



SIMPLIFYING ANTENNA SELECTION

Pocket Guide



WE ENABLE WIRELESS CONNECTIVITY

Your business has its own unique applications. Your operations have their own specific challenges. PCTEL® is ready to meet your wireless communication needs with our...

Experience – We've been a leading manufacturer of high-performance antennas for over 30 years.

Broad Portfolio – We offer the most expansive antenna portfolio in the market.

Ruggedized Products – Our antennas are designed to withstand the harshest work environments and weather conditions, and are vandal-proof and easy to install.

Global Supply Chain – We have manufacturing and distribution channels in every region of the world to ensure quick and efficient delivery.

Engineering Expertise – Our team has decades of experience in RF technology, holds 100+ patents, and is committed to developing innovative wireless solutions that solve your challenges.

Transparency – We share product performance data and reports that customers need to make informed decisions.

Dedicated Support – Our team of experts work side-by-side with customers throughout the entire design and development cycle, from planning to production.

Adaptability – Our products work across markets and applications, and can be customized with up to nine ports and various connector types and cable lengths to meet your specific requirements.

All-in-One Solutions – We offer 9-in-one, 7-in-one, 5-in-one, and 4-in-one combination antennas to simplify and reduce the footprint of deployments.

Quality – We make sure our products meet the latest industry standards and certifications.





WHO IS PCTEL?

PCTEL, an Amphenol company, is a global manufacturer of high-performance multiband antenna solutions. Our wireless solutions are used in a wide variety of markets, including Fleet & Intelligent Transportation, Industrial IoT, and Enterprise.

**We Solve Complex
Wireless Challenges**



Founded
1994



Headquarters
Bloomington, IL
USA



Employees Globally in
9 Countries



Patents
+100



Product Combinations
Over 2,000



Global Customers
900+ in Over
60 Countries

OUR PORTFOLIO

We are trusted by OEM leaders worldwide and offer the broadest antenna portfolio in the market.

300,000+

multiband/combination
antennas shipped
annually

100% flexible

portfolio offering
various cable lengths &
connectors for every
antenna platform

More than half

of our products
are white-labeled by
OEM leaders



**ENTERPRISE
WIRELESS**



**FLEET & INTELLIGENT
TRANSPORTATION**



**INDUSTRIAL
IoT**

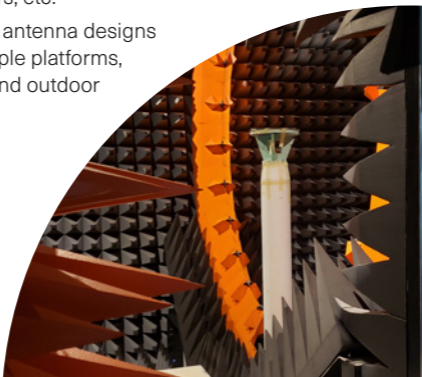
MARKETS WE SERVE

Optimized for real-life applications, our portfolio of high-RF performance antennas deliver reliable connectivity for mission and business critical communications.

IN-HOUSE ENGINEERING CAPABILITIES



- State-of-the-art 3D EM field solvers for accurate first-time simulation of antenna performance
- Mechanical test capabilities and top-of-the-line mechanical CAD tools
- Antenna measurements with MVG-Satimo Stargate-24 multi-probe near-field chambers
- Expertise in multiband antennas, arrays, isolation requirements, etc.
- Mechanical designs for industrial deployments, outdoors, vehicles, and rail
- Experts with system-level testing in cabled test beds, over-the-air, channel emulators, etc.
- Creative antenna designs for multiple platforms, indoor and outdoor



INTRODUCTION

Reliable connectivity is essential, and choosing the right antenna plays a critical role in building high-performing wireless solutions. This *Pocket Guide* simplifies that process. Whether you are selecting products, advising customers, or installing equipment in the field, it provides a clear, concise overview of the fundamentals.

Why antenna selection matters

In any wireless system, the antenna is often the most influential component. Choosing the right one helps you:

- Maintain reliable, continuous connectivity
- Achieve the correct coverage
- Save time and reduce costs

Designed as a quick, dependable reference, this guide supports you in delivering robust, future-ready connectivity solutions. Keep it close, refer to it often, and use it to maximize the performance of your wireless deployments.

