OPEN ACCESS

Journal Info
ISSN: To be assigned
Scholaria Publications
Scholaria International Journal of Research
International Peer Reviewed Journal
2026, Volume 1 – Issue 1

Article Info
Received: 15 Feb 2026
Revised: 08 Mar 2026
Accepted: 18 Mar 2026
Published: 16 Apr 2026
DOI: Not Assigned
Article Type: Research Article

Radio Receivers and Their Function in Modern Communication Systems

Malisetty Divya Manasa
Assistant Professor
Department of Electr. Commun. Engg
TKR College of Engineering and Technology,Hyderabad, Telangana, India
divya.tanaya@gmail.com

Abstract

In a communication system, a radio transmitter sends information by transmitting a modulated carrier signal through a transmission medium. This signal is captured by the receiving antenna of a radio receiver. Typically, the received signal is very weak and is accompanied by unwanted noise and interference from nearby frequencies.
To process this signal, the receiver first strengthens it using a radio frequency (RF) amplification stage. It then employs filtering techniques to isolate the desired signal while suppressing noise and interference. After signal selection, the recovered audio signal is usually weak and requires further amplification through one or more audio amplifier stages before it can be effectively utilized.

Keywords: radio receiver, RF amplifier, demodulation, communication system, signal processing, noise filtering

1 Introduction

Based on the fundamental operation of communication systems, the primary functions of a radio receiver can be outlined as follows:

1. Capture the incoming electromagnetic signal using a receiving antenna.
2. Isolate the required signal from other unwanted signals and noise.
3. Strengthen the selected radio frequency (RF) signal through amplification.
4. Recover the original information signal by demodulating the received waveform.
5. Increase the strength of the recovered baseband signal for practical use.

In essence, a radio receiver is an electronic system designed to extract useful information from a transmitted signal. It performs signal acquisition, filtering, amplification, and demodulation to reproduce the original message signal while minimizing the effects of interference and noise.

2 Classification of Radio Receivers

Radio receivers can be categorized based on their application as well as their operating principles.

2.1 Based on Applications

Depending on their intended use, radio receivers are classified into the following types:

1. **AM Broadcast Receivers:** These receivers are designed to receive amplitude-modulated signals carrying audio content such as speech and music.
2. **FM Broadcast Receivers:** These are used for receiving frequency-modulated transmissions, generally in the VHF and UHF frequency ranges, and are widely used for high-quality audio broadcasting.
3. **Communication Receivers:** Such receivers are employed in communication systems for receiving telegraph signals and shortwave voice transmissions. Their applications extend beyond standard broadcasting.
4. **Television Receivers:** These receivers are used to capture television signals transmitted over VHF and UHF bands, enabling both audio and video reception.
5. **Radar Receivers:** These are specialized receivers used in radar systems to detect and process reflected radio waves for applications such as object detection and distance measurement.

2.2 Based on Operating Principles

From a design and operational perspective, radio receivers can also be grouped into:

1. Tuned Radio Frequency (TRF) Receivers
2. Superheterodyne Receivers

Over time, various receiver architectures have been developed; however, the TRF and superheterodyne receivers have been the most significant in practical applications. TRF receivers were commonly used in earlier systems, particularly around the mid-20th century, but they exhibited several limitations. These shortcomings were effectively addressed by the superheterodyne design, which offers improved performance and reliability. As a result, the superheterodyne receiver has become the standard choice in modern communication systems.

In the following sections, the TRF receiver will be discussed first, followed by an examination of the superheterodyne receiver.

3 Tuned Radio Freq - (TRF) Acceptor

The tuned radio freq - TRF receiver represents one of the earliest and simplest forms of radio receivers. A typical block diagram of a TRF receiver is shown in Fig. 1. The first stage of this receiver consists of a radio frequency (RF) section, which generally includes multiple cascaded RF amplifiers. These amplifiers are equipped with tunable circuits at both their input and output, allowing frequency selection.

At the input, a receiving antenna captures signals transmitted from various sources. The desired signal is selected using the tuning mechanism of the RF stage, which filters out unwanted frequencies. Since the selected signal is usually very weak (in the microvolt range), it is amplified by the RF amplifiers to a suitable level.

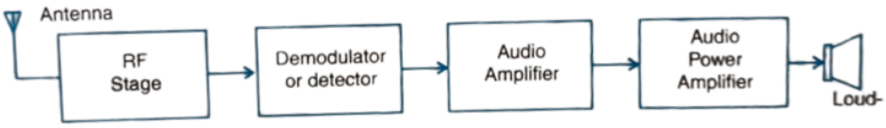

Figure 1: Block diagram of a TRF receiver.

The amplified modulated signal is then passed to a demodulator (detector), where the original baseband or audio signal is extracted. This recovered signal is further strengthened using an audio amplifier, followed by a power amplifier to provide sufficient output to drive a loudspeaker.

3.1 Drawbacks of TRF Receiver

Despite its simplicity and low cost, the TRF receiver has several limitations:

1. **Instability:** High-gain multi-stage RF amplification operating at the same frequency can lead to unintended feedback. Even may cause oscillations due to positive feedback. This instability can arise from factors such as stray capacitance, power supply coupling, or electromagnetic radiation.

2. **Poor Selectivity:** Achieving sharp selectivity at higher frequencies is difficult, especially when using single-tuned circuits.

3. **Bandwidth Variation:** The bandwidth of the tuned circuits changes with frequency, making it challenging to maintain consistent performance across the entire tuning range. For instance, maintaining a fixed bandwidth (e.g., 10 kHz) at different operating frequencies is not straightforward.

