AMATEUR RADIO FUNDAMENTALS

FOR BEGINNERS

A Practical Guide to Understanding and Practicing Amateur Radio in Saudi Arabia

- Understand the basics of radio communication
- Learn how radio signals propagate
- Use equipment and antennas effectively
- Practice safe and responsible operations
- Prepare for amateur radio licensing exams

BY

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GENERAL CHAIRMAN

Saudi Amateur Radio Society

HZ1DG

FIRST EDITION - 2026

COMMUNICATION | COMMUNITY | TECHNOLOGY | PASSION

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Secretary General, Saudi Amateur Radio Society

Kingdom of Saudi Arabia

2026 Edition

Updated and Revised Edition

This book is intended for educational and informational purposes in the field of amateur radio and is based on the laws and regulations in force in the Kingdom of Saudi Arabia.

First Edition – 2026

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Kingdom of Saudi Arabia

Dedication

To His Highness Prince Bader bin Fahd Al Faisal Al Saud,

Chairman of the Board of the Saudi Amateur Radio Society, In appreciation of his continuous support and significant contributions to advancing amateur radio in the Kingdom of Saudi Arabia, empowering enthusiasts, and strengthening the presence of this field.

His leadership has played a key role in fostering a professional community built on knowledge, experience, and innovation, and in driving this hobby toward growth and excellence.

To the members of the Saudi Amateur Radio Society, and to all amateur radio enthusiasts in the Kingdom of Saudi Arabia—united by passion and connected by the signal - and to everyone who seeks to explore the world of radio communication, **this work is for you.**

Acknowledgments

The author extends his sincere thanks and appreciation to His Highness Prince Bader bin Fahd Al Faisal Al Saud, Chairman of the Board of the Saudi Amateur Radio Society, as well as to the Society and its members, in recognition of their continuous support in advancing amateur radio in the Kingdom of Saudi Arabia.

The author also expresses his deep gratitude to the Communications, Space and Technology Commission, particularly the Frequency Allocation and Licensing Department within the Spectrum Sector, for their efforts in regulating the use of the radio frequency spectrum and enabling the practice of this hobby.

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- Dhaher bin Saad Al Asmari HZ1DS
- Nahw Suhaiman Al Shammari HZ1TL

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Finally, the author extends his heartfelt gratitude to his beloved family, whose unwavering support, patience, and constant encouragement were instrumental in bringing this work to completion.

About the Author

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Focused on simplifying radio communication concepts and supporting enthusiasts and beginners, while promoting technical awareness and satellite communications.

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Introduction

Amateur radio is an advanced technical hobby that combines theory and practice, enabling communication over the air through the principles of telecommunications and electronics. It provides a unique experience based on exploration, experimentation, and continuous development.

Despite the evolution of modern communication technologies, it remains a valuable educational field that develops technical skills, enhances practical thinking, and fosters a collaborative community of enthusiasts.

This book is designed as a practical guide for beginners, presenting the fundamentals of radio communication in a clear and structured manner, from basic concepts to operational practices that support confident and effective use. It also highlights the regulations in the Kingdom of Saudi Arabia, helping readers understand licensing requirements and operate within approved frameworks.

This work is intended for beginners and enthusiasts alike, offering clear and accurate content to support learning and facilitate passing the amateur radio licensing exam, while promoting knowledge and encouraging further exploration of this field.

Chapter 1: Introduction to Amateur Radio and Regulation

1.1 The Concept of Amateur Radio

When a user tunes their device to a specific frequency and receives a signal from a distant station, they are not using conventional means of communication.

Rather, they are engaging with a system based on advanced scientific and technical principles, fundamentally different from everyday communication methods such as the internet or cellular networks.

Amateur radio is defined as the use of radio frequencies by individuals interested in communication technologies for the purposes of learning, experimentation, and communication, without relying on conventional communication networks such as the internet or mobile networks.

This hobby is not limited to simply making contacts; it encompasses several important aspects, including:

- Developing knowledge in communication technologies
- Conducting technical and experimental activities
- Enhancing operating skills
- Contributing to communication support during emergencies

Figure (1-1): Example of radio communication between two stations.

The fundamental principle of this hobby is that it is practiced solely for personal and scientific purposes, and not intended for any financial gain.

1.2 Components of the Radio Communication System

The process of radio communication relies on a set of elements that work together to establish communication between stations, as illustrated in the following figure:

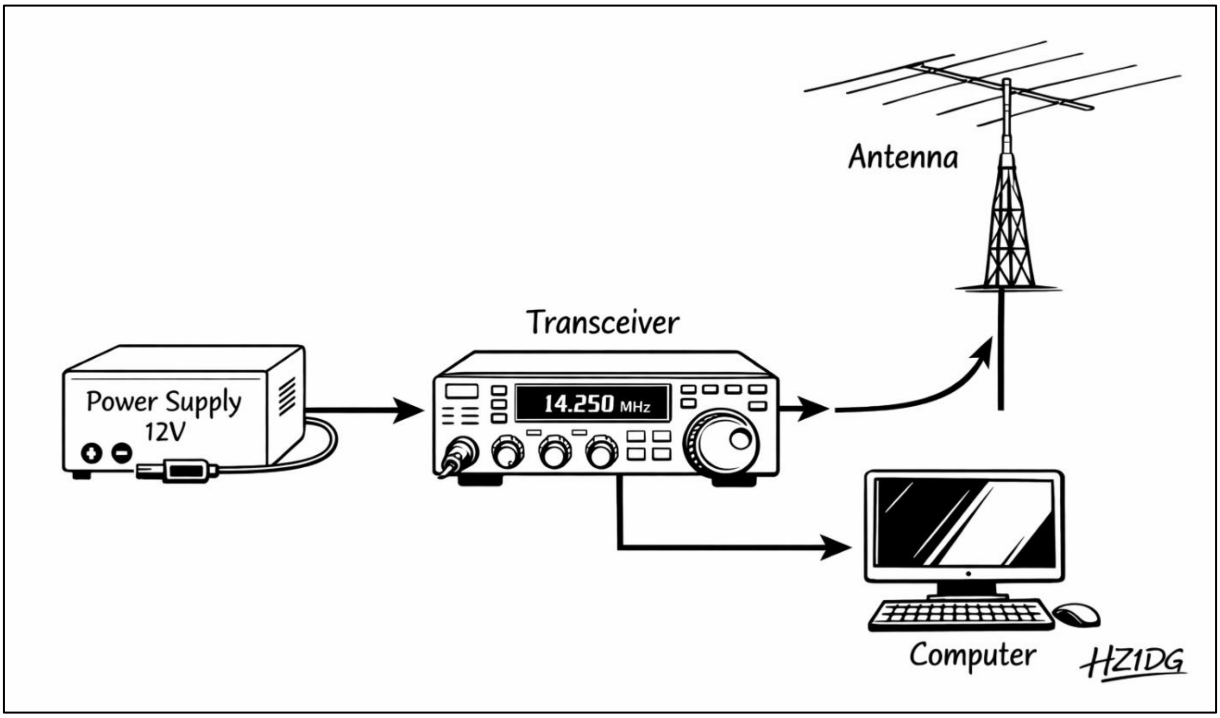


Figure (1–2): A simplified diagram of the components of an amateur radio station.

The figure illustrates the main components of an amateur station:

- Operator: The person who manages the communication process and controls the equipment
- Station: The equipment used for transmitting and receiving
- Frequency: The path through which the signal travels
- Signal: The radio wave that carries the information

Successful communication depends on understanding these elements and handling them correctly, as any issue in one of them may directly affect the quality of the communication.

In some cases, the equipment may be functioning properly, yet the signal remains weak.

What factors influence this behavior?

It may be related to the choice of frequency, wave propagation conditions, or timing.

1.3 Basic Terminology

1.3.1 Amateur Radio Service

Within this framework, amateur radio communications are practiced as a regulated service that allows individuals interested in the hobby to use radio equipment through terrestrial communication or via satellites for the purposes of self-training, experimentation, and technical communication. This is carried out under specific regulations that ensure safe use and prevent interference with other services.

It is a requirement that this service is not used for commercial purposes and remains focused solely on self-development and technical interest.

Why is licensing required?

Because the radio frequency spectrum is a limited resource shared by multiple entities, some of which are associated with critical services such as aviation and emergency communications. Therefore, its use must be carefully regulated.

Licensing aims to:

- Ensure that the user possesses a minimum level of operational knowledge (technical, regulatory, and behavioral)
- Prevent harmful interference with other services
- Ensure organized and efficient use of the radio frequency spectrum

1.3.2 Amateur Radio License

Before an operator can legally use radio equipment, they must obtain an official license from the competent authority, the Communications, Space and Technology Commission, which defines the permitted scope of use.

This license qualifies the operator to establish and operate an amateur radio station within specified frequency bands, in compliance with the approved operating conditions, as outlined in the Amateur Radio Service Regulations and the associated technical rules and procedures.

Licenses vary among operators, with certain privileges being limited in some categories compared to higher license classes.


رخصة هواة لاسلكي فئة (1)
Radio Amatura License Class (1)
CST
هيئة الاتصالات والفضاء والتقنية
Communications, Space &
Technology Commission
FOR EDUCATIONAL PURPOSES ONLY - NOT CERTIFIED
محمد احمد فيصل
Call Sign: HZ1SAR إشارة النداء:
National ID/Iqama: 1234567890 رقم الهوية / الإقامة :
License No: 12345 رقم الرخصة :
Exp.Date: 01/01/2029 تاريخ الانتهاء:
ملحوظة : يتطلب تأسيس وتشغيل محطة أجهزة اللاسلكي الحصول على ترخيص بذلك من الهيئة
Note: establishment and operation of wireless station requires a license from CST

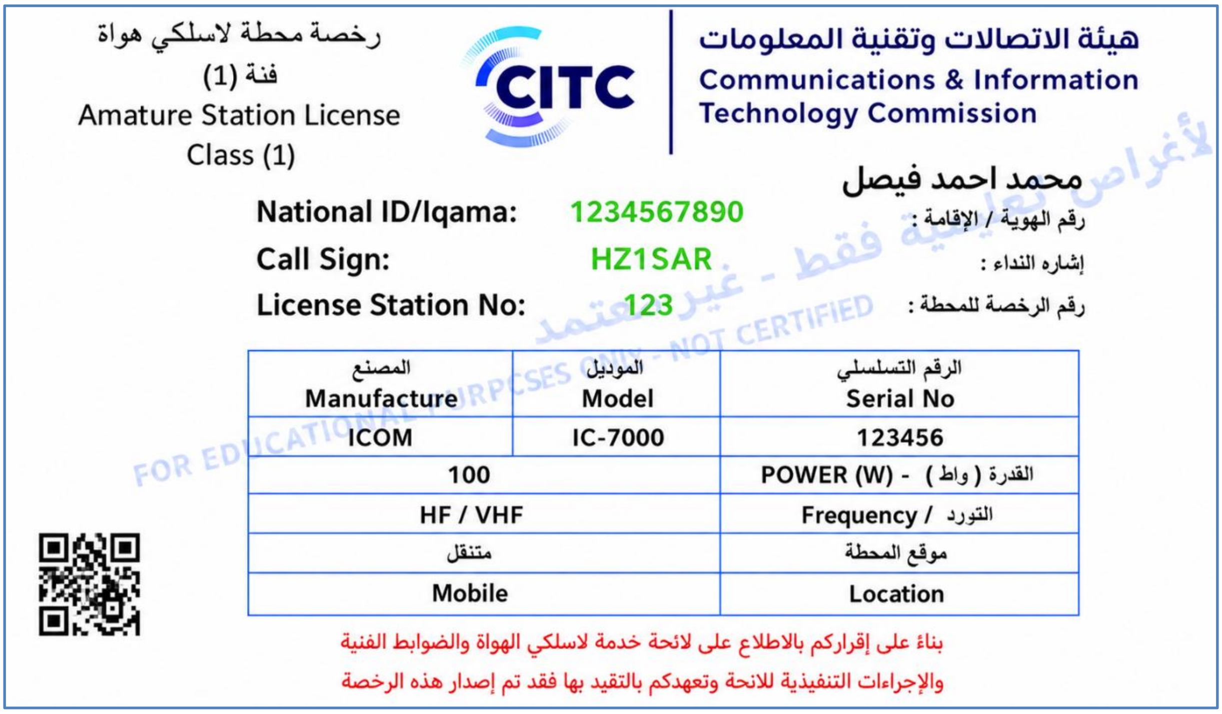
Figure (1–3): Example of an amateur radio license with call sign and operator name.

1.3.3 Amateur Radio Station License

An amateur radio station represents the practical environment through which communications are conducted. A licensed amateur operator is required to obtain an amateur radio station license in order to establish and legally operate their own station.

The amateur radio station license is an official authorization issued by the Communications, Space and Technology Commission in the name of the operator, allowing them to establish and operate a radio station in accordance with approved regulations.

This license includes the technical specifications of the station, such as the type of equipment, power levels, frequency bands, and operating location. No station may be operated without obtaining this license and complying with the specified regulatory requirements.


رخصة محطة لاسلكي هواة
فئة (1)
Amature Station License
Class (1)

هيئة الاتصالات وتقنية المعلومات
Communications & Information Technology Commission

محمد احمد فيصل

National ID/Iqama: 1234567890 : رقم الهوية / الإقامة
Call Sign: HZ1SAR : إشاره النداء
License Station No: 123 : رقم الرخصة للمحطة

المصنع Manufacture	الموديل Model	الرقم التسلسلي Serial No
ICOM	IC-7000	123456
100		POWER (W) - القدرة (واط)
HF / VHF		Frequency / التورد
متنقل		موقع المحطة
Mobile		Location

بناء على إقراركم بالاطلاع على لائحة خدمة لاسلكي الهواة والضوابط الفنية
والإجراءات التنفيذية للائحة وتعهدكم بالتقيد بها فقد تم إصدار هذه الرخصة

Figure (1–4): Amateur Radio Station License .

An amateur radio station is an integrated system, with the transceiver being its main component. The license is associated with the station and its approved components.

A station typically consists of several elements working together, such as:

- Transmitting and receiving equipment
- Antennas
- Associated accessories

1.4 Operating Regulations

Amateur radio is governed by a set of regulations that must be followed during operation to ensure proper use of frequencies and organized communication.

1.4.1 Language Usage

To ensure clear communication, a mutually understood language must be used. English is commonly used in international communications, while Arabic may be used for local contacts.

1.4.2 Call Sign

The call sign represents the official identity of the station and is used to identify the operator during communication.

Its use is required:

- At the beginning of a transmission
- At the end
- Periodically during communication (at least once every 10 minutes)

  This topic will be explained in greater detail in a later chapter.

1.4.3 Operating Etiquette

Proper use of frequencies requires adherence to professional conduct that reflects the nature of this hobby. Key practices include:

- Using polite and respectful language
- Avoiding interruptions
- Respecting others' turn to speak
- Avoiding interference with other stations

1.4.4 Prohibited Activities

Despite the flexibility of this service, there are clear limitations that must be observed. Prohibited activities include:

- Broadcasting music
- Engaging in political discussions
- Rebroadcasting content from external sources
- Connecting equipment to the internet for any purpose
- Using frequencies for commercial purposes

1.5 Licensing Requirements

To legally practice this hobby, several basic requirements must be met, including:

- Minimum age of 18 years

- Passing the required examination
- Compliance with applicable regulations and instructions

1.6 Supporting Organizations for Amateur Radio

Several organizations at both the local and international levels contribute to supporting and developing amateur radio by organizing activities, spreading knowledge, and enhancing communication among enthusiasts.

In the Kingdom of Saudi Arabia, the Saudi Amateur Radio Society (SARS) plays a key role in supporting this hobby. It promotes awareness, organizes events, supports enthusiasts, and enhances communication among them locally and internationally. It also contributes to developing technical skills through training programs and specialized activities, while promoting the regulated use of the radio spectrum in accordance with approved regulations.

The Society also represents the amateur radio community in national and international forums and contributes to technical and humanitarian initiatives that highlight the role of this hobby in serving society. It supports the development of an integrated technical community based on knowledge sharing and experience exchange, helping to raise the level of practice and professionalism in this field.

It also keeps pace with technological advancements in wireless communications and fosters partnerships that contribute to the development and visibility of the hobby both locally and internationally.

There are also specialized initiatives in advanced areas of amateur radio, such as satellite communications. One of the most notable is **AMSAT-HZ**, established in coordination with **AMSAT**, which focuses on spreading knowledge and supporting enthusiasts in satellite communications.

At the international level, the International Amateur Radio Union **(IARU)** represents amateur radio operators worldwide. It coordinates between national societies, protects amateur frequency allocations, and represents them in international forums.

Many amateur radio societies and clubs also exist worldwide, contributing to knowledge exchange, organizing activities and competitions, and supporting the technical community of enthusiasts.

Together, these organizations help build an integrated environment that supports amateurs and enhances the development of this hobby at both local and global levels.

1.7 Chapter Summary

Amateur radio is based on a combination of technical knowledge and regulatory compliance. Operators use radio equipment within defined frequency ranges and under clear regulations.

Understanding the fundamentals, adhering to operating rules, and being aware of governing regulations are essential for practicing this hobby correctly and safely.

This understanding provides a foundation for moving to a deeper stage involving frequency usage and the radio spectrum, and how they affect communication success—topics that will be covered in the next chapter.

Chapter 2: The Radio Spectrum and Regulation

2.1 Introduction to the Radio Spectrum

When attempting to establish a radio communication, an operator may notice that some signals travel long distances, while others fade after a short range—even when using the same equipment. What determines this difference?

This is primarily related to what is known as the **radio spectrum**, the medium through which radio waves propagate between stations through the air.

Frequency is measured in **Hertz (Hz)**, which represents the number of cycles per second. As the frequency changes, the characteristics of the signal also change in terms of:

- Propagation range
- Ability to penetrate obstacles
- Type of use (local or long-distance)

Important:

Selecting the appropriate frequency is just as important as the power of the equipment—indeed, it may be the decisive factor in the success of a communication.

2.2 Radio Spectrum Allocation

Not all frequency bands are used in the same way; rather, the radio spectrum is divided into ranges, each with distinct characteristics that influence how it is utilized. This classification is based on the propagation properties of radio waves, such as coverage range, their ability to penetrate obstacles, and their interaction with atmospheric conditions and the upper layers of the atmosphere. These ranges are typically categorized according to standardized designations, starting from Very Low Frequencies (VLF) up to Extremely High Frequencies (EHF), where frequency increases progressively while wavelength decreases accordingly.

Each frequency band is used for specific applications. Some are suitable for long-distance communication through ionospheric reflection, while others are used for short-range, high-capacity communications, such as satellite communications and modern wireless networks. These bands are allocated according to international and national regulations to ensure organized usage and to prevent interference among different services, such as broadcasting, aeronautical communications, maritime communications, and amateur radio.

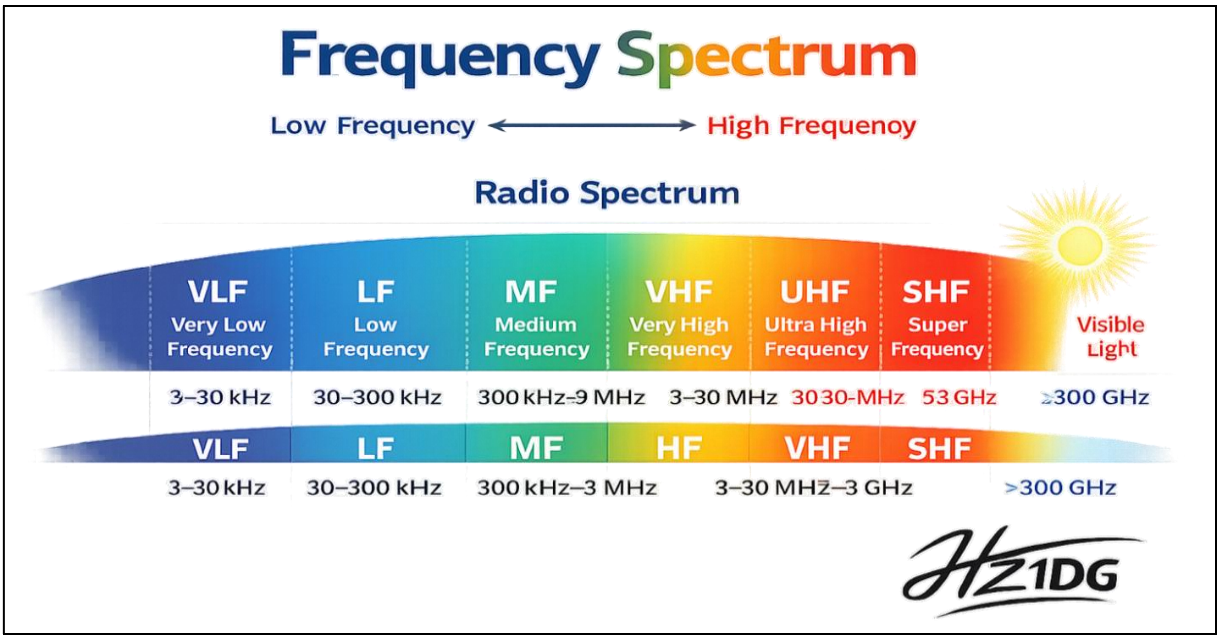


Figure (2–1): Radio frequency spectrum showing bands such as HF, VHF, and UHF.

2.2.1 Medium Frequency (MF)

This band includes various broadcasting and communication uses, and contains the 160-meter amateur band (1.8–2.0 MHz).

Key characteristics:

- Good ground-wave propagation
- Supports long-distance communication at night
- More affected by noise and interference than higher bands

2.2.2 High Frequency (HF)

Used for long-distance communication, where signals reflect off the ionosphere, enabling international (DX) contacts.

Range: 3–30 MHz

Performance depends on:

- Ionospheric conditions
- Time of day (day/night)
- Solar activity

2.2.3 Very High Frequency (VHF)

Typically used for local or regional communication, with signals traveling in a line-of-sight path.

Range: 30–300 MHz

Key characteristics:

- Clear and stable signals
- Requires direct path between stations
- Obstacles (buildings, mountains) can weaken signals

2.2.4 Ultra High Frequency (UHF)

Commonly used in urban environments, where signals interact better with buildings and obstacles.

Range: 300 MHz – 3 GHz

Key characteristics:

- Good performance in cities
- Better obstacle penetration
- Shorter range than VHF in open areas

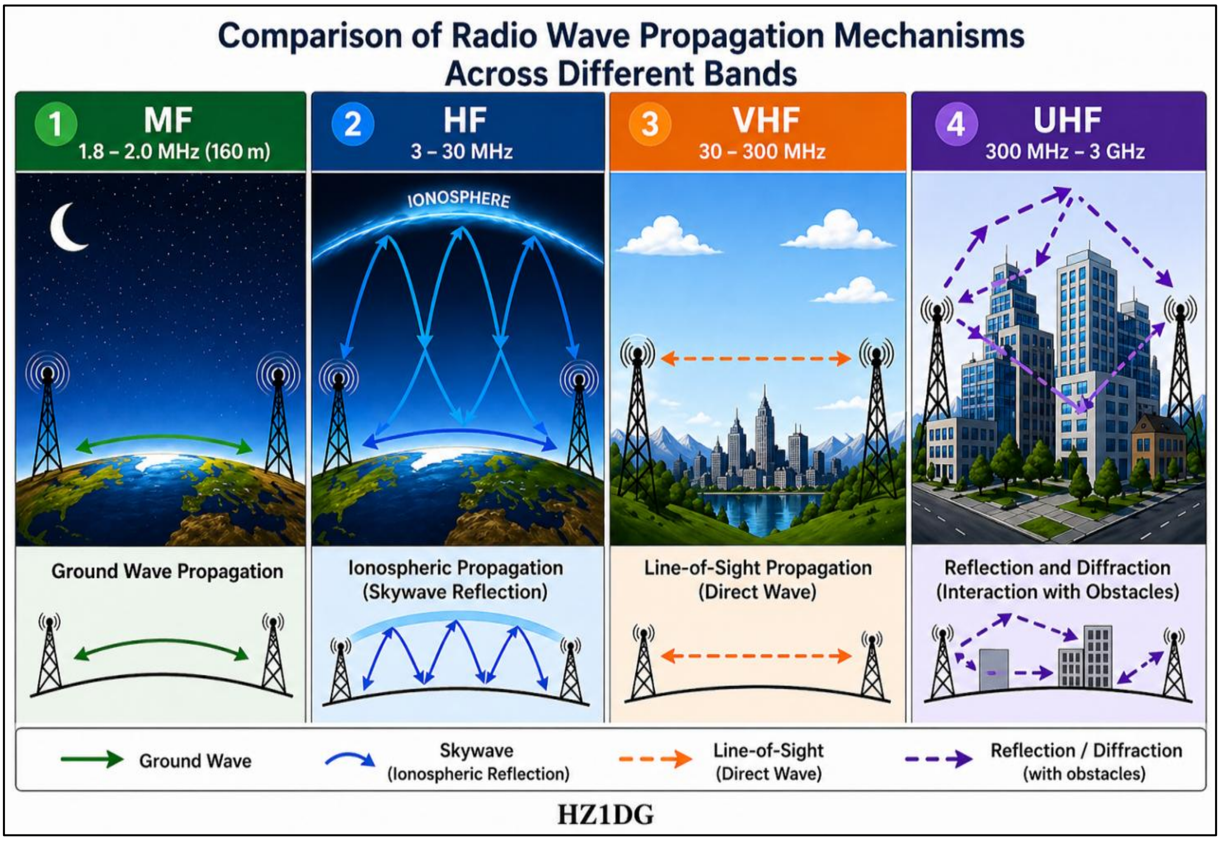


Figure (2–2): Comparison of propagation mechanisms of HF, VHF, and UHF radio waves.

2.3 Amateur Radio Frequency Bands

The radio spectrum is not available for unrestricted use; instead, specific frequency bands are allocated to different services, including amateur radio. These bands vary in terms of:

Range

Signal quality

- Type of use

Selecting the appropriate band is one of the most important factors affecting successful communication.

Band	Frequency Range (Start – End)	License Class	Max Power
160 m (HF)	1810 – 1850 kHz	Class 1	500 W
80 m (HF)	3620 – 3635 kHz	Class 1	200 W
40 m (HF)	7.0 – 7.2 MHz	Class 1	200 W
30 m (HF)	10.100 – 10.150 MHz	Not permitted	
20 m (HF)	14.0 – 14.35 MHz	Class 1	200 W
17 m (HF)	18.068 – 18.168 MHz	Class 1	200 W
15 m (HF)	21.0 – 21.45 MHz	Class 1	200 W
12 m (HF)	24.89 – 24.99 MHz	Class 1	200 W
10 m (HF)	28.0 – 29.7 MHz	Class 1	200 W
6 m (VHF)	50.0 – 54.0 MHz	Class 1	100 W
2 m (VHF)	144.0 – 146.0 MHz	Class 1 / Class 2	50 W
70 cm (UHF)	430.0 – 440.0 MHz	Not permitted	
1.25 cm	24.000 – 24.050 GHz	Class 1 / Class 2	50 W

(SHF)			
6 mm (EHF)	47.00 – 47.20 GHz	Class 1 / Class 2	50 W
4 mm (EHF)	77.50 – 78.00 GHz	Class 1 / Class 2	50 W
2 mm (EHF)	134.0 – 136.0 GHz	Class 1 / Class 2	50 W
1.2 mm (EHF)	248.0 – 250.0 GHz	Class 1 / Class 2	50 W

Table (2–3): Amateur radio frequency allocations in the Kingdom of Saudi Arabia.

These bands and power limits may vary depending on national regulations.

2.4 Regulation within the Kingdom

The use of frequencies in the Kingdom is strictly regulated by the Communications, Space and Technology Commission (CST). Frequency allocations are defined for each service to ensure organized spectrum use. This includes:

- Frequency allocation
- Power limits
- Prevention of interference

Important:

Using unauthorized frequencies may cause interference with other services and is strictly prohibited.

2.5 International Telecommunication Union (ITU)

At the global level, the radio spectrum is regulated by the International Telecommunication Union (ITU), which establishes the general framework for frequency allocation among countries.

The world is divided into three regulatory regions:

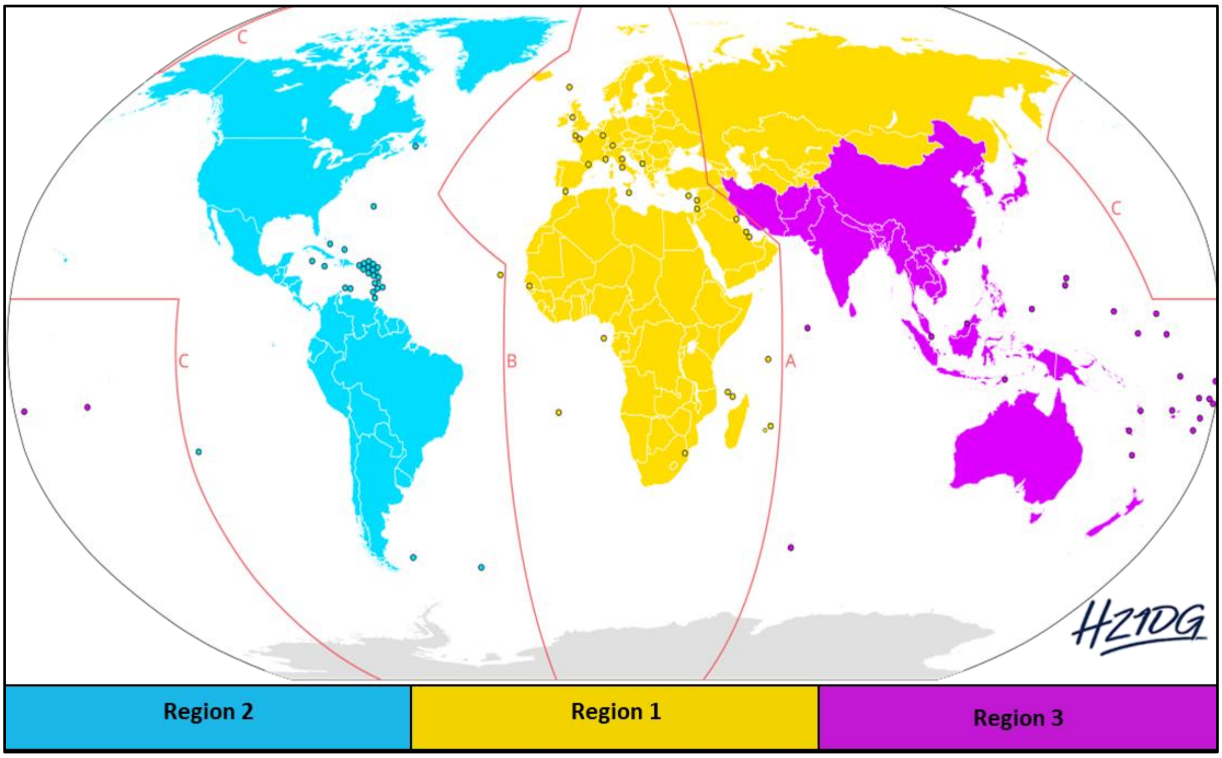


Figure (2-4): ITU world regions.

- **Region 1:** Europe, Africa, and the Middle East (including Saudi Arabia)
- **Region 2:** The Americas
- **Region 3:** Asia and Australia

This division affects:

- Available frequency bands

- Usage methods
- Operating privileges

2.6 License-Based Band Access

Operating privileges vary depending on the license class, including:

- Accessible frequency bands
- Permitted power levels

In Saudi Arabia, license classes do not require sequential progression.

Applicants may choose and test directly for the desired class. Upon passing, they are granted the privileges associated with that class.