HOW TO CHOOSE THE RIGHT ANTENNA

Choosing the right antenna is critical to achieving optimal performance. Before selecting a solution, there are several key questions you need to answer. This guide will walk you through them.

1. What is the application?

When selecting an antenna, the first and most critical step is to clearly understand the application. The intended use case drives key requirements such as form factor, mounting method, supported frequency bands, port configuration, environmental durability, and overall performance.

Choosing the right antenna means aligning the product's capabilities with the functional needs of the device or system. Asking "*What is the application?*" early in the design process helps ensure the antenna delivers reliable and effective performance once deployed.

Below are examples of two different applications and the antenna characteristics they typically require.



Vehicle	Vending Machine
Multiple ports	LTE/5G or LPWAN
Rugged low profile	Compact or concealed
External mounting	Metal enclosure challenges
High durability	Remote monitoring
Exposure to weather	Indoor/outdoor

2. Define operating frequency

Our antennas are engineered to operate within defined frequency ranges (e.g., 600–960 MHz, 1710–2690 MHz, and 1559–1610 MHz). If an antenna does not fully cover your system's operating band, performance may be compromised, leading to reduced range, weaker signal strength, and unreliable connections.

This is particularly important for modern wireless systems, since LTE, 5G, and WiFi technologies often use MIMO (multiple-input, multiple-output) to improve reliability and throughput, which relies on consistent performance across the required frequency bands.

**Need coverage
in all directions?**

Choose an
*omnidirectional
antenna*

**Need long-range
communication?**

Choose a
*directional
antenna*

3. How much coverage do you need?

Radiation pattern determines how the signal spreads from the antenna. Ask yourself what coverage your application needs, in simple terms:

LOWER GAIN



Broader coverage,
Shorter reach

HIGHER GAIN



Longer reach,
Narrower coverage

4. How far should the signal reach?

Antenna gain influences range and coverage shape. The goal is to match the antennas performance to your applications coverage requirements.

5. Environment

Environmental conditions directly impact antenna reliability and determine mechanical and material requirements. Consider the following to optimize performance:

Indoor Applications

- Form factor
- Aesthetic integration
- Optimized for multipath environments

Outdoor Applications

- IP rating
- UV resistance and vandal proof
- Wind and temperature durability

Mobile or Industrial Applications

- Rugged construction
- Vibration resistance
- Flexible and secure mounting

6. Mechanical requirements

Our antennas come in different mounting options to provide you flexibility. To ensure smooth installation and integration make sure to consider and verify what kind of mounting is required and:

1. Connector type
2. Cable length
3. Cable exit orientation
4. Available installation space

7. Regulatory & Compliance

Ensure that the antenna meets the necessary regulations and compliances for your region and end-application.

**READY TO ORDER A
PCTEL[®] ANTENNA?**

Start here



Every wireless application needs antennas.

THINK ANTENNAS. THINK PCTEL.

What antenna brand are you currently using?



Other



I can offer a PCTEL equivalent antenna

Great!
I can help you find the right PCTEL antenna

1. What antenna brand and model are you currently using?

2. Can you describe your application?

3. What frequency range do you need the antenna to cover?

4. What technology are you using? (*UHF, VHF, 4GLTE, 5G, GNSS, WiFi, combination, BT, etc*)

5. What type of antenna are you looking for?
(*Low profile whipless, omni, panel, base station, whip, whipless, embedded etc*)

6. Where will the antenna be mounted?

7. What radios (wireless router) is the customer using?
(*Cradlepoint, Digi, Sierra...*)

8. What cable length and connector type do you need?



ANTENNA PORTFOLIO

Our antennas are optimized for specific applications, mounting conditions, and performance requirements. Selecting the appropriate antenna type and form factor is as important as choosing the correct frequency.

Combination Antennas

Integrating multiple technologies such as GNSS, cellular, and WiFi into a single housing, these antennas improve efficiency and extend coverage across several applications.



