



MONO
STEREO
MPX

In the FM transmission there are mainly two types of audio signals:

- Mono
- Stereo

Stereo signals are actually more common in broadcast radio and they consist of two channels that can be labelled L and R (Left and Right) providing one channel for each of the two speakers and create the impression of sound heard from various directions, as in natural hearing.

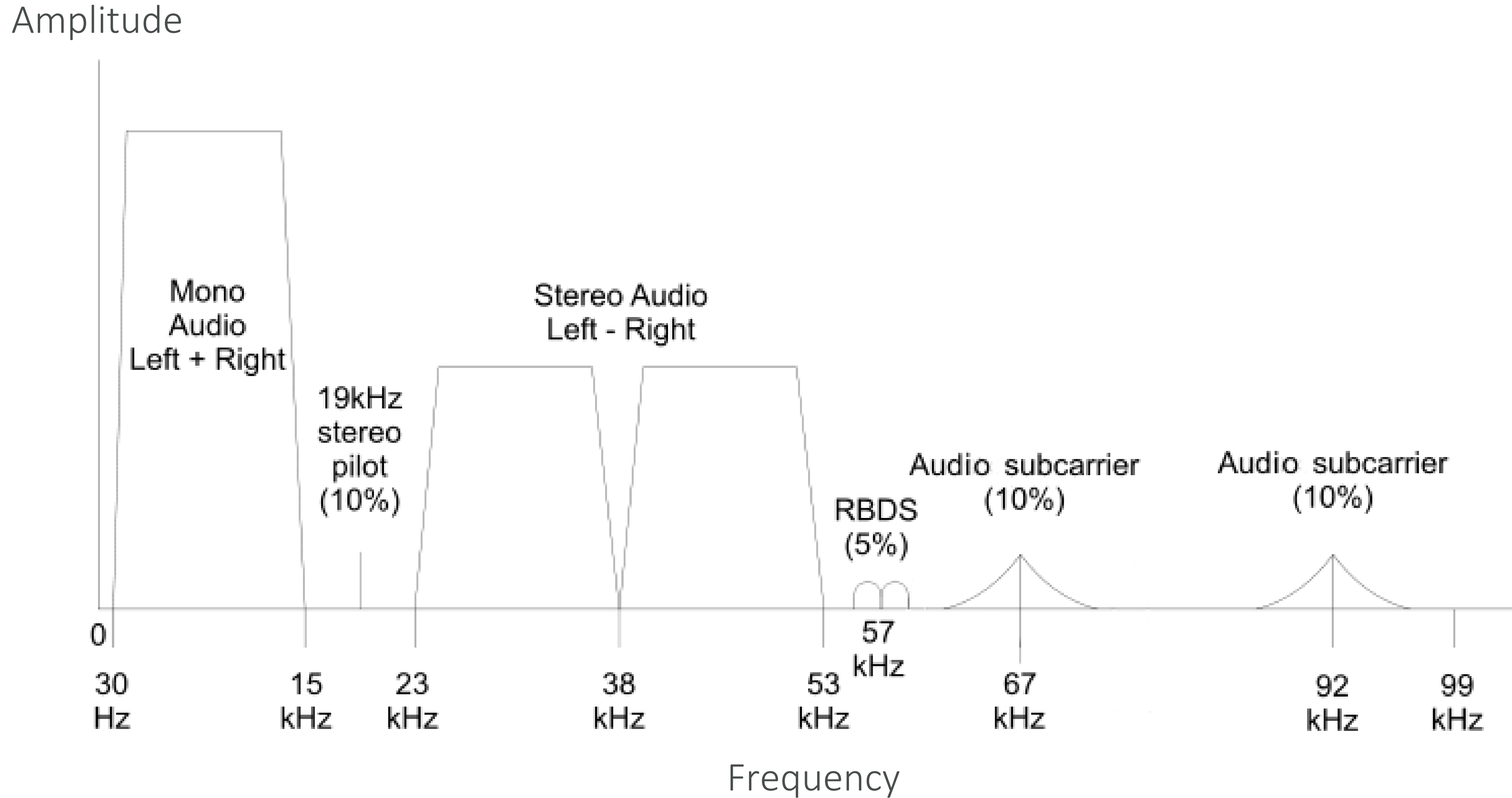


The MPX FM stereo system was designed to be backward compatible and it allows broadcast signals to be received on mono equipment as well. It is composed of three parts.

