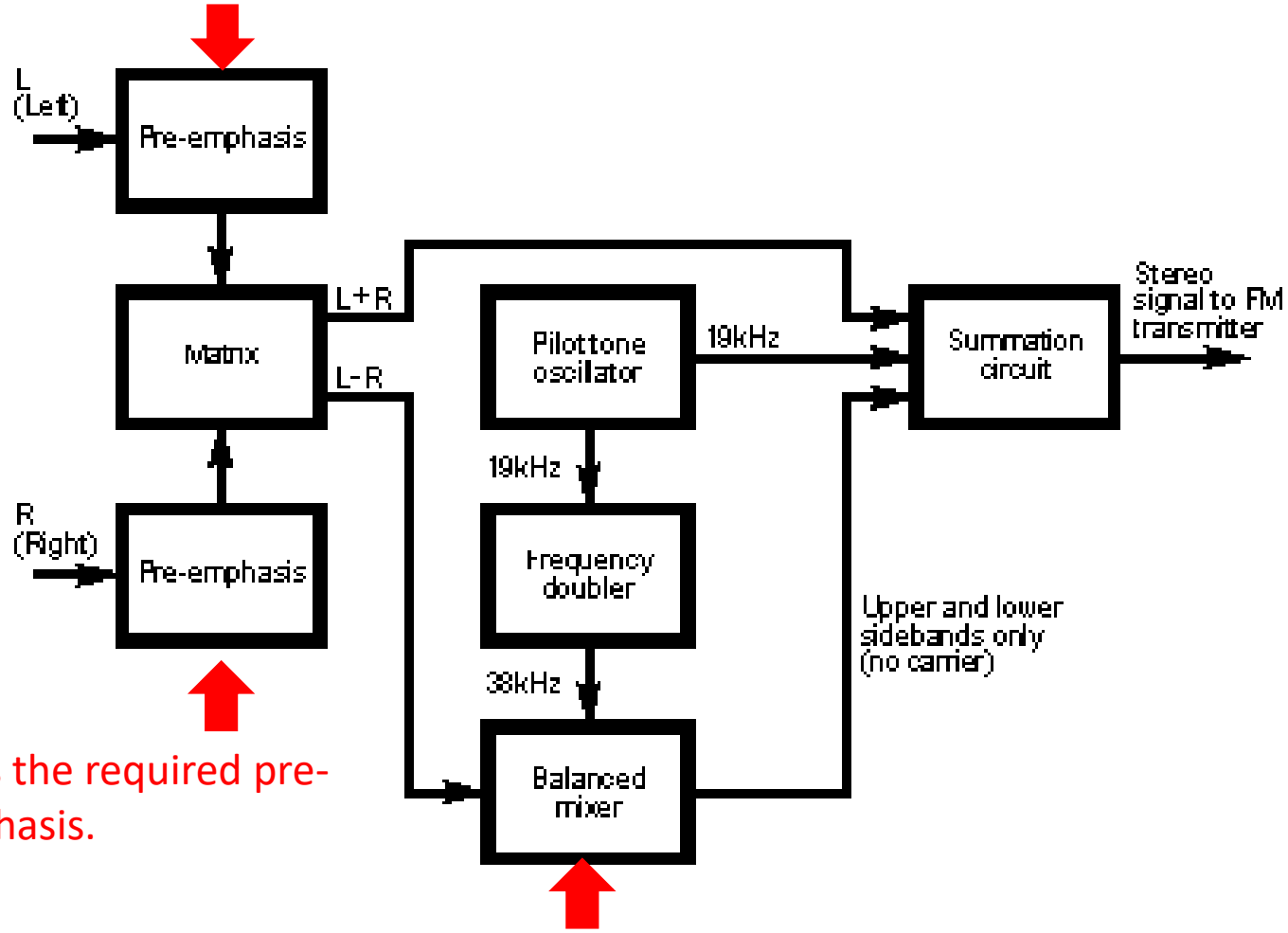
STEREO Vs MONO SIGNALS IN FM TRANSMISSION