WE OFFER THESE COMBINATIONS

- GNSS/Cellular/WiFi antennas
- GNSS/Cellular antennas
- GNSS/WiFi antennas
- Cellular/WiFi antennas

TYPICAL APPLICATIONS

- Intelligent transportation
- Cellular routers
- Industrial IoT
- Smart city
- Energy and utility



Coach™ II 4G/5G FR1 GNSS Multiband Antenna

- Configurable up to 9x1 ports
 - Low profile and rugged
 - Superior out-of-band rejection
-



Trooper™ Multiband 5G Cellular & 802.11AC Antenna

- Configurable up to 5x1 ports
 - Weatherproof IP67 housing
 - Multiband coverage
-



LPCA MIMO 5G

- Configurable up to 5x1 ports
 - 5G and WiFi 6E
 - LNA gain 30dB with pre-filter
-



SmartDisc™ Combi GNSS+

- LTE + GNSS+ combination antenna
 - Pre-filter LNA with dual feed GNSS antenna
 - IP67 class
-



MultiFin GNSS, Cellular and WiFi Antenna

- Configurable up to 5x1 ports
 - Rod functionality
 - IP6K9K class
-



Trooper™ Max

- Configurable up to 4x1 ports
 - Perfect for ITS applications
 - Rugged, aerodynamic and UV resistant
-

WiFi/Bluetooth/BLE Antennas

Optimized for the 2.4 GHz and 5/6 GHz bands, these purpose-built antennas provide high-speed data transmission and reliable connections.



TYPICAL APPLICATIONS

- Access points and routers
- IoT devices
- In-building and enterprise



VenU® Heavy-Duty Omnidirectional Base Station Antennas

- Made for harsh environments
 - IP67 class
 - DC grounded design
-



Horizontally-Polarized Omnidirectional Antenna for WiFi 6E/7 Applications

- Frequency: 4.94-7.125 GHz
 - Slender rugged housing
 - IP67 class
-



VenU® Dual-band WiFi Antennas

- Four RF ports providing dual-band 2.4/5 GHz operations
 - Low profile housing
 - Easy installation
-



MiniBlade

- WiFi 6E, BT, V2X, 5G
 - Frequency: 2400-7200 MHz
 - Slim and flexible design
-



Tri-band WiFi Sealed Omnidirectional Antenna

- Tri-band coverage
 - Ideal for harsh environments
 - White UV resistant housing
-



Low Profile Access Point

- Frequency: 4 GHz and 5 GHz
 - Rugged UL94 V0 plastic housing
 - High performance in low profile housing
-

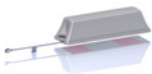
LTE450/LMR/TETRA Antennas

Operating in lower frequency bands (380-470 MHz), these antennas provide long-range, reliable communication for mission critical applications.



TYPICAL APPLICATIONS

- Public safety
- Utility and energy infrastructure
- Transport fleets



LP450 Wide

- Single-port LTE450 wideband antenna
 - Rugged and low-profile design
 - IP65 class
-



LPCA 450 LTE/5G

- Single-port 380-470 MHz and 5G
 - MIMO variant available
 - IP67 class
-



Ground Plane Independent, Low Profile Cellular Antenna

- 4G LTE coverage with or without a ground plane
 - Low-profile housing maximizes overhead clearance
 - Convenient – no tuning required
-



Bluewave Marathon Yagi Series

- Elements and boom manufactured from 6061-T6 aluminum
 - Built for harsh conditions
 - Adaptable – supplied with a 2" pigtail (RG213), N Female connector, mounting clamp
-



Aluminum Yagi MYA Series

- Wind Load Rating 100 mph stainless steel hardware
 - Heavy-duty, double-walled aluminum boom
 - DC grounded
-



VO450 Omnidirectional Antenna

- Frequency 430-470 MHz
 - Ideal for harsh conditions
 - Pole mount
-

GPS/GNSS Antennas

Designed to receive signals from global navigation satellite systems such as GPS, GLONASS, Galileo, QZSS and BeiDou, these GNSS/GPS antennas deliver accurate location data even in challenging environments, including dense urban areas and remote locations.



TYPICAL APPLICATIONS

- Navigation systems
- Vehicle and asset tracking
- Timing synchronization



Multi-Constellation GNSS Precision Timing Antenna

- Full multi-GNSS compatibility
 - Advanced out-of-band filtering
 - Excellent multipath mitigation
-



26 dB High Rejection Antenna with Enhanced Narrow Band Filtering

- High performance: 26 dB amplifier
 - Superior filtering – multi-stage, narrow band high rejection filtering
 - Weatherproof – unique housing shape sheds water and ice
-



Stingray GNSS Magnetic High Rejection Tracking Antenna

- Wideband coverage – GPS L1, GLONASS L1, Galileo E1 and BeiDou B1 frequencies
 - Superior out-of-band rejection
 - Quality – 30 dB LNA gain
-

Cellular (5G, LTE, CBRS, 2G, 3G, 4G) Antennas

Supporting a wide range of network technologies such as 4G LTE, LTE-M, NB IoT, and 5G, these antennas enable devices to connect to mobile operator networks for broadband data, IoT communication, and mission critical applications.