Important:

Higher license classes require greater technical and regulatory knowledge due to broader privileges.

2.7 Transmit Power Limits

Regulations apply not only to frequency use but also to transmission power.

Power limits vary depending on the frequency band and license class (refer to Table 2–3).

Typical examples include:

- HF bands: up to **200 watts**
- VHF bands: up to **50 watts**

These limits aim to:

- Reduce interference
- Protect users from potential health risks
- Improve communication quality

2.8 Operating Notes

To achieve optimal performance, operators should follow best practices such as:

- Listening before transmitting to ensure the frequency is clear
- Selecting the appropriate band based on communication goals
- Considering regulatory differences between countries

A frequency permitted in one country may be restricted in another due to regulatory differences.

2.9 Chapter Summary

The radio spectrum is the foundation of all wireless communications, determining signal characteristics and propagation behavior.

Understanding different frequency bands and selecting the appropriate frequency enables more efficient and stable communication.

This knowledge prepares the reader for the next stage, which focuses on how to conduct practical communication between stations using different operating techniques.

Chapter 3: Operating Fundamentals and Communication

3.1 Introduction to Radio Communication

When pressing the transmit button, an operator may assume that communication is simply about sending and receiving voice. In reality, successful communication depends on a set of practices and techniques that ensure clarity and ease of understanding for the receiving station.

A strong signal alone does not guarantee a successful contact. In many cases, the operator's speaking style and organization of communication play a more significant role in delivering the message accurately.

This highlights the importance of understanding operating fundamentals, which help the operator to:

- Organize communication
- Reduce errors and misunderstandings
- Adapt to varying signal conditions

Summary:

Communication efficiency depends more on the operator than on the equipment.

3.2 Phonetic Alphabet

In some situations, signals may be unclear, or letters may be difficult to distinguish due to interference. How can the receiving station ensure the message is understood correctly?

This is achieved by using the phonetic alphabet, where each letter is represented by a standardized word agreed upon internationally.

Examples:

- A → Alpha
- B → Bravo
- C → Charlie

When spelling a call sign, this method helps prevent errors. For example:

HZ1SAR is pronounced as:

Hotel Zulu One Sierra Alpha Romeo

Important Note:

The standard words must be used exactly as defined. Substituting them may lead to misunderstanding and reflects a lack of professionalism.

Figure (3–1): International Phonetic Alphabet

3.3 Q-Codes

In some cases, an operator needs to convey information quickly, especially under weak signal conditions or during fast communications. Although Q-codes were originally developed for Morse code (CW), they are also used in voice and digital communications, though less commonly in voice compared to plain language.

Q-codes are three-letter abbreviations, each with a specific meaning. They can be used as either a question or a statement depending on context. These codes help to:

- Save time
- Reduce effort during communication
- Overcome weak signal conditions

Common examples include:

- **QTH** → Location
- **QSL** → Acknowledgment of receipt
- **QRP** → Low transmit power
- **QRG** → Operating frequency

Example

Station **HZ1SAR** sends the following Morse message to station **HZ1DG**:

- HZ1DG de HZ1SAR your QTH ?

Reply from **HZ1DG**:

- HZ1SAR de HZ1DG MY QTH ABHA

This example shows how meaning can be efficiently conveyed using abbreviated codes. It is important to distinguish between similar codes, such as:

- **QRM** → Man-made interference
- **QRN** → Natural interference

3.4 Morse Code (CW) and Analysis

Morse code is one of the oldest forms of radio communication. It represents letters and numbers using sequences of short and long signals:

- Dot (·) → Short tone
- Dash (–) → Longer tone

Despite advances in modern communication methods, Morse code is still widely used in amateur radio, particularly for long-distance (DX) communication, due to its high efficiency and ability to operate under weak signal conditions.

Basic Principle

Signals are transmitted using combinations of dots and dashes.

Examples:

- A → · –
- S → · · ·

Practical Example

- **SOS → · · · – – – · · ·**

- **Signal Analysis**

Understanding Morse code depends on:

- Distinguishing signal length (short vs. long)

- Recognizing spacing between letters
- Maintaining the rhythm of transmission

Advantages of Morse Code

Works under very weak signal conditions

Requires low transmit power

Highly effective for long-distance communication

Note:

Mastering Morse code requires continuous training in listening and recognition and is considered a professional skill in amateur radio.

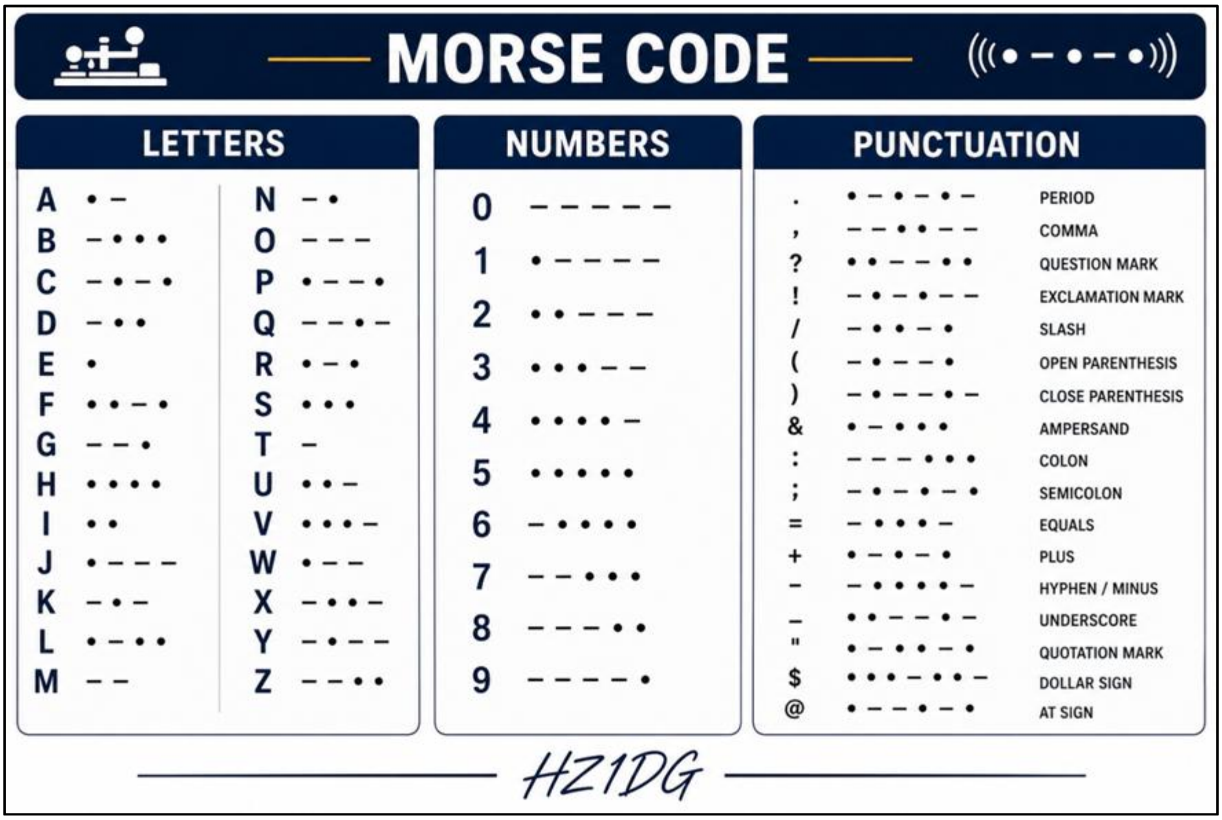


Figure (3–2): International Morse Code

3.5 Signal Reports

During a contact, each operator needs to evaluate the quality of the received signal. How can this be expressed clearly and concisely?

This is done using **signal reports**, which provide a numerical description of signal strength and readability.

3.5.1 Voice Communications

The report consists of two numbers:

- **First digit:** Readability
- **Second digit:** Signal Strength

- *Readability Scale*

Value	Description
1	Unreadable
2	Barely readable
3	Readable with difficulty
4	Readable with slight difficulty
5	Perfectly readable

Figure (3–3): Readability Scale

- *Signal Strength Scale*

Value	Description
1	Very weak
2	Weak
3	Weak to moderate
4	Moderate
5	Fairly good
6	Good
7	Strong
8	Very strong
9	Extremely strong

Figure (3–4): Signal Strength Scale

Examples

- 59 → Strong signal, perfectly clear audio
- 33 → Weak signal, poor readability

3.5.2 CW and Digital Communications (RST System)

In Morse code (CW) and digital modes, the **RST system** is used by adding a third value:

- **R (Readability)**
- **S (Strength)**
- **T (Tone)**
- **Tone Scale (CW)**

Value	Description
1	Very poor
3	Unstable
5	Average
7	Good
9	Pure tone

Figure (3-5): Tone Scale

Examples

- 599 → Very strong signal, excellent readability, pure tone
- 232 → Weak signal, poor readability, unstable tone

Important Note:

Do not give higher reports than actually received out of courtesy. Accurate reporting helps the other operator improve their transmission.

3.6 QSL Confirmation

After completing a contact, operators may wish to confirm it for personal records or participation in amateur radio programs.

This is done using **QSL**, which confirms that a contact has taken place.

Confirmation methods include:

Paper QSL cards

Electronic systems such as **Logbook of The World (LoTW)**

A QSL serves as official proof of the contact.

Figure (3-6): QSL Card.

3.7 Basic Operating Practices

With experience, operators learn how to manage communication more professionally. A skilled operator is often recognized by practices such as:

- Listening before transmitting to ensure the frequency is clear
- Using the call sign appropriately
- Speaking clearly and at a moderate pace
- Allowing pauses for others to respond

3.7.1 Common Mistakes

Using phrases such as **"Break Break"** !! unnecessarily should be avoided.

This expression is reserved for emergency situations only.

Interrupting an ongoing contact without valid reason is considered unprofessional and negatively affects communication quality.

Important Note:

You represent your country over the air—always maintain a professional and respectful conduct.

3.8 Calling Procedure

When initiating a contact, a general call is used:

CQ CQ CQ This is (your call sign) calling and standing by

This type of call is used to attract the attention of other stations.

A reply typically includes the called station's call sign followed by the responding station's call sign.

3.9 Chapter Summary

Successful radio communication does not depend solely on equipment, but largely on operating skills and adherence to established practices.

Using proper tools—such as the phonetic alphabet, Q-codes, and signal reports—ensures clear and effective communication.

Following proper etiquette and operating practices reflects professionalism and directly impacts the overall communication experience.

Amateur radio operators act as ambassadors of their countries over the air; therefore, maintaining a positive and respectful image is essential.

Chapter 4: Call Signs and Countries

4.1 What is a Call Sign?

While monitoring frequencies, an operator may notice that each station begins with a unique combination of letters and numbers. What is the purpose of this sequence?

This sequence is known as a **call sign**, which serves as the primary identification of a station during communication. It ensures that each operator is uniquely identified in an organized and standardized manner.

Call signs are not only used for identification but also play a key role in organizing communications and accurately distinguishing stations during operation.

4.2 Structure of a Call Sign

A call sign typically consists of several parts, each with a specific meaning:

- **Prefix:** Indicates the country
- **Number:** Often represents a region or license classification within the country (varies by national regulations)
- **Suffix:** Uniquely identifies the station, similar to an individual ID

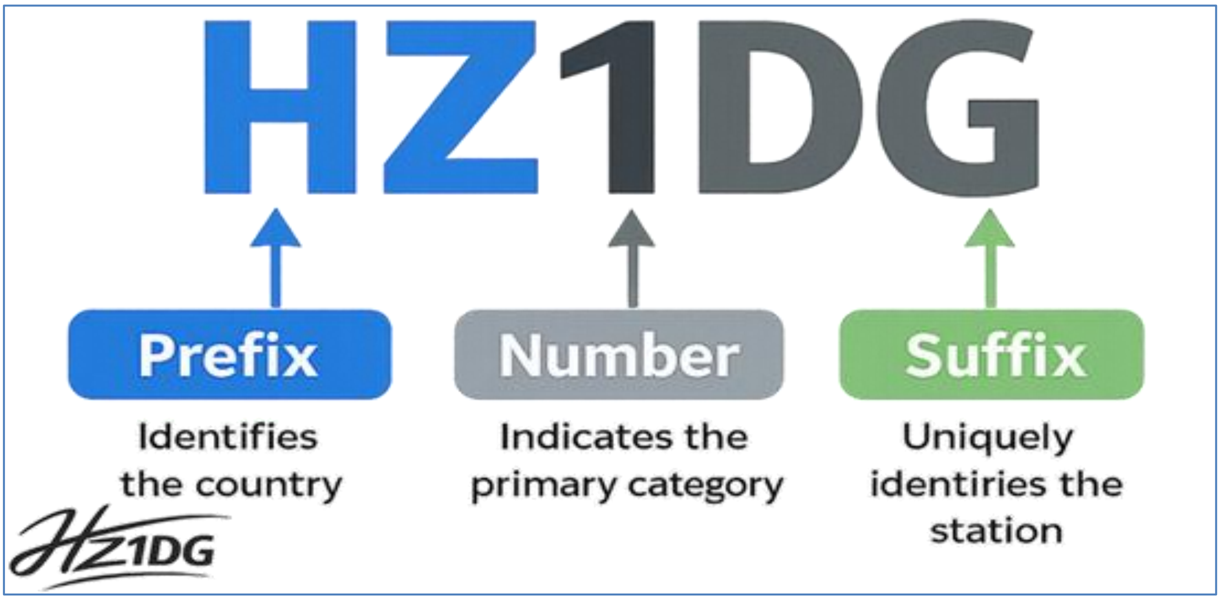


Figure (4–1): Components of a Call Sign

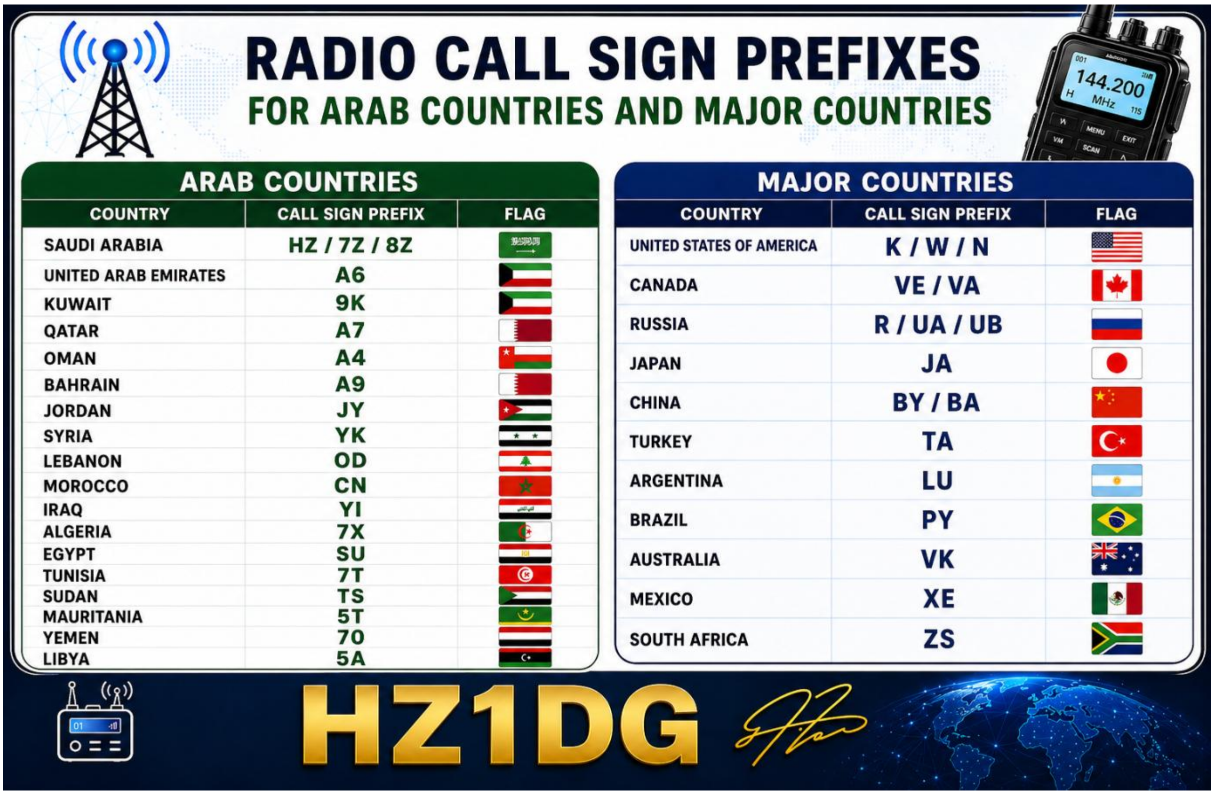
Failure to understand the components of a call sign may make it difficult to identify the source of the signal.

4.3 International Prefixes

In many cases, an operator can identify the country of a station simply by hearing the beginning of its call sign. How is this possible?

This is due to the allocation of **international prefixes** for each country, based on a globally standardized system. Examples include:

- **HZ / 7Z / 8Z** → Saudi Arabia
- **K / W / N** → United States
- **G** → United Kingdom
- **JA** → Japan



ARAB COUNTRIES

COUNTRY	CALL SIGN PREFIX	FLAG
SAUDI ARABIA	HZ / 7Z / 8Z	
UNITED ARAB EMIRATES	A6	
KUWAIT	9K	
QATAR	A7	
OMAN	A4	
BAHRAIN	A9	
JORDAN	JY	
SYRIA	YK	
LEBANON	OD	
MOROCCO	CN	
IRAQ	YI	
ALGERIA	7X	
EGYPT	SU	
TUNISIA	7T	
SUDAN	TS	
MAURITANIA	5T	
YEMEN	7O	
LIBYA	5A	

MAJOR COUNTRIES

COUNTRY	CALL SIGN PREFIX	FLAG
UNITED STATES OF AMERICA	K / W / N	
CANADA	VE / VA	
RUSSIA	R / UA / UB	
JAPAN	JA	
CHINA	BY / BA	
TURKEY	TA	
ARGENTINA	LU	
BRAZIL	PY	
AUSTRALIA	VK	
MEXICO	XE	
SOUTH AFRICA	ZS	

Figure (4–2): Examples of international prefixes

Example

If the call sign **A71XX** is heard, the country can be identified from the prefix.

In this case, the station is from **Qatar**.

4.4 Use of Call Signs in Communication

Call signs must be used correctly during communication according to specific rules, including:

- Stating the call sign at the beginning of the contact
- Stating it at the end of the contact

- Repeating it periodically during the contact (at least once every 10 minutes)

A general calling format is:

CQ CQ CQ This is (your call sign) calling CQ and standing by.

When responding:

(Call sign) this is (your call sign)...

4.5 Practical Example of Call Sign Usage

Voice Contact Example

Station 1 (Saudi Arabia – HZ1DG):

CQ CQ, this is HZ1DG, **Hotel Zulu One Delta Golf**, calling CQ and standing by.

Station 2 (Kuwait – 9K2GS):

HZ1DG this is 9K2GS, good evening. You are 59 in Kuwait. My name is Abdullah, I'm from Kuwait City. HZ1DG this is 9K2GS, back to you.

Reply (Saudi station):

9K2GS this is HZ1DG, good evening Abdullah. Nice to meet you. You are 59. My name is Abdulrahman, I'm from Abha. Thank you for the contact, 73.

Closing (Kuwaiti station):

HZ1DG this is 9K2GS, thank you Abdulrahman. Nice to meet you, 73.

In this example, Q-codes are not used. In voice communication, plain language is generally preferred, although Q-codes may be used when necessary.

4.6 Special Suffixes

In some cases, special suffixes are added to a call sign to indicate a specific operating condition, such as:

- **/P** → Portable operation
- **/M** → Mobile (vehicle)
- **/MM** → Maritime mobile (at sea)
- **/AM** → Aeronautical mobile (aircraft)

These suffixes provide additional information about the station’s operating status or location.

Figure (4–3): Examples of special suffixes

4.7 Relation to Licensing

Call signs play a fundamental role in organizing communications by:

- Clearly identifying stations
- Structuring communication
- Reducing confusion between operators
- Facilitating contact logging and documentation

4.8 Chapter Summary

A call sign serves as the official identity of a station and follows a structured system that allows easy identification of the signal source.

Understanding its components, recognizing international prefixes, and using call signs correctly during communication are essential skills for any radio operator.

This knowledge prepares the reader for the next important topic: radio wave propagation and its impact on communication performance.

Chapter 5: Wave Propagation

5.1 Introduction to Wave Propagation

When using the same equipment and transmit power, an operator may sometimes communicate with stations thousands of kilometers away, yet fail to reach nearby stations. Why does this happen?

It is not always related to transmit power, but rather to how radio waves propagate through the atmosphere. This propagation is influenced by multiple factors that determine signal range and quality.

Understanding wave propagation is therefore an essential operating skill, not just theoretical knowledge.

Why Does Signal Propagation Vary?

Propagation depends on several factors, including:

- Operating frequency
- Environment (urban areas, mountains, sea)
- Time (day/night)
- Atmospheric conditions
- Solar activity

This is why radio communication is dynamic and constantly changing.

5.2 Types of Wave Propagation

Radio waves do not propagate in a single way; their behavior varies depending on frequency and environment.

5.2.1 Ground Wave

At lower frequencies, waves tend to follow the Earth's surface, allowing relatively short-range coverage.

Characteristics:

- Can bend around some obstacles
- Relatively stable performance
- Used for local communication

5.2.2 Sky wave

In bands such as HF, waves behave differently. They are reflected by the ionosphere and return to Earth, enabling long-distance communication.

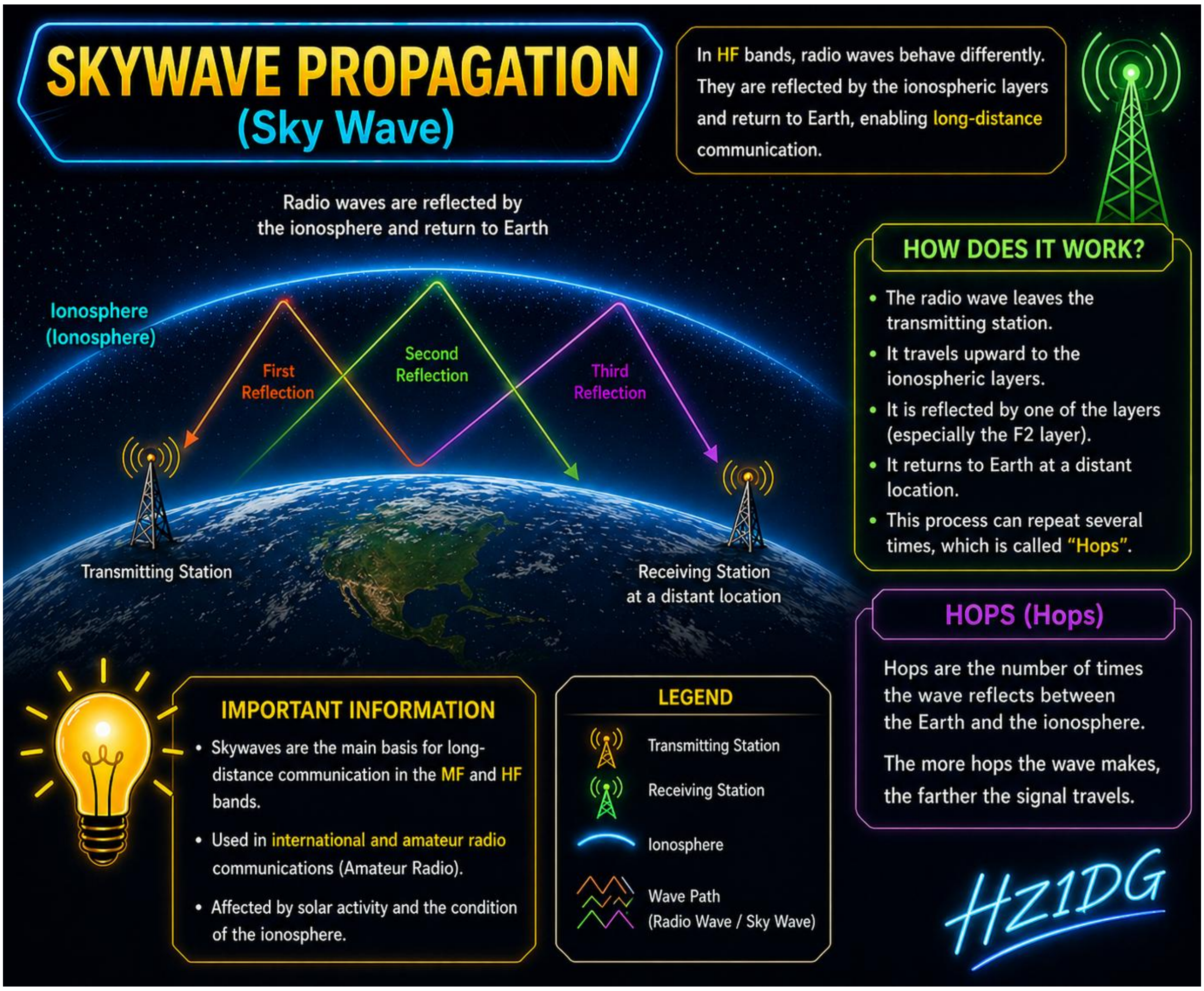


Figure (5–1): Sky wave reflection via the ionosphere

Signals may bounce multiple times between the Earth and the ionosphere, known as **hops**, allowing international (DX) communication.

5.3 The Ionosphere

Wave reflection depends on atmospheric layers, each affecting propagation differently.

Key layers include:

- **D Layer:** Absorbs signals, especially during daytime

- **E Layer:** Reflects some frequencies, useful for medium distances
- **F Layer (especially F2):** Responsible for long-distance (DX)communication

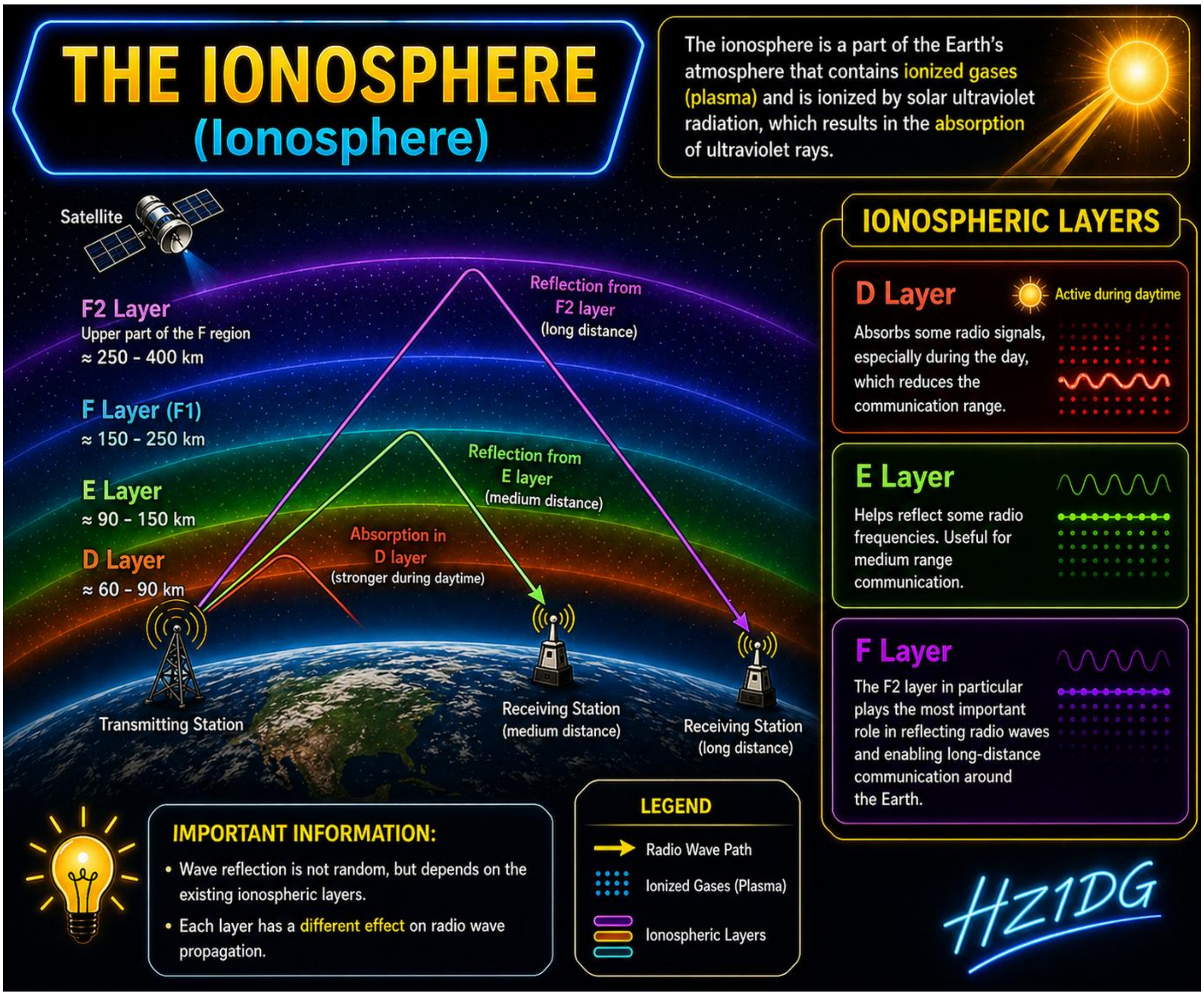


Figure (5–2): Ionospheric layers and their effects on propagation

Why Do Some Signals Improve at Night?

Because the D layer weakens, reducing signal absorption.

5.4 Maximum Usable Frequency (MUF)

When selecting a frequency, some signals reflect back to Earth, while others escape into space.

The highest frequency that can be reflected is called the **Maximum Usable Frequency (MUF)**.

If this frequency is exceeded:

- The wave will not reflect
- It will continue into space
- Communication will fail

MUF depends on:

- Solar activity
- Ionospheric conditions
- Ultraviolet radiation levels

Using higher frequencies does not always mean better performance.

5.5 Skip Distance

Sometimes, signals are not received at nearby locations but reappear at greater distances.

This is known as **skip distance**, caused by ionospheric reflection returning the signal to Earth at a distant point.