4 Classification of Radio Receivers

Radio receivers can be categorized based on their application as well as their operating principles.

4.1 Based on Applications

Depending on their intended use, radio receivers are classified into the following types:

1. **AM Broadcast Receivers:** These receivers are designed to receive amplitude-modulated signals carrying audio content such as speech and music.

2. **FM Broadcast Receivers:** These are used for receiving frequency-modulated transmissions, generally in the VHF and UHF frequency ranges, and are widely used for high-quality audio broadcasting.

3. **Communication Receivers:** Such receivers are employed in communication systems for receiving telegraph signals and shortwave voice transmissions. Their applications extend beyond standard broadcasting.

4. **Television Receivers:** These receivers are used to capture television signals transmitted over VHF and UHF bands, enabling both audio and video reception.

5. **Radar Receivers:** These are specialized receivers used in radar systems to detect and process reflected radio waves for applications such as object detection and distance measurement.

4.2 Based on Operating Principles

From a design and operational perspective, radio receivers can also be grouped into:

1. Tuned Radio Frequency (TRF) Receivers
2. Superheterodyne Receivers

Over time, various receiver architectures have been developed; however, the TRF and superheterodyne receivers have been the most significant in practical applications. TRF receivers were commonly used in earlier systems, particularly around the mid-20th century, but they exhibited several limitations. These shortcomings were effectively addressed by the superheterodyne design, which offers improved performance and reliability. As a result, the superheterodyne receiver has become the standard choice in modern communication systems.

In the following sections, the TRF receiver will be discussed first, followed by an examination of the superheterodyne receiver.

5 Superheterodyne Receiver: Basic Elements

The superheterodyne receiver is good for modern communication systems, as it effectively overcomes the limitations associated with earlier designs such as the TRF receiver. A typical block diagram of a SHRr is shown in Fig. 4.1.

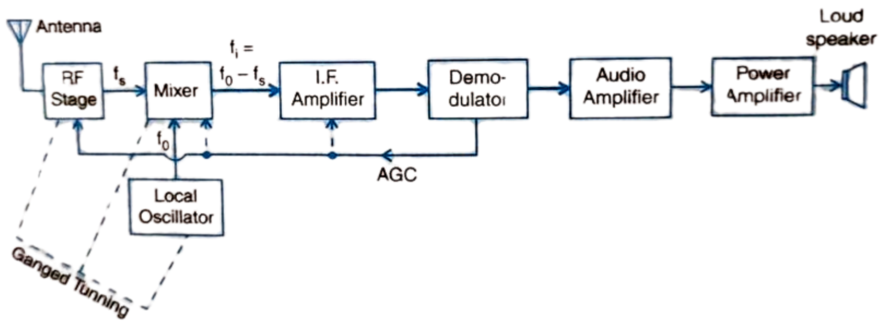

Figure 2: Block diagram of superheterodyne receiver.

The term "heterodyne" refers to the process of frequency mixing. By maintaining a fixed difference between the local oscillator frequency and the incoming RF signal, the receiver ensures that the resulting IF remains constant. This is typically achieved through ganged tuning, where multiple tuning elements are adjusted simultaneously using a single control.

The intermediate frequency signal is then amplified using an IF amplifier stage, which usually consists of multiple tuned circuits. These circuits are designed to operate at the fixed IF and are responsible for providing most of the receiver's gain and selectivity. Since the IF stage operates at a constant frequency, it is easier to achieve high amplification and a stable bandwidth.

One of the major advantages of this approach is that the sensitivity and selectivity of the receiver remain nearly constant across the entire tuning range. Additionally, the narrow bandwidth of the IF stage helps in rejecting unwanted signals and minimizing interference from adjacent channels.

Following IF amplification, the signal is applied to a demodulator, where the original baseband (audio) signal is recovered. This signal is then processed through audio and power amplifier stages to achieve the required output level. Finally, a loudspeaker converts the electrical signal into audible sound, thereby reproducing the transmitted information.

Due to its superior performance in terms of stability, selectivity, and sensitivity, the superheterodyne principle is widely used in various applications, including AM and FM receivers, communication systems, television, and radar systems. It is considered the standard receiver architecture in modern electronics.

6 Conclusion

The superheterodyne receiver remains the most widely adopted architecture in modern communication systems due to its superior performance characteristics. It offers a constant bandwidth across its entire tuning range, ensuring consistent signal quality. Additionally, it provides enhanced sensitivity and improved selectivity, enabling accurate reception of desired signals while effectively suppressing interference from adjacent channels.

For AM receivers, several important frequency parameters define their operation. These receivers typically operate over two primary bands: medium wave (MW) and short wave (SW). The carrier frequency range for the MW band extends from approximately 535 kHz to 1650 kHz, while the SW band covers frequencies from about 5 MHz to 15 MHz. A standard intermediate frequency (IF) of 455 kHz is commonly used, along with a typical bandwidth of around 10 kHz, which ensures proper signal detection and audio quality.

References

[1] S. Haykin and M. Moher, *Communication Systems*, 5th ed., Indian Adaptation. Wiley India, 2022.

[2] M. S. Alencar and V. C. da Rocha Jr., *Communication Systems*. Springer Nature Switzerland AG, 2022.

[3] U. Madhow, *Introduction to Communication Systems*. Cambridge University Press, 2014.

[4] J. G. Proakis and M. Salehi, *Fundamentals of Communication Systems*, 1st ed. Pearson, 2014.