TYPICAL APPLICATIONS

- Industrial IoT
- Smart city
- Routers, modems, gateways



LP70x-series Multiband Antenna

- Cellular 5G
 - Different mounting options
 - Performs well on metallic or non-metallic surfaces
-



SmartDisc

- Cellular 2G/3G/4G and NB IoT
 - Low profile and easy installation
 - Different mounting options
-



AllDisc

- Cellular 2G/3G/4G/5G
 - Low profile and easy installation
 - IP6K9K class
-



5G NR (FR1), WiFi 6E, Low Profile Vertical Antenna

- Attractive, low-profile design
 - Multiband coverage with no tuning required
 - N female termination option (-VP) available
-



5G FR1 Omnidirectional Antenna

- Slender, rugged housing (1.25" OD)
 - Innovative sealed version for harsh environments
 - White UV-resistant fiberglass housing
-



Direct Mount Multiband Blade Antenna for 5G FR1 Devices

- Multiband performance covering 618 MHz to 6 GHz 5G FR1 frequencies
 - Ground plane independent design provides added installation flexibility
 - Rugged UV stable plastic housing
-

ISM/LoRa/LPWAN Antennas

These antennas primarily operate in unlicensed spectrum and support low-power, wide-area networks and long-range communication.



TYPICAL APPLICATIONS

- Industrial IoT
- Environmental monitoring
- Asset and livestock tracking



LP4487 ISM Antenna

- Dual output 444 + 868 MHz
 - Discreet and durable design
 - Flexible cable routing
-



LP868 Low Profile ISM Band Antenna

- Frequency: 867–876 MHz
 - Ground plane independent
 - Durable design
-



LPWAN Stick Antennas

- Supports both 868 MHz and 915 MHz
 - Robust, integrated mounting bracket
 - UV protected housing
-



900 MHz Horizontally Polarized Omnidirectional Antenna

- 5G FR1
 - Cellular
 - Horizontally polarized ideal for high RF density installations
-



Compact Omnidirectional Antenna

- Rugged, IP67 rated design (installed)
 - UV-resistant housing
-



Marathon Yagi Antennas

- Elements and boom are made from 6061-T6 aluminum
 - Anodized for corrosion resistance and aesthetic appearance
 - Supplied with a 2' pigtail (RG213) and N Female connector
-

Embedded Antennas

Designed to operate efficiently in tight spaces and often interacting with nearby materials and electronics, these antennas help device manufacturers overcome space limitations and meet aesthetic requirements without sacrificing performance.



TYPICAL APPLICATIONS

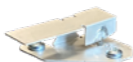
- Access points
- Portable devices
- Wearable devices



Horizontally-Polarized Monopole Antenna for 5 GHz WiFi

- Easy to integrate into tight spaces
- Straightforward to deploy using nylon or metal hardware and comes with two nylon spacers for mounting
- Horizontal polarization to increase MIMO diversity

Tri-Band Inverted-F Antenna for 2.4/5/6 GHz WiFi



- Easy to deploy using common hardware
- Mixed-polarized, broad radiation patterns enable wireless connectivity over a hemisphere
- Solid mechanical construction and cable attachment

Tri-Band Monopole Antenna for 2.4/5/6 GHz WiFi



- The antenna mounts directly to a metal ground plane using two screws
- Easily integrated into tight spaces or onto multi-antenna platforms
- Comes with a micro-coaxial cable soldered to the element that is terminated in a U.FL-style connector

Dual-Band Dipole Antenna for 2.4 GHz and 5 GHz WiFi



- Designed to be mounted to a plastic support or directly to a non-metallic surface
- Low-profile antenna design exhibits wide coverage patterns in the 2.4 and 5 GHz frequency bands
- Comes with an attached 6" micro-coax cable with a U.FL-style connector

UHF/VHF Antennas

Operating within the 30–300 MHz and 300 MHz–3 GHz bands, these antennas provide reliable performance for long-range and line-of-sight communications.