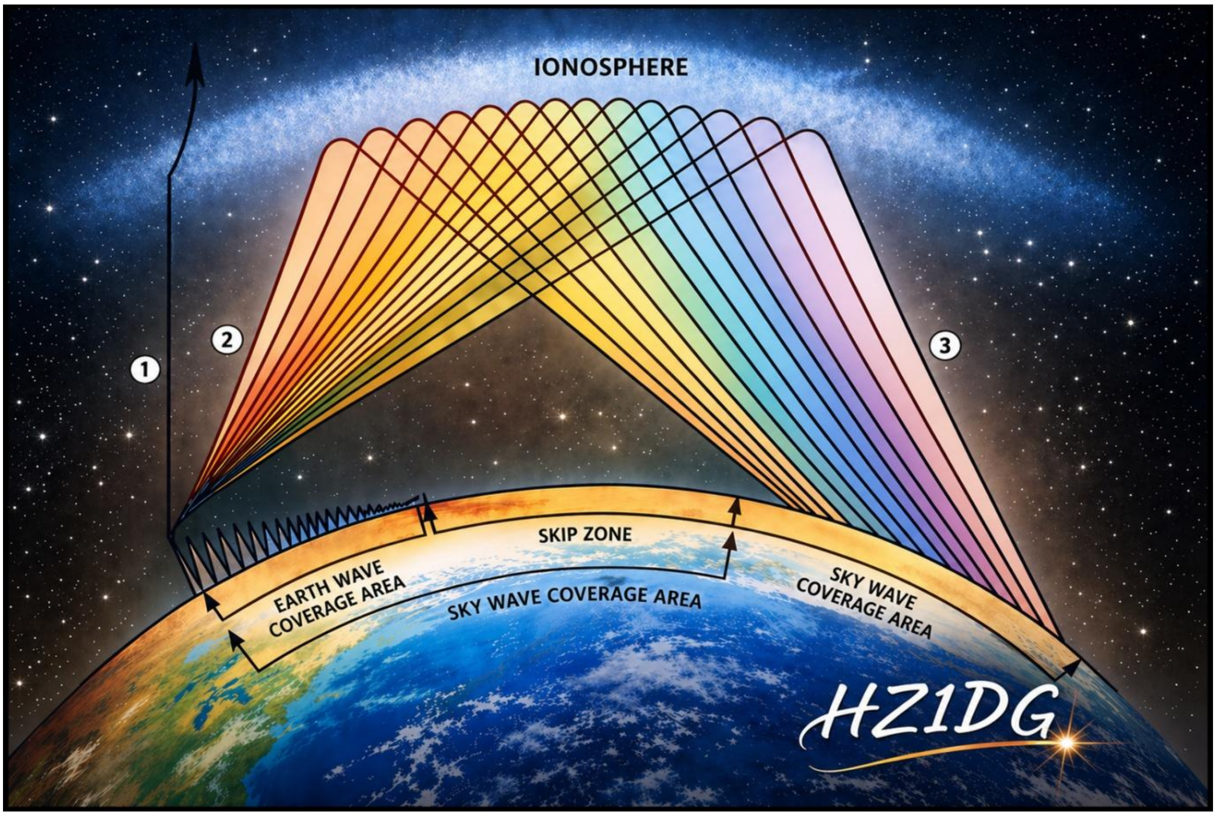


Figure (5–3): Illustration of skip distance

A distant station may be clearly received while a closer one is not.

5.6 Maximum Single-Hop Distance

When HF waves are transmitted toward the ionospheric layers at an appropriate angle, the wave undergoes a gradual refraction phenomenon due to changes in electron density, causing it to return toward the Earth’s surface. A single hop represents the distance between the transmission point and the first point at which the wave returns to the Earth after being refracted by the ionosphere. This distance depends on several factors, most importantly the angle of transmission, the signal frequency, and the height of the ionospheric layer.

Upon reaching the Earth, the wave may be partially reflected and return back to the ionosphere, leading to a repeated process known as **multi-hop propagation**. This phenomenon enables the signal to travel over very long distances, potentially reaching thousands of kilometers.

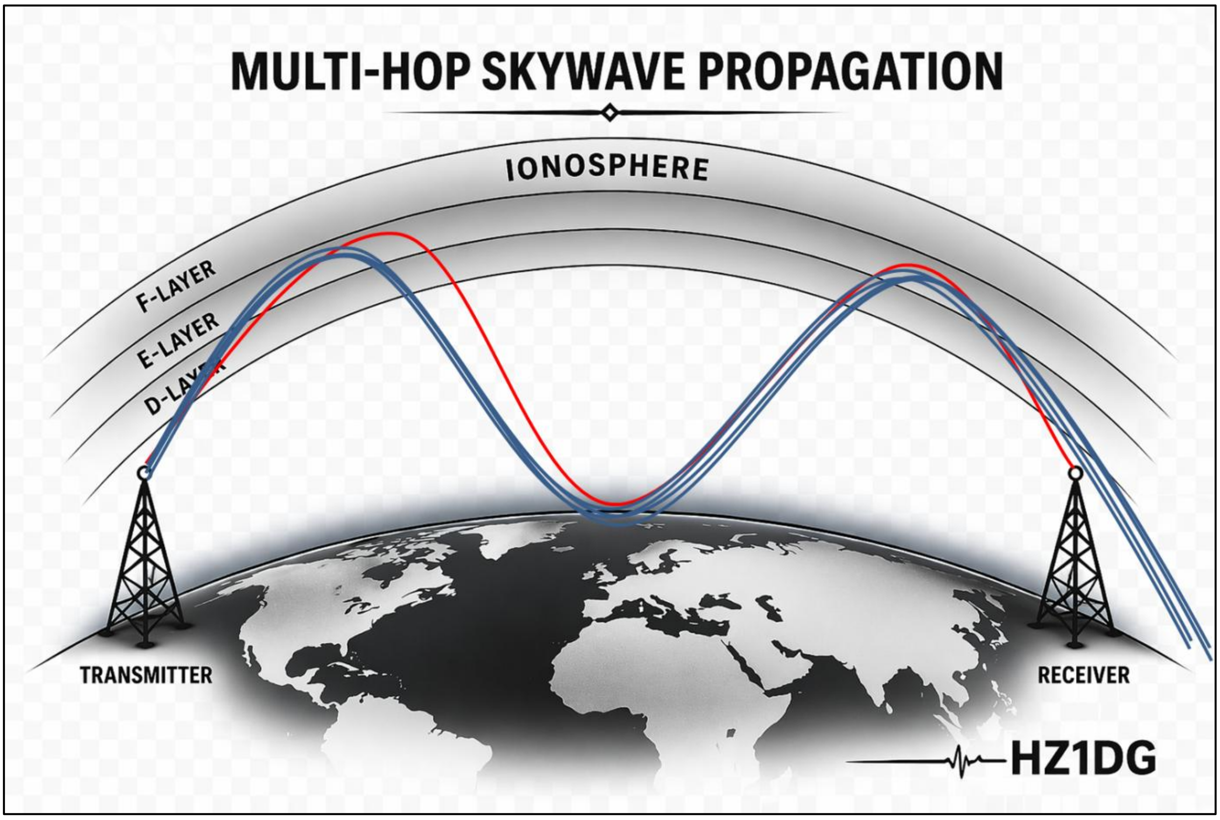


Figure (5–4): Multiple wave hops

Higher reflection layers result in longer distances on Earth.

Layer	Approx. Height	Single-Hop Distance	Typical Use
E Layer	90–130 km	500–1500 km	Short to medium range
F1 Layer	150–220 km	1000–2500 km	Medium range (daytime)
F2 Layer	250–400+ km	2000–4000+ km	Long-distance (DX)

Figure (5–5): Approximate hop distances by layer

Increasing the number of hops extends range but may reduce signal quality.

5.7 Effect of Solar Activity

Solar activity plays a major role in radio wave propagation, requiring operators to monitor it regularly.

When Solar Activity Increases:

- Increased ionization
- Improved propagation conditions
- Higher frequencies become usable
- Greater long-distance communication opportunities

When Solar Activity Decreases:

- Weaker reflections
- More difficult communication

Important Note:

Solar conditions can change rapidly, significantly affecting performance within short periods.

5.8 Dellinger Effect

This phenomenon is caused by sudden solar flares, leading to ionospheric disturbances.

It may result in:

- Weak signals
- Temporary communication loss
- Sudden degradation in performance

This can occur even if communication was previously stable.

5.9 Operating Tips

To better understand propagation, operators should:

- Choose frequencies based on time (day/night)
- Try different bands when signals are weak
- Monitor solar activity
- Expect changing conditions throughout the day

Often, improving communication is not about increasing power, but selecting a better frequency band.

5.10 Chapter Summary

Successful radio communication depends largely on wave propagation, not just transmit power or equipment quality.

Understanding ionospheric layers and concepts such as MUF and skip distance enables better operating decisions.

This knowledge prepares the reader for the next advanced topic: antennas and transmission systems, which play a key role in directing and optimizing signal performance.

Chapter 6: Electronics Fundamentals

6.1 Introduction to Electronics

Radio equipment relies on electronic circuits that convert, process, transmit, and receive signals. To understand how these devices work, it is essential to learn the fundamental concepts of electronics, which form the basis of any communication system.

When working with electronic circuits, an operator may notice that some circuits perform efficiently, while others behave differently despite having similar components. So, what determines the behavior of these circuits?

This is governed by four fundamental elements:

- **Voltage**
- **Current**
- **Resistance**
- **Power**

These relationships can be understood through a simple analogy:

- **Voltage** represents the force that pushes electrons through a circuit.
- **Current** represents the flow of these electrons due to that force.
- **Resistance** regulates and controls this flow.
- **Power** represents the amount of energy consumed or transferred as a result of the interaction of these elements.

6.1.1 Voltage

The force that drives electric charges through a circuit.

Unit: Volt (V)

6.1.2 Current

The flow of electric charges through a conductor.

Unit: Ampere (A)

6.1.3 Resistance

The opposition to the flow of current in a circuit.

Unit: Ohm (Ω)

6.1.4 Power

The amount of electrical energy consumed or produced in a circuit due to current flow under the influence of voltage.

Unit: Watt (W)

The relationship between these values is fundamental to understanding any electrical circuit.

Example:

If voltage = 12 V and current = 20 A:

$P = V \times I = 12 \times 20 = 240$ W

This shows how power is calculated in electrical circuits.

6.2 Ohms Law

If any two of the three elements (voltage, current, resistance) are known, the third can be calculated. This is expressed by **Ohms Law**:

$$\boldsymbol{E = I \times R}$$

Where:

E = Voltage

I = Current

R = Resistance

This law is used for:

- Calculating circuit values
- Troubleshooting faults
- Understanding component behavior

6.3 Power and Decibels (dB)

Power is not always expressed directly. Instead, the **decibel (dB)** scale is used to measure relative changes in power or voltage.

Element	Formula	Example	Result
Power	$dB = 10 \log_{10}(P_2 / P_1)$	10 W → 40 W	+6 dB
Voltage	$dB = 20 \log_{10}(V_2 / V_1)$	10 V → 40 V	+12 dB

Figure (6-1): Decibel (dB) formulas and examples for power and voltage

This shows that the relationship between electrical values and decibels is **logarithmic**, not linear.

- Increasing power by 4× results in **+6 dB**
- Increasing voltage by 4× results in **+12 dB**

Practical Example (TX Power Increase)

Assume a transmitter output increases from 10 W to 40 W:

- $dB = 10 \log_{10}(40 / 10)$
- $dB = 10 \log_{10}(4)$
- $dB = 10 \times 0.602 \approx 6$ dB
- 10 W → 40 W ⇒ **+6 dB**

Conclusion:

Increasing power from 10 W to 40 W (×4) equals approximately **+6 dB**, confirming that the relationship between power and dB is logarithmic, not linear.

Think about it: How can we convert dB back into a power ratio?

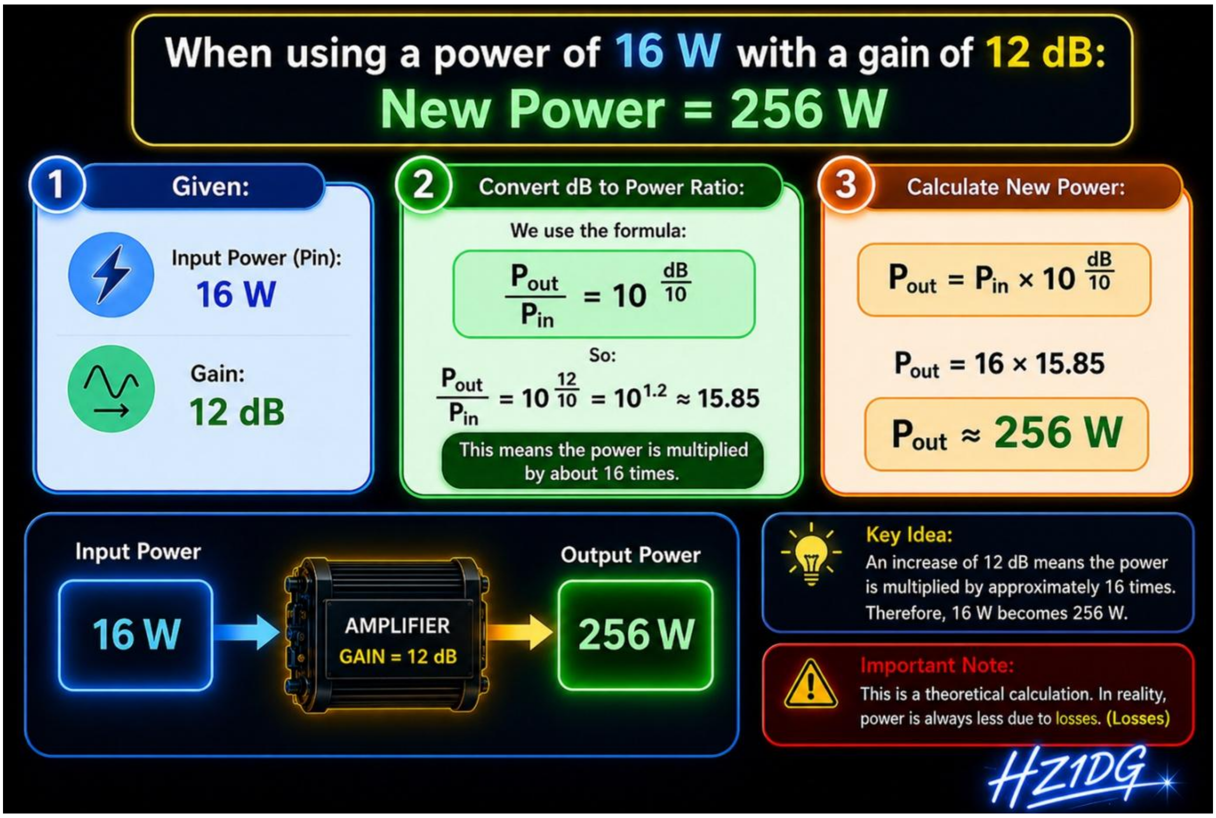


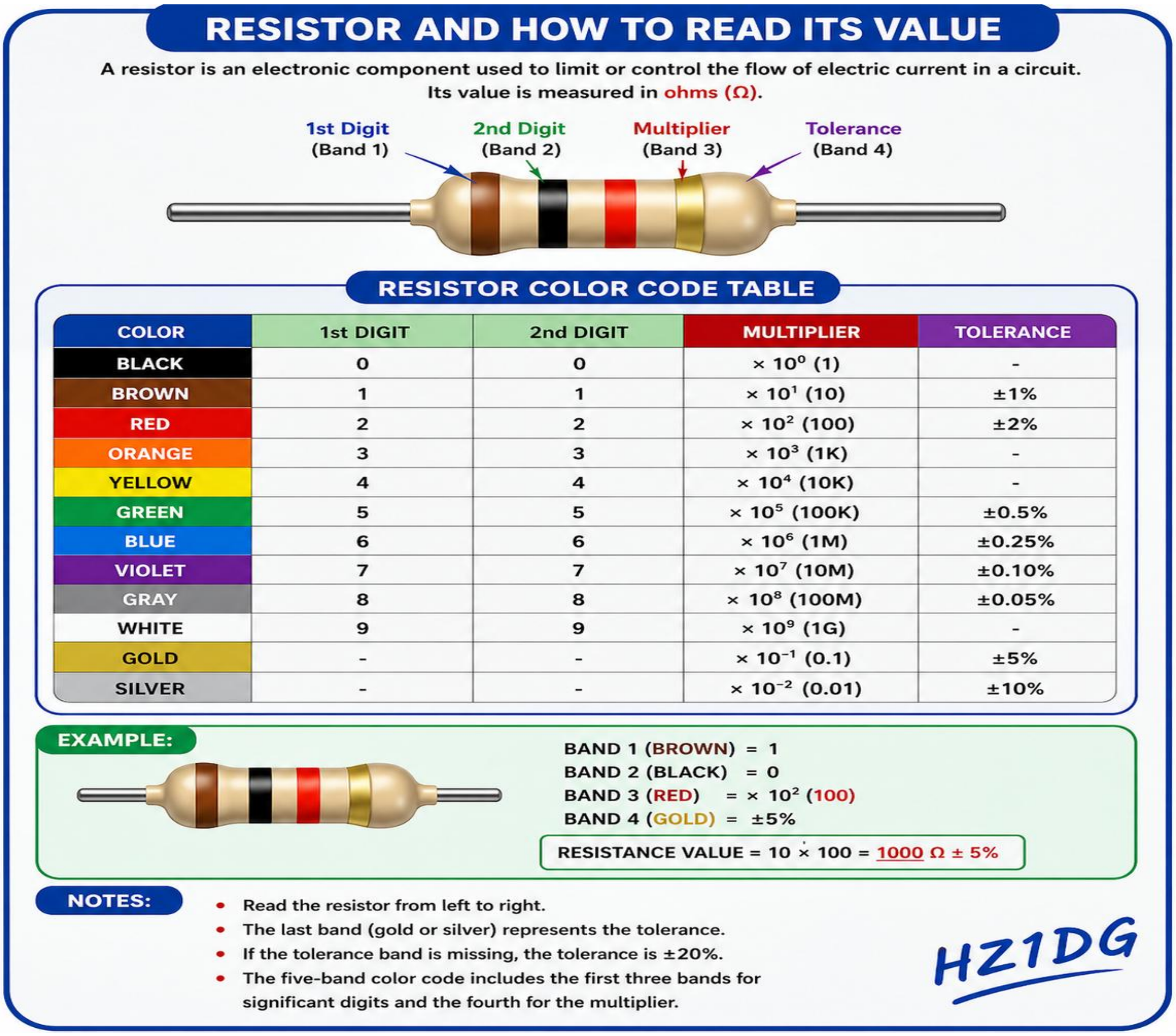
Figure (6-2): Example of Power Calculation Using Decibels (dB)

6.4 Electronic Components

6.4.1 Resistance

A resistor is used to control the flow of current in a circuit. The higher the resistance value, the lower the current; and the lower the resistance, the higher the current.

To determine the resistance value, a color-coding system is used, represented by colored bands on the body of the resistor. Each band corresponds to a specific value according to a defined sequence.



COLOR	1st DIGIT	2nd DIGIT	MULTIPLIER	TOLERANCE
BLACK	0	0	$\times 10^0$ (1)	-
BROWN	1	1	$\times 10^1$ (10)	±1%
RED	2	2	$\times 10^2$ (100)	±2%
ORANGE	3	3	$\times 10^3$ (1K)	-
YELLOW	4	4	$\times 10^4$ (10K)	-
GREEN	5	5	$\times 10^5$ (100K)	±0.5%
BLUE	6	6	$\times 10^6$ (1M)	±0.25%
VIOLET	7	7	$\times 10^7$ (10M)	±0.10%
GRAY	8	8	$\times 10^8$ (100M)	±0.05%
WHITE	9	9	$\times 10^9$ (1G)	-
GOLD	-	-	$\times 10^{-1}$ (0.1)	±5%
SILVER	-	-	$\times 10^{-2}$ (0.01)	±10%

Figure (6-3): Resistor Color Code System and Value Calculation

During current flow through a resistor, part of the energy is dissipated as heat, which causes the resistor's temperature to rise during operation.

6.4.2 Capacitor

A capacitor is an electronic component used to temporarily store electrical energy in the form of an electric field, and then release it when needed within the circuit.

A capacitor consists of:

- Two conductive plates
- An insulating material between them called the **dielectric**

When connected to a power source:

- Charges accumulate on the plates
- An electric field is formed between them
- Energy is stored within this field

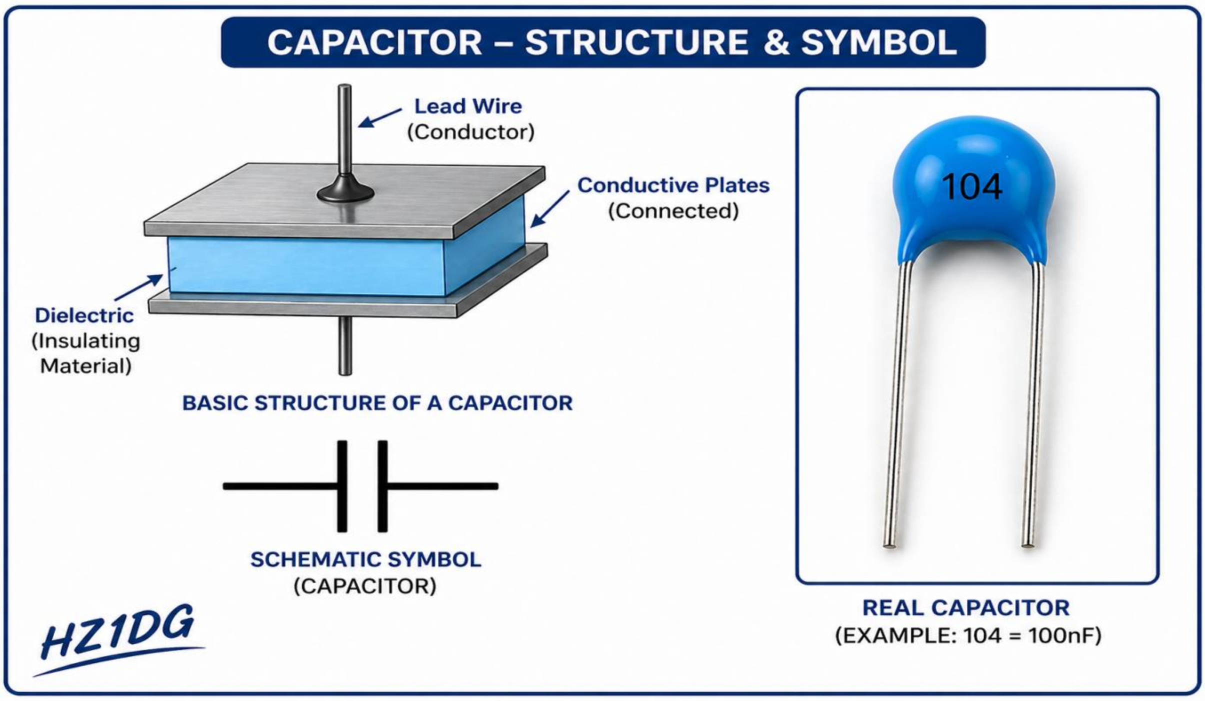


Figure (6-4): Basic structure of a capacitor and its schematic symbol

In some circuits, changing the capacitance value alters circuit behavior, especially frequency.

Key properties:

- Increasing capacitance → decreases frequency
- Capacitive reactance decreases as frequency increases
- In DC circuits → reactance becomes infinite after full charge, preventing current flow

Capacitive reactance varies with frequency, as shown below:

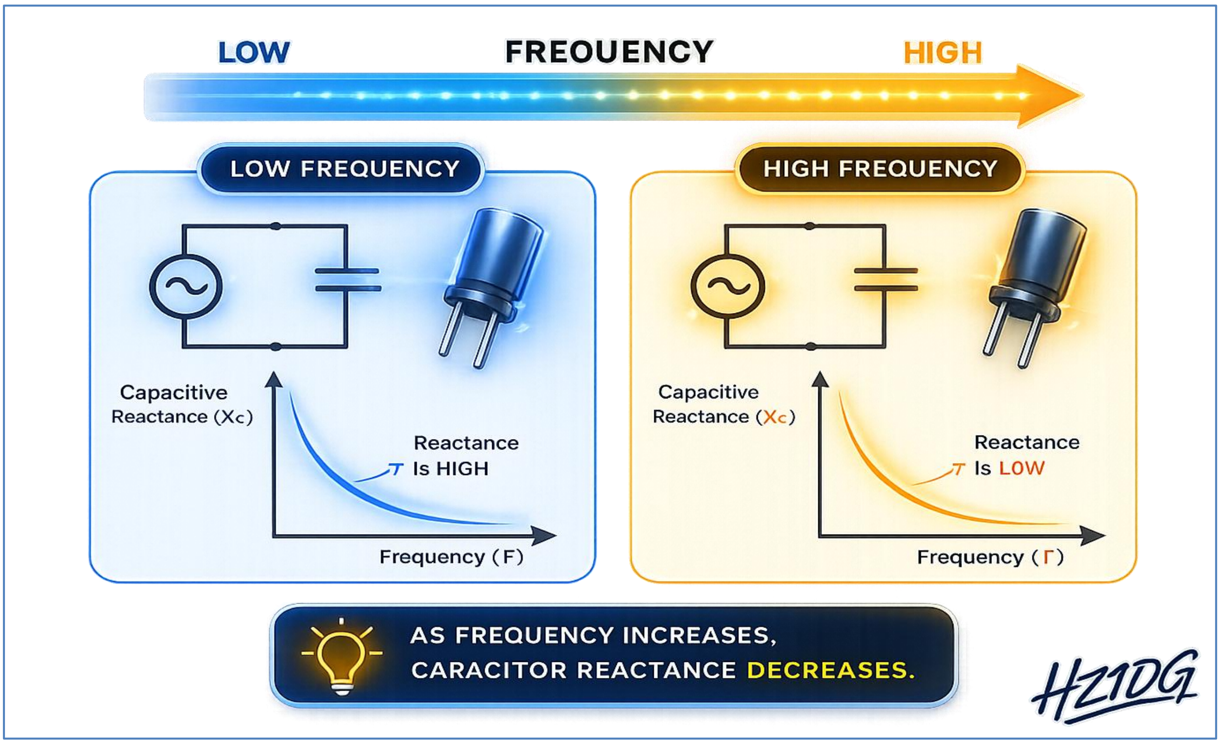


Figure (6-5): Variation of capacitive reactance with frequency

6.4.3 Inductor

An inductor stores energy in the form of a magnetic field.

Properties:

- Inductance increases when using an iron core
- In parallel connection, the total inductance decreases

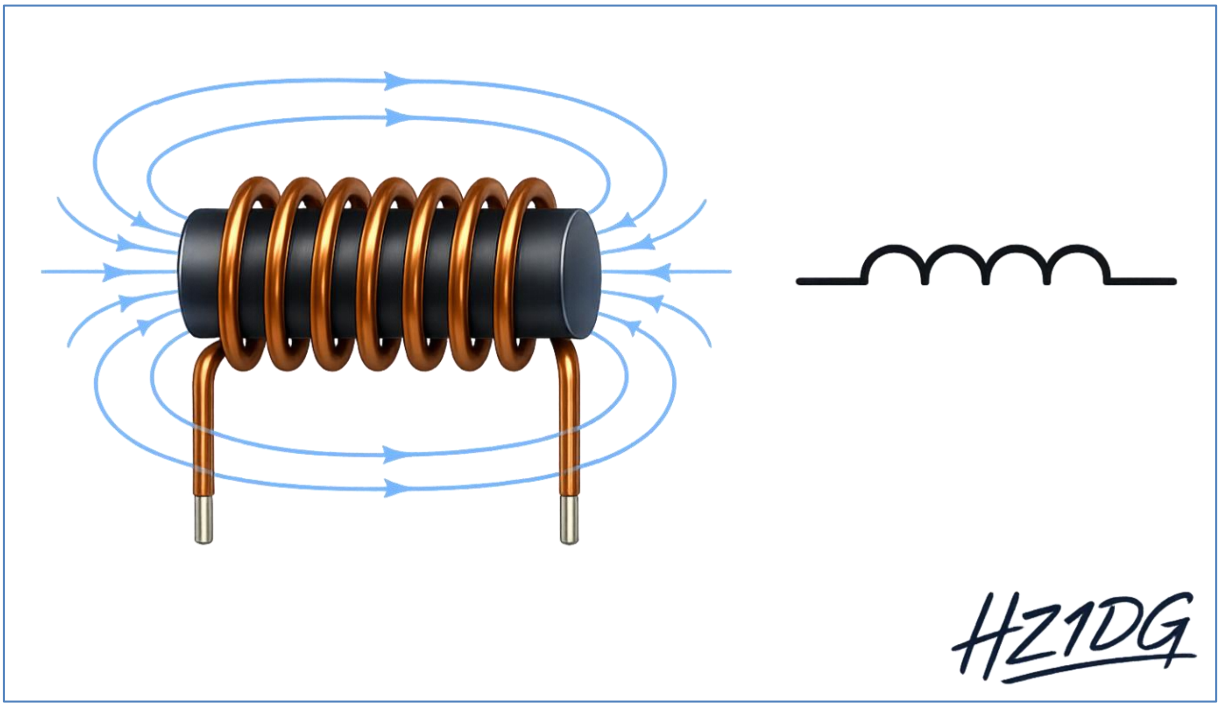


Figure (6-6): Inductor, magnetic field, and symbol

6.4.4 Diodes

Diodes are used to control voltage or signals.

Types:

- Zener Diode: Maintains a constant voltage
- Varactor Diode: Capacitance varies with voltage → used for frequency control

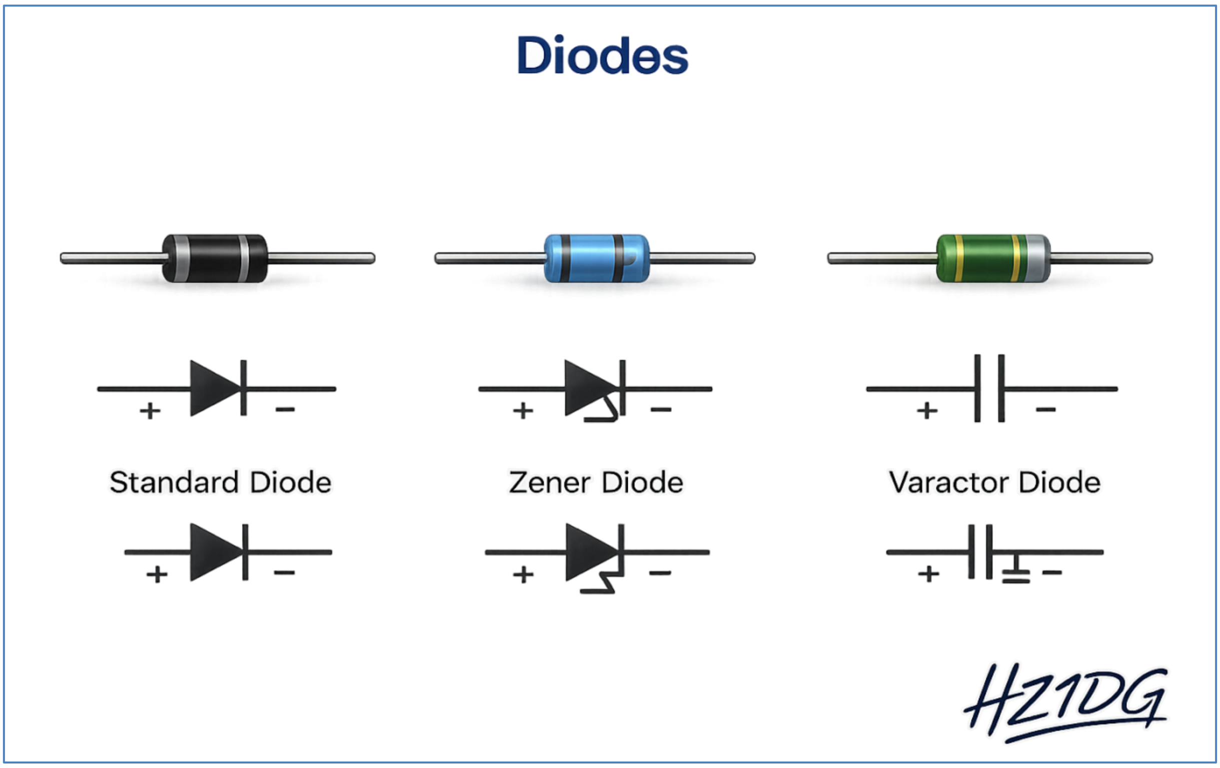


Figure (6-7): Diodes and their main types

6.5 Resonance in Circuits

In some cases, a circuit reaches a balanced condition known as **resonance**.

This occurs when:

Capacitive reactance equals inductive reactance

At this point, the circuit operates efficiently at a specific frequency.