- The first is a normal audio signal made up of the Sum of Left and Right channels. This is the signal heard on a Mono radio and it is the same as switching the Stereo/Mono Switch on an amplifier to “Mono”.
- In addition, a difference signal (Left - Right) is generated and then used to modulate a 38 kHz subcarrier using Double sideband suppressed carrier (DSBSC) modulation. This is an AM modulation of the subcarrier.
- To keep the receiver decoder locked into the 38kHz subcarrier, a 19 kHz pilot tone (EXACTLY 1/2 of 38 kHz) is transmitted as well. The pilot is feeded with a 10% modulation.



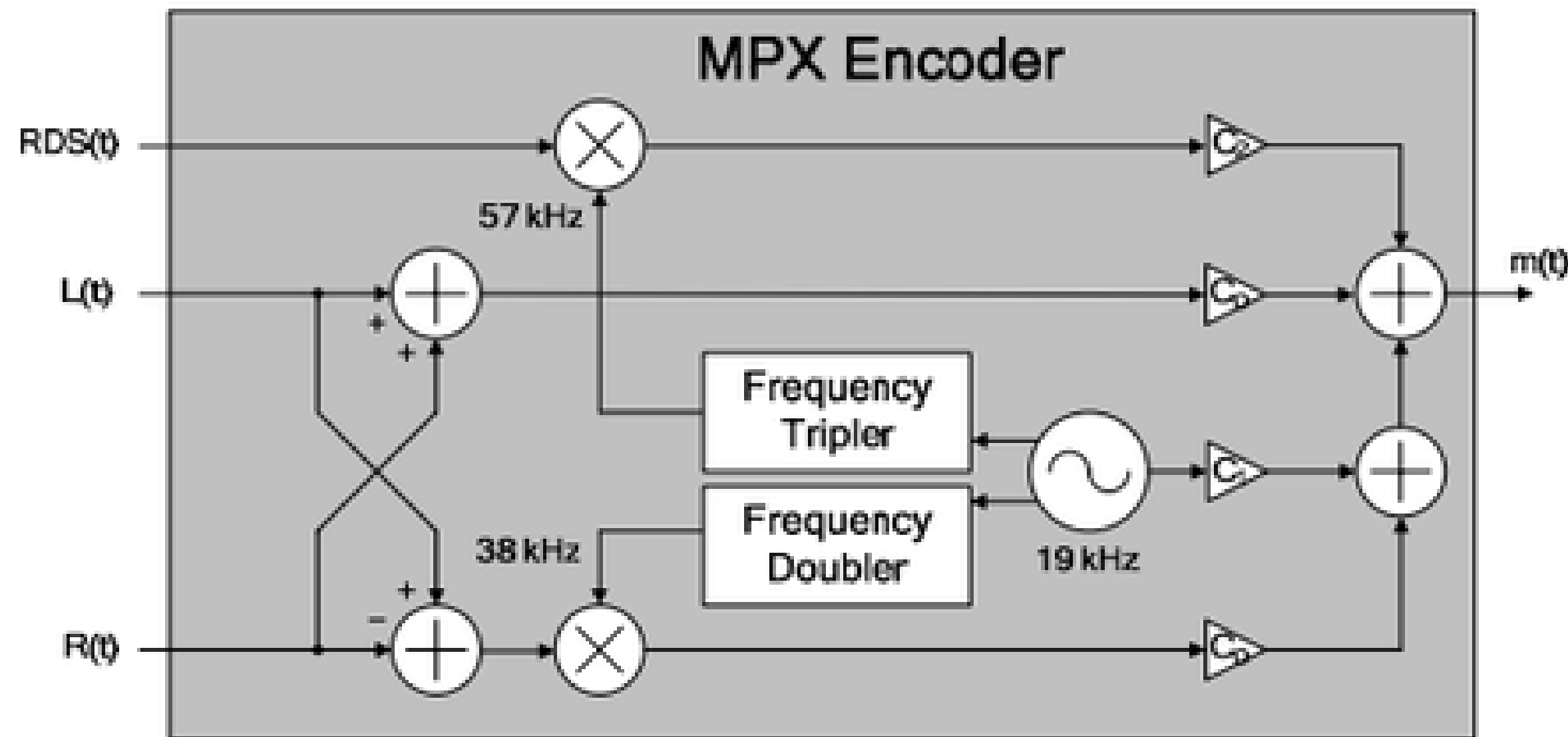
FM STEREO BROADCAST BAND



MPX ENCODER

It is also possible to encode other information on an MPX signal together with the Left and Right audios: often the RDS signal is mixed with them.

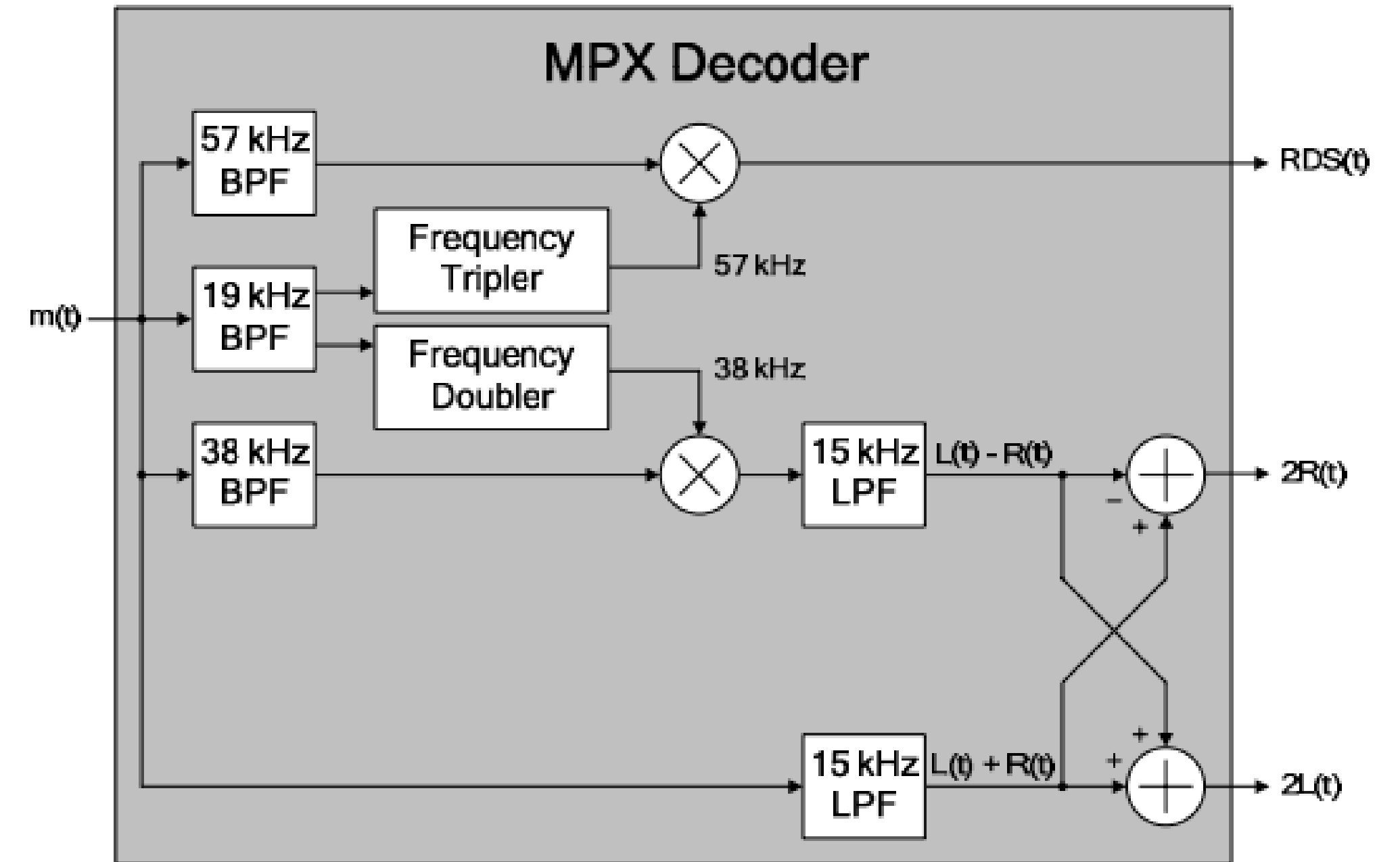
RDS stands for Radio Data System. It uses a 57kHz subcarrier to carry data at 1187.5 bits per second. The 57kHz was chosen for being the third harmonic (3x) of the pilot tone for FM stereo, so it would not cause interference or intermodulation with it, or with the stereo difference signal at 38kHz (2x).