TYPICAL APPLICATIONS

- Critical communication
- Industrial IoT
- Intelligent transportation



Field Tunable VHF and UHF Wide-band Mobile Antennas

- Outstanding bandwidth performance – VHF and UHF
- Field tunable
- Rugged compact design
- Adaptable – mates with all 1-1/8" -18 thread mounts, including 3/4" mounts



Heavy Duty Flexible Antennas

- Maximum installation flexibility
- Rugged – heavy-duty, flexible housing design for harsh conditions
- High performance – wideband coverage without added field tuning



Ultra-Flexible Wide Spectrum Multiband Antenna

- No tune, multiband coverage of full spectrum VHF, TETRA/UHF and 700/800/900 MHz frequencies
- Rugged ultra-flexible design
- NMO compatible interface for easy installation or upgrade

CABLES AND ACCESSORIES

We offer a comprehensive range of high-quality extension cables for our antennas. Choose bulk options for complete flexibility, decide your exact length and connectors needed or select from our ready-to-use cables for a fast and smooth installation.



We also offer a broad portfolio of high-performance antenna mounts and accessories that increases the versatility and flexibility of our antenna solutions platforms.

YOUR GUIDE TO ANTENNAS

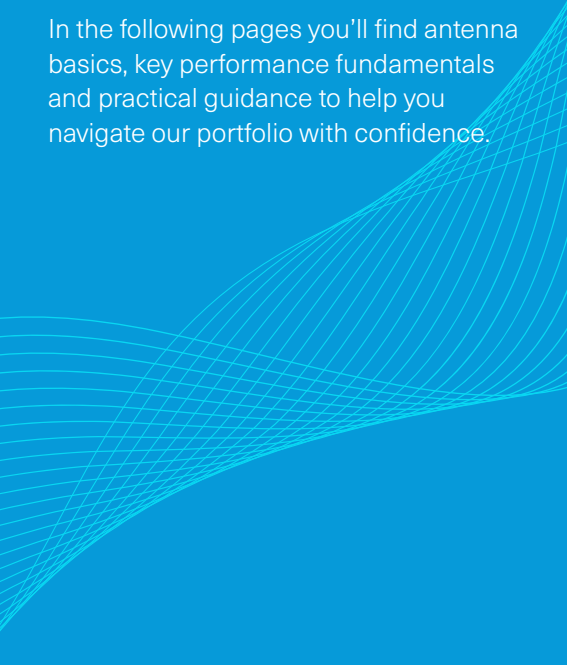
What is an antenna?

An antenna is a device that converts electrical energy into electromagnetic waves (for transmission) and electromagnetic waves into electrical energy (for reception). Most antennas are resonant devices, which operate over a relative narrow frequency band.

A simplified analogy is that an antenna is both ears and mouth. Imagine the antenna as a sharp-eared listener, listening carefully for different pitches of sound, some high, some low. We can compare those pitches of sound to frequencies. When the antenna hears a message spoken at the right pitch (frequency) it can understand the message and everything else becomes background noise.

The antenna is also a powerful voice, when it needs to send information, it “speaks” out loud, using a specific pitch and anyone tuned into that specific pitch(frequency) can receive the message.

In the following pages you’ll find antenna basics, key performance fundamentals and practical guidance to help you navigate our portfolio with confidence.

A decorative graphic in the bottom right corner of the page, consisting of numerous thin, overlapping, curved lines that create a sense of motion and depth. The lines are light blue and curve upwards and to the right, creating a grid-like pattern that fades into the background.

FREQUENCY GUIDE

Technology	Frequency Ranges
Bluetooth	2.4 GHz
Cellular 2G	1900 MHz
Cellular 3G	850 MHz/1900 MHz
Cellular 4G	700, 1700-2100, 1900, 2500-2700 MHz
Cellular 5G	600 MHz-6 GHz
Cellular CBRS/5G NR	3300-4200 MHz
Cellular LTE	700/900 MHz
Iridium	1616-1626.5 MHz
LoRa/ISM/SRM	806-960 MHz
Lowband/Amateur Radio	27-60 MHz
LTE450	410-470 MHz
UHF	380-520 MHz
VHF	132-174 MHz
WiFi	2.4 GHz, 5 GHz
WiFi 6E	5.925-7.125 GHz
WiFi 7	2.4, 5, 6 GHz