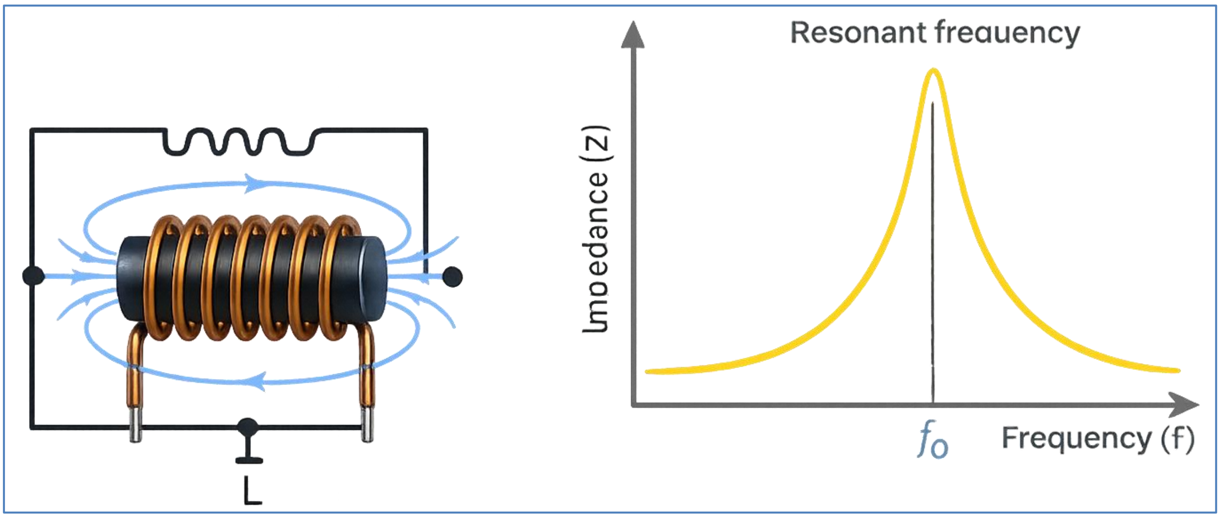


Figure (6-8): Resonance curve and its relation to frequency

6.6 Practical Circuit Applications

The **varactor diode** is used for frequency control in certain circuits, as its capacitance varies with the applied voltage. This allows electronic tuning of frequency without the need for mechanical components. This principle is utilized in some radio equipment to achieve precise and rapid frequency adjustment.

In some circuits, the varactor diode is used within a **Voltage-Controlled Oscillator (VCO)**, where the output frequency is varied by changing the voltage applied to the diode. This results in a change in its capacitance, and consequently, a change in the circuit frequency.

Frequency Control:

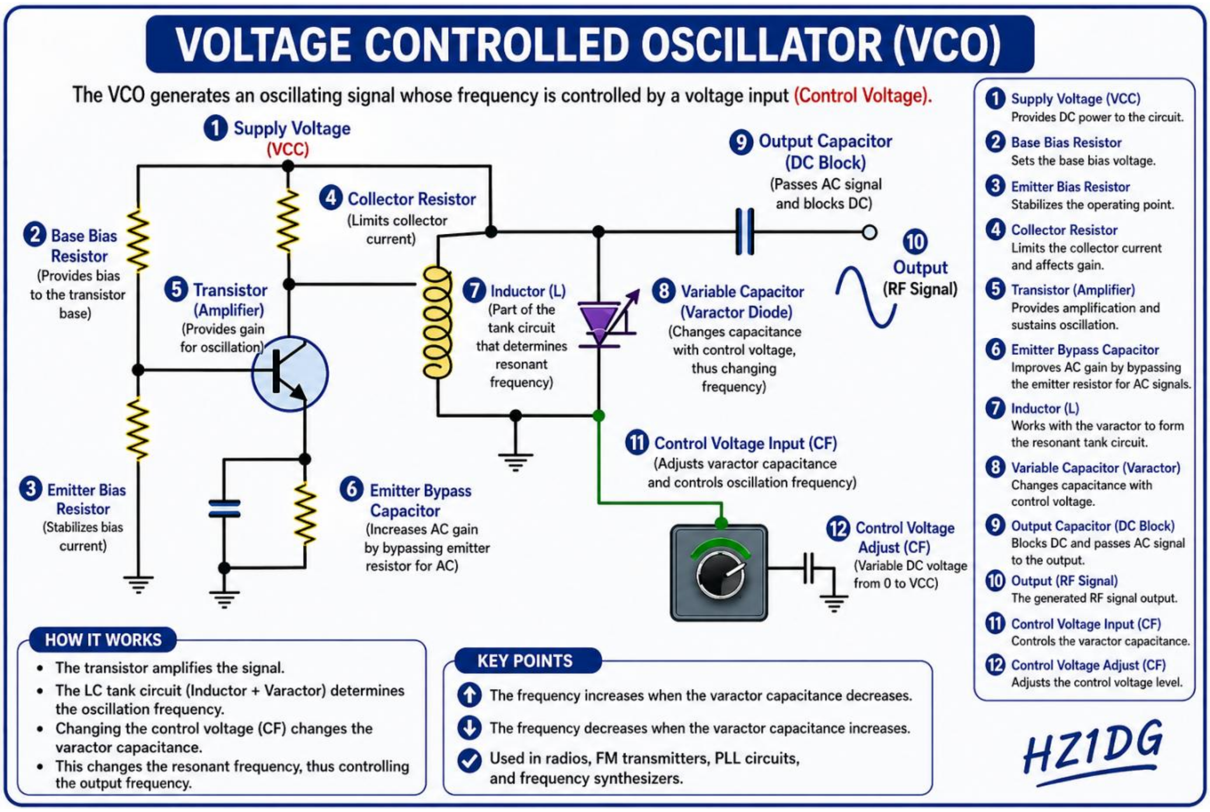


Figure (6-9): Voltage Controlled Oscillator (VCO)

Signal Filtering

Filtering is performed using a **Low-Pass Filter** to reduce harmonics.

When a signal is transmitted from an HF device:

- It is not perfectly pure
- It contains the fundamental frequency plus higher frequencies (**harmonics**)

Other filters include:

- **Notch Filter:** Used to suppress an unwanted frequency (e.g., removing interference in SSB signals)

Example:

If transmitting on **7 MHz**, signals may also appear at:

- 14 MHz
- 21 MHz
- and so on

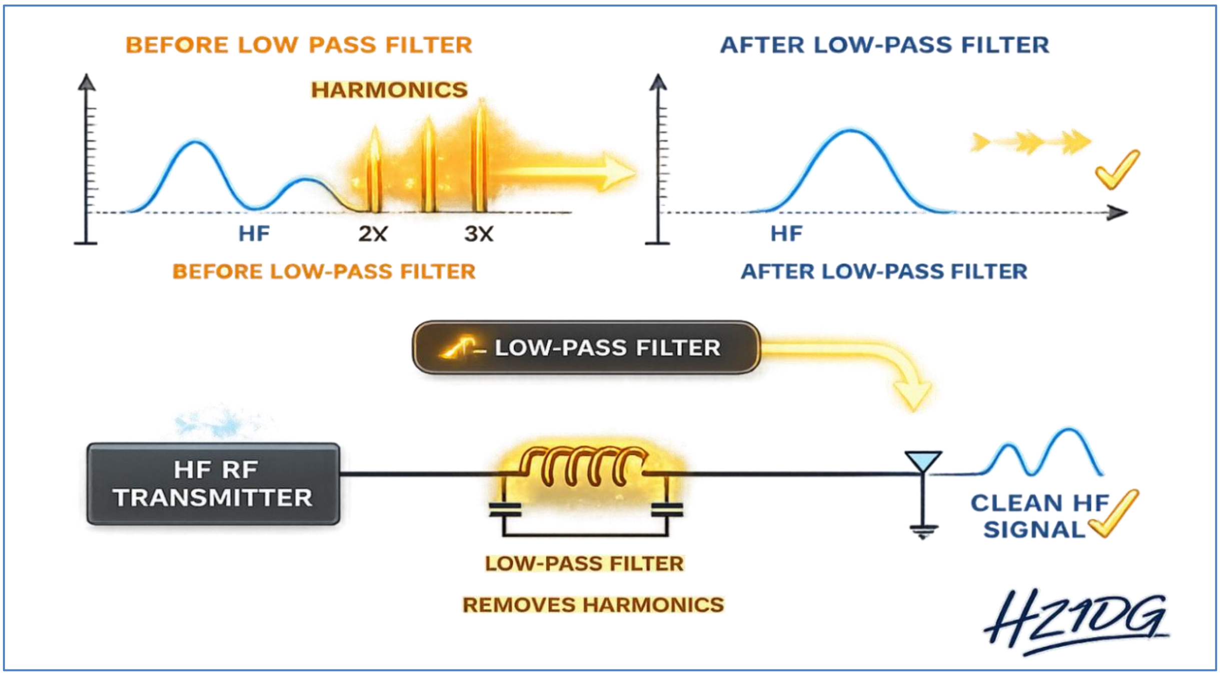


Figure (6-10): Effect of a Low-Pass Filter in removing harmonics

Resonant Circuits

Used to select a desired frequency:

They allow the desired frequency to pass at resonance while reducing other frequencies.

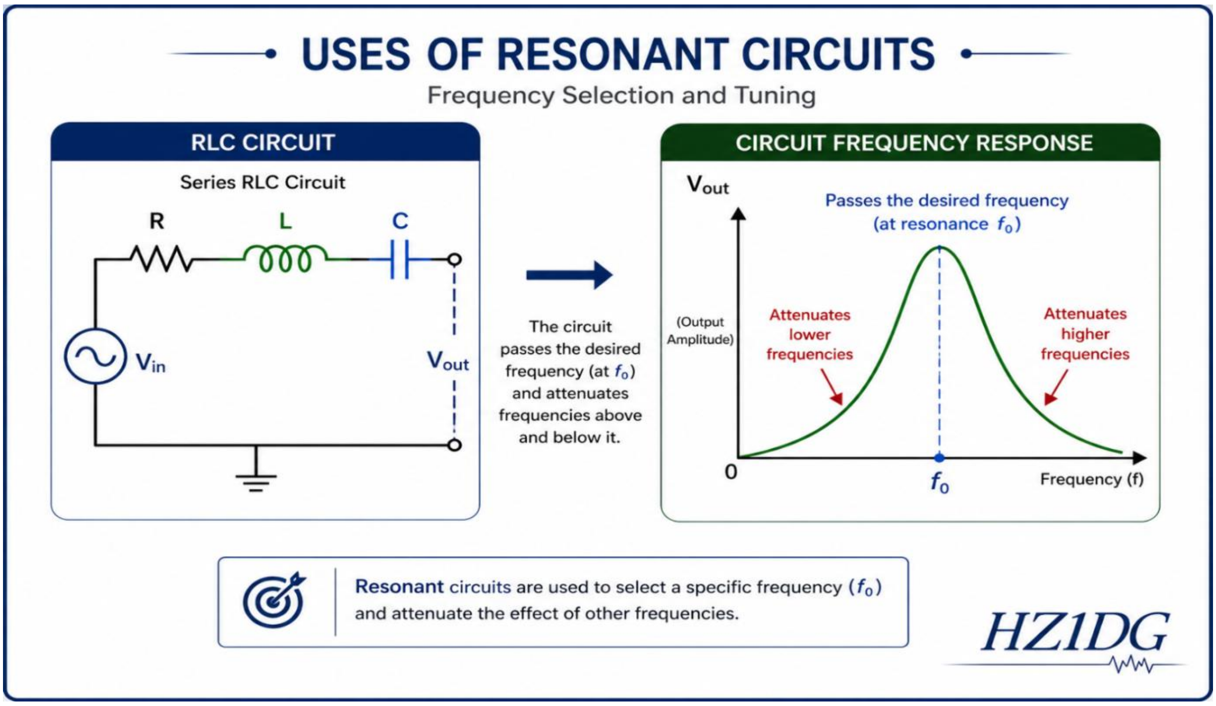


Figure (6-11): Resonant circuits and frequency selection

6.7 Measurement Instruments

These devices help operators analyze signals and evaluate station performance, improving communication quality and reducing interference.

- **S-Meter:** Measures relative signal strength
- **Dip Meter:** Indicates and determines resonance frequency
- **SWR Meter:** Checks impedance mismatch between antenna and transmitter

- **Spectrum Analyzer:** Displays signal amplitude versus frequency to analyze signals and detect interference and harmonics

  These tools help identify problems and improve transmission and reception performance.

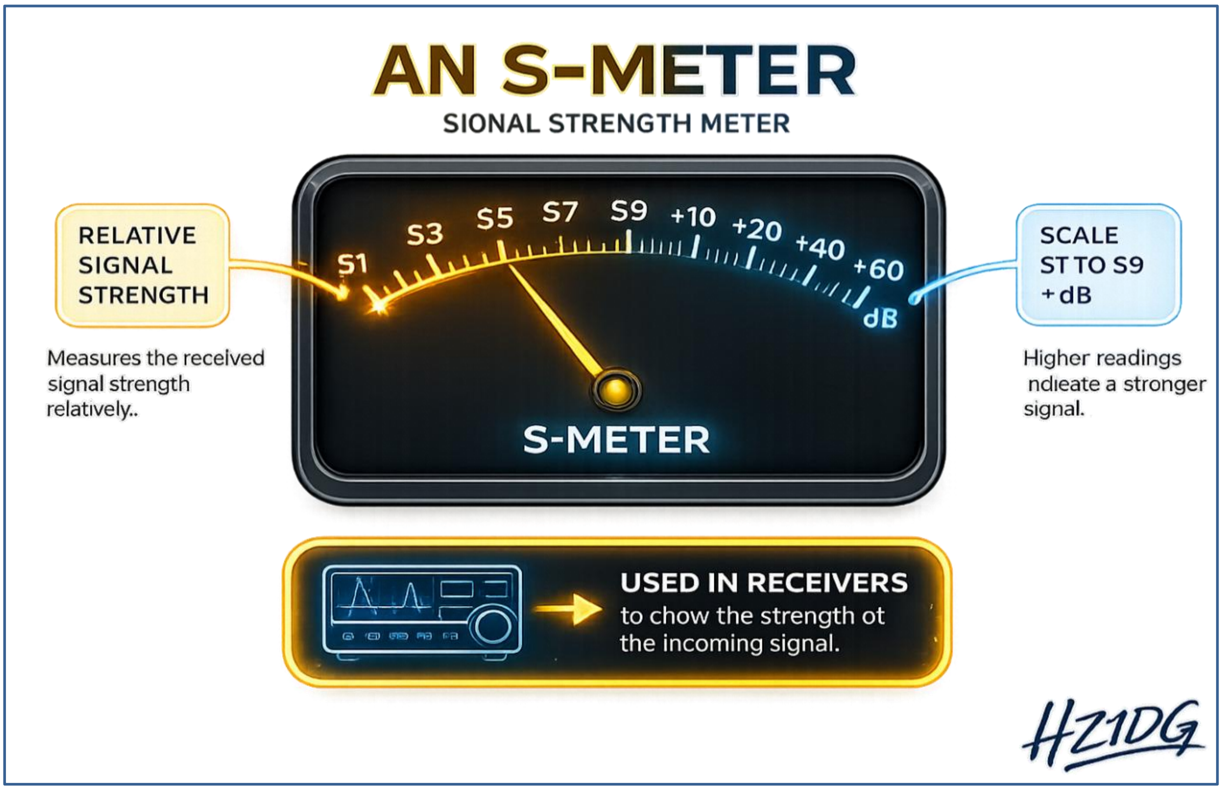


Figure (6-12): An S-Meter and signal reading

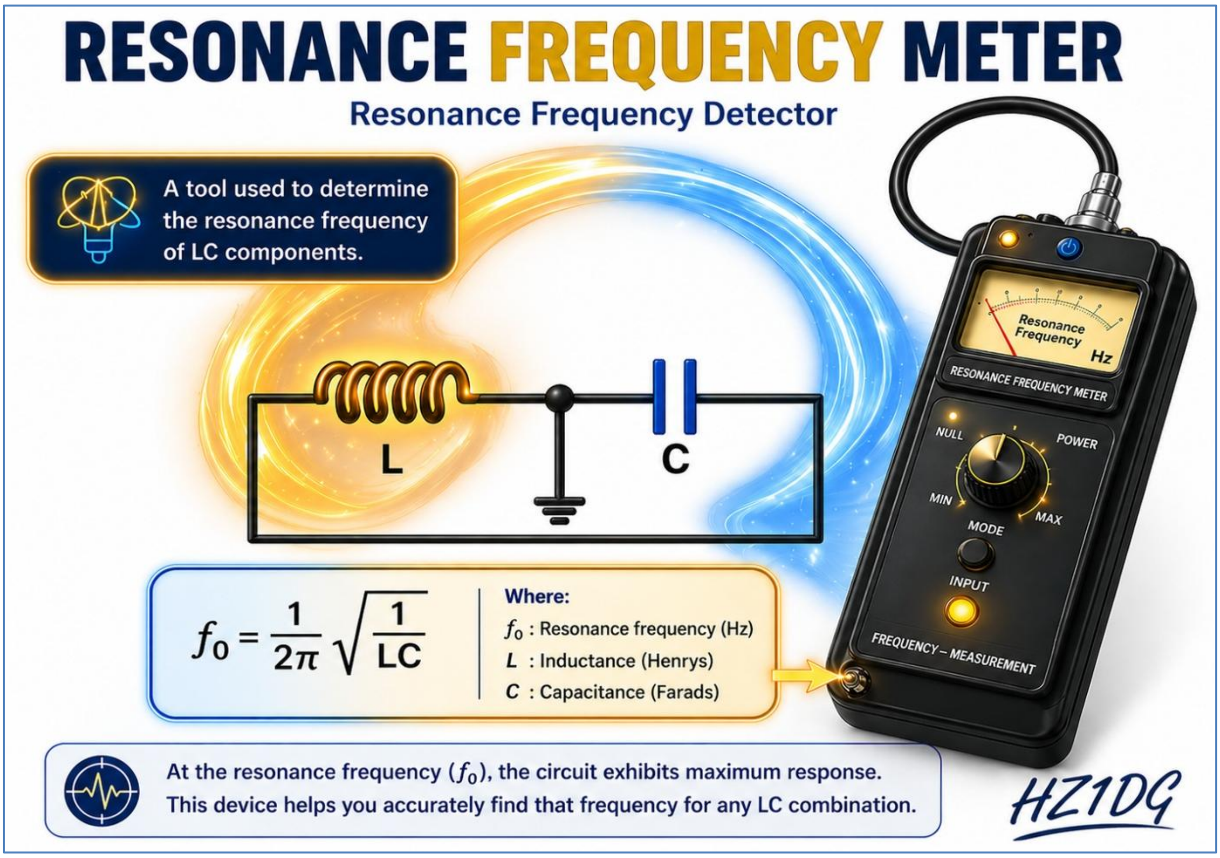


Figure (6-13): Dip Meter for resonance frequency measurement

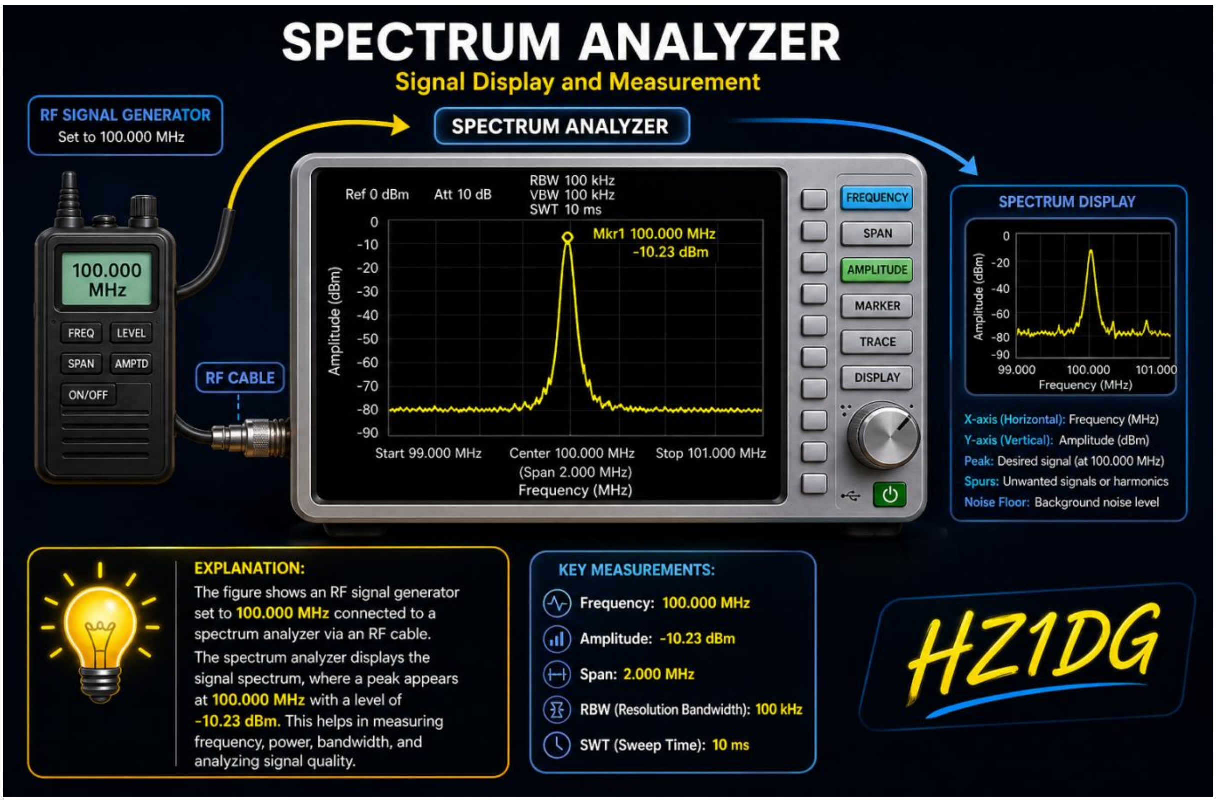


Figure (6-14): Signal display using a Spectrum Analyzer

Figure (6-15): SWR Meter and transmission efficiency monitoring

6.8 Signal Control in Receivers

Receivers include controls to improve signal quality and reduce interference, such as:

- **Attenuator:**

  Reduces incoming signal strength to prevent receiver overload

- **Noise Blanker:**

Reduces interference from electrical sources such as car ignition systems or household devices .

6.9 Practical Example

When a capacitor is connected to DC:

- Its reactance becomes **infinite**

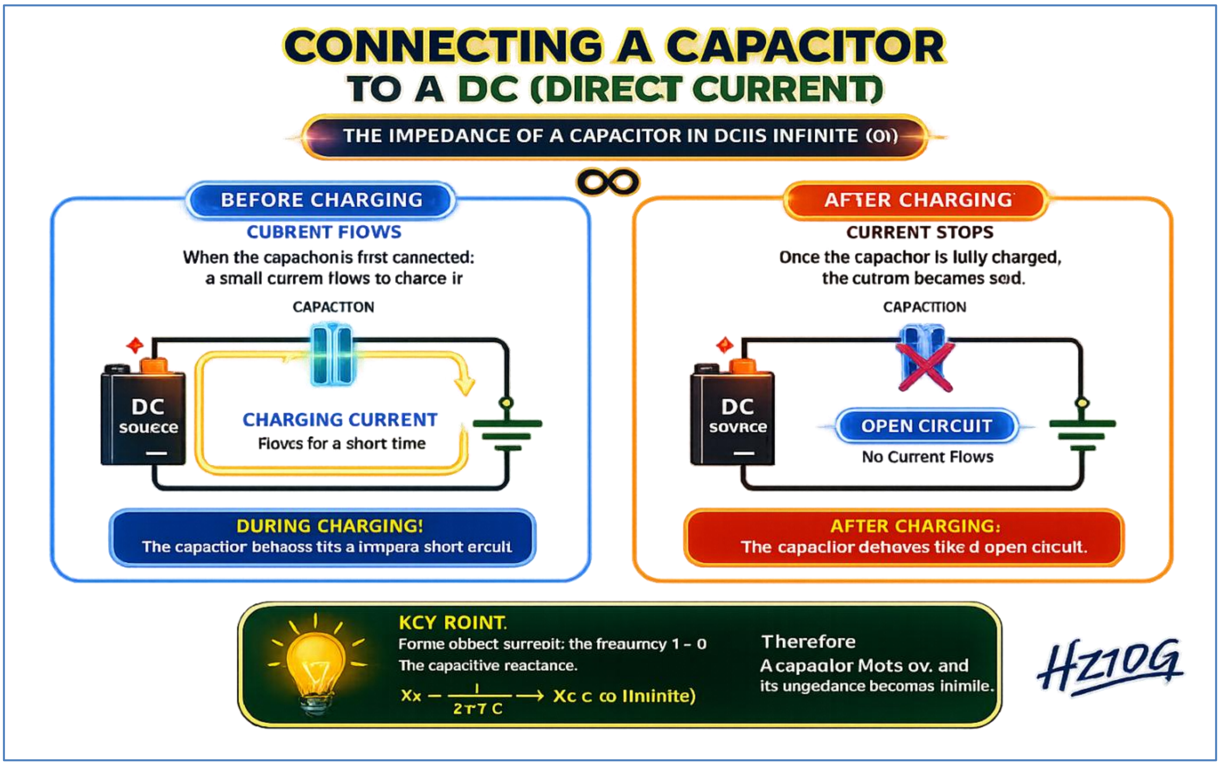


Figure (6-16): Capacitor response to DC before and after charging

6.10 Chapter Summary

Electronic circuits rely on a set of laws and components that determine signal behavior within the system.

Understanding the relationship between voltage, current, and resistance, along with the properties of capacitors and inductors, helps the operator interpret many phenomena encountered during operation.

This knowledge prepares the reader for studying transmitters and receivers, which directly depend on these electronic principles.

Additionally, using tools such as filters, attenuators, and spectrum analyzers helps improve signal quality and reduce interference during operation.

Chapter 7: Equipment and Transmit/Receive Systems

7.1 Introduction to Radio Equipment

Wireless communication relies on devices that convert sound into radio signals that can be transmitted through the air, and then convert them back into sound at the receiver.

This device is known as a **Transceiver**, as it combines both transmitting and receiving functions in a single unit.

All previously discussed concepts (frequency, propagation, electronics) are applied within this device.

7.2 Basic Components of a Radio System

A radio device consists of several main units:

- **Microphone**
- **Transmitter**
- **Receiver**
- **Speaker**
- **Power Supply**

In advanced receivers, additional modules may be used such as:

- IF Filters
- Gain control circuits

- Noise reduction systems

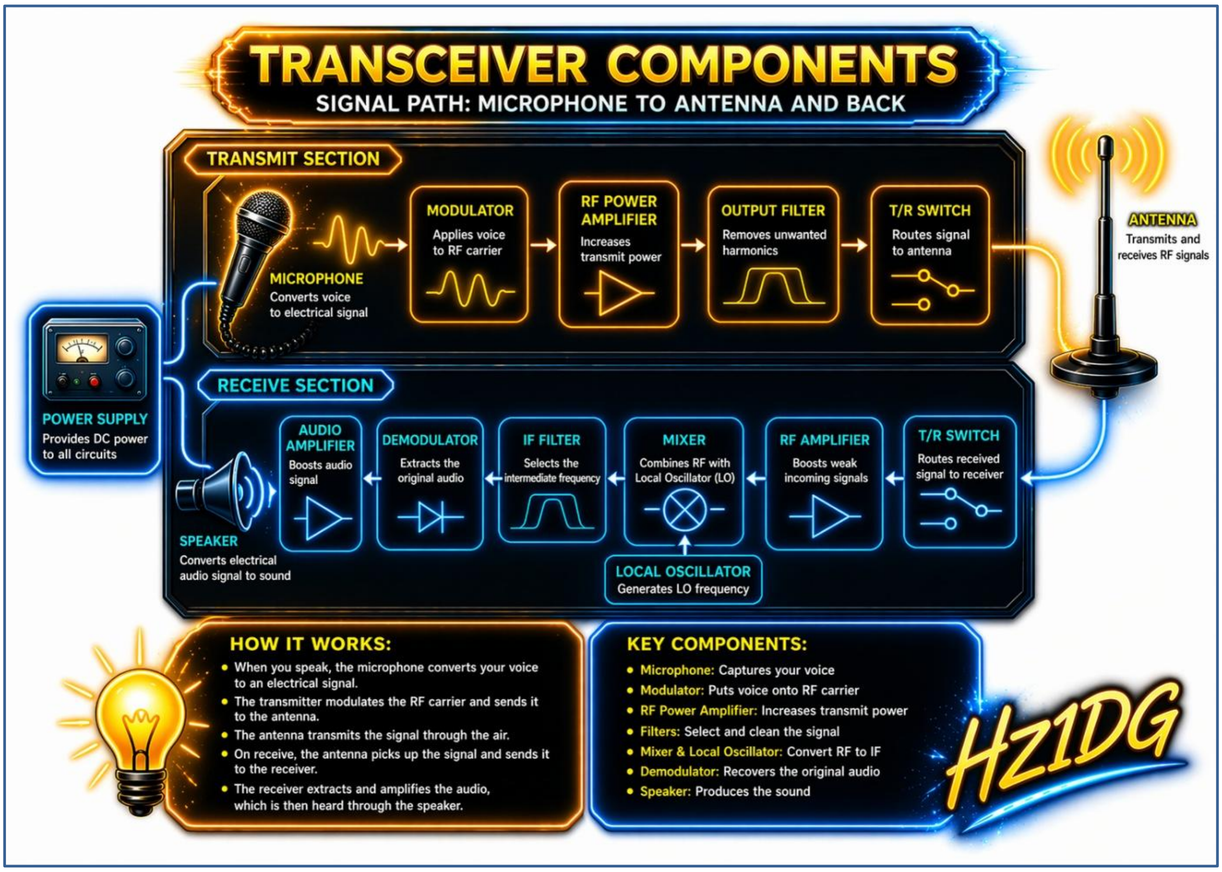


Figure (7-1): Components of a transceiver

Illustrates the signal path from the microphone to the antenna and vice versa.

How Transmission and Reception Work

During transmission:

- Sound is converted into an electrical signal
- The signal is modulated
- It is transmitted via the antenna

During reception:

- The signal is received
- It is demodulated
- It is converted back into sound

7.3 Transmitter (Transmitter Unit)

The transmitter performs several functions:

- Frequency generation
- Power amplification
- Signal transmission via the antenna
- Signal modulation

Each modulation type has an **Emission Designator**, which defines the characteristics of the transmitted signal.

For example:

- **FM (Frequency Modulation) → F3E**

Increasing power may improve range, but can also cause interference if not used properly.