Using different filters it is also possible to recover all the information at the receiver side: although this is not the only method which can be used it shows the basic required processes.

The signal is first separated into its three components:

- The L + R mono signal between 0 and 15 kHz,
- The pilot tone at 19 kHz,
- The stereo difference signal situated between 23 and 53 kHz.



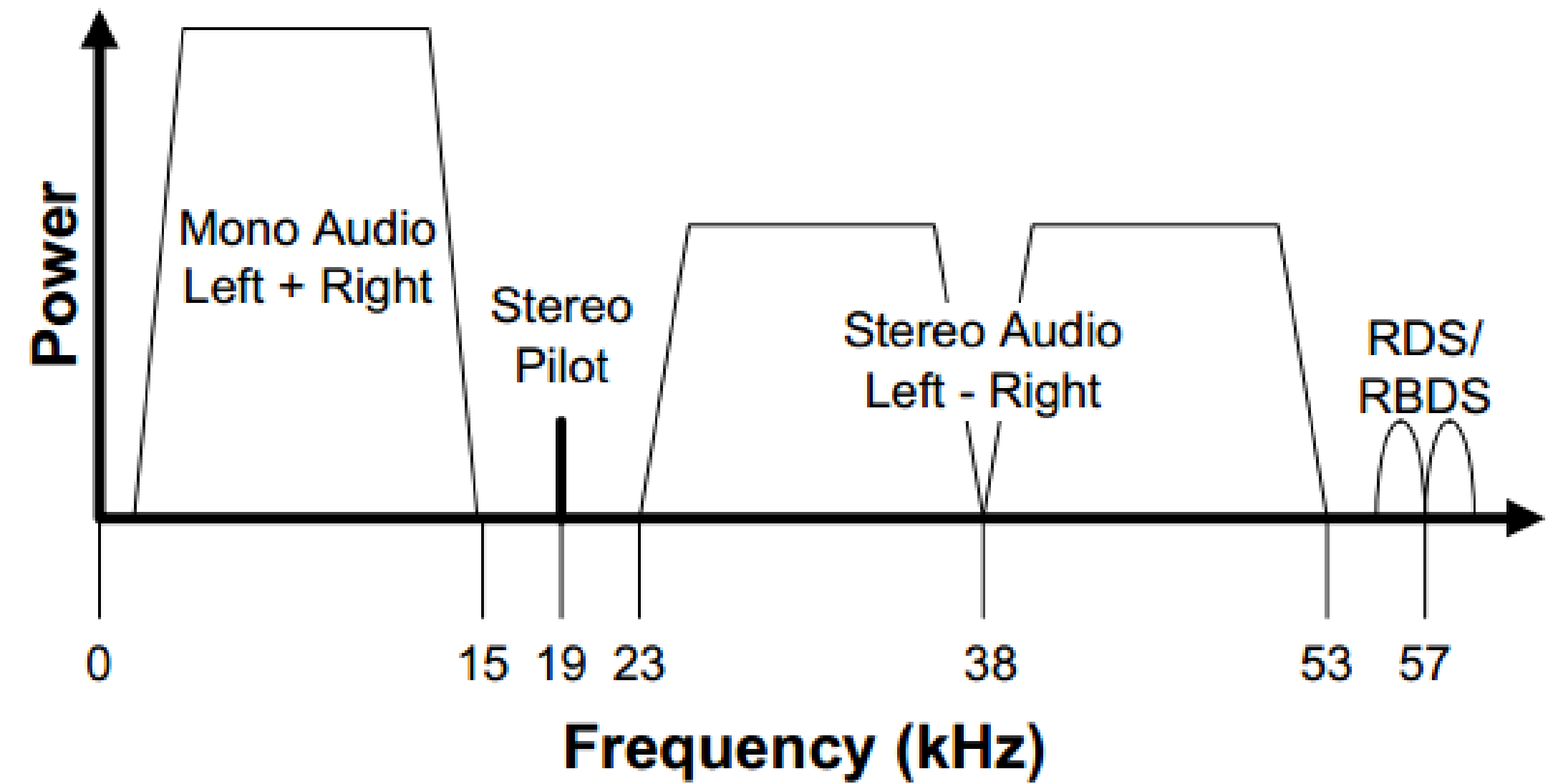
First the pilot tone at 19 kHz is doubled in frequency to 38 kHz. It is then fed into a mixer with the stereo difference signal to give the L - R signal at audio frequencies. Once the L + R and L - R signals are available they enter a matrix where they are added and subtracted to regenerate the L and R signals. At this point both signals are amplified separately in the normal way in a stereo amplifier before being converted into sound by loudspeakers or headphones.