FREQUENCY GUIDE

GNSS BANDS

Band	Center Frequency (MHz)
GPS L1	1575.42
GPS L2	1227.60
GPS L5	1176.45
GALILEO E1	1575.42
GALILEO E5	1191.795
GALILEO E5a	1176.45
GALILEO E5b	1207.14
GLONASS L1OC	1600.995
GLONASS L2OC	1248.06
GLONASS L3OC	1202.025
BEIDOU B1I	1561.098
BEIDOU B1C	1575.42
BEIDOU B2a	1176.45
BEIDOU B2b	1207.14
QZSS L1	1575.42
QZSS L2	1227.60
QZSS L5	1176.45

KEY ANTENNA FUNDAMENTALS

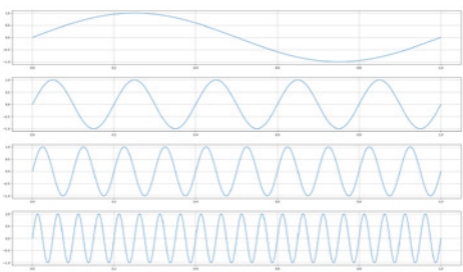
1. Radio waves

Radio waves are electromagnetic signals that carry information wirelessly. Antennas transmit and receive these waves by converting electrical energy into radio energy and back again.

Frequency & Wavelength

Radio waves vary by frequency.

- **Low frequencies** travel far and penetrate obstacles well.
- **High frequencies** offer higher data rates but shorter range.



Radio waves can reflect, bend, scatter, or be absorbed by objects. Understanding the environment and application helps ensure good coverage.

2. Frequency

Antennas are designed to operate efficiently at specific frequencies.

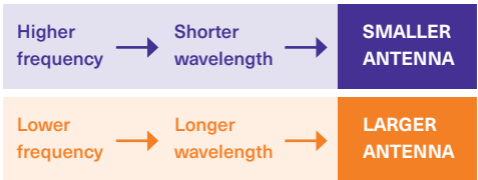
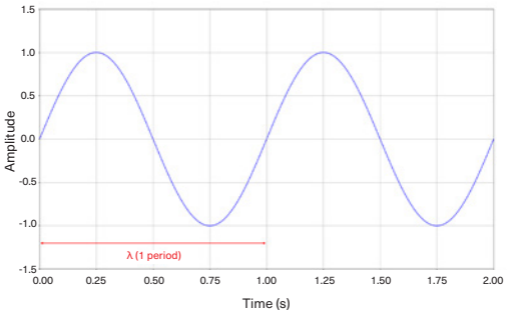
Frequency (f) is related to wavelength (λ):

$$\lambda = c/f$$

λ = wavelength

c = speed of light

f = frequency



EXAMPLE: What is the equivalent wavelength for frequencies 2.4 GHz and 800 MHz?

2.4 GHz	800 MHz
$\lambda_{2.4\text{GHz}} = c / f_{2.4\text{GHz}} =$ $3 \times 10^8 / 2.4 \times 10^9 =$ $0.125\text{m} = 125\text{mm}$	$\lambda_{800\text{MHz}} = c / f_{800\text{MHz}} =$ $3 \times 10^8 / 0.8 \times 10^9 =$ $0.375\text{m} = 375\text{mm}$

3. Bandwidth

Bandwidth is the frequency range over which an antenna performs acceptably (usually defined by $\text{VSWR} \leq 2:1$).

Wide bandwidth antennas:

- Support multiple channels
- Are more tolerant to detuning

Narrow bandwidth antennas:

- More frequency-specific
- Often higher performance within a tight range

4. Gain

Gain describes how effectively an antenna directs RF energy in a particular direction. It is measured in:

dBi (*relative to isotropic radiator*)

dBd (*relative to dipole*)

IMPORTANT: Gain does not create power. It redistributes power.

Higher gain:

- Narrows beamwidth
- Increases range in a specific direction
- Reduces coverage elsewhere

EXAMPLE:

- 2 dBi → *Wide coverage*
- 8 dBi → *Flatter, longer reach*
- 18 dBi → *Narrow, focused beam*

Gain is directly related to antenna directivity and efficiency.