7.4 Receiver (Receiver Unit)

The receiver performs:

- Signal reception
- Signal amplification
- Audio extraction
- Noise reduction

Special techniques are used to handle interference:

- **Noise Blanker:** Reduces electrical noise (e.g., car ignition, appliances)
- **Attenuator:** Reduces strong signals to prevent receiver overload

Reception quality depends on:

- Sensitivity
- Filter performance
- Noise level

7.4.1 Mixer Circuit

The **Mixer** is a fundamental stage in the receiver, where:

- The received signal is combined with the **Local Oscillator (LO)**

- Produces the **Intermediate Frequency (IF)**

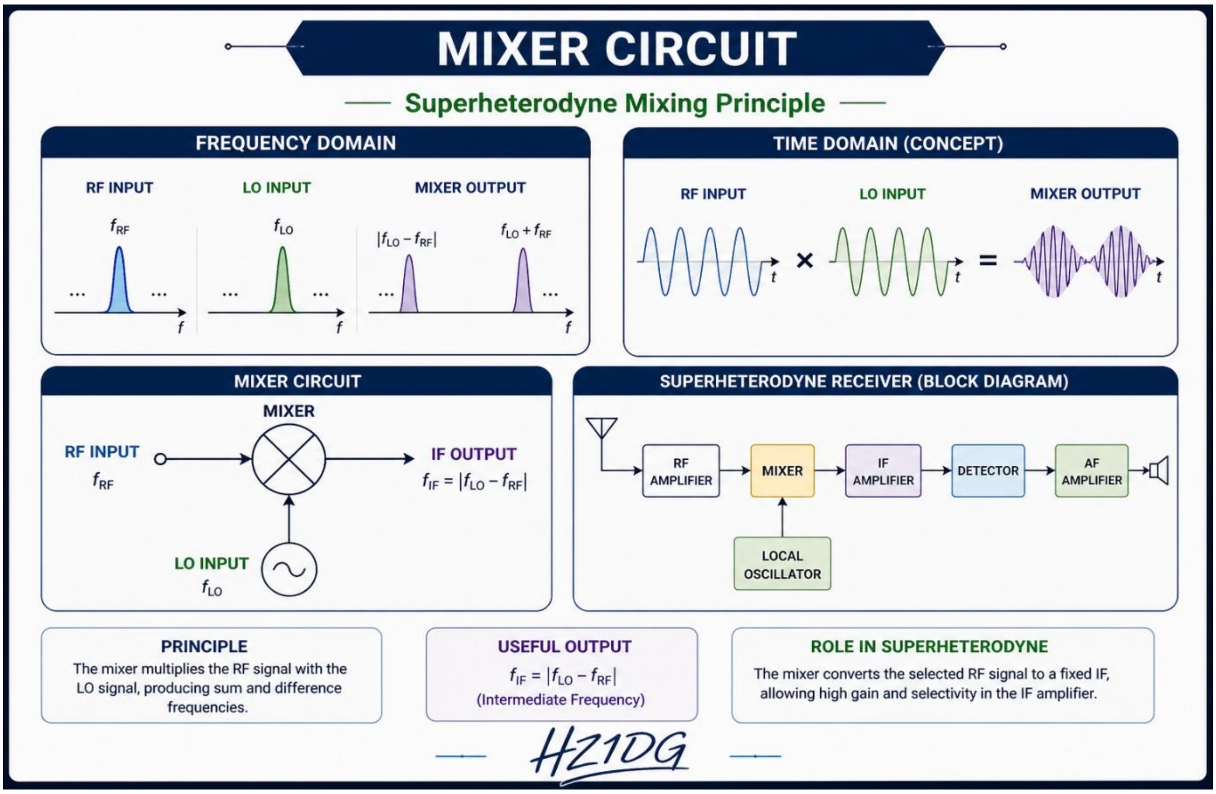


Figure (7-2): Superheterodyne mixing principle

However, strong input signals may produce unwanted outputs called:

- **Spurious Mixer Products**

These cause interference and distortion.

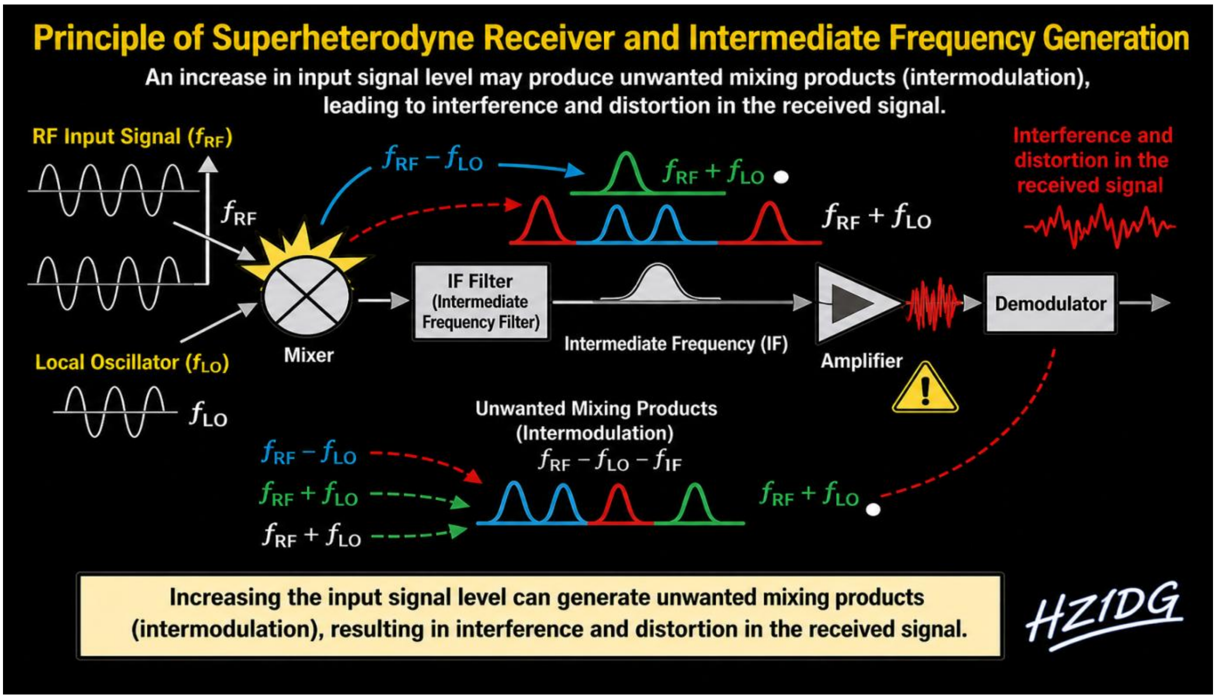


Figure (7-3): Effect of mixer spurious signals.

7.5 Modulation

Modulation is the process of placing information onto a carrier wave to allow long-distance transmission.

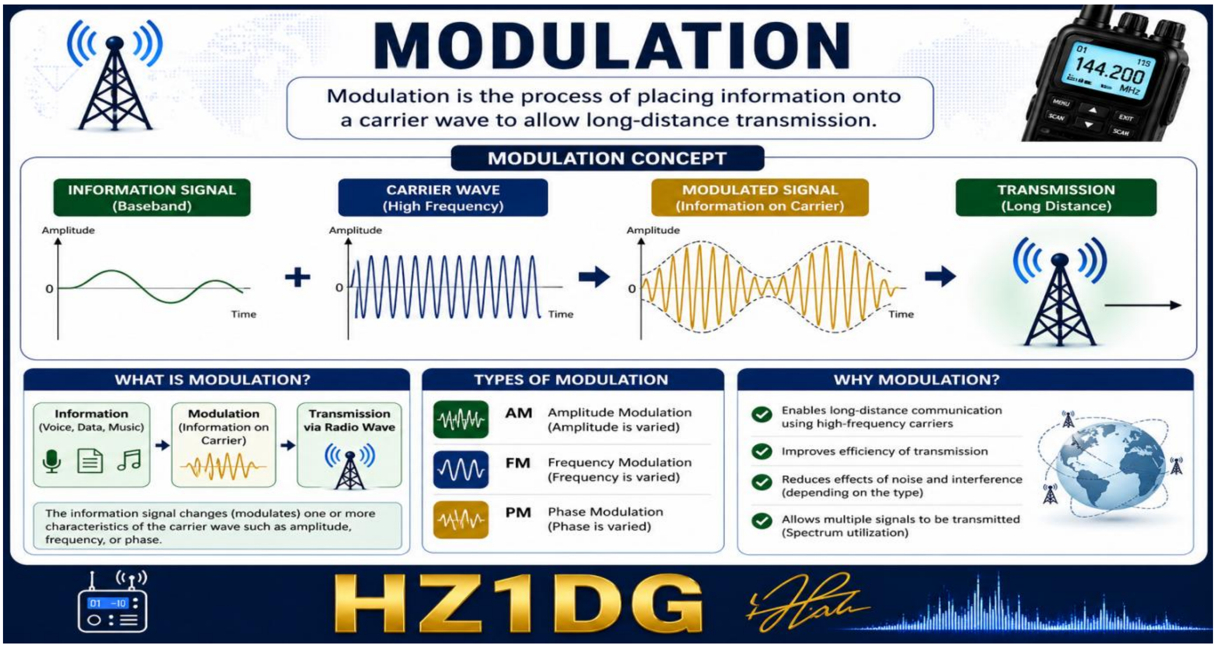


Figure (7-4): Modulation concept.

7.5.1 Types of Modulation

1. Analog Modulation

Includes traditional methods:

- **AM (Amplitude Modulation):** Varies amplitude, constant frequency
- **FM (Frequency Modulation):** Varies frequency, constant amplitude
- **PM (Phase Modulation):** Varies phase, constant amplitude

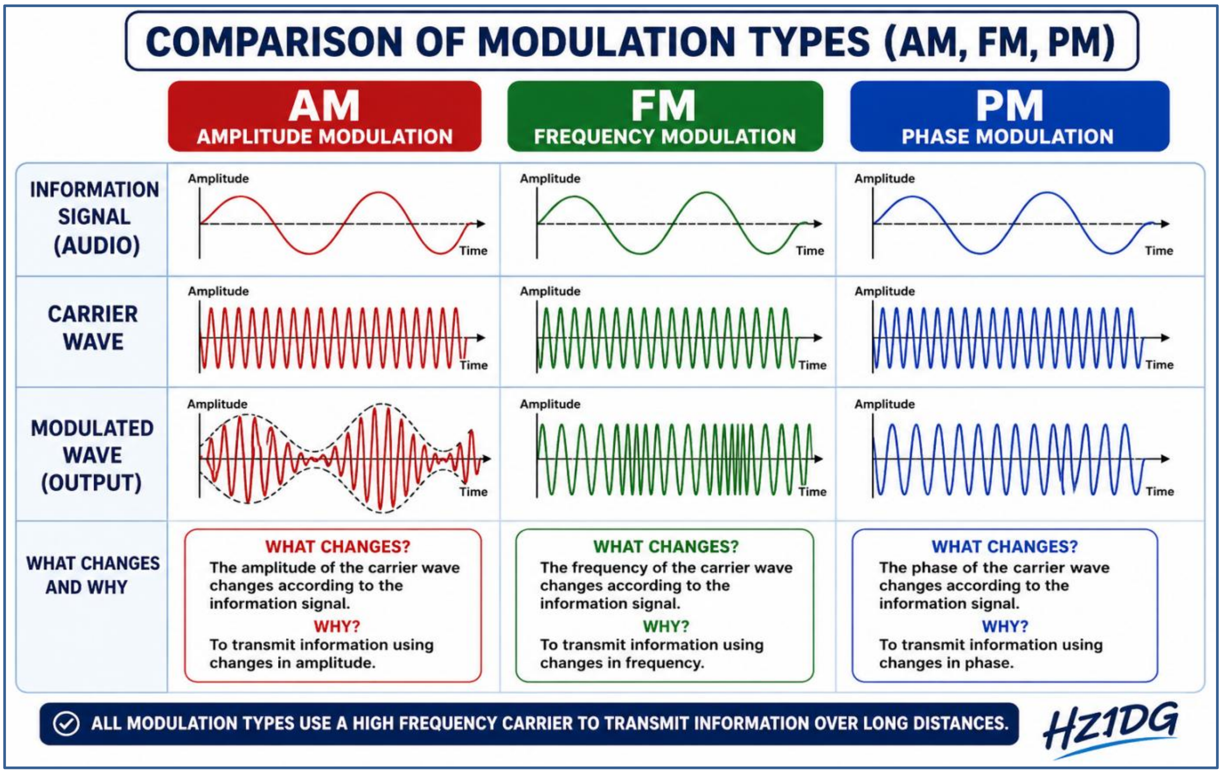


Figure (7-5): Comparison of AM, FM, and PM

Example:

- FM → commonly used in VHF/UHF
- AM → used in some HF bands

2. Digital Modulation

Used in modern systems:

- ASK
- FSK
- PSK
- QAM
- RTTY (Radioteletype)

Example:

- **RTTY** uses **FSK** for text transmission

3. Specialized Modulation Types

Examples include:

- **Amplitude-keyed telegraphy (ASK)**
- **Frequency-shift-keyed telegraphy (FSK)**
- **Frequency-modulated telephony (FM)**
- **Phase-modulated telephony (PM)**

7.5.2 Difference Between FM, AM, and SSB

- **FM:**

High audio clarity, less noise, wider bandwidth, used for local communication

- **AM:**

Simple but sensitive to noise, consumes more power

- **SSB (Single Sideband):**

Improved AM with:

- Higher efficiency
- Narrow bandwidth
- Longer range

Types:

- **USB (Upper Sideband)**
- **LSB (Lower Sideband)**

Note:

- LSB → below 10 MHz
- USB → above 10 MHz

7.5.3 Modulation Applications

- **SSB:** Long-distance HF communication
- **FM:** Local communication (VHF)
- **AM:** Aviation and broadcasting

7.5.4 Balanced Modulator

Used to suppress the carrier (**Carrier Suppressed**), especially in SSB systems.

7.5.5 Overmodulation

Excessive modulation causes:

- **Splatter Interference**

Example:

- Excessive microphone gain → signal distortion and adjacent channel interference

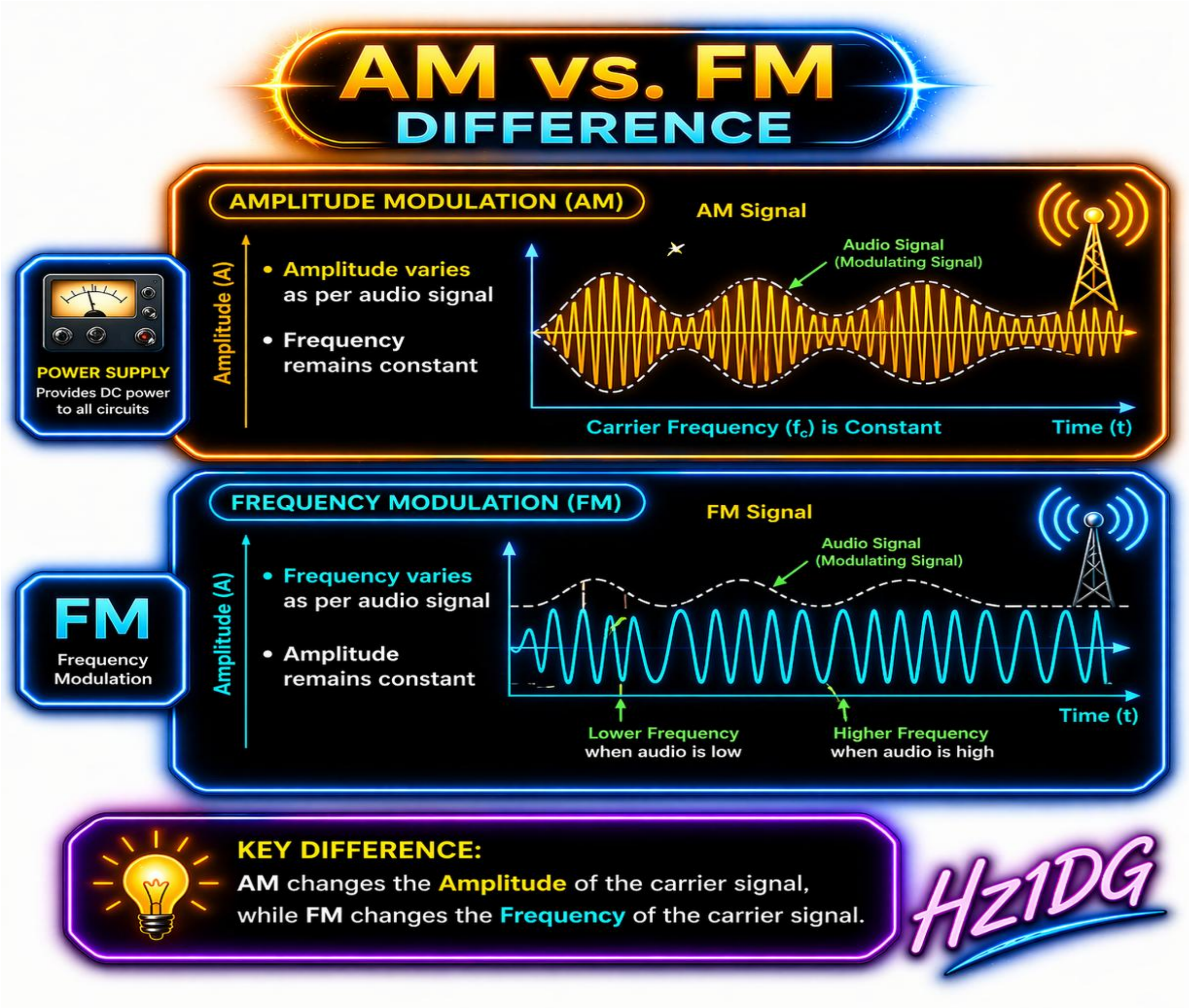


Figure (7-6): AM vs FM comparison

7.6 Intermediate Frequency (IF)

Used in receivers to convert signals to a fixed frequency for easier processing.

In **Superheterodyne receivers**:

- Signal is mixed with LO → produces IF

Benefits:

- Improved reception
- Reduced noise
- Simplified design

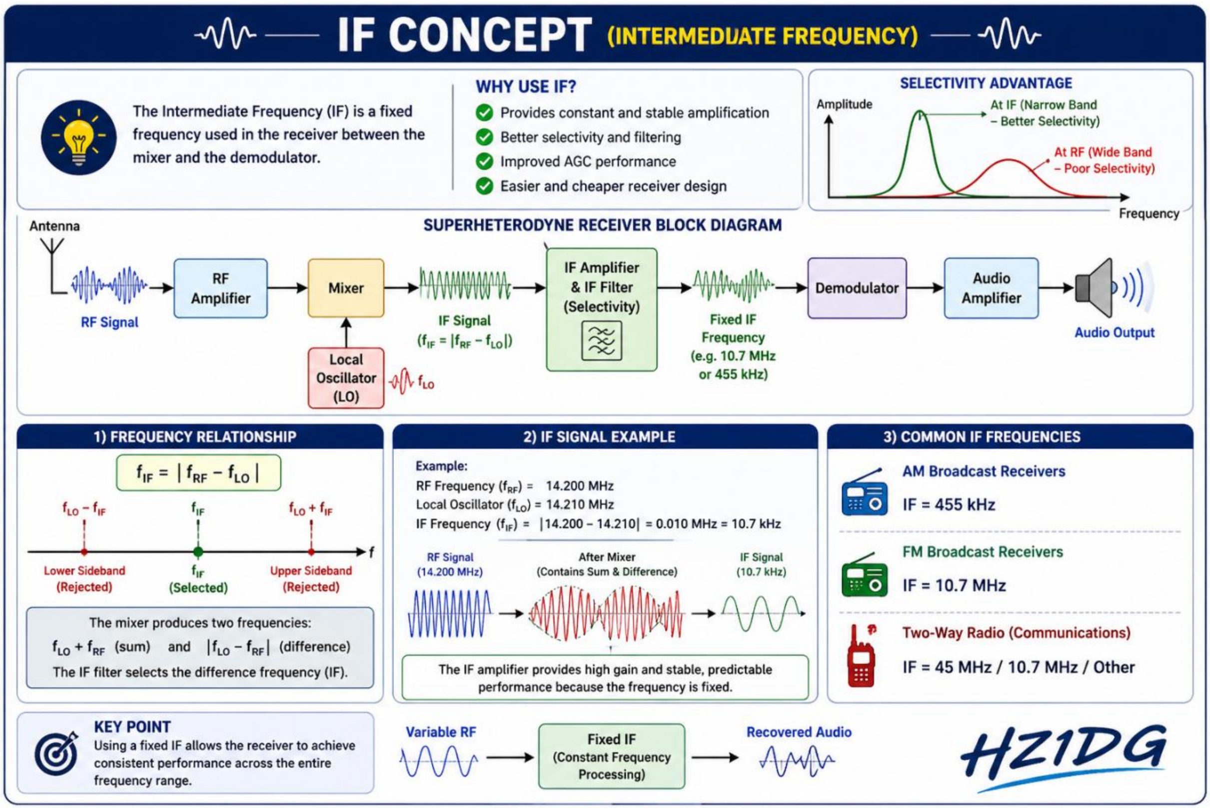


Figure (7-5): IF concept

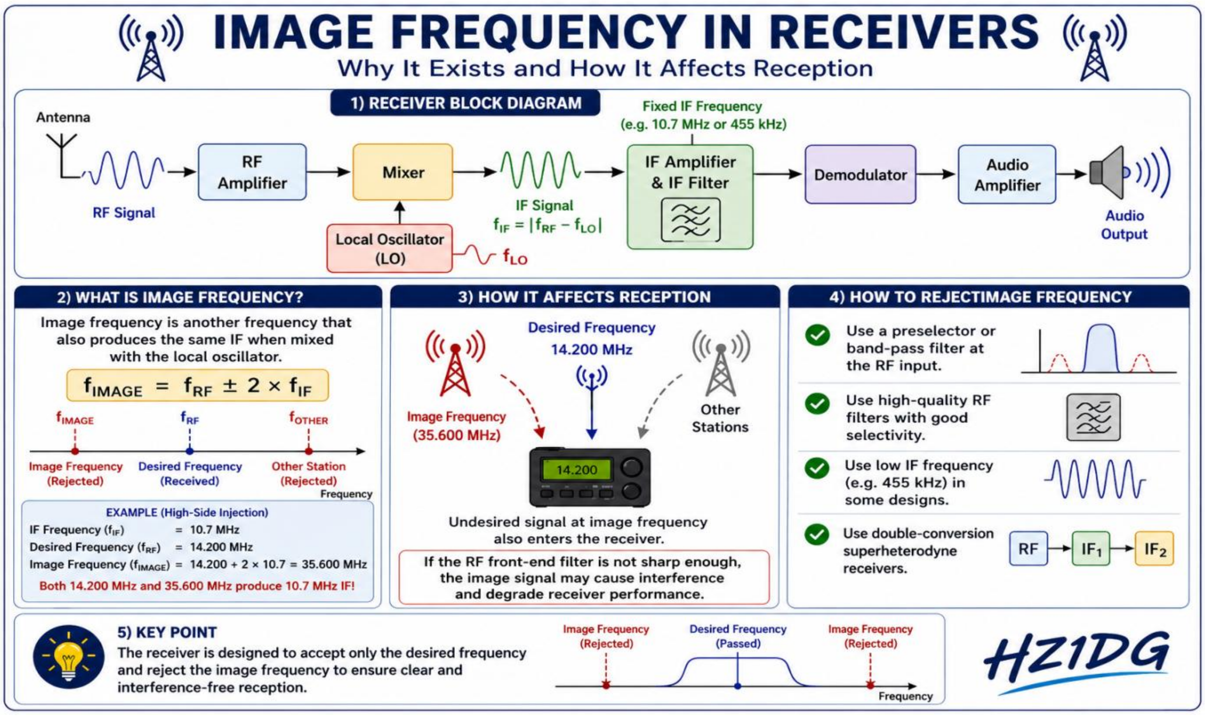


Figure (7-6): Image frequency in receivers

7.7 Filters

Used to select desired frequencies:

Types:

- **Low-pass filter** → passes low frequencies
- **High-pass filter** → passes high frequencies
- **Band-pass filter** → passes a specific range

Special filters:

- **Notch Filter:** Removes a specific unwanted frequency

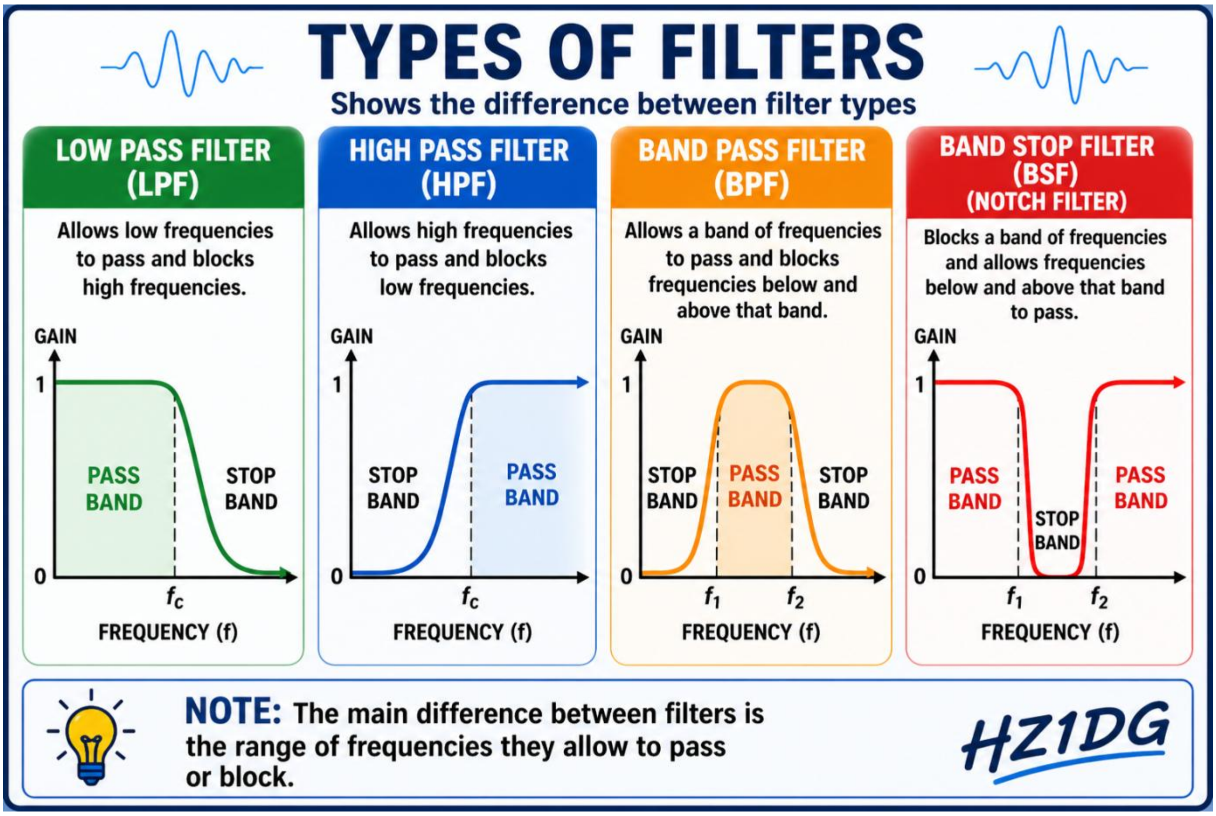


Figure (7-7): Filter types

7.8 S-Meter

Measures received signal strength:

S1 → very weak

S9 → very strong

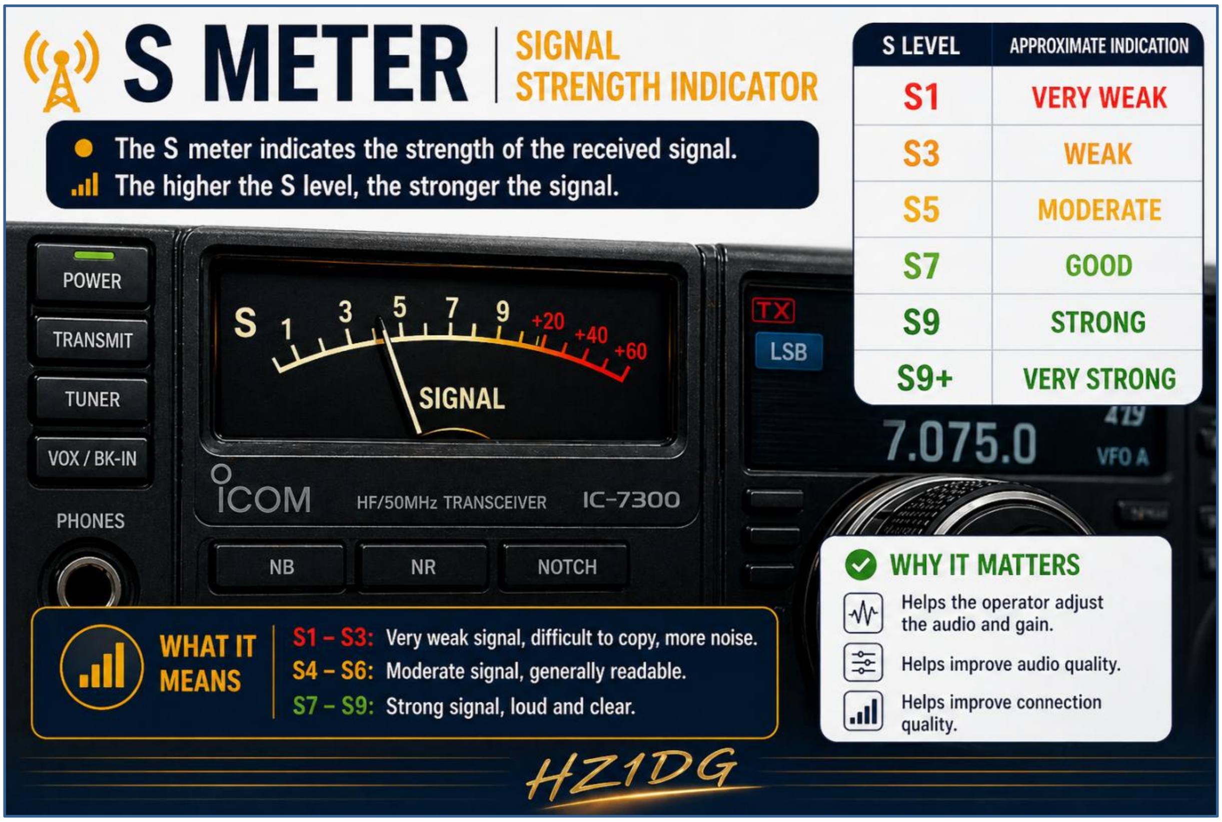


Figure (7-8): S-Meter scale

7.8.1 S-Meter Beyond S9

The S-meter is used in radio receivers to display the strength of the received signal on a standardized scale ranging from S1 to S9. This scale provides an approximate indication of signal level, where each increase of one S-unit corresponds to approximately 6 dB.

When the signal reaches S9, which is considered a standard reference level of about -73 dBm in the HF band, the measurement no longer continues in additional S-units. Instead, any further increase in signal strength is expressed in decibels (dB).

Figure (7-9): S- Signal Strength Above S9 (S-Meter +dB)

For example:

- S9 +10 dB indicates the signal is 10 dB stronger than S9
- S9 +20 dB indicates an increase of 20 dB

- S9 +40 dB indicates a very strong signal, far exceeding S9

After S9, measurement is expressed in **dB** for higher accuracy.

The importance of using dB above S9 lies in providing higher accuracy for measuring strong signals, as the S-scale is limited and cannot represent large differences in signal power. Therefore, a more precise scale—decibels—is used.

It is worth noting that the approximate relationship between S-units and decibels (6 dB per S-unit) remains useful for understanding; however, measurements above S9 rely directly on dB to represent the actual increase in signal strength.