1. A stereo signal consists of two channels labelled L and R, (Left and Right), providing one channel for each of the two speakers.
2. An ordinary mono signal consists of the summation of the two channels, i.e. L + R, and this can be transmitted in the normal way.
3. If in addition, a signal containing the difference between the left and right channels, i.e. L - R is transmitted then it is possible to reconstitute the left only and right only signals.
    1. Adding the sum and difference signals, i.e. (L + R) + (L - R) gives 2L
    2. Subtracting the two signal, i.e. (L + R) - (L - R) gives 2R, i.e. the right signal.



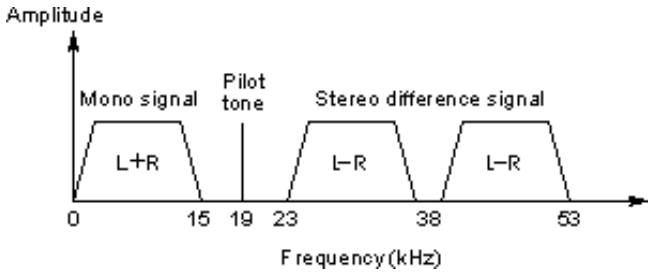
SIMPLIFIED BLOCK DIAGRAM OF STEREO FM MODULATOR

Adds the required pre-emphasis.

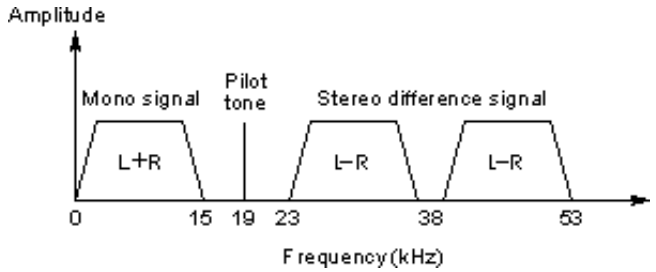


Adds the required pre-emphasis.

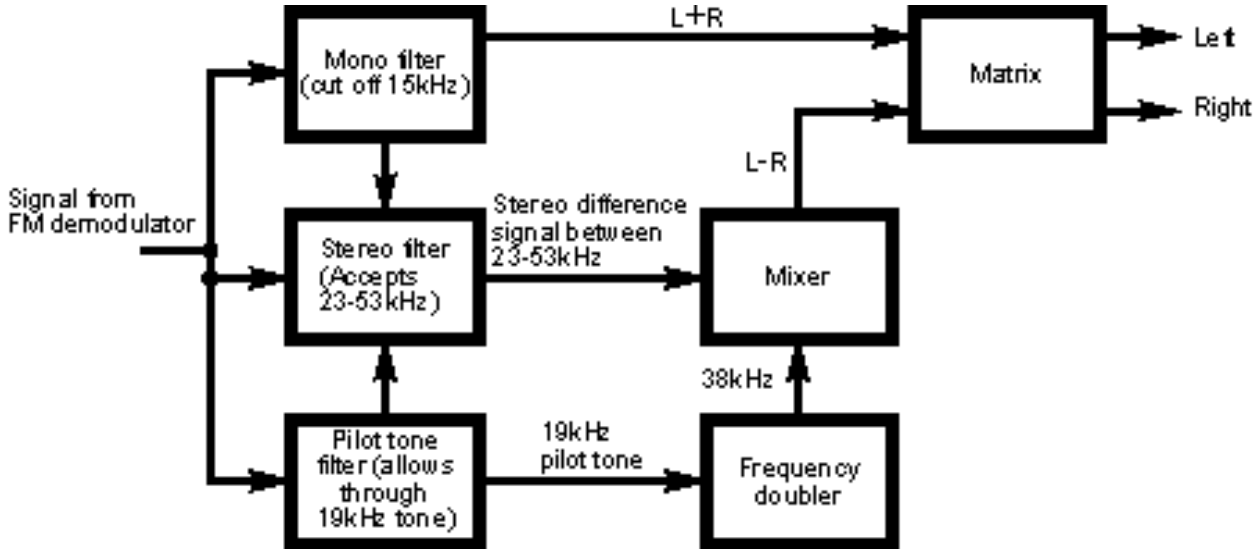
Creates a DSB-SC signal.