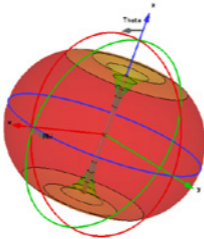
5. Radiation pattern

The radiation pattern describes how an antenna distributes its radiated power in space. In simple terms, it shows where the antenna sends or receives energy most effectively. Understanding the radiation pattern helps ensure that the antenna's strongest coverage is aligned with the needs of the application.

Radiation patterns are typically visualized as 2D or 3D plots, illustrating how signal strength varies with direction. Although real patterns can be complex, most antennas fall into a few common categories:

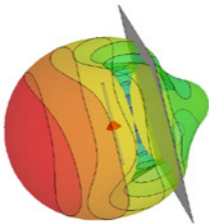
Omnidirectional – Radiates equally in horizontal directions

- 360° horizontal coverage
- Ideal for mobile applications or broad-area coverage



Directional – Focuses energy in one direction

- Narrower beam and higher gain
- Ideal for long distance or point-to-point communication



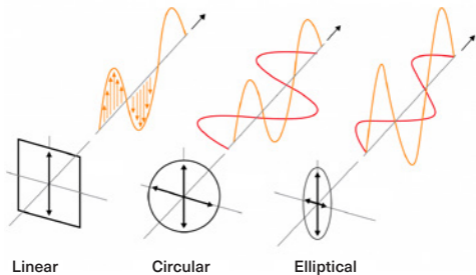
In short, radiation patterns determine coverage, range and link behavior and are helpful to guide you to the correct antenna selection.

6. Polarization

Polarization describes the orientation of the electric field.

Common types:

- Linear (Vertical or Horizontal)
- Circular (RHCP / LHCP)
- Elliptical



Maximum signal transfer occurs when transmitter and receiver polarizations match.

Polarization mismatch loss:

- Vertical to horizontal = up to 20–30 dB loss
- Linear to circular = ~3 dB loss

Correct polarization improves:

- Link reliability
- Multipath rejection
- System efficiency

7. Efficiency

Antenna efficiency describes how well an antenna converts input power into radiated signal. For example, if an antenna has 50% efficiency, only half of the power is actually transmitted, while the remaining 50% is lost as heat, reflection, or internal resistance.

Efficiency is influenced by factors such as the antenna's design, surrounding materials, tuning, and installation environment. Understanding and optimizing these elements ensures the antenna performs as intended, especially in compact or challenging setups.

8. VSWR and return loss

These parameters describe how well the antenna is impedance-matched (typically to 50Ω systems). VSWR and return loss are different ways to express the same phenomenon.

VSWR

VSWR indicates how much power is reflected back due to mismatch. The lower the value, the better the match is. High VSWR causes:

- Reduced transmitted power
- Increased heat
- Possible transmitter damage

Return loss

Return loss shows reflected power in dB:

$$RL = -20\log|\Gamma|$$

Γ = Reflection coefficient

9. Cables

Coaxial cables are the essential link between the antenna and the communication device. Their job is to carry RF signals with minimal loss, minimal interference and consistent impedance.

See comparison table between different common cable types and their typical nominal attenuation.

Cable Type							
Frequency (MHz)	RG178	RG174	RG316	RG316 LSOH	RG223	Low Loss	NFC-200
	Nominal attenuation for dB / 100m						
100	43.8	26.5	27.4	28.9	12.9	10.2	15.7
200	62.2	38.7	39.0	38.8	18.8	14.8	22.8
400	93.4	54.2	58.0	53.9	27.7	21.4	33.1
700	125.7	73.0	78.3	72.7	35.8	31.2	45.5
1000	152.3	89.0	95.3	88.9	43.4	35.1	54.8
2000	224.8	149.2	137.0	133.9	64.7	55.8	81.6
2500	254.4	169.6	155.0	150.7	73.5	57.8	94.5
3000	280.8	190.0	174.0	170.0	79.9	64.9	104.6
6000	411.4	299.7	325.0	257.7	119.4	110.7	168.5
Overall cable diameter (mm)	1.8	2.8	2.5	2.7	5.3	5.5	5.0

INSTALLATION BEST PRACTICES / MISTAKES TO AVOID

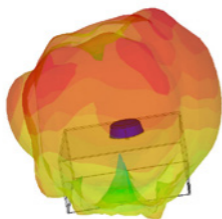
There are some things to consider during installation of an antenna to reduce any issues that might affect performance.