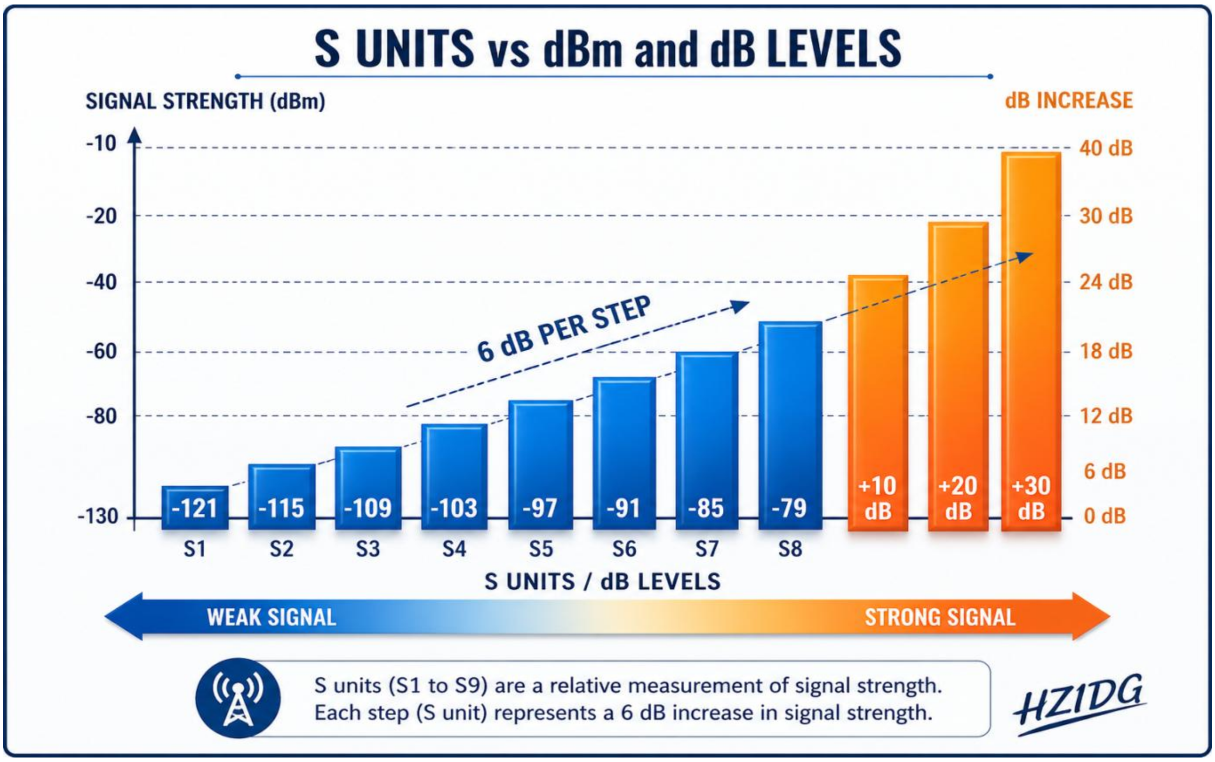


Figure (7-10): Graph of Signal Strength Above S9 (S-Meter +dB)

7.9 Sensitivity and Selectivity

- **Sensitivity:** Ability to detect weak signals
- **Selectivity:** Ability to isolate desired signals

Primarily determined by:

- **IF Filter**

High sensitivity + good selectivity = better performance

7.10 Operational Notes

- Antenna greatly affects performance
- Frequency and timing are critical
- Reducing noise improves reception
- Do not rely only on power

The issue may be in the antenna or environment, not the device.

7.11 Chapter Summary

Transceivers are the foundation of wireless communication, converting sound to radio waves and vice versa.

Understanding:

- Modulation
- IF
- Filters
- Sensitivity

Helps in:

- Improving communication quality
- Understanding system performance
- Troubleshooting

A solid grasp of modulation, filtering, and IF operation enables better signal analysis and interference management.

Chapter 8: Antennas

8.1 Introduction to Antennas

The antenna is one of the most important components of a radio station. It converts electrical signals into radio waves that propagate through the air, and performs the reverse process during reception.

Despite the importance of the transceiver, communication performance depends greatly on the type of antenna and how it is installed.

In many cases, changing the antenna can improve communication more than changing the radio itself.

8.2 Principle of Antenna Operation

When current flows through an antenna:

- An electric field and a magnetic field are generated
- These fields produce an electromagnetic wave that propagates through the air carrying the signal

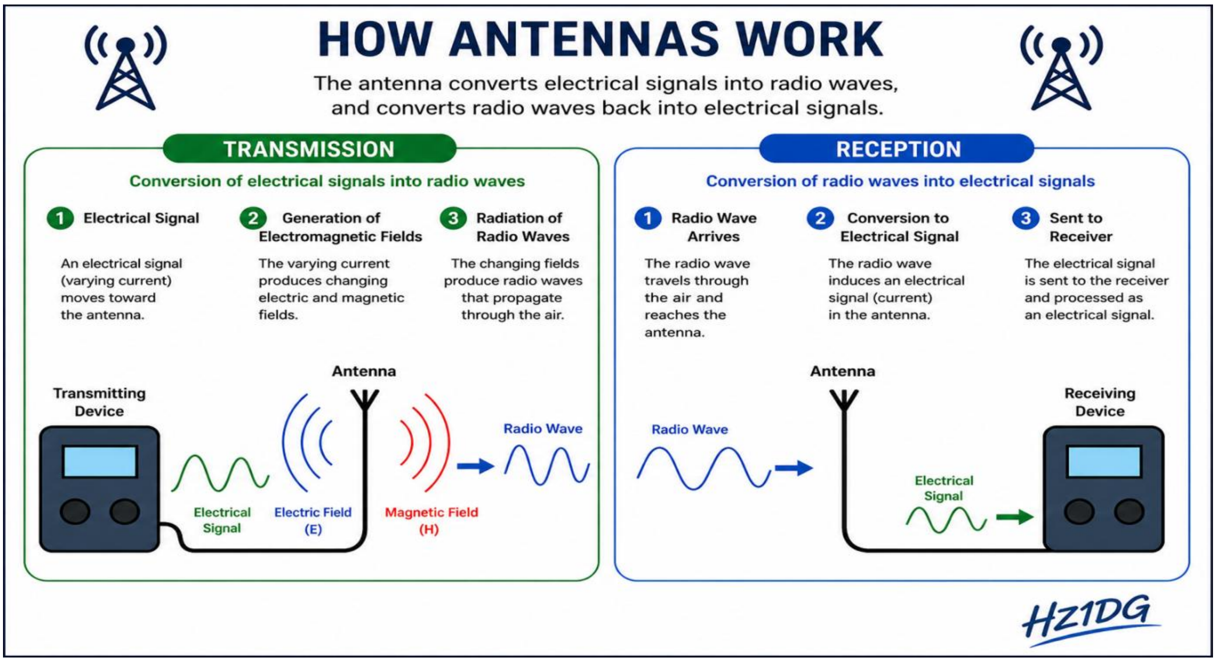


Figure (8-1): Antenna operating principle

During reception:

The antenna elements receive the incoming electromagnetic wave, inducing a weak electrical current that is carried through the feed line to the receiver, where it is processed into understandable audio or data.

8.3 Antenna Tuner

In some cases, the antenna impedance does not match the transmitter impedance, causing power reflection and a high **SWR**.

To solve this, an **Antenna Tuner** is used to achieve better impedance matching between the antenna and feed line.

It helps to:

- Reduce reflected power
- Improve power transfer
- Protect the transmitter

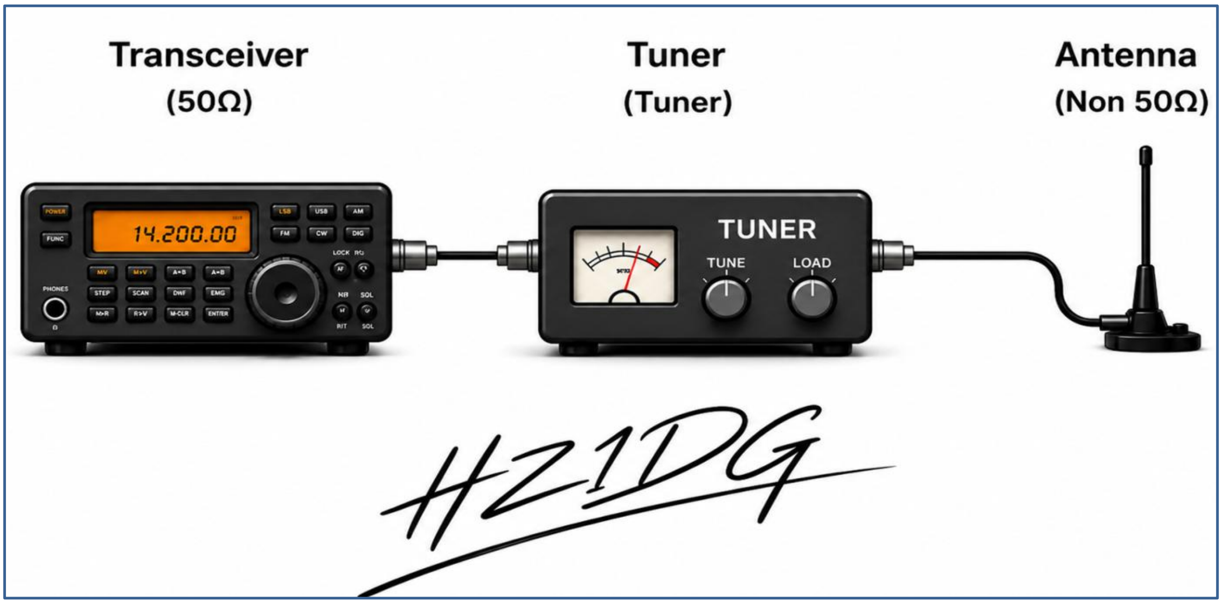


Figure (8-2): Impedance matching using an antenna tuner

Important Note

The tuner does not improve the antenna itself, but only improves system matching.

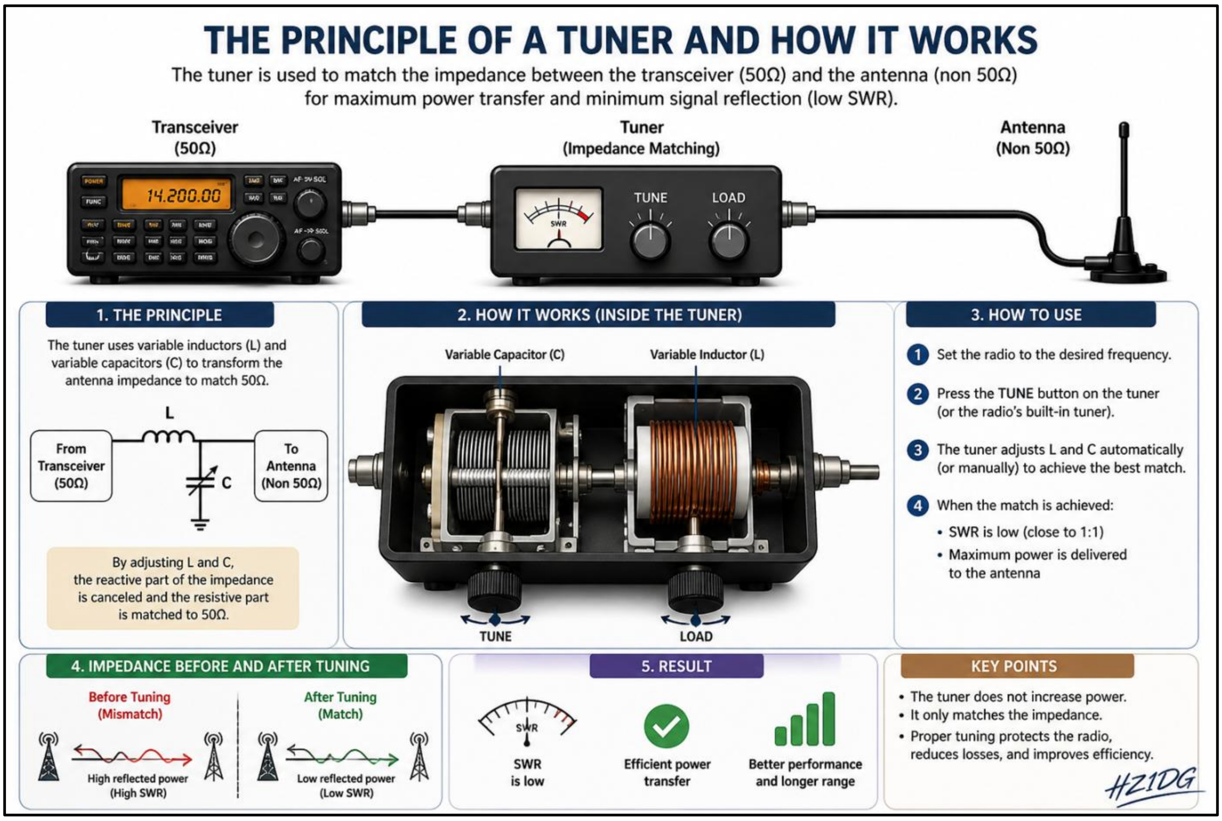


Figure (8-3): Antenna tuner principle

8.4 Types of Antennas

8.4.1 Dipole Antenna

One of the simplest and most widely used antennas.

Consists of:

- Two (conductors)
- A center feed point

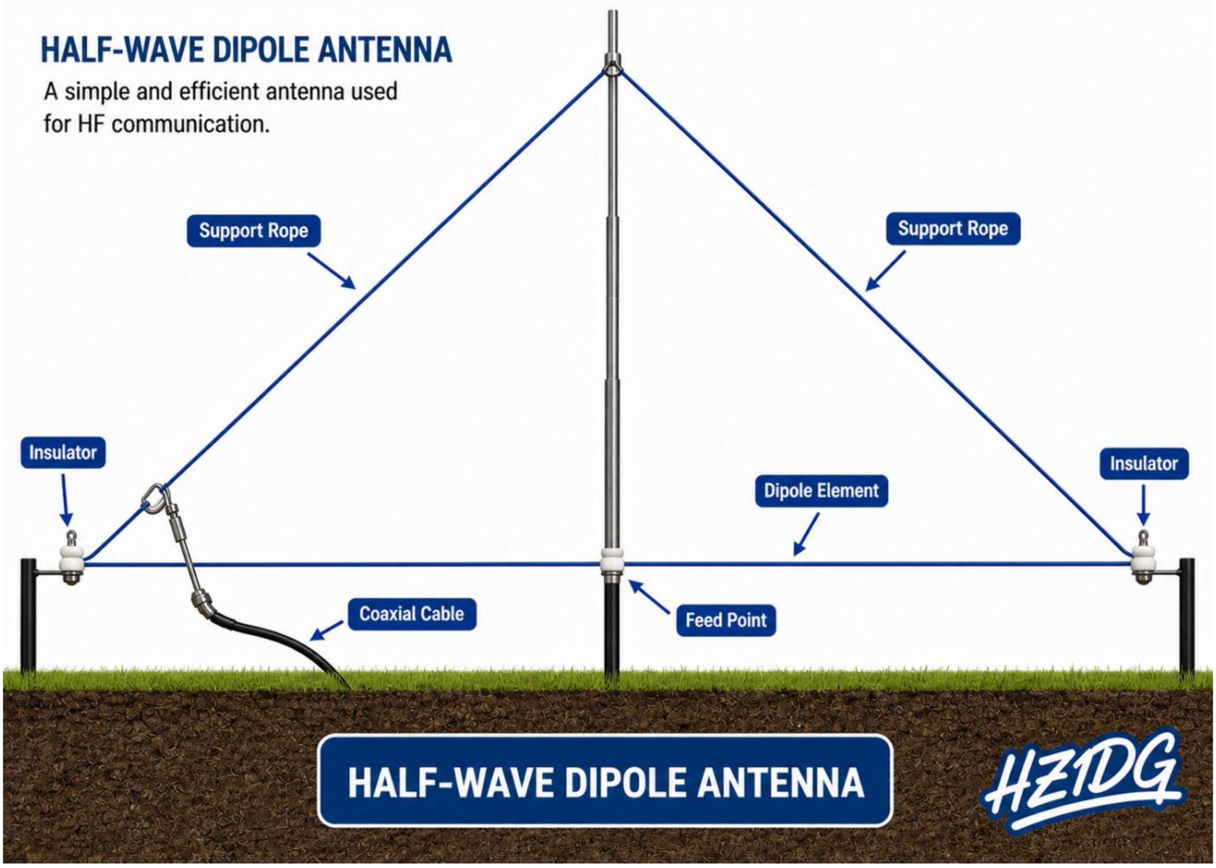


Figure (8-4): Dipole antenna

Advantages:

- Easy installation
- Good performance
- Low cost

8.4.2 Yagi Antenna

A directional antenna consisting of:

- Driven element
- Reflector
- Directors

Provides:

- High gain
- Directional radiation
- Long-distance communication

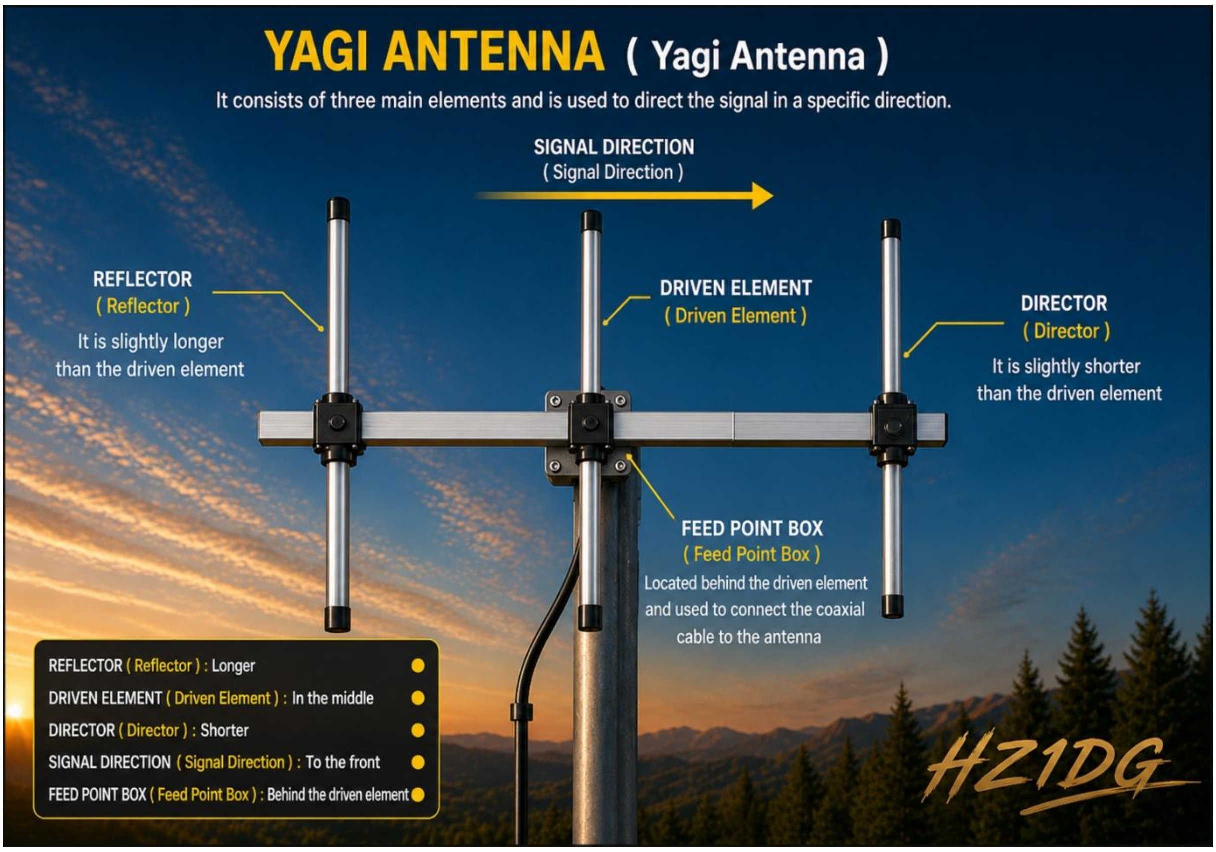


Figure (8-5): Yagi antenna

8.4.3 Vertical Antenna

Commonly used for local communication (VHF/UHF).

Features:

- Omnidirectional coverage
- Easy installation

However:

- More susceptible to noise

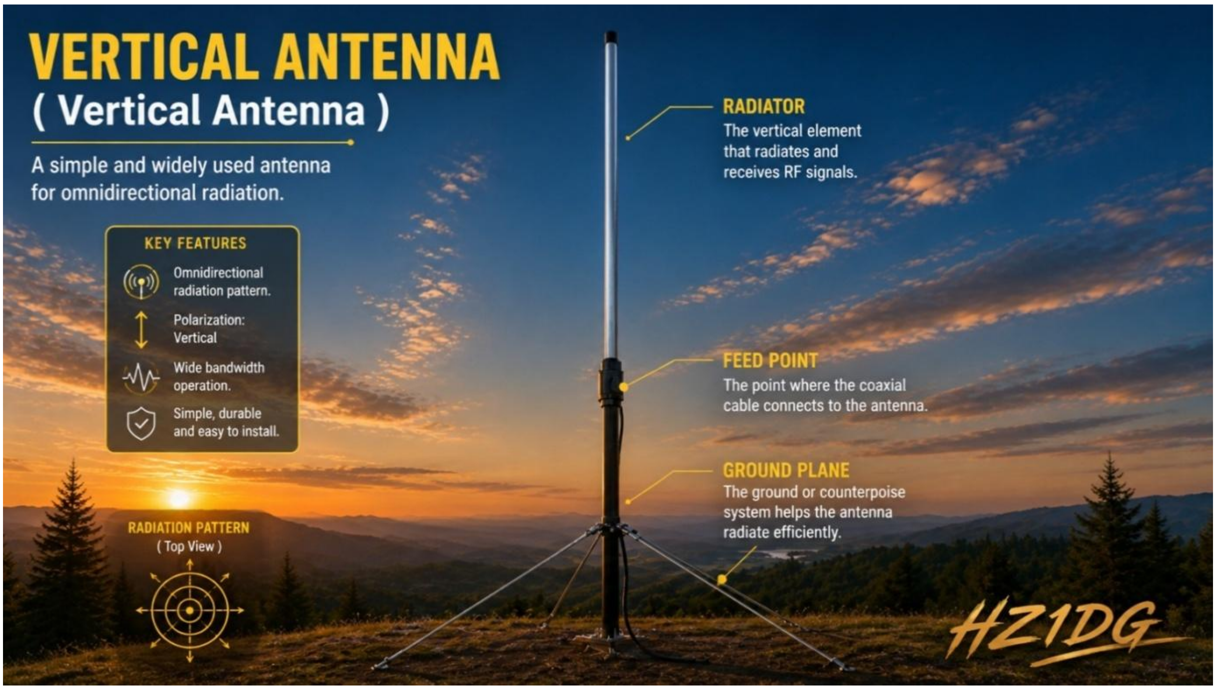


Figure (8-6): Vertical antenna

8.4.4 Delta Loop Antenna

A triangular loop antenna used mainly in HF.

Features:

- High efficiency
- Low noise
- Good for long-distance communication

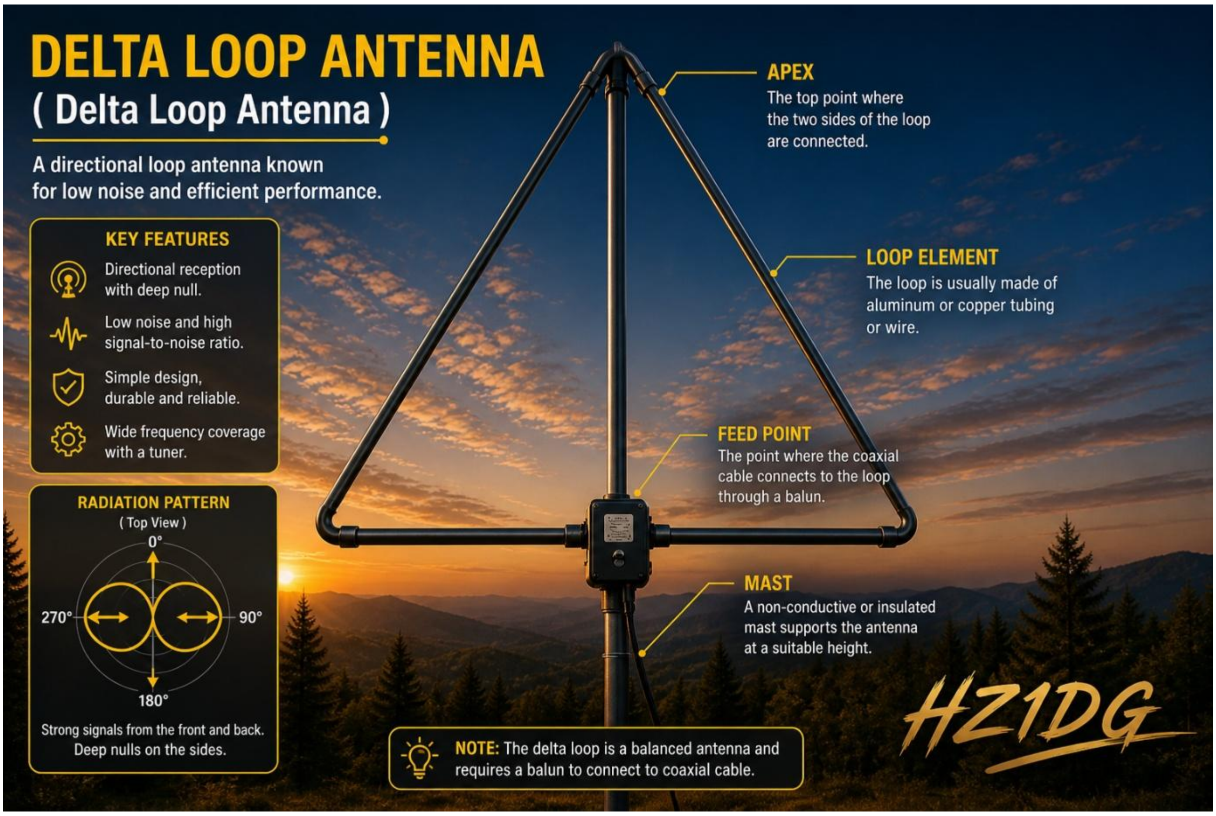


Figure (8-7): Delta loop antenna

8.4.5 Quad Antenna

A loop-based antenna similar to Yagi but using square elements.

Features:

- High gain
- High efficiency
- Suitable for DX

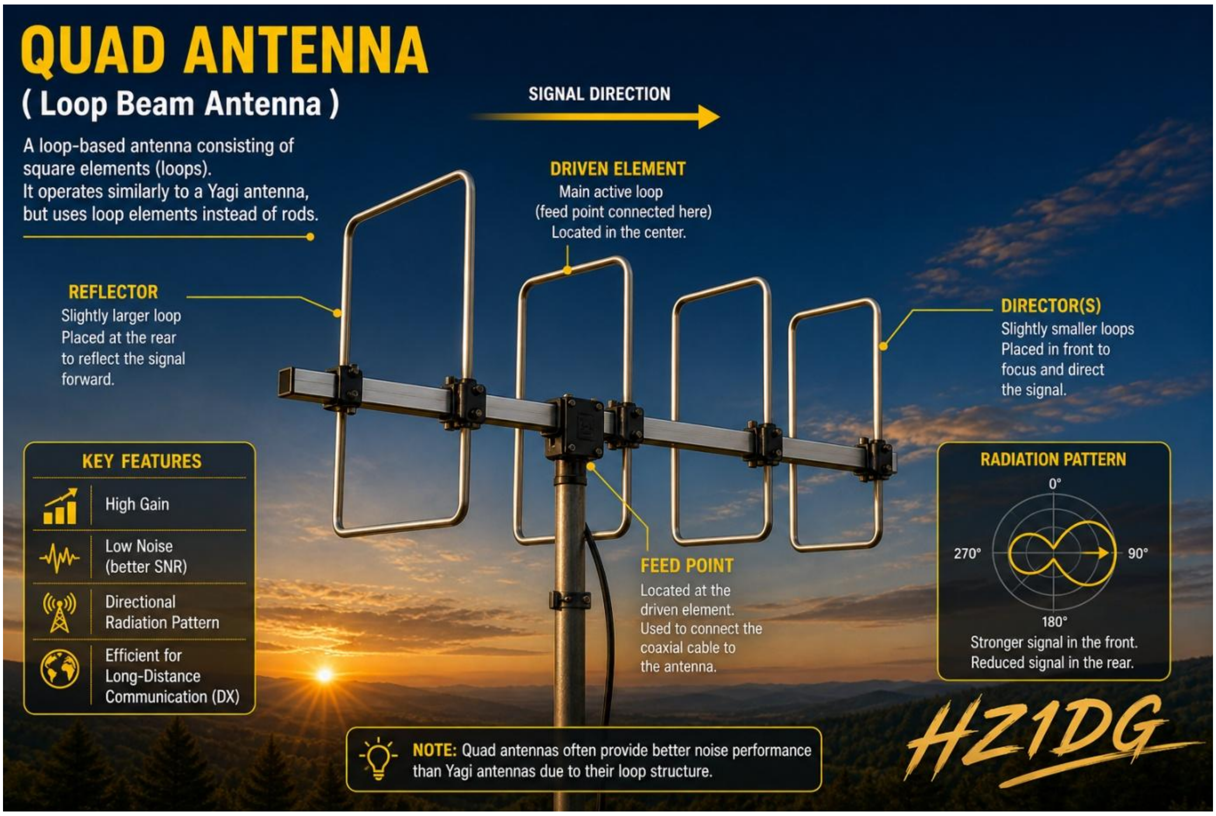


Figure (8-8): Quad antenna

8.4.6 Trap Antenna

Uses resonant traps to operate on multiple bands.

Features:

- Multi-band operation
- Space saving

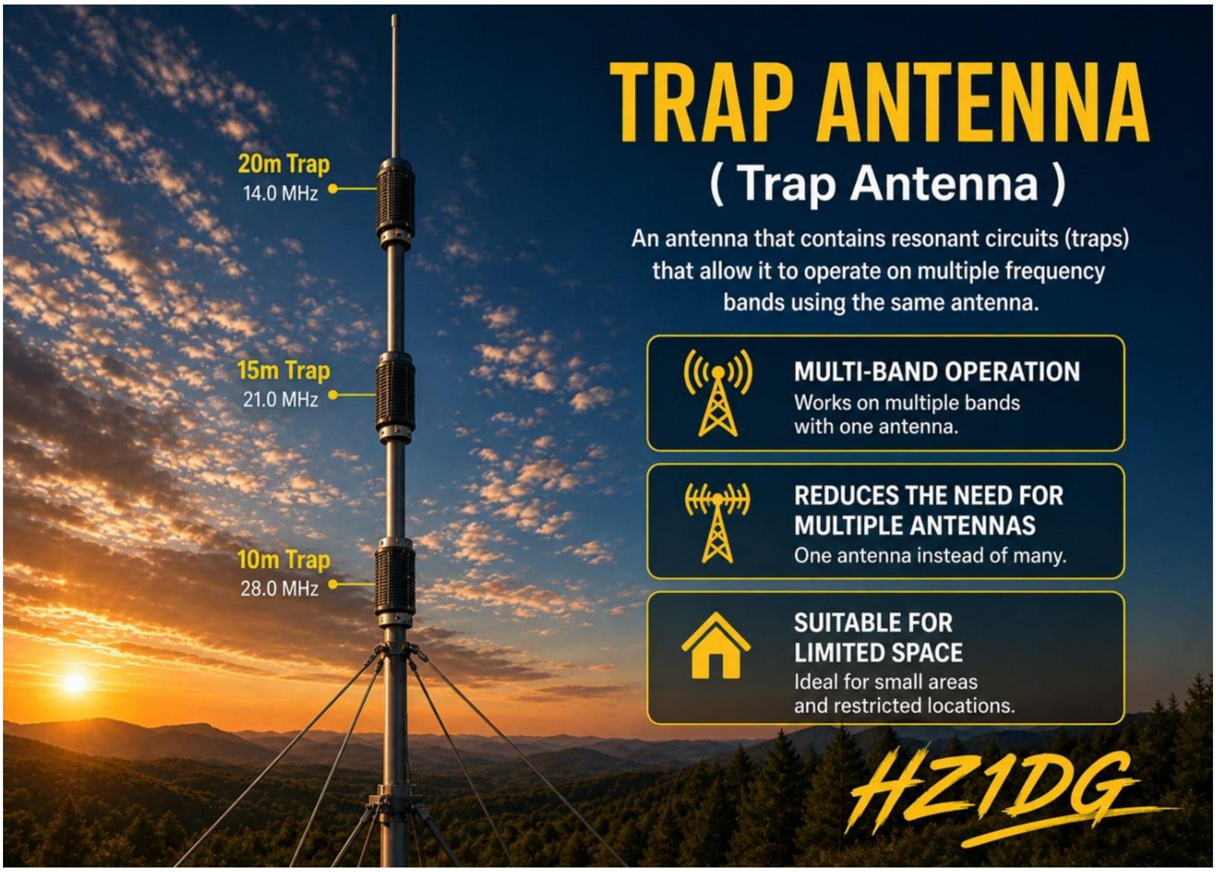


Figure (8-9): Trap antenna

8.4.7 Beamwidth

The angle where signal strength drops by 3 dB from maximum.