BLOCK DIAGRAM OF A STEREO FM DECORDER

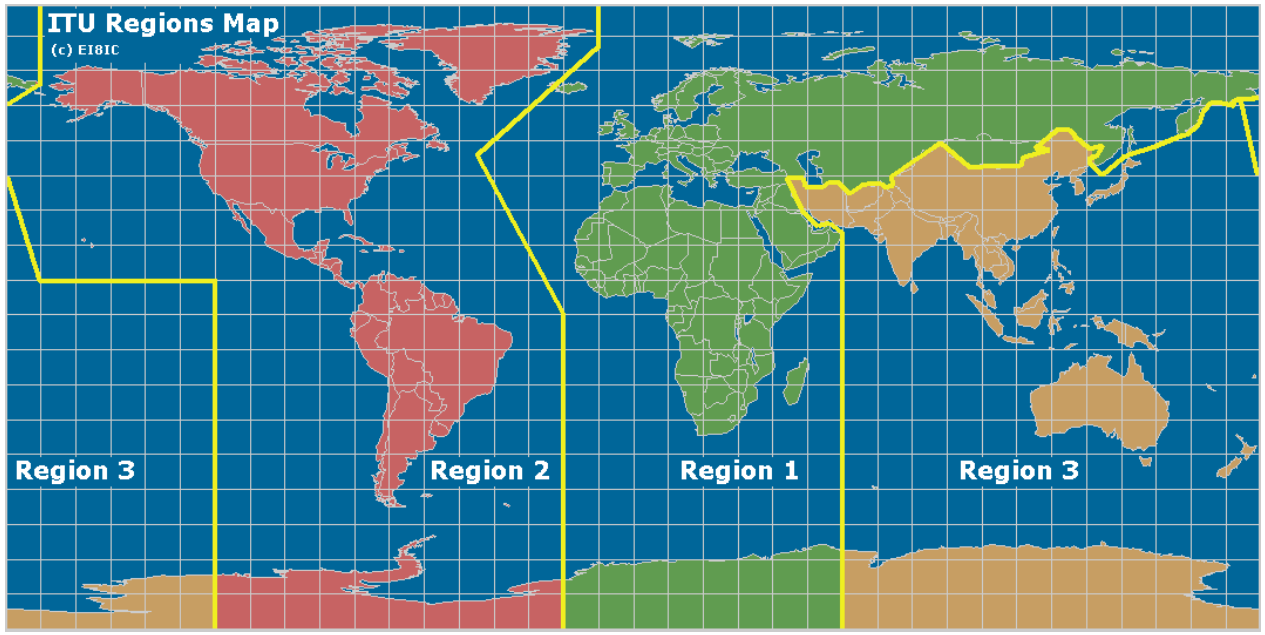


(L+R)-(L-R) = 2R
(L+R)+(L-R) = 2L



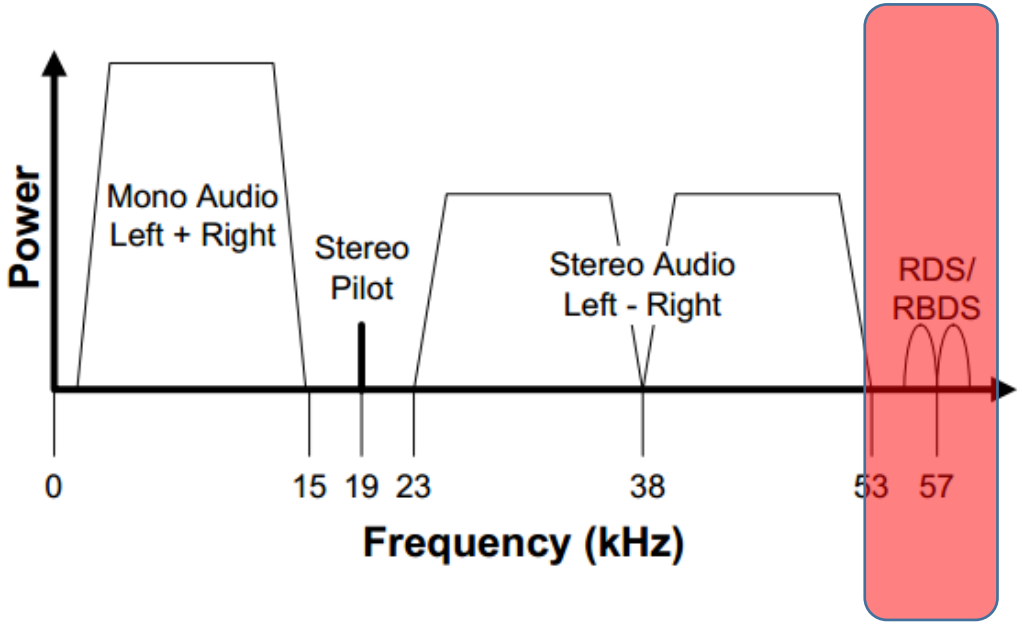
FM TRANSMITTER BANDS

1. **87.5 - 108.0 MHz:** The "standard" VHF FM band used around the globe.
2. **76.0 - 90 MHz:** FM band is used in Japan.



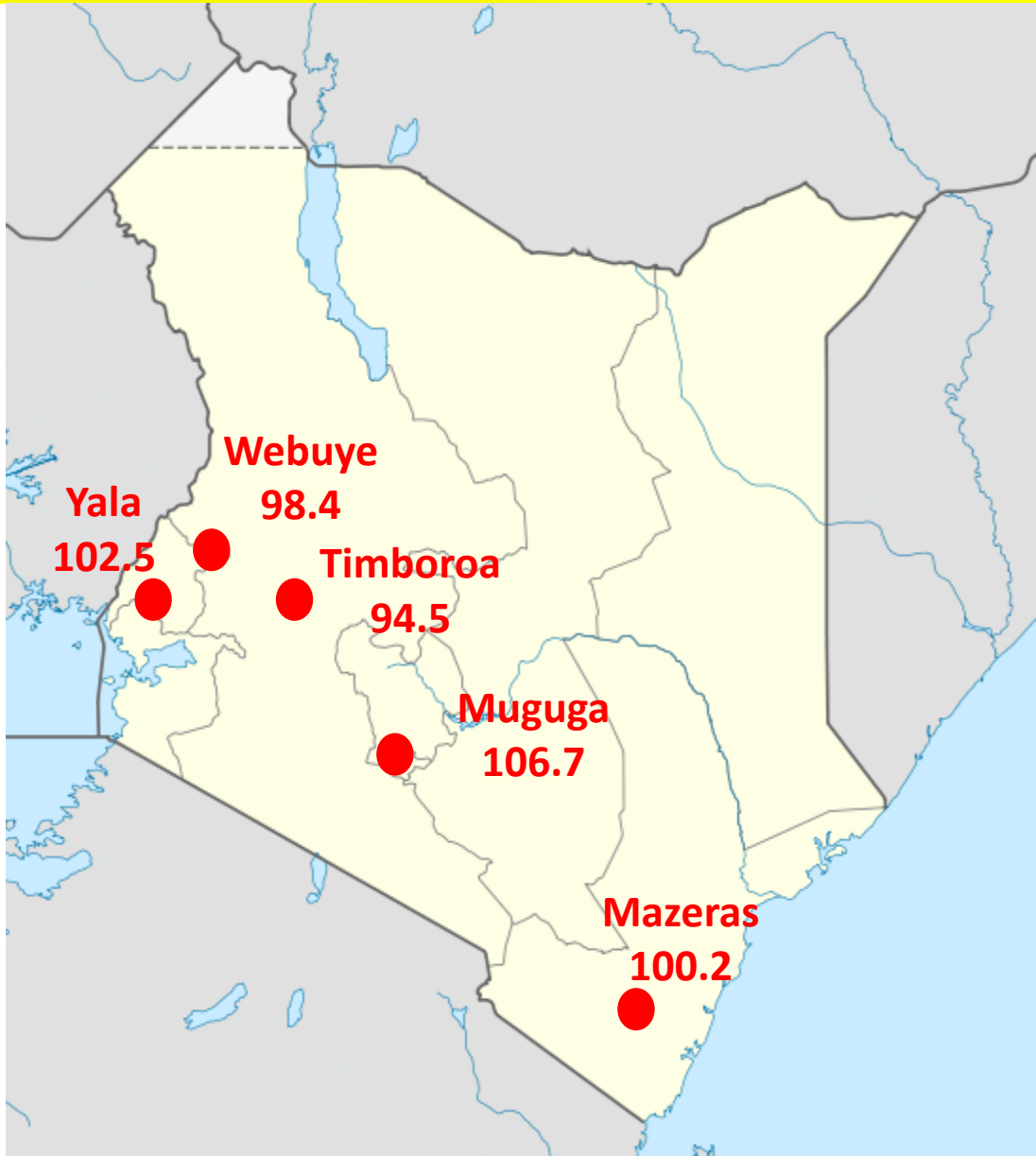
RADIO DATA SERVICE (RDS)

1. First developed in Germany where system was developed to place traffic information onto FM broadcasts using a 57 kHz sub-carrier.
2. In 1974, trial was taken up by the European Broadcasting Union, who proposed that the Germany traffic information model be expanded to:
   a) carry other data like programme information
   b) allow automatic re-tuning of a receiver when it went outside the range of one transmitter.

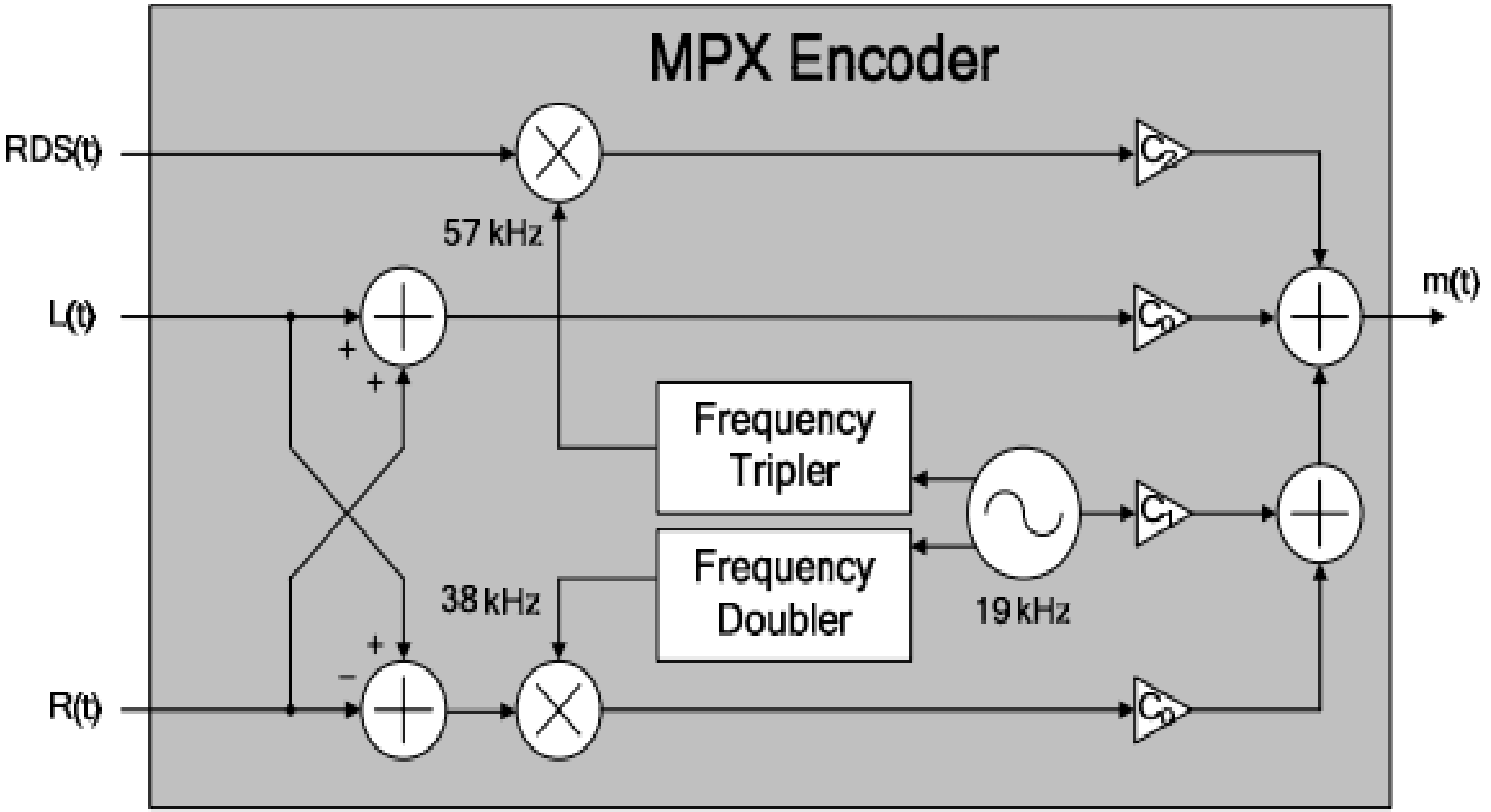


USING RDS FOR AUTO-TUNING

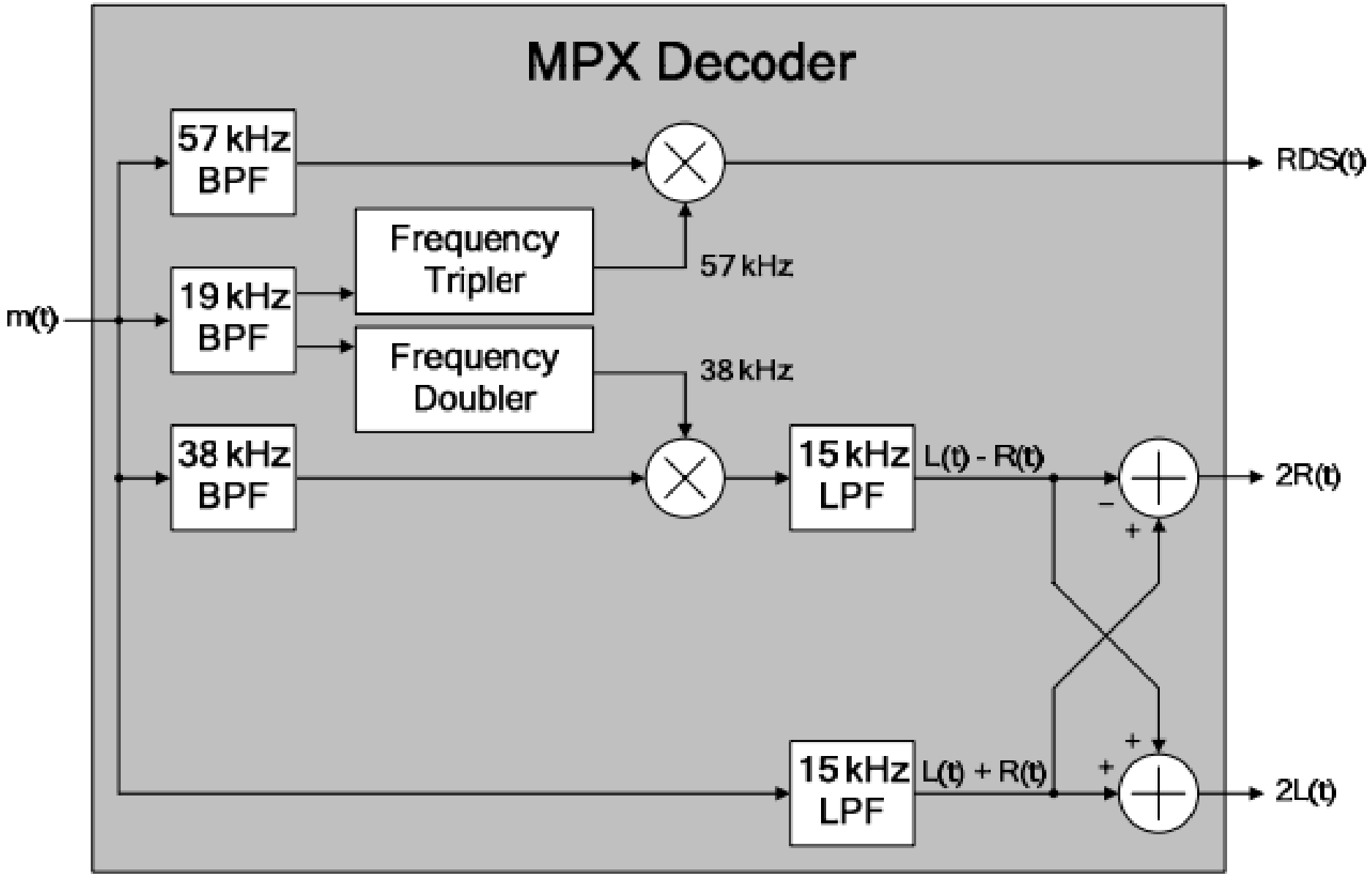
1. Each station has its own **Programme Identification (PI) code.**
2. A national FM broadcasting Station will be broadcast from a large number of different transmitters around the country.
3. When the radio moves out of the range of one transmitter the radio will seek the strongest signal which has the same PI code, allowing the radio to remain tuned to the same programme.
   a) When radios fitted with RDS store a station frequency, they also store the PI code alongside it.
   b) When the radio is turned on in a place outside the coverage area for the transmitter frequency which is stored then the radio will seek the strongest signal which has the correct PI code.



BLOCK DIAGRAM RDS MPX CODER



BLOCK DIAGRAM OF RDS MPX DECODER



COMPARISON OF MONO & STEREO FM

EATURE	MONO FM	STEREO FM
Sound Channels	One (Monaural)	Two (Left & Right)
Sound Reproduction	Identical sound from all speakers. No spatial or directional information.	Separate Left and Right channels create a sense of direction, depth, and soundstage.
Bandwidth Requirement	Narrower (Max 15 kHz audio frequency)	Wider. Requires extra bandwidth for the stereo difference (L-R) signal.
Compatibility	**Universal.** All FM radios can receive a mono broadcast.	**Selective.** A stereo receiver is required. Mono receivers will still play the broadcast in mono.
Signal-to-Noise Ratio (SNR)	Higher (Less background hiss, especially in weak signal areas)	Lower. The stereo process inherently introduces more noise ("hiss").
Data Service	None	Radia Data Service (RDS)