1. The importance of placement

Where and how an antenna is installed directly affects the signal quality it can transmit and receive. A well positioned antenna maximizes coverage, reduces interference, and ensures a stable link. Ideally, antennas should be placed high, in open areas, with minimal physical obstructions.

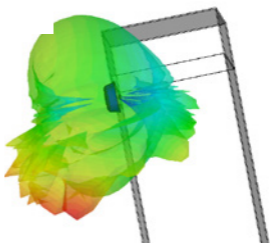
Placement also dictates orientation, which is crucial because antennas radiate differently depending on how they're aligned. An omnidirectional antenna, for example, must remain upright to preserve its 360 degree horizontal coverage. Mounting it on its side alters the radiation pattern, reducing range and creating potential dead zones.

The figures below demonstrate the impact on radiation performance when the AllDisc antenna is installed in different orientations:



◀ **AllDisc antenna center radiation:** *Placement on top. Uniformed radiation is distributed horizontally.*

AllDisc antenna side radiation: ▶
Placement on the side. Less coverage in horizontal directions.



Always check orientation during installation and recheck after mechanical stress, wind, or vibration.

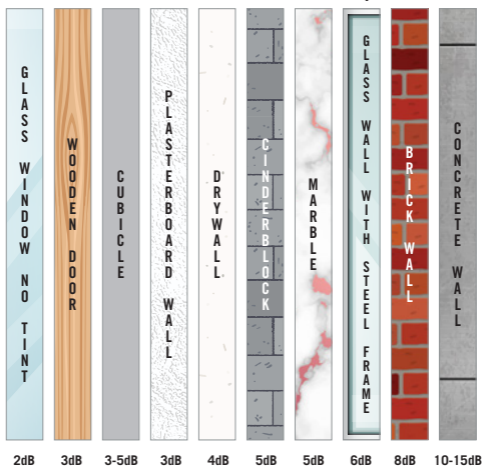
2. Impact of surroundings

Metal objects (rails, beams, ducts, cabinets) and enclosed spaces like boxes, housings, or sealed compartments can significantly impact antenna performance. Metal surfaces can reflect, absorb, or distort radio waves, altering the antenna's radiation pattern and affecting its tuning.

When an antenna is placed too close to metal or inside restrictive enclosures, it often becomes less efficient, loses range, or behaves unpredictably.

Even non-metallic materials can introduce issues. Thick concrete may completely block signals, while plastics or thin walls can partially detune or weaken them through absorption, where obstacles reduce a signal's amplitude while its frequency remains unchanged.

Overview of attenuation due to absorption:



When installing an antenna, always follow the recommended mounting location and specifications.

3. Using wrong frequency band

Every antenna is designed to operate efficiently at specific frequencies. Using an antenna outside its intended band results in severe performance loss, poor matching, increased VSWR, and reduced range. Always confirm that the antenna's frequency specification matches the transmitter/receiver and regulatory requirements.

4. Ignoring cable losses

Coaxial cables introduce attenuation that increases with length and frequency. High-frequency systems (e.g., 2.4 GHz, 5 GHz) are especially sensitive. Using long, low quality, or weather damaged cables can eliminate most of the antenna's gain.

5. Overestimating gain benefits

High-gain antennas focus their energy on narrower patterns. While gain increases range in one direction, it reduces coverage in others. Many installers mistakenly rely solely on high gain to improve performance, forgetting the trade-offs: narrower beamwidth, reduced vertical coverage, and more precise alignment requirements. Choose gain based on the actual use case. Higher gain is not always better.

6. Incorrect polarization alignment

Polarization describes the orientation of the electromagnetic wave (vertical, horizontal, circular, etc.). If two antennas use different polarizations, they can lose up to 20–30 dB of signal—essentially breaking the link. Ensure both ends of a communication link use the same polarization, unless intentionally designed otherwise.

7. Cable routing

Cable routing affects signal quality and long-term reliability. Avoid running cables near power lines, motors, or sources of electrical noise. Prevent sharp bends, pinching, or crushing of coax. Secure the cable to prevent movement in wind and ensure weatherproofing at entry points. Good routing reduces interference, loss, and equipment wear.

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