- Narrow beam → higher focus
- Wide beam → wider coverage

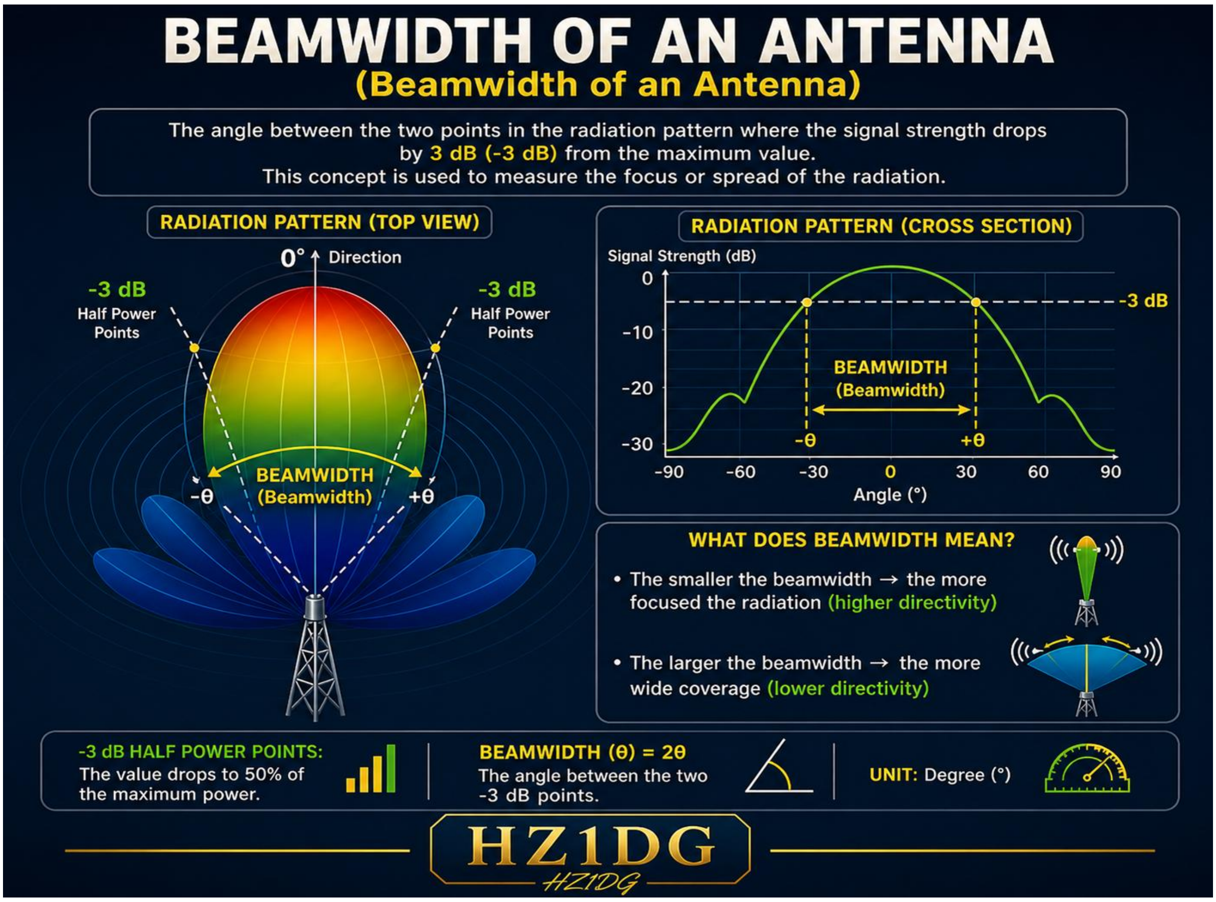


Figure (8-10): Beamwidth

8.5 Antenna Gain

Antenna gain is a measure that describes the ability of an antenna to concentrate electromagnetic energy in a specific direction compared to a reference antenna. It does not mean increasing the transmitted power; rather, it redistributes the power so that it becomes more concentrated in one direction and weaker in others.

Reference Antenna

Gain is measured relative to a reference antenna. The most common types are:

• **Isotropic Antenna:** A theoretical antenna (not physically realizable) that radiates equally in all directions. Gain is expressed relative to it in **dBi**.

• **Dipole Antenna:** A practical and commonly used antenna. Gain is expressed relative to it in **dBd**.

When an antenna operates, energy can either spread in all directions or be focused in a particular direction. The higher the antenna gain, the greater its ability to concentrate the signal, resulting in improved signal strength in the desired direction and increased communication range.

Illustrative Example

A low-gain antenna can be compared to a light source that radiates in all directions, while a high-gain antenna is like a spotlight that focuses light in a specific direction over a longer distance.

Important Note

Increasing gain means:

• Higher signal strength in a specific direction

• Reduced signal strength in other directions

Summary

Gain does not increase power; it redistributes it.

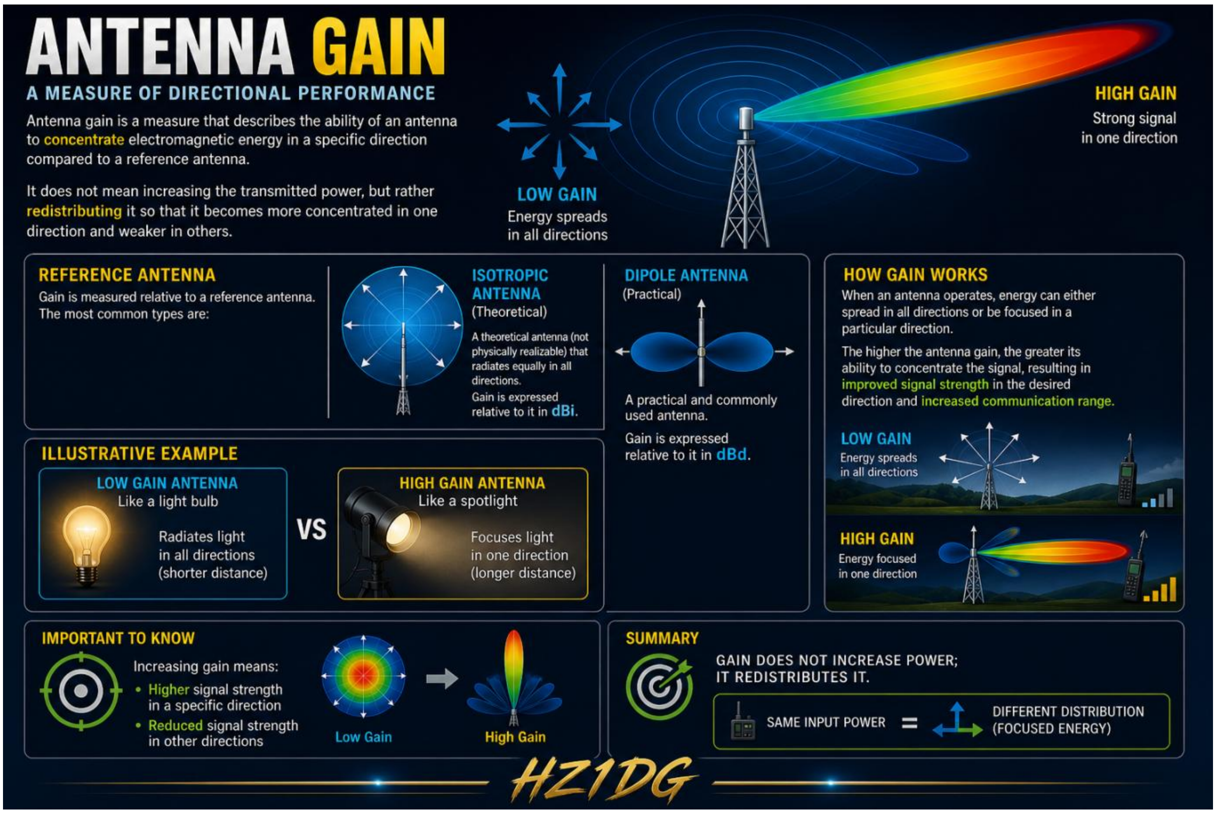


Figure (8-11): Antenna gain

8.6 SWR (Standing Wave Ratio)

Measures antenna matching.

High SWR causes:

- Power loss
- Weak transmission
- Equipment damage

Acceptable value:

- Up to **2:1** (preferably < 1.7:1)

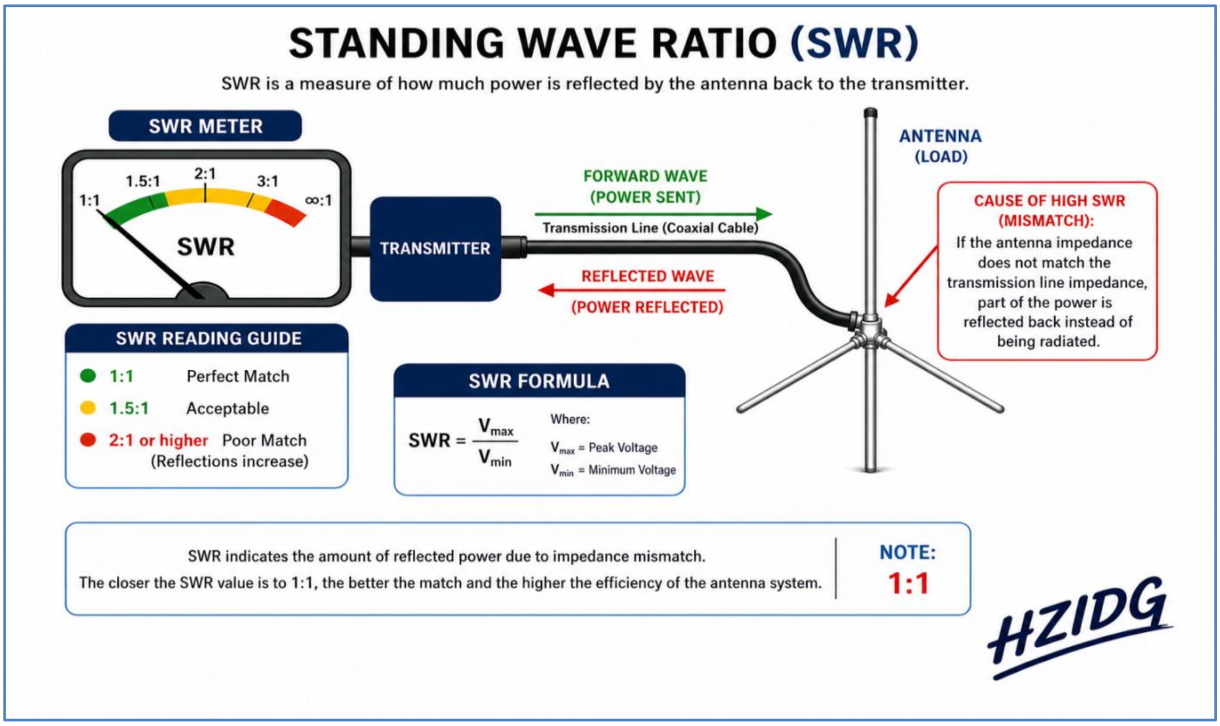
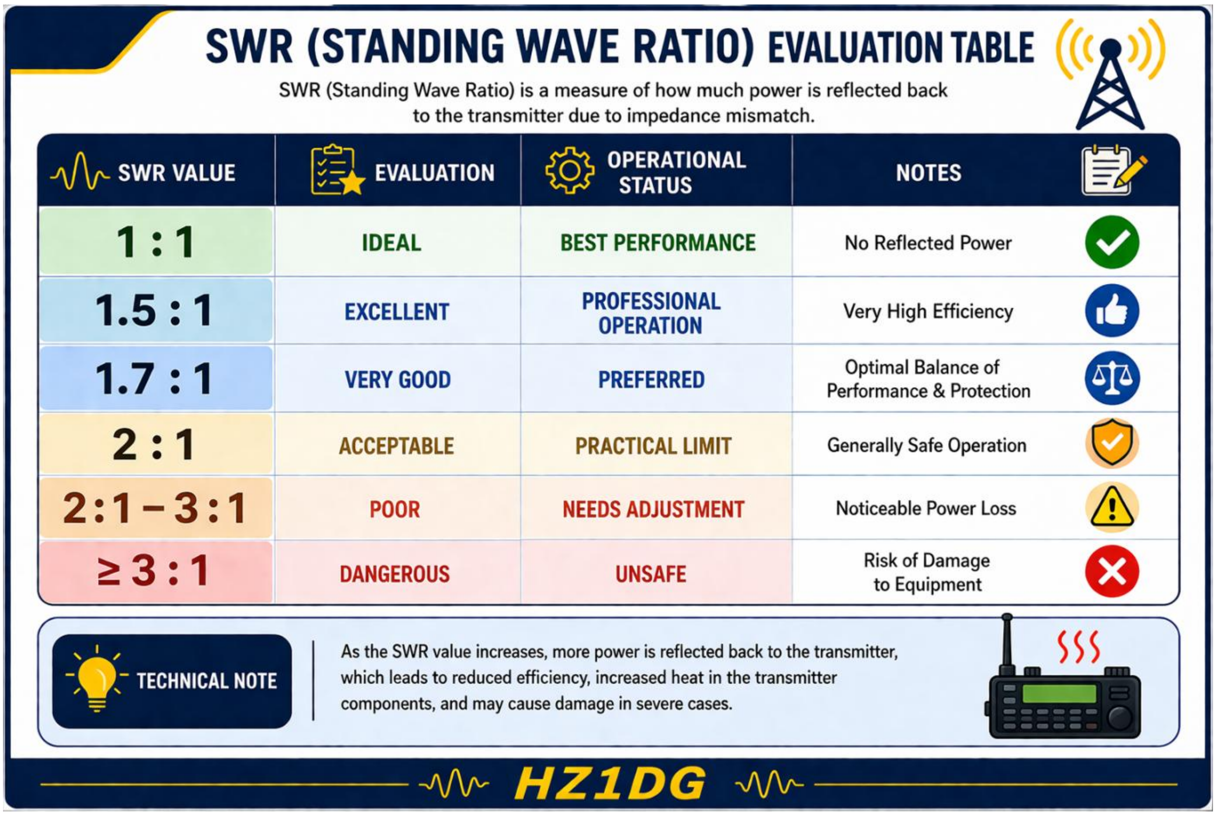


Figure (8-12): SWR concept



SWR (STANDING WAVE RATIO) EVALUATION TABLE

SWR (Standing Wave Ratio) is a measure of how much power is reflected back to the transmitter due to impedance mismatch.

SWR VALUE	EVALUATION	OPERATIONAL STATUS	NOTES
1 : 1	IDEAL	BEST PERFORMANCE	No Reflected Power
1.5 : 1	EXCELLENT	PROFESSIONAL OPERATION	Very High Efficiency
1.7 : 1	VERY GOOD	PREFERRED	Optimal Balance of Performance & Protection
2 : 1	ACCEPTABLE	PRACTICAL LIMIT	Generally Safe Operation
2:1 – 3:1	POOR	NEEDS ADJUSTMENT	Noticeable Power Loss
≥ 3 : 1	DANGEROUS	UNSAFE	Risk of Damage to Equipment

TECHNICAL NOTE: As the SWR value increases, more power is reflected back to the transmitter, which leads to reduced efficiency, increased heat in the transmitter components, and may cause damage in severe cases.

HZ1DG

Figure (8-13): SWR table

8.7 Transmission Lines

Transmission lines are the media or paths used to carry radio frequency (RF) signals from the transmitter or receiver to the antenna, and vice versa, while preserving as much of the signal power and quality as possible.

They are a fundamental component of any wireless communication system, as they directly affect performance efficiency and signal quality.

Transmission lines include several main types, most notably **coaxial cables**, which are the most widely used among amateur radio operators due to their ease of use, resistance to interference, and suitability for various applications, whether in home stations or portable operation.

Another type is the **open-wire line (ladder line)**, which is commonly used with high-frequency (HF) antennas. It is characterized by low loss and high efficiency, but it requires careful installation and the use of an antenna tuner.

As for the **waveguide**, it is used at very high frequencies and offers high efficiency; however, it is less common among amateurs due to its complexity.

In general, coaxial cable is the preferred choice for amateur radio operators, while other types are used in specific cases depending on frequency and application requirements.

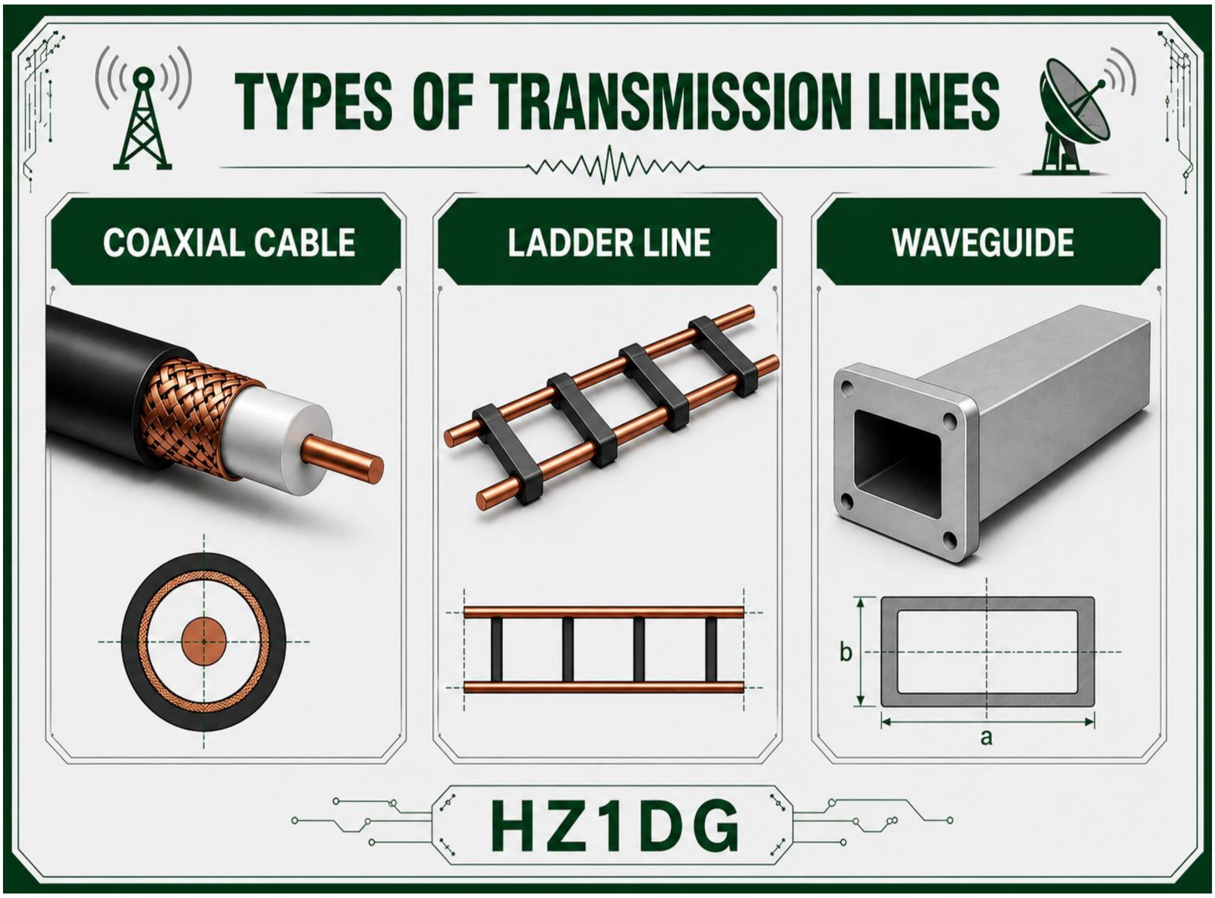


Figure (8-14): Transmission lines

8.7.1 Coaxial Cable

Most common type.

Features:

- Easy to use
- Resistant to interference

8.7.2 Attenuation

Signal loss in cables depends on:

- Cable type
- Length
- Frequency

Higher frequency → higher loss

8.8 Polarization

Direction of wave propagation:

- Horizontal
- Vertical

Matching polarization improves performance.

8.9 Antenna Height

Height greatly affects communication range.

HF:

- ¼ λ → short range (NVIS)
- ½ λ → medium range
- ½ λ → long range (DX)

VHF/UHF:

- Line-of-sight propagation

Approximate range:

$$\mathbf{3.57} \times \sqrt{\text{Height}} \text{ (Meter)} \approx \text{Distance}(km)$$

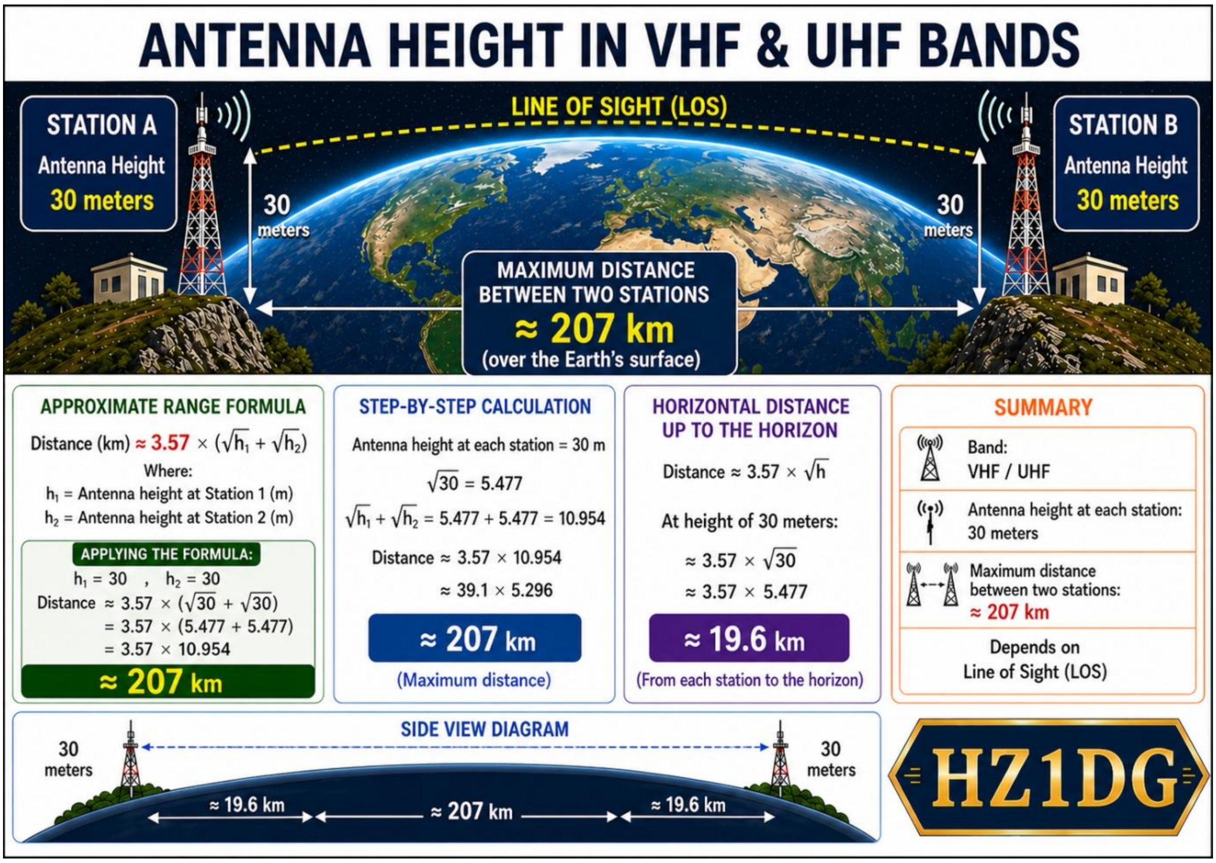


Figure (8-15): Height vs range

8.10 Radiation Angle

Determines communication distance:

- Low angle → long distance
- High angle → short distance

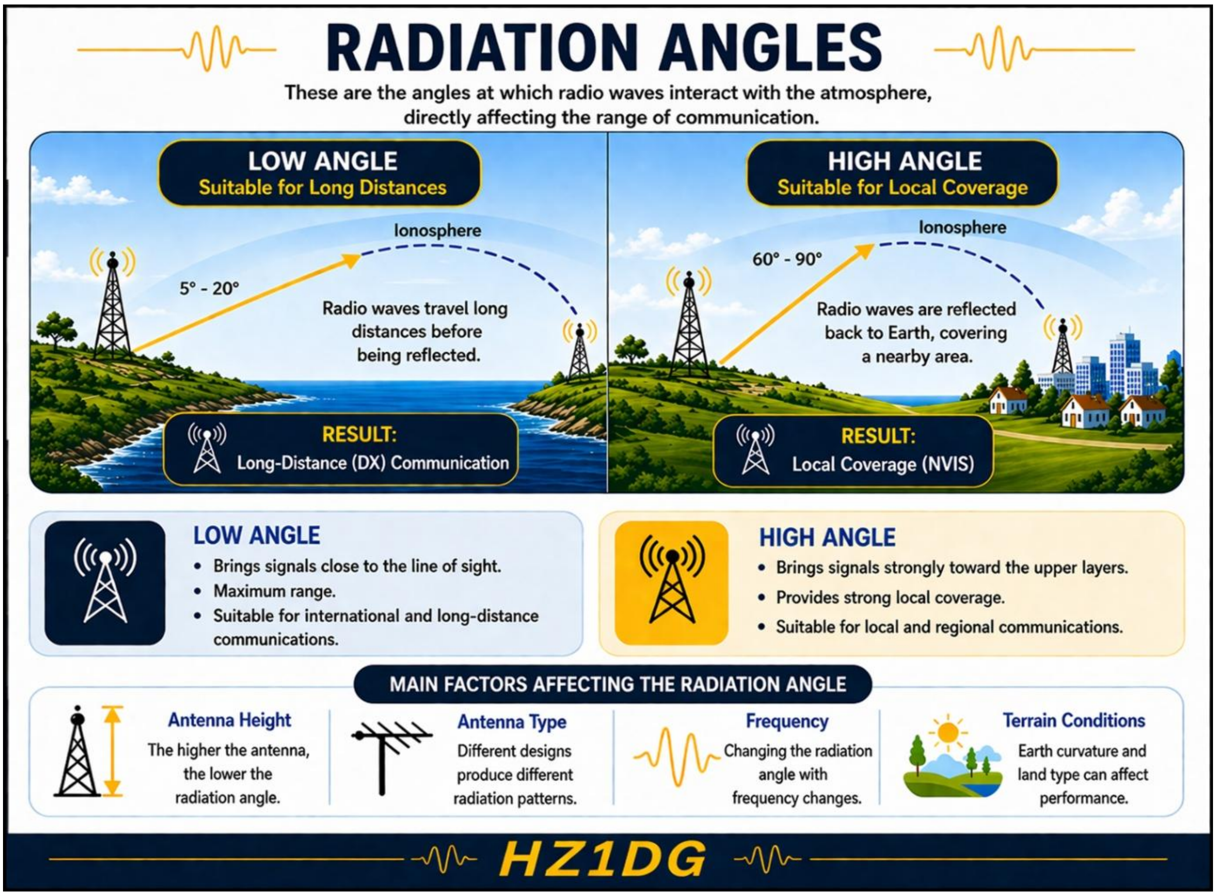


Figure (8-16): Radiation angle

8.11 Impedance Matching

Mismatch causes:

- Signal reflection

- High SWR
- Poor performance

8.12 Operational Notes

- Antenna choice is more important than power
- Proper direction improves communication
- Low SWR is essential

8.13 Chapter Summary

The antenna is a fundamental component of a wireless communication system, directly affecting both the range and quality of the signal.

Understanding the following:

- Antenna types
- Gain
- SWR
- Transmission lines
- Polarization
- Angle of radiation

Helps in:

- Improving performance
- Achieving the best possible communication

Chapter 9: Interference and Safety

9.1 Introduction to Interference

An operator may experience interference while using a radio, which affects signal clarity - even when the signal strength is high. This effect is known as **interference**, and it results from the presence of unwanted signals that disrupt the original signal.

Not all communication issues are caused by distance; the problem may be due to other signals operating on the same or nearby frequencies.

9.2 Types of Interference

- **QRM:** From other stations
- **QRN:** Natural noise (lightning, storms)
- **Man-made noise:** Electrical devices

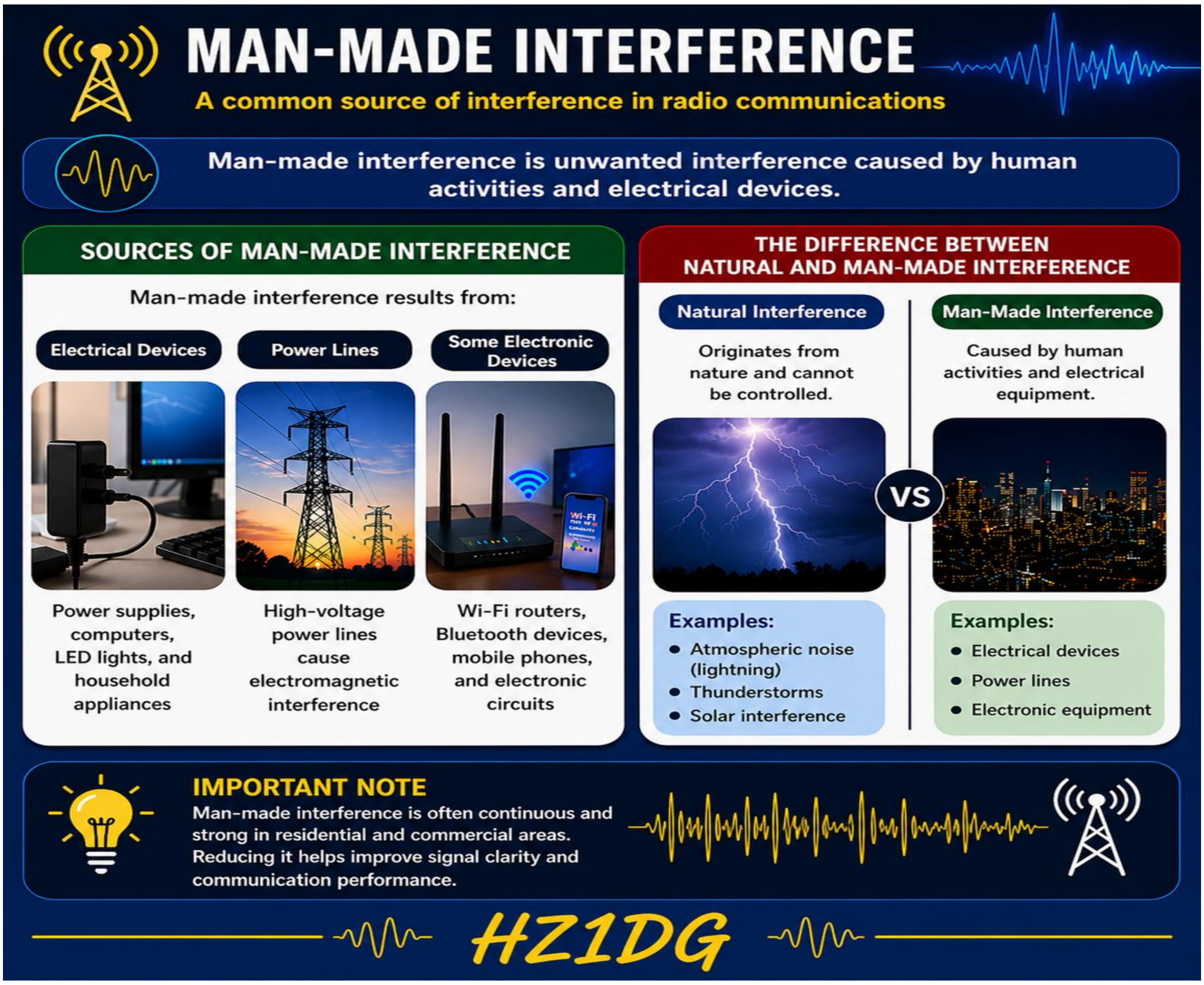


Figure (9-1): Interference sources

9.3 Reducing Interference

Interference can be reduced by:

• Changing the frequency

• Using appropriate filters

• Improving the antenna

• Moving away from sources of noise

In some cases, the solution can be as simple as turning off a nearby electrical device.