Left channel:

$$L = \frac{(L + R) + (L - R)}{2}$$

Right channel:

$$R = \frac{(L + R) - (L - R)}{2}$$



Mono sound is preferred in radiotelephone communications, telephone networks, and radio stations dedicated to talk shows and conversations, public address system, hearing aids.



Stereo sound is preferred for listening to music, in theaters, radio stations dedicated to music, FM broadcasting and Digital Audio Broadcasting (DAB).



The difference between mono and stereo, in long distances, is that the mono-only signal is a bit more than twice as powerful as the stereo signal. Also, if the receiver is moving (like in a car) there is less multi-path interference.

In fringe areas, the stereo signal can become weak enough to be undecodable, causing the receiver to switch between mono and stereo modes, which is disconcerting to the average listener, especially during music.

Stereo encoded signals (MPX) are in any case preferred for the sound reproduction that creates an illusion of multi-directional audible perspective and for the quantity of information that can be carried by a single signal.



LET'S SUMMARIZE

	MONO	STEREO (L & R)	STEREO MPX
INTRODUCTION	Monaural or monophonic sound reproduction is intended to be heard as if it was a single channel of sound perceived as coming from one position.	Stereophonic sound or, more commonly, stereo, is a method of sound reproduction that creates an illusion of multi-directional audible perspective.	Stereophonic sound or, more commonly, stereo, is a method of sound reproduction that creates an illusion of multi-directional audible perspective.
COST	Less expensive for recording and reproduction	More expensive than mono for recording and reproduction	More expensive than mono for recording and reproduction
RECORDING	Easy to record, requires only basic equipment	Requires technical knowledge and skill to record, apart from equipment. It's important to know the relative position of the objects and events.	Same as for stereo (L&R) but more common because most of the audio processors now have this kind of output signal.
KEY FEATURE	Audio signals are routed through a single channel	Audio signals are routed through 2 or more channels to simulate depth/direction perception, like in the real world.	2 audio signals are coded in a single channel and then decoded on the receiver side. Often the encoder is already included into the FM transmitter (no additional costs)
STAND FOR	Monaural or monophonic sound	Stereophonic sound	Stereophonic sound
USAGE	Public address system, radio talk shows, hearing aid, telephone and mobile communication, some AM radio stations	Movies, Television, Music players, FM radio stations	Movies, Television, Music players, FM radio stations
NUMBER OF CHANNELS	1	2	1



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