Practical Example:

The interference disappeared after turning off a household device.

What is the likely cause?

Man-made interference.

9.4 Electrical Safety

Electrical safety is a fundamental aspect of operating a radio station.

Attention must be given to:

- Proper equipment connections
- Using appropriate wiring
- Avoiding overloads

Overloading may lead to:

- Increased temperature
- Equipment damage

9.5 RF Safety

When transmitting high-power signals, nearby individuals may be exposed to electromagnetic fields.

Therefore, it is important to:

• Avoid standing close to the antenna during transmission

• Install the antenna in a suitable location

• Follow safe distance guidelines

Standing next to the antenna while transmitting may be unsafe, especially when using high power.

9.6 Grounding

The grounding system is considered one of the most critical safety and protection elements in an amateur radio station. It plays a key role in protecting both equipment and the operator from electrical discharge hazards and lightning strikes, in addition to improving overall system performance and reducing interference.

A common misconception is that each part of the station should have its own independent grounding system, meaning the tower, antenna, equipment, and power source are all grounded separately and completely isolated from one another.

Although this approach may appear organized at first glance, it is not technically correct unless all these grounding points are properly bonded together.

When separate, unconnected grounding points exist, a voltage difference can develop between them—especially during electrical discharge events or lightning strikes. This can force current to flow through the equipment itself, potentially causing serious damage or complete failure.

9.6.1 The Proper Grounding Principle:

The proper grounding system is based on the concept of Equipotential Bonding, which means that all grounding points in the station must be at the same electrical potential. This prevents the development of voltage differences that could cause unwanted currents to flow through the equipment.

This is achieved through the following:

• Establishing a main grounding point (Ground Bus) inside the station

• Connecting all equipment directly to this point

• Using multiple ground rods when necessary

• Bonding all ground rods together using an appropriate copper conductor

9.6.2 Practical Application

In a properly implemented amateur radio station:

• The metal tower is grounded using a ground rod

• The lightning arrestor is connected to the same grounding system

• Equipment inside the operating room is bonded to a unified ground point

• The household electrical ground is connected to the same grounding network

All grounding points are then bonded together to ensure no voltage difference exists between them.

Important Note

In some cases, partial isolation techniques may be used to reduce RF noise. However, even in such cases, grounding is not completely isolated; instead, it is connected in a controlled manner that ensures electrical safety.

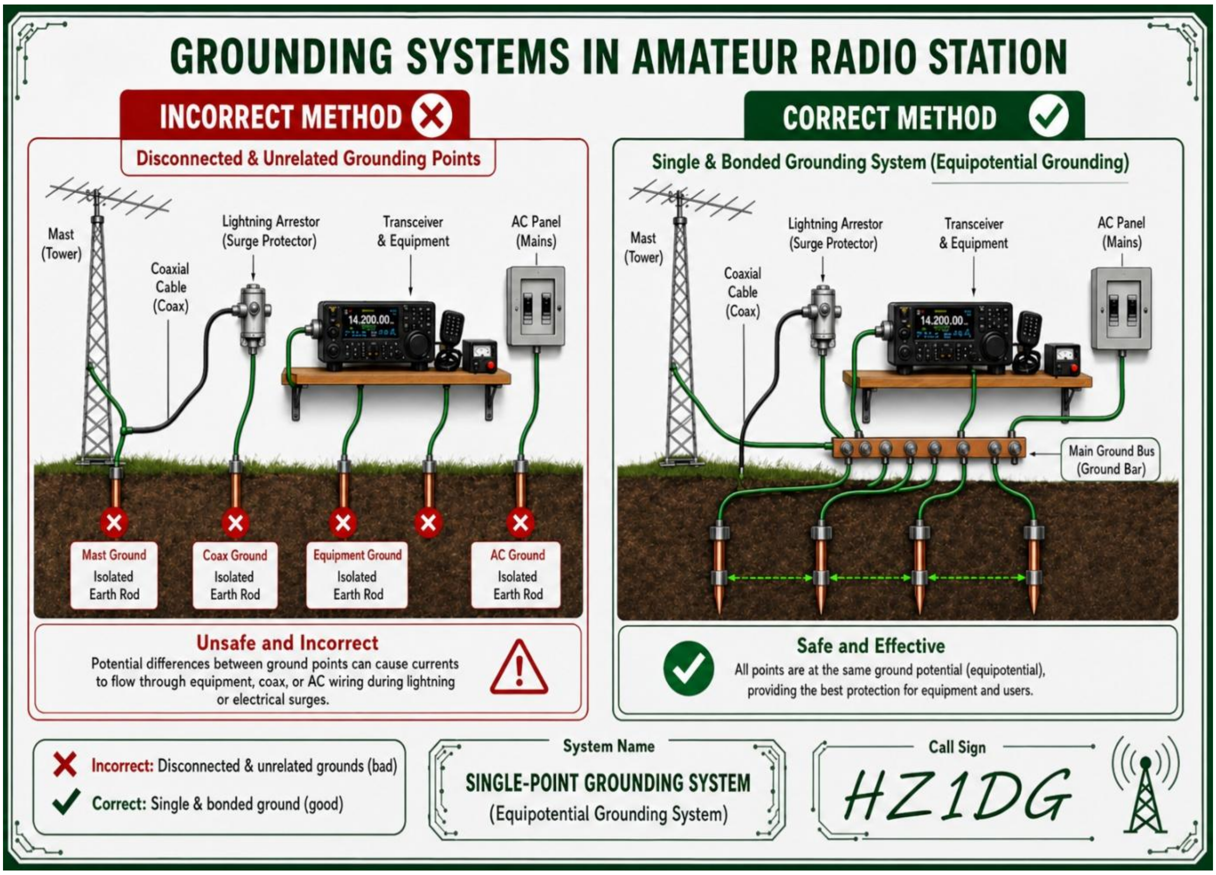


Figure (9-2): Grounding system

9.7 Practical Safety

Practical safety practices are essential to ensure the safe operation of an amateur radio station and to protect both the user and the equipment from potential hazards.

They also contribute to improved performance efficiency and help reduce faults and interference during operation.

9.7.1 Antenna Handling:

- Do not touch the antenna during transmission
- Install it in a high and safe location
- Keep it away from people

9.7.2 Power Handling:

- Use the lowest power level that achieves communication
- Avoid operating at high power without necessity

9.7.3 During Installation:

- Stay away from electrical power lines
- Ensure the antenna is properly secured
- Use appropriate tools

9.7.4 Operating Environment:

- Organize and manage cables properly
- Avoid humidity and moisture
- Keep equipment away from heat sources

9.8 Operational Notes

- Do not use an occupied frequency
- Ensure all connections are secure
- Monitor power levels
- Be aware of sources of interference

The cause of interference may be simple, but ignoring it can significantly affect communication quality.

9.9 Chapter Summary

Interference is one of the most common issues in radio communications and may originate from natural sources, man-made sources, or other stations. Adhering to proper safety practices-such as grounding, correct power usage, and safe antenna installation-helps improve communication quality and protect both the equipment and the operator.

Chapter 10: Review and Concept Reinforcement

10.1 Importance of Review

After studying the concepts of amateur radio, the next step is to connect these concepts together to understand the complete picture.

True understanding does not rely solely on memorizing information, but on the ability to:

- Link concepts together
- Interpret what happens during communication
- Make correct decisions during operation

A skilled operator does not rely only on rules, but understands when to use them and how to apply them.

10.2 Communication Process

The radio communication process goes through several interconnected stages:

- Selecting the appropriate frequency
- Adjusting the equipment
- Using the antenna
- Transmitting the signal
- Receiving the response

Any issue in one of these stages can affect the overall communication quality.

10.3 Concept Integration

The relationship between the chapters can be summarized as follows:

- The frequency spectrum → determines where communication takes place
- Propagation → determines how far the signal travels
- Equipment → performs the transmission and reception process
- Antennas → affect signal quality and range
- Operation → organizes how communication is conducted
- Safety → protects both the operator and the equipment

Successful communication depends on the integration of all these elements, not just a single factor.

10.4 Practical Scenarios

10.4.1 Scenario One:

An HF frequency was used at an inappropriate time, and no signal was received.

What is the likely cause?

It may be related to propagation conditions or improper frequency selection.

10.4.2 Scenario Two:

High transmission power was used, yet the signal did not reach a long distance.

What is the influencing factor in this case?

It is most likely related to the antenna or the radiation angle.

10.4.3 Scenario Three:

Continuous interference is experienced during operation inside the home.

What is the likely cause?

It may be man-made interference from electrical devices.

10.5 Key Concepts

- **Frequency:** The number of cycles per second
- **Signal:** The medium used to carry information
- **Power:** The amount of energy used for transmission
- **SWR:** A measure of antenna efficiency
- **Q-codes:** Abbreviations used to facilitate communication
- **Call sign:** The station’s identity

These concepts form the foundation for understanding all aspects of amateur radio.

10.6 Licensing Levels

After completing this content, the reader becomes able to:

- Understand the fundamentals of radio communication
- Use equipment correctly
- Select the appropriate frequency
- Improve communication quality

It is always recommended to start with listening—then more listening, and continued listening. After gaining familiarity with protocols and conversation style, and when ready to make a contact, attention should be given to:

- Choosing the appropriate frequency
- Ensuring the frequency is clear
- Using the call sign correctly

10.7 Readiness for Practice:

After completing this content, the reader becomes able to:

- Understand the fundamentals of radio communication
- Use equipment correctly
- Select the appropriate frequency
- Improve communication quality

It is always recommended to start with listening—then more listening, and continued listening. After gaining familiarity with protocols and conversation style, and when ready to make a contact, attention should be given to:

- Choosing the appropriate frequency
- Ensuring the frequency is clear
- Using the call sign correctly

10.8 Book Summary:

Amateur radio combines:

- Technical knowledge
- Practical skills
- Regulatory compliance

This book has covered the fundamentals that help in understanding this hobby, starting from general concepts to technical and operational aspects. These foundations significantly support passing the amateur radio license exam with a high success rate—provided that the reader has reviewed all chapters, understood the concepts היט, studied the examples and practical applications, and consistently reviewed the material.

It is also recommended not to rely solely on theory, but to actively listen to amateur radio stations, as this plays a major role in reinforcing understanding and gaining practical experience.

Appendix A: Reinforcing Key Concepts for the Exam

This appendix is designed to reinforce key information that frequently appears in the exam, presented in a concise format to support quick review without relying on traditional question-based methods.

It also includes brief summaries and reference tables that can be consulted when needed.

A.1 Basic Q Codes:

Q codes are used to facilitate communication between stations, and each code has a specific meaning that must be clearly distinguished. Some of the most common include:

QTH, QRM, QRN, QSL, QSY, QRG, QRO

Confusion may occur between certain codes—especially between **QRM** and **QRN** -so attention must be paid to the source of interference.

Reinforcement Questions:

• Which code indicates noise caused by lightning?

• Which code is used to change frequency?

A.2 Complete Q-Code List:

Q codes represent a set of abbreviations used in radio communications to enable fast and clear information exchange.

Note:

This table is intended as a quick reference. It is not required to memorize all codes, as the focus has been placed earlier on the most commonly used codes in the amateur radio service.

Code	Question Meaning	Answer Meaning
QRA	What is your station name?	My station name is
QRB	What is the distance between us?	Approximate distance
QRG	What is my frequency?	Your frequency is
QRH	Is my frequency varying?	Your frequency is unstable
QRI	How clear is my signal?	Signal is clear
QRK	What is signal readability?	Readability (1–5)
QRL	Is the frequency busy?	Frequency is busy
QRM	Is there interference?	There is interference
QRN	Is there natural noise?	There is noise
QRO	Shall I increase power?	Increase power
QRP	Shall I reduce power?	Reduce power
QRQ	Shall I send faster?	Increase speed
QRS	Shall I send slower?	Reduce speed
QRT	Shall I stop transmitting?	Stop transmission
QRU	Do you have anything for me?	Nothing
QRV	Are you ready?	I am ready

QRX	When will you call again?	Wait
QRZ	Who is calling me?	You are being called
QSA	What is signal strength?	Signal strength (1–5)
QSB	Is signal fading?	Signal is fading
QSD	Is my transmission distorted?	Transmission is distorted
QSG	Shall I send multiple messages?	Send messages
QSK	Can I interrupt?	Interruption allowed
QSL	Do you confirm receipt?	Message received
QSM	Shall I repeat?	Repeat transmission
QSN	Did you hear me?	I heard you
QSO	Can you communicate?	Communication established
QSP	Will you relay?	I will relay
QST	General call	Broadcast message
QSU	Shall I send or receive?	Send/Receive
QSV	Shall I send a series?	Send series
QSX	Are you listening elsewhere?	Listening on...
QSY	Shall I change frequency?	Change frequency
QSZ	Shall I send twice?	Send twice
QTA	Shall I cancel?	Message canceled
QTB	Do you agree?	I agree
QTC	Do you have messages?	I have messages

QTH	What is your location?	My location is
QTR	What is the time?	The time is

Figure (A-1): Q-Code table for amateur radio

A.3 International Phonetic Alphabet

Used to clearly spell letters during communication.

INTERNATIONAL PHONETIC ALPHABET

Also Known As: NATO Phonetic Alphabet

LETTER	WORD	PRONUNCIATION
A	Alpha	AL-FAH
B	Bravo	BRAH-VOH
C	Charlie	CHAR-LEE
D	Delta	DELL-TAH
E	Echo	ECK-OH
F	Foxtrot	FOKS-TROT
G	Golf	GOLF
H	Hotel	HOH-TEL
I	India	IN-DEE-AH
J	Juliett	JEW-LEE-ET
K	Kilo	KEY-LOH
L	Lima	LEE-MAH
M	Mike	MIKE
N	November	NO-VEM-BER
O	Oscar	OSS-CAH
P	Papa	PAH-PAH
Q	Quebec	KEH-BECK
R	Romeo	ROW-ME-OH
S	Sierra	SEE-AIR-RAH
T	Tango	TANG-GO
U	Uniform	YOU-NEE-FORM
V	Victor	VIK-TAH
W	Whiskey	WISS-KEY
X	X-ray	ECKS-RAY
Y	Yankee	YANG-KEY
Z	Zulu	ZOO-LOO

NOTE:
This alphabet is used worldwide to clearly communicate letters over radio and avoid misunderstandings.

Figure (A-2): Phonetic alphabet

Used for:

- Call sign spelling
- Names clarification

Check your understanding:

How would you pronounce: **HZ2AB**?

A.4 Frequency Bands

- HF: 3–30 MHz
- VHF: 30–300 MHz
- UHF: 300 MHz – 3 GHz

HF → long-distance communication

VHF → local communication

Band	Frequency Range (Start – End)	License Class	Max Power
160 m (HF)	1810 – 1850 kHz	Class 1	500 W
80 m (HF)	3620 – 3635 kHz	Class 1	200 W
40 m (HF)	7.0 – 7.2 MHz	Class 1	200 W
30 m (HF)	10.100 – 10.150 MHz	Not permitted	—
20 m (HF)	14.0 – 14.35 MHz	Class 1	200 W
17 m (HF)	18.068 – 18.168 MHz	Class 1	200 W
15 m (HF)	21.0 – 21.45 MHz	Class 1	200 W
12 m (HF)	24.89 – 24.99 MHz	Class 1	200 W
10 m (HF)	28.0 – 29.7 MHz	Class 1	200 W
6 m (VHF)	50.0 – 54.0 MHz	Class 1	100 W
2 m (VHF)	144.0 – 146.0 MHz	Class 1 / Class 2	50 W
70 cm (UHF)	430.0 – 440.0 MHz	Not permitted	—
1.25 cm (SHF)	24.000 – 24.050 GHz	Class 1 / Class 2	50 W
6 mm (EHF)	47.00 – 47.20 GHz	Class 1 / Class 2	50 W
4 mm (EHF)	77.50 – 78.00 GHz	Class 1 / Class 2	50 W
2 mm (EHF)	134.0 – 136.0 GHz	Class 1 / Class 2	50 W
1.2 mm (EHF)	248.0 – 250.0 GHz	Class 1 / Class 2	50 W

Figure (A-3): Frequency bands

A.5 Signal Reports

Used to describe signal quality:

- First digit: Readability (1–5)
- Second digit: Strength (1–9)
- Third digit: Tone (for Morse/digital)

Examples:

- 59 → Strong and clear
- 33 → Weak and unclear

A.6 Electrical Power

$$\boldsymbol{P} = \boldsymbol{V} \times \boldsymbol{I}$$

Increasing power may:

- Improve signal
- Cause interference

A.7 Interference

- QRM → man-made (stations)
- QRN → natural noise

A.8 Antennas

- Affect communication range
- Gain controls direction
- SWR measures efficiency

SWR = 1:1 → Excellent

A.9 Safety

• Do not touch the antenna during transmission

• Avoid working near electrical power lines

• Use proper grounding

Safety is an essential part of operation, not an optional addition.

Reinforcement Question:

Why is it not recommended to stand near the antenna during transmission?

Appendix B: Practical Scenarios

This appendix aims to train the reader to analyze real-life situations similar to those encountered during operation, by linking theoretical concepts with practical application.

B.1 Interference and Signal:

Scenario:

While listening on a frequency, you notice continuous noise resembling static caused by lightning, with no clear stations present.

What is the most likely explanation?

This indicates natural noise (QRN).

B.2 Frequency Selection:

Scenario:

An operator attempted long-distance communication using the VHF band but was unable to reach far distances.

What is the likely reason?

The VHF band relies on line-of-sight propagation and is not suitable for long-distance communication.

B.3 Q Codes:

Scenario:

An operator says: QSY 145.500

What does this mean?

A request to change the frequency to **145.500 MHz**.

B.4 Signal Reports:

Scenario:

You received a signal report: **59**

How can this be interpreted?

A strong and clear signal.

B.5 Antennas:

Scenario:

Two stations are using the same equipment and the same power, but one reaches a longer distance.

What is the most influential factor?

The antenna type or its installation.

B.6 SWR:

Scenario:

An operator notices a high SWR value.

What is the likely result?

Power loss and weak transmission, with a risk of equipment damage.

B.7 Safety:

Scenario:

A person stands near the antenna during high-power transmission.

What is the potential risk?

Exposure to unsafe radio frequency radiation.

B.8 Power:

Scenario:

Transmission power is significantly increased, but communication does not improve.

What is the explanation?

Power is not the only factor; the issue may be related to the antenna or frequency.

B.9 Propagation:

Scenario:

You are able to hear a distant station but not a nearby one.

What is the most likely explanation?

The skip distance phenomenon.

B.10 Phonetic Alphabet:

Scenario:

A call sign is spoken using non-standard words.

What is the likely result?

Misunderstanding during communication and the impression of an unprofessional operator.

Amateur Radio License Exam Question Bank

Inspired by the ARRL style and international exam models

Notice:

These questions are for training and educational purposes only and are not official exam questions.

B.11.1 Technician Level – Technical Questions

T2A01

What is the function of a repeater?

A) Reduce signal

B) Increase range

C) Reduce noise

D) Store signals

T3C01

Which band is commonly used for satellite communication?

A) LF

B) HF

C) VHF/UHF

D) ELF

T5B01

What is the unit of electrical voltage?

A) Ampere

B) Volt

C) Ohm

D) Watt

T5C01

If the voltage is 12 V and the resistance is 6 Ω, what is the current?

A) 0.5 A

B) 2 A

C) 6 A

D) 72 A

T7B01

What does SWR = 3:1 indicate?

A) Perfect transfer

B) Partial power reflection

C) No loss

D) Increased frequency

T8A01

What does FM stand for?

A) Amplitude Modulation

B) Frequency Modulation

C) Phase Modulation

D) Power Modulation

T5C02

If the current is 3 A and the resistance is 4 Ω, what is the voltage?

A) 7 V

B) 12 V

C) 1.3 V

D) 0.75 V

T5C03

If the power is 24 W and the current is 2 A, what is the voltage?

A) 12 V

B) 48 V

C) 22 V

D) 6 V

T6A01

What is the function of a resistor?

A) Store energy

B) Reduce current

C) Generate signal

D) Amplify

T6A02

What is the function of a capacitor?

A) Generate energy

B) Store charge

C) Reduce frequency

D) Increase current

T6A03

What is the function of an inductor?

A) Store magnetic energy

B) Reduce voltage

C) Increase frequency

D) Reduce power

T7A01

What is the function of a transceiver?

A) Transmit only

B) Receive only

C) Transmit and receive

D) Store

T7A02

What is the function of a receiver?

A) Transmit

B) Receive

C) Amplify

D) Store

T7A03

What is the function of a transmitter?

A) Receive

B) Transmit

C) Store

D) Reduce

T7C01

What does SWR stand for?

A) Type of wave

B) Standing Wave Ratio

C) Power

D) Frequency

T7C02

What does a high SWR indicate?

A) High efficiency

B) Signal loss

C) Excellent transmission

D) No effect

T8A02

What is CW?

A) Voice

B) Morse code

C) Video

D) Data

T8A03

What is SSB?

A) Full wave

B) Single Sideband

C) Digital wave

D) Broadcast

T8B01

Which mode commonly uses voice?

A) CW

B) FM

C) RTTY

D) Packet

T8B02

Which mode is more efficient?

A) AM

B) FM

C) SSB

D) TV

T9A01

What is the function of an antenna?

A) Store

B) Convert signals

C) Amplify

D) Reduce

T9A02

What does Gain refer to?

A) Loss

B) Signal concentration

C) Noise

D) Frequency

T9A03

What happens when the antenna height increases?

A) Range decreases

B) Range increases

C) Stops

D) Noise increases

T0A01

What is the danger of high voltage?

A) Nothing

B) Electric shock

C) Reduce frequency

D) Increase power

T0A02

Why is grounding important?

A) Sound

B) Protection

C) Power

D) Frequency

B.11.2 General Level

G1A01

What is the typical maximum allowed transmission power?

A) 100 watts

B) 500 watts

C) 1500 watts PEP

D) 50 watts

G2A01

What does QSO mean?

A) Device

B) Contact (communication)

C) Antenna

D) Frequency

G3B01

What is the main factor affecting HF wave reflection?

A) Humidity

B) Solar activity

C) Pressure

D) Wind

G5C01

What is Ohm’s Law?

A) V = IR

B) P = VI

C) F = ma

D) $E = mc^2$

G5C03

If the power is 100 W and the resistance is 50 Ω, what is the approximate voltage?

A) 22 V

B) 70 V

C) 5 V

D) 100 V

G7C01

What is the effect of high cable loss?

A) Increased power

B) Weak signal

C) Improved gain

D) Increased frequency

G9A01

What is an advantage of a directional antenna?

A) Omnidirectional coverage

B) Higher gain in a specific direction

C) Lower cost

D) Random pattern

G1B01

Why is it important to know authorized frequency bands?

A) Increase power

B) Avoid violations

C) Improve audio

D) Reduce frequency

G2A02

What does QTH mean?

A) Location

B) Power

C) Audio

D) Frequency

G2A03

What does QRM mean?

A) Strong signal

B) Interference

C) Clear audio

D) Transmission

G3A01

What is the troposphere?

A) Ground layer

B) A layer close to the Earth

C) Reflective layer

D) Cold layer

G3A02

What is the ionosphere?

A) A layer that reflects HF waves

B) Ground layer

C) Pressure layer

D) Heat layer

G4A01

What is the function of a power supply?

A) Transmit

B) Provide electrical power

C) Reduce frequency

D) Amplify

G4A02

What is AC?

A) Direct current

B) Alternating current

C) Digital current

D) Constant current

G4A03

What is DC?

A) Alternating current

B) Direct current

C) Pulsed current

D) Digital current

G5B01

What is the unit of power?

A) Volt

B) Watt

C) Ampere

D) Ohm

G5B02

What is the unit of frequency?

A) Hertz

B) Volt

C) Ampere

D) Watt

G5B03

What happens to wavelength when frequency increases?

A) Increases

B) Decreases

C) Remains constant

D) Disappears

G6A01

What is the function of a diode?

A) Amplify

B) Allow current in one direction

C) Store energy

D) Reduce

G6A02

What is the function of a transistor?

A) Store

B) Amplify

C) Reduce

D) Convert

G7A01

What is an amplifier?

A) Reduce

B) Increase signal

C) Store

D) Modify

G7A02

What is cable loss?

A) Increase

B) Signal loss

C) Amplification

D) Reduction

G8A01

What is digital modulation?

A) Voice

B) Data

C) Video

D) Wave

B.11.3 Extra Level

E2A01

Why is SSB more efficient than AM?

A) Larger bandwidth

B) Higher power efficiency

C) More noise

D) Higher consumption

E5C02

If the power is 200 W and the voltage is 100 V, what is the current?

A) 0.5 A

B) 2 A

C) 20 A

D) 100 A

E6C01

What is the function of a band-pass filter?

A) Pass all frequencies

B) Pass only a specific range of frequencies

C) Remove all signals

D) Amplify

E7B01

What is the function of a mixer in a receiver?

A) Amplify

B) Convert frequency

C) Store

D) Reduce

E9D01

Why is a directional antenna used in DX communication?

A) Reduce power

B) Focus signal over long distances

C) Reduce frequency

D) Random radiation

E1A01

Why is compliance with regulations important?

A) Increase power

B) Legal compliance

C) Improve audio

D) Reduce frequency

E2B01

What is digital modulation?

A) Voice

B) Digital data

C) Video

D) Wave

E3A01

What is reflection?

A) Passing through

B) Bouncing back

C) Absorption

D) Scattering

E4A01

What is noise?

A) Useful signal

B) Unwanted interference

C) Power

D) Frequency

E5B01

What is power?

A) Voltage

B) Energy per unit time

C) Current

D) Resistance

E5C03

If the power is 400 W and the resistance is 100 Ω, what is the voltage?

A) 200 V

B) 20 V

C) 40 V

D) 400 V

E6C02

What is the function of a low-pass filter?

A) Pass high frequencies

B) Pass only low frequencies

C) Amplify

D) Remove all signals

E7B02

Why is an intermediate frequency (IF) used in receivers?

A) Increase power

B) Simplify processing and filtering

C) Only reduce frequency

D) Reduce voltage

E8C02

What is the advantage of FEC in digital communications?

A) Increase noise

B) Error correction

C) Reduce power

D) Always reduce speed

E9D02

What is the effect of increasing antenna height?

A) Reduce range

B) Improve radiation angle and communication range

C) Increase noise

D) Reduce gain

B.11.4 Technician Level – Answer Key:

T2A01 → B

T3C01 → C

T5B01 → B

T5C01 → B

T7B01 → B

T8A01 → B

T5C02 → B

T5C03 → A

T6A01 → B

T6A02 → B

T6A03 → A

T7A01 → C

T7A02 → B

T7A03 → B

T7C01 → B

T7C02 → B

T8A02 → B

T8A03 → B

T8B01 → B

T8B02 → C

T9A01 → B

T9A02 → B

T9A03 → B

T0A01 → B

T0A02 → B

B.11.5 General Level – Answer Key:

G1A01 → C

G2A01 → B

G3B01 → B

G5C01 → A

G5C03 → B

G7C01 → B

G9A01 → B

G1B01 → B

G2A02 → A

G2A03 → B

G3A01 → B

G3A02 → A

G4A01 → B

G4A02 → B

G4A03 → B

G5B01 → B

G5B02 → A

G5B03 → B

G6A01 → B

G6A02 → B

G7A01 → B

G7A02 → B

G8A01 → B

B.11.6 Extra Level – Answer Key:

E2A01 → B

E5C02 → B

E6C01 → B

E7B01 → B

E9D01 → B

E1A01 → B

E2B01 → B

E3A01 → B

E4A01 → B

E5B01 → B

E5C03 → A

E6C02 → B

E7B02 → B

E8C02 → B

E9D02 → B

References

This book has been developed based on the author's practical experience, in addition to a selection of recognized scientific and regulatory references in the field of radio communications. These sources are considered among the most authoritative and widely used references worldwide. The most notable include:

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1. ARRL Handbook for Radio Communications

Published by: American Radio Relay League (ARRL)

One of the most essential technical references for amateur radio, covering the fundamentals of electronics, antennas, and communication systems.

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2. ARRL Operating Manual

Published by: American Radio Relay League (ARRL)

A specialized reference in professional operating practices, covering communication procedures, operating etiquette, Q codes, and signal reporting.

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3. Radio Regulations

Published by: International Telecommunication Union (ITU)

The primary international reference governing the radio spectrum and its global use.

4. ITU Radio Regulations – Appendix (Q Codes)

Published by: International Telecommunication Union (ITU)

Provides the official definitions and standardized usage of Q codes in radio communications.

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5. IARU Amateur Radio Operating Guidelines

Published by: International Amateur Radio Union (IARU)

Outlines best operating practices at the international level and promotes efficient and organized spectrum use among amateur operators.

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6. Amateur Radio Service Regulations

Published by: Communications, Space & Technology Commission (CST) – Saudi Arabia

Represents the official regulatory framework governing amateur radio licensing and operation within the Kingdom of Saudi Arabia.

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7. ARRL Amateur Radio License Manuals

Published by: American Radio Relay League (ARRL)

Structured training resources designed to support candidates in passing amateur radio examinations, covering fundamental concepts in a clear and systematic manner.

8. Specialized Technical References in Amateur Radio

A collection of specialized books and technical references in electronics and radio communications, used to support and enhance the scientific content of this book.

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9. Practical Experience and Field Operations

Hands-on experience and field operation practices in amateur radio stations, contributing to the integration of theoretical concepts with real-world applications in a simplified and practical approach.

Note:

Some concepts have been simplified and presented progressively to suit beginners, while maintaining scientific accuracy in accordance with established practices in the field of radio communications.

Table of Contents: