Industrial wireless catalog

Wireless from the sensor to the network

PHOENIX CONTACT
INSPIRING INNOVATIONS

Open communication with customers and partners worldwide

Phoenix Contact is a global market leader based in Germany. We are known for producing future-oriented components, systems, and solutions in the fields of electrical engineering, electronics, and automation. With a global network reaching across more than 100 countries with over 17,400 employees, we maintain close relationships with our customers, something we believe is essential for success.

Our wide variety of innovative products makes it easy for our customers to implement the latest technology in a variety of applications and industries. We focus on developing the fields of energy, infrastructure, process, and factory automation.

Global player with customer proximity

Phoenix Contact values in-house expertise. Our design and development departments continuously implement innovative product ideas and deliver special solutions to meet customer requirements. Numerous patents have resulted from products developed at Phoenix Contact.

Wireless technology for today's industrial challenges

Wireless technology is being adopted by a rapidly increasing number of industries, from simple monitoring and control to Supervisory Control and Data Acquisition (SCADA). Flexibility, simple installation and cost savings give wireless several advantages over traditional cable-based systems. Wireless technology from Phoenix Contact provides highly reliable data communication in harsh and interference-heavy environments.

As system complexity increases, relying on cable-based solutions results in high installation costs, as well as limited flexibility for system expansion. The wireless option overcomes these challenges by providing easy-to-alter permanent or temporary communication.

Benefits of industrial wireless

- Eliminates time and expenses associated with cable installations
- Ends dependence on expensive and potentially unreliable leased lines
- Offers an alternative to wiring harnesses and slip rings that wear out on moving devices
- Monitors and controls remote locations where cable installations are impractical and/or phone lines are unavailable

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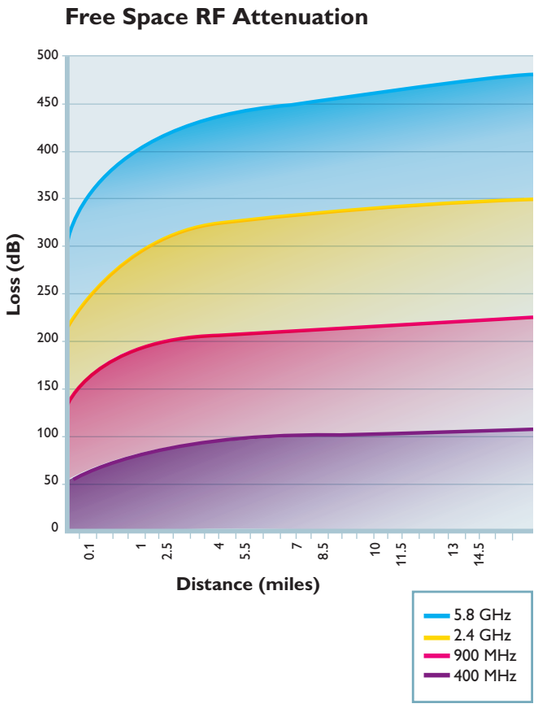
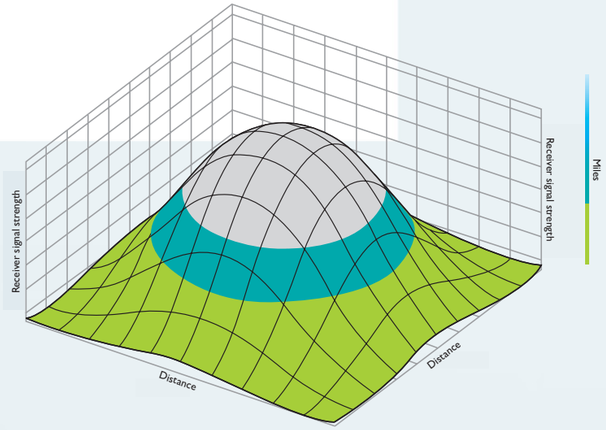
Choosing a wireless technology

There are several key factors to consider when determining a wireless technology's performance in specific applications. Because each of the listed parameters impacts the others, users must find the correct balance when choosing a wireless device.

Transmission range
Transmission range is affected by operating frequency, transmission method, over-the-air speed and interference. High-gain antennas and good installation practices help achieve optimal range.

Free Space RF Attenuation





Circle of success
Achieving long-distance radio links with RF knowledge

- **No-worry zone -**
  - Works out of the box
  - Wireless conduits up to 1/4 mile*
- **Common sense zone**
  - Success with experience
  - Wireless links up to 1 mile*
- **Performance zone -**
  - Path engineering required
  - Wireless links up to 20 miles*

** For 900 MHz*

Over-the-air speed
A radio's over-the-air speed depends on the transmission method as well as the application installation.

A high-speed radio uses a wider channel bandwidth regardless of the transmission method. Channel bandwidth refers to the amount of data that can be transmitted by radio signal and is measured in bytes transferred over a specific prescribed period of time (kbps or Mbps).

A radio using a wide bandwidth is more susceptible to interference due to an increased probability of existing interference over the utilized band and because there is less energy per data bit.

Energy per bit refers to the amount of available RF power to send each bit of data over the air. The slower the transmission rate, the higher the energy level per bit. The higher the energy per bit, the greater the achievable transmission range. Therefore, longer range and higher interference immunity result from reducing the transmission speed.

Interference and coexistence
Interference occurs when environmental circumstances or the superposition of additional waves interrupt, redirect, fade, or terminate a wave pattern, resulting in data loss. Interference can be caused by physical obstructions, emissions from electronic devices, or other radio devices operating nearby. Interference is overcome by transmitting multiple versions of the same signal, utilizing interference-tolerant technology and strategic antenna placement.

Practical wireless

- When installing antennas, always mount them higher than any obstructions in the radio path.
- Whenever possible, adjust the radio's over-the-air data rate to the slowest speed allowed by the application.
- Select a radio with the lowest frequency band to maximize distance. If equivalent products are available in 2.4 GHz or 900 MHz, choose 900 MHz.
- Minimize interference with nearby systems by following antenna mounting height or gain regulations.

Security

Regardless of whether your network is wired or wireless, security is always a concern. Ensuring that your data will remain safe and private is a major point to consider when installing a new system.

Reducing accessibility to a wireless network can be achieved in three ways:

- **Transmission technology**
- **Encryption authentication**
- **Installation practices**

By combining these three methods, you can successfully prevent unwanted users from accessing information sent via any wireless network.

Transmission technology

There are several different ways in which a radio can utilize bandwidth and modulation techniques to transmit data. Each of these transmission technologies has different benefits and trade-offs, including range, security, data volumes, and efficiency. This means that some technologies handle interference better with longer range, while others are meant for higher throughput applications over shorter distances. Using different transmission methods or technologies decreases the likelihood of a hacker stealing data or jamming signals.

Encryption/authentication

Encryption converts the actual data or information with the use of a key into a coded message for transmission. The coded message that is transmitted requires the key to decrypt, preventing unauthorized interception of data.

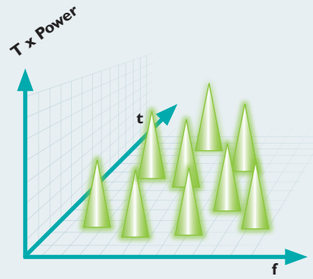
Authentication places a password on the network, allowing access only by authorized users. Encryption and authentication are the two most common practices for security in a wireless system.

Installation practices

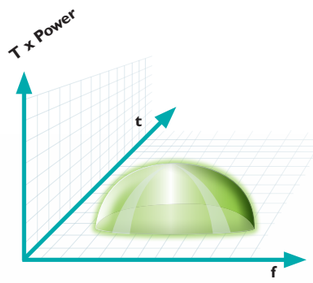
Wireless installers typically use the highest transmit power and gain antennas available, often creating a wireless network with a much greater range than is really needed. Wireless network security can be greatly enhanced with a minimalist installation. Limiting transmit power and antenna gain to only what is needed for adequate wireless coverage across a facility makes it inherently more difficult for an outside hacker, because the intruder would have to be physically located in or near the facility in order to detect the network.

Differentiating technologies

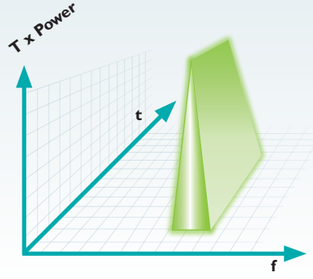
Comparing transmission methods



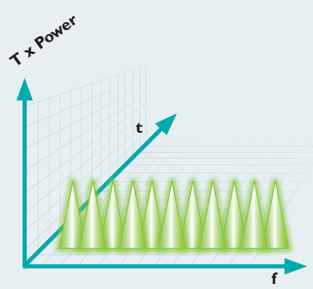
Frequency-Hopping Spread Spectrum (FHSS)
transmits radio signals by rapidly switching a carrier between many frequency channels using a pseudorandom sequence known to both transmitter and receiver. FHSS tolerates interference because a transmission will immediately resend on the next hop if it is blocked on a channel.



Direct Sequence Spread Spectrum (DSSS)
broadcasts transmission signals that spread over the full bandwidth of a device's transmitting frequency. User data combines with a spreading code before being sent over the air, creating a wide-band transmission. Interference is suppressed during the demodulation process in the receiver. When the spreading code is removed to extract the user data, the noise signal is simultaneously suppressed.

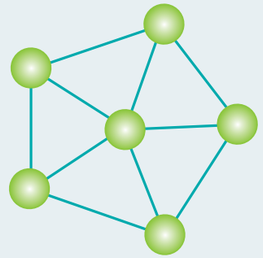


Fixed frequency
transmits a signal on a single frequency with a specific channel width (usually very narrow). Fixed-frequency radios typically have high-power transmitters and require a license to operate. Strong interference can affect a fixed-frequency transmitter in or near the channel. The licensing requirement prevents nearby systems from operating on the same channel and reduces the likelihood of interference.

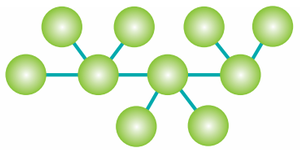


Orthogonal Frequency-Division Multiplexing (OFDM)
broadcasts simultaneously on multiple subcarrier frequencies. Each subcarrier is a narrow-band transmission, summarily allowing high data rates to be achieved. OFDM is flexible in coping with severe channel conditions. Interference is handled with a variety of methods due to the higher complexity of OFDM transmission. Narrow-band interference is tolerated because of the high number of interleaved subcarriers and channel coding mechanisms, similar to DSSS.

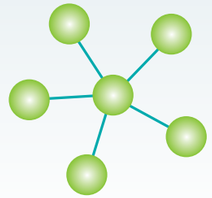
Network architectures



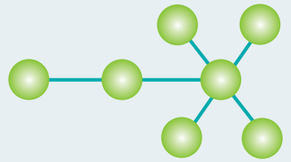
Mesh networking
A mesh network can route data between multiple nodes of receiver/transmitters. It supports self-healing, continuous connections and reconfiguration around broken or blocked paths by hopping from node to node until data reaches the designated destination.



Trunk networking
Trunking uses break-off connection points to leverage existing infrastructures, add bandwidth capabilities, and provide high availability at low cost. This allows data to flow only where needed, optimizing available bandwidth.



Star/point-to-multipoint
A master control regulates the flow of information on a polled basis with remote sites. Store-and-forward repeater configurations are supported to extend the reach of the wireless network.



Repeaters
The signal is received and then retransmitted to cover longer distances or to avoid obstacles. Repeaters can be incorporated into point-to-point, point-to-multipoint, mesh and trunk networking architectures.

Wireless technologies

Wi Fi™

- Rugged, industrial products create high-speed Ethernet links in plant floor and SCADA applications using this technology
- Capable of high data throughputs up to 54 Mbps
- Common in the consumer market for wireless Ethernet applications

TRUSTED WIRELESS

- Proprietary, unlicensed frequency-hopping technology for harsh industrial environments
- Used for transferring Ethernet, serial, and I/O data over distances up to 20 km/12 miles or more
- Proven high data reliability

Bluetooth®

- Industrial products use Bluetooth technology to send I/O, serial, or Ethernet data over short distances
- Short-range frequency-hopping technology for global use
- Used in phones, printers, headsets, and other consumer products

Lte™

- Known as cell phone technology and operates on a cellular network
- Globally available
- Requires a service plan

Industrial wireless usage

	Enterprise Ethernet network	SCADA Ethernet network	Serial data	Analog digital I/O
Trusted Wireless Frequency: 900 MHz/2.4 GHz Speed: Varies, < 1 Mbps Range: Varies, 900 MHz 32 km/20 miles 2.4 GHZ 2 km/1 mile		■	■	■
Cellular Frequencies Verizon: LTE bands B4 and B13 Frequencies AT&T: LTE bands B2, B4, B5, B13, and B17 Speed: 20 Mbps		■	■	
Bluetooth Frequency: 2.4 GHz Speed: 1 Mbps Range: < 100 m/300 ft			■	■
WLAN (802.11 a/b/g/n) Frequency: 2.4/5 GHz Speed: Up to 300 Mbps Range: 600 ft.	■	■		

Our industrial wireless product portfolio for your applications

Phoenix Contact is a leading global provider of industrial wireless solutions. Today, with more than 50,000 installed units, Phoenix Contact's wireless products provide dependability and security while monitoring and controlling signals such as level, temperature, frequency, and digital alarms.

Phoenix Contact strives to meet customer needs with both standard and application-specific wireless products designed to effectively endure and operate in an extensive variety of industrial environments. Cable-based circuits create increasingly high installation costs and limit alteration flexibility. Wireless solves these challenges with easy-to-alter permanent or temporary communication.

Whether serial or I/O data, fieldbus or Ethernet communications, Phoenix Contact offers the solution for every application, utilizing technologies ranging from Bluetooth to WLAN, GSM/GPRS, proprietary Trusted Wireless or WirelessHART.

WIRELESS PORTFOLIO

Each section above is indicated by the colored sidebar on each page – indicated below.

Wireless I/O – Transmission of I/O signals

With wireless I/O, analog and digital signals are transmitted without using a signal cable via the following technologies:

- **Bluetooth**
- **Cellular**
- **Trusted Wireless**

Wireless serial – Serial data transmission

For the wireless transmission of signals from serial interfaces, the following technologies are utilized:

- **Bluetooth**
- **Cellular**
- **Trusted Wireless**

Wireless Ethernet – Transmission in Ethernet networks

In order to integrate devices in the Ethernet network, these technologies are optimized:

- **Bluetooth**
- **Cellular**
- **WLAN**

Wireless accessories – For indoor and outdoor use

For a wireless network to operate properly, additional accessories may be needed. These include not only various antennas and cables, but also adapters, splitters, and surge protection. These accessories and many others are all part of our extensive wireless portfolio.

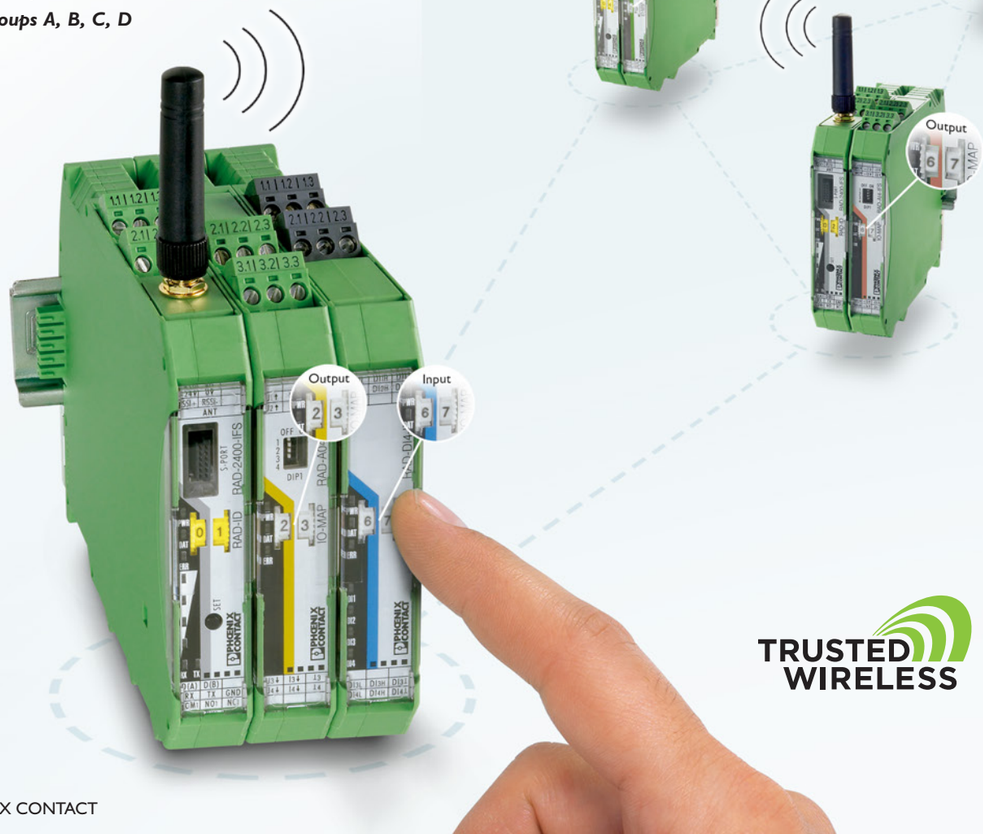
Wireless I/O

Radioline – easy start-up with I/O mapping

Radioline is the new wireless system for large systems and networks. Special features include extremely easy assignment of inputs and outputs by simply turning the thumbwheel – without any programming.

Radioline transmits I/O signals as well as serial data and is therefore very versatile. In addition, you can implement various network structures from a simple point-to-point connection to complex networks.

Class I, Division 2
Groups A, B, C, D



I/O mapping

I/O mapping simplifies signal distribution in your system. Assign inputs and outputs quickly by simply turning the thumbwheel.
In this way, you can distribute and multiply I/O signals freely in your network – without the need for any complex programming.

900 MHz wireless module

RAD-900-IFS
Order no. 2901540

- **Supply voltage: 10.8 – 30.5 V DC**
- **Can be extended with I/O modules via T-bus**
- **Extended temperature range: -40°C – 70°C**
- **Antenna connection: RSMA (female)**

2.4 GHz wireless module

RAD-2400-IFS
Order no. 2901541

- **Supply voltage: 19.2 – 30.5 V DC**
- **Can be extended with I/O modules via T-bus**
- **Extended temperature range: -40°C – 70°C**
- **Suitable for ATEX Zone 2**
- **Antenna connection: RSMA (female)**

Accessories

RAD-900-CONF-RF1 (RF band 1)
Order no. 2702122

RAD-CONF-RF3 (RF band 3)*
Order no. 2902814

RAD-CONF-RF5 (RF band 5)*
Order no. 2902815

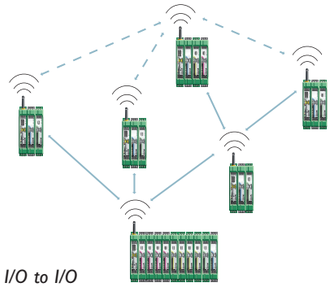
RAD-CONF-RF7 (RF band 7)*
Order no. 2902816

RAD-MEMORY (freely configurable)
Order no. 2902828

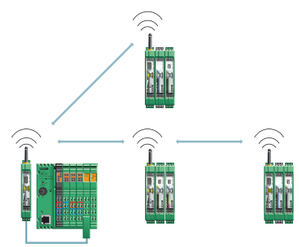
- **Unique network addressing via plug-in configuration memory for secure, parallel operation of multiple networks (different RF bands)**

** RAD-2400-IFS only*

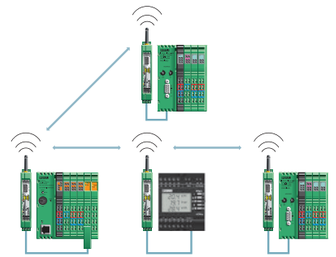
Signal transmission with the Radioline wireless system:



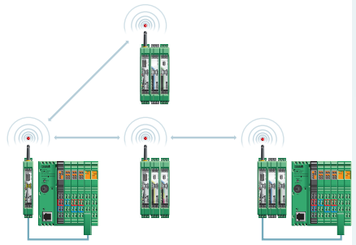
I/O to I/O



I/O-to-serial (Modbus RTU)



Serial-to-serial (transparent)



I/O and serial dual mode

The Radioline wireless system features:

- Quick and easy start-up without programming
- Easy point-to-point or network connections (star, mesh)
- Can be extended with up to 32 I/O modules per station via T-bus (hot-swappable)
- Applications: I/O-to-I/O, I/O-to-serial, serial-to-serial
- Integrated RS-232 and RS-485 interface
- Trusted Wireless 2.0 technology
- Adjustable data rates for the wireless interface (16 – 500 kbps)
- 128-bit data encryption (AES)

Wireless I/O

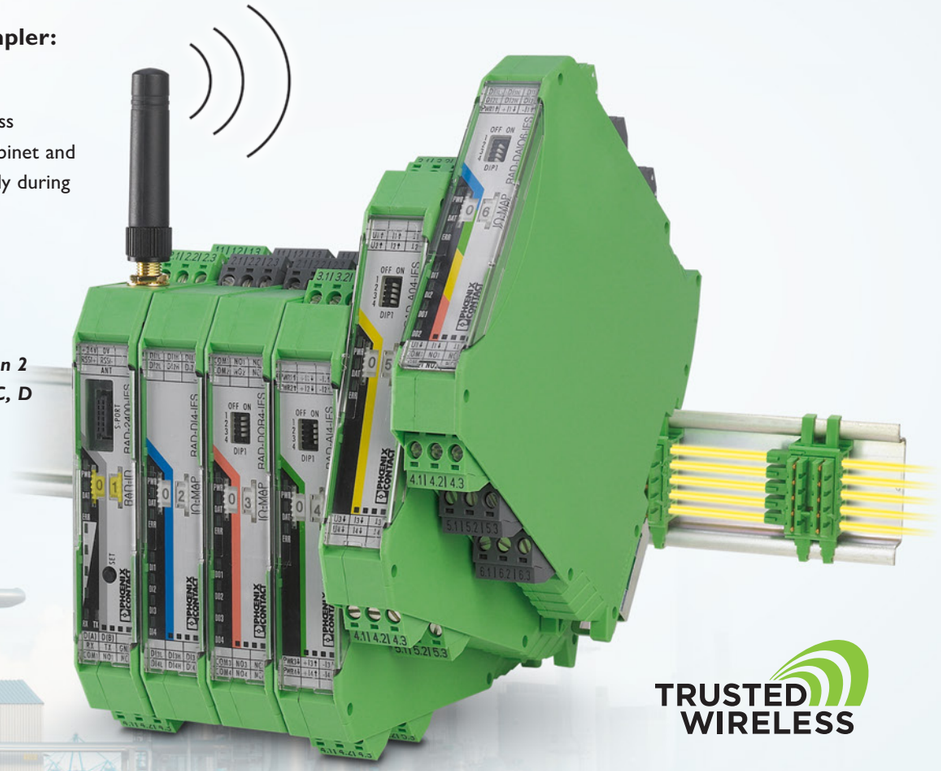
Radioline – I/O extension modules

Various extension modules are available for extending the Radioline wireless system quickly and easily; the number and type of signals can be adapted to the special requirements of the specific applications.

It could not be simpler:

1. Easy installation

Create a modular wireless station in the control cabinet and extend or replace it easily during operation.



Class I, Division 2
Groups A, B, C, D

TRUSTED WIRELESS

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High-density digital expansion module

RAD-DI8-IFS
Order no. 2901539

RAD-DO8-IFS
Order no. 2902811

- **Eight digital inputs/outputs (0 – 30.5 V DC or 2x32 bit counter)**

Digital extension modules

RAD-DI4-IFS
Order no. 2901535

RAD-DOR4-IFS
Order no. 2901536

- **Four digital wide-range inputs (0 – 250 V AC/DC)**
- **Four digital relay outputs (24 V DC/250 V AC/6 A)**

RAD-NAM4-IFS
Order no. 2316275

- **4-channel Namur input module – Maps to 8 channel DO8 (2902811) or Modbus**

Analog/digital extension module

RAD-DAIO6-IFS
Order no. 2901533

- **One analog input (0/4 – 20 mA)**
- **One analog output (0/4 – 20 mA, 0 – 10 V)**
- **Two digital wide-range inputs/ outputs (0 – 250 V AC/DC)**

Analog extension modules

RAD-AI4-IFS
Order no. 2901537

- **Four analog inputs (0/4 – 20 mA)**

RAD-AI4-IFS-U
Order no. 2702290

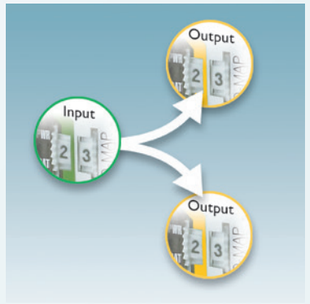
- **Four analog inputs (0-5/10 V)**

RAD-AO4-IFS
Order no. 2901538

- **Four analog outputs (0/4 – 20 mA, 0 – 10 V DC)**

2. Easy addressing

Set the address on the wireless module by simply turning the thumbwheel.



3. Easy distribution

On the I/O module, the thumbwheel is also used to assign the inputs and outputs, thereby easily distributing the I/O signals in the system.

Pt100 extension module

RAD-PT100-4-IFS
Order no. 2904035

- **Four Pt100 inputs**
- **Temperature measuring range: -50°C to 250°C**
- **Two- or three-wire connection**

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Wireless I/O

For outdoor Radioline installation

All the benefits of the Radioline platform in an outdoor-rated, NEMA-style enclosure. Save time on parts, assembly, and installation with this fully assembled Radioline outdoor module. It is fully compatible with the existing DIN rail-mounted 900 MHz Radioline systems.

- **AC/DC power switch for easy installation**
- **Two half-inch NPT cable entries for data and power isolation**
- **Separated and angled terminals for easy cable termination**
- **Wire-tie loops for cable management**

900 MHz wireless module

RAD-900-DAI06
Order no. 2702877

- **Supply voltage: 10.8 – 30.5 or 100 – 240 V AC**
- **Extended temperature ranges: -40°C – 70°**
- **Antenna connection: N (female) antenna included**
- **NEMA 4X housing**
- **Class I Division 2 approval**
- **2 digital in, 2 digital out, 1 analog in, 1 analog out, I/O onboard**

Accessories

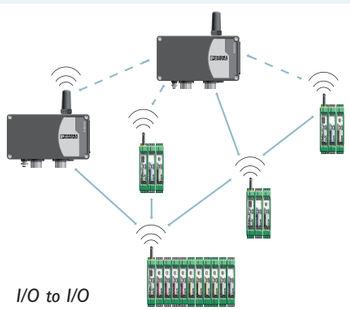
RAD-900-CONF-RF1 (RF band 1)
Order no. 2702122

RAD-MEMORY (freely configurable)
Order no. 2902828

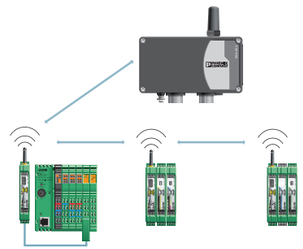
Configuration cable
Order no. 2903447

- **Unique network addressing via plug-in configuration memory for secure, parallel operation of multiple networks (different RF bands)**

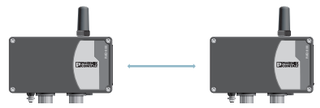
Signal transmission with the RAD-900-DAI06 Radioline module



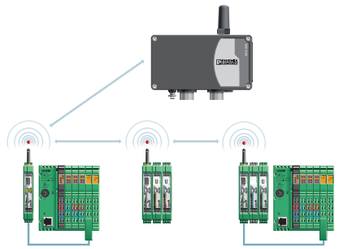
I/O to I/O



I/O-to-serial (Modbus RTU)



Outdoor-to-outdoor, point-to-point I/O



I/O and serial dual mode

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- Quick and easy start-up without programming
- Easy point-to-point or network connections (star, mesh)
- Applications: I/O-to-I/O, I/O-to-serial
- Trusted Wireless 2.0 technology
- Adjustable data rates for the wireless interface (16–500 kbps)
- 128-bit data encryption (AES)

Wireless I/O

Wireless-MUX, the wireless signal cable

The Wireless-MUX transmits 16 digital and two analog signals bidirectionally so that it can replace a 40-wire signal cable. The connection is monitored at all times. If it is severely disturbed or interrupted, the outputs are reset to the defined status LOW. This is displayed on the module via the diagnostics LED. The link quality display also provides the user with constant information on the connection quality.

The Wireless-MUX is sold as a “ready to use” package: You take the device out, connect it, switch it on, and you have your wireless path!

Bluetooth

Possible usage ranges

The Wireless-MUX is used wherever fewer digital or analog input and output signals are to be exchanged with a remote or a mobile station without using cables. The wireless components are offered as cable replacement in various packages:

- **As a standard package with omnidirectional antenna, which can be used to realize ranges* between 50 and 100 m in halls and those of more than 200 m in outdoor areas**
- **As a package with panel antenna, which can be used to bridge distances* of more than 400 m outdoors with free line of sight**
- **Versions with reduced transmission power**

** The range can be considerably exceeded or undercut depending on the environment, antenna technology, and the product used.*

Omnidirectional wireless set

ILB BT ADIO MUX-OMNI
Order no. 2884208

- **Consisting of two fixed-pair modules, two omnidirectional antennas with 1.5 m cable, and a DIN rail adapter**

Wireless set – no antennae

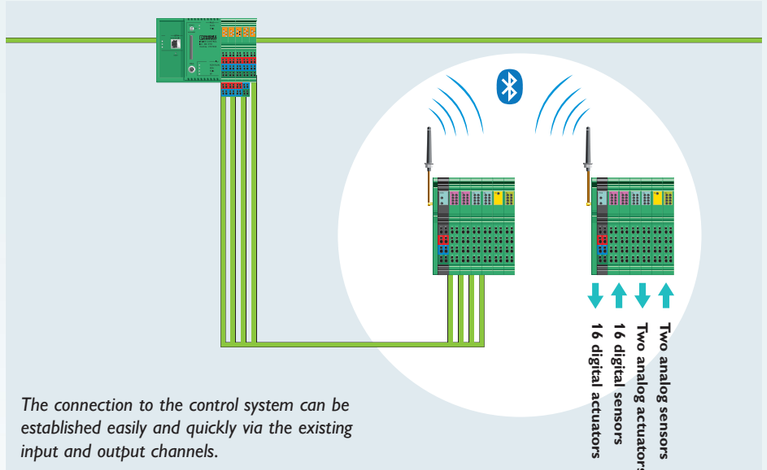
ILB BT ADIO MUX
Order no. 2702875

- **Consisting of two paired modules, no antennas, RSMA (F) antenna connector**

Omnidirectional wireless set

World’s first Bluetooth module with marine approval
Further information on request.

GL Lloyd’s Register DNV



The connection to the control system can be established easily and quickly via the existing input and output channels.

Our Wireless-MUX system convinces with the following features:

- The fixed pairing automatically takes care of setting up the connection and transmitting the signals
- No configuration or settings
- Typical transmission time of less than 10 ms
- Technical data:
  - Supply voltage: 19.2 V DC – 30 V DC
  - 16 digital inputs and two analog inputs
  - 16 digital outputs with an output current of max. 500 mA and two analog outputs with 0 – 20 mA or 0 – 10 V

Factoryline Bluetooth is the industrial Bluetooth technology from Phoenix Contact for transmission of control data in factory automation.

- Extremely rugged and reliable
- Can be operated together with WLAN without any interference
- Parallel operation of several Bluetooth systems
- Manipulation- and tap-proof

Wireless Serial

Radioline – wireless networking of serial interfaces

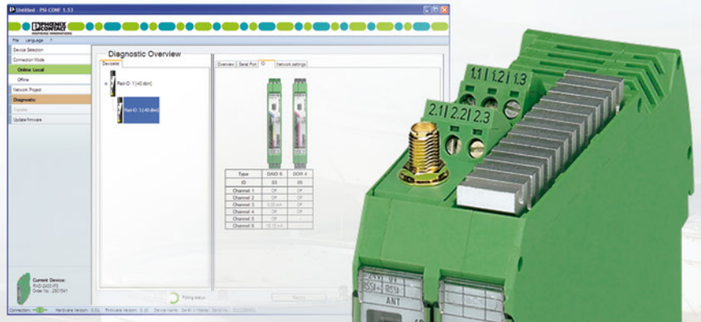
The Radioline wireless modules can be used to wirelessly network multiple controllers or serial I/O devices quickly and easily via RS-232 and RS-485 serial interfaces using either the 900 MHz or 2.4 GHz bands.

Data transmission is transparent, which means that any protocols, such as Modbus, can be forwarded. In addition, various network structures can be implemented, from a simple point-to-point connection to complex mesh networks.

User-friendly software diagnostics:

All network devices can be monitored easily via the master.

- Quick and easy setup without programming
- Can be extended up to 32 I/O modules per station
- Online diagnostics:
  - Network structure
  - Signal quality of each network station (RSSI)
  - Status display of I/O extension modules at each network station
  - Recording of RSSI signal and I/O status of each network station



Class I, Division 2
Groups A, B, C, D

TRUSTED WIRELESS

900 MHz wireless module

RAD-900-IFS
Order no. 2901540

- **Supply voltage: 10.8 – 30.5 V DC**
- **Can be extended with the I/O modules via T-BUS**
- **Extended temperature range: -40°C – 70°C**
- **Antenna connection: RSMA (female)**

2.4 GHz wireless module

RAD-2400-IFS
Order no. 2901541

- **Supply voltage: 19.2 – 30.5 V DC**
- **Integrated RS-232 and RS-485 interface**
- **Extended temperature range: -40°C – 70°C**
- **Antenna connection: RSMA (female)**
- **Suitable for ATEX Zone 2**

Programming tools

RAD-900-CONF-RF1 (RF band 1)
Order no. 2702122

RAD-CABLE-USB
Order no. 2903447

- **USB cable for diagnostics and configuration**

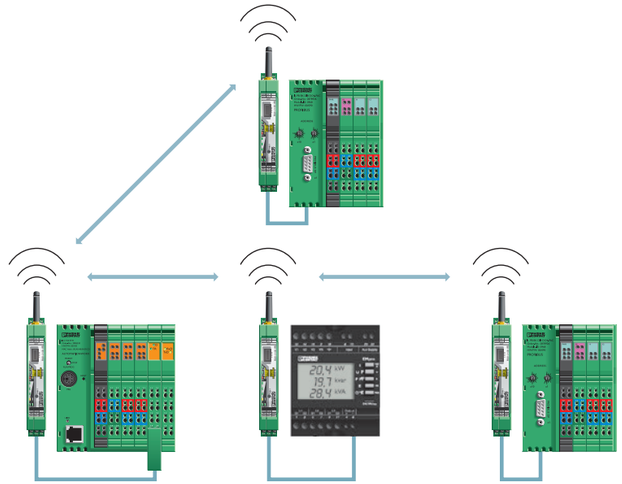
RAD-CONF-RF3 (RF band 3)*
Order no. 2902814

RAD-CONF-RF5 (RF band 5)*
Order no. 2902815

RAD-CONF-RF7 (RF band 7)*
Order no. 2902816

RAD-MEMORY (freely configurable)
Order no. 2902828

* *RAD-2400-IFS only*



Replacement for serial cabling

The slaves are connected directly or via repeater slave intermediate stations. Up to 250 repeater slaves can be connected one after the other in order to extend the wireless path or to integrate several (repeater) slaves. Serial I/O devices can also be connected to the repeater slave intermediate stations, and data can be received and forwarded.

Wireless Ethernet

Industrial WLAN access points

The latest generation of FL WLAN modules offers maximum reliability, data throughput, and range. In an extremely compact metal housing, the FL WLAN family combines rugged industrial technology with high 802.11n performance and modern MiMo technology. The central cluster management makes configuration and maintenance of WLAN networks considerably faster and easier.

Properties of the FL WLAN family

- **Faster** – High-speed WLAN modules bring WLAN 802.11n to industrial applications, along with a data rate of up to 300 Mbps modules, which is up to four times greater
- **Farther** – The range of the WLAN is due to its excellent receiver technology and higher transmission power
- **More reliable** – MiMo technology with three antennas significantly increases the ruggedness, speed, and range of wireless communication

FL WLAN 1101

FL WLAN 1101
Order no: 2702538
For use within USA and Canada.

FL WLAN 1100
Order no: 2702534
For use outside USA and Canada.

- **802.11 a/b/g/n**
- **IP54 housing**
- **AP, repeater, client**
- **M40 mounting hole**
- **Internal MiMo antennas**
- **9-30 V DC**
- **Class I Division 2**

FL WLAN 2101

FL WLAN 2101
Order no: 2702540
For use within USA and Canada.

FL WLAN 2100
Order no: 2702535
For use outside USA and Canada.

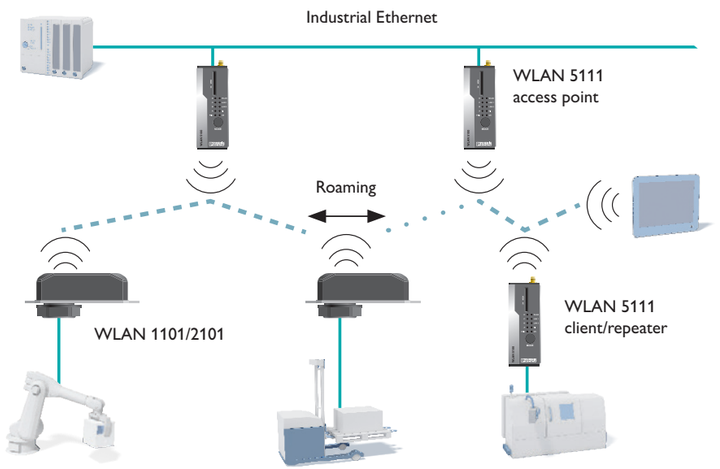
- **802.11 a/b/g/n**
- **IP68 housing**
- **AP, repeater, client**
- **M40 mounting hole**
- **Internal MiMo antennas**
- **9-30 V DC**
- **Class I Division 2**

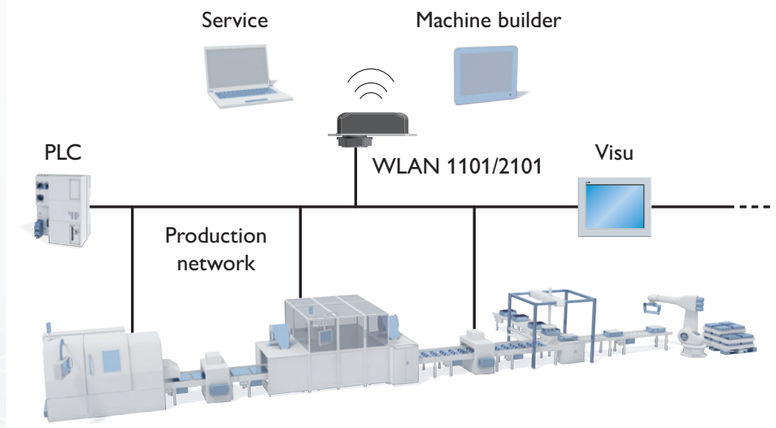
FL WLAN 5111

FL WLAN 5111
Order no: 1043201
For use within USA and Canada.

FL WLAN 5110
Order no. 1043193
For use outside USA and Canada.

- **802.11 a/b/g/n**
- **AP, repeater, client**
- **SD card slot for programming**
- **Two-port unmanaged switch**
- **Antenna connections RSMA (F)**
- **9-30 V DC**
- **Class I Division 2**





Wireless Ethernet

Compact network adapters

Reliable, rugged, and secure. Factoryline Ethernet port adapters are developed specifically for harsh industrial conditions. They enable the easy and cost-effective integration of automation devices and PLCs with serial or Ethernet connection into a WLAN network.

FL EPA 2 properties

- Two options: WLAN/Bluetooth in the same device or Bluetooth only
- Options with internal and external antennas
- Protocol-transparent data transmission
- Fast establishment of connection
- Auto-configuration mode for point-to-point cable replacement within only a few seconds
- PROFINET conformance Class A
- Configuration, diagnostics, and connection control via SNMP and AT commands

WLAN/Bluetooth adapter – internal antenna

FL EPA 2
Order no. 1005955

- **802.11 a/b/g AP (up to seven connections) or client**
- **Bluetooth NAP or PANU**
- **50 mW Tx power**
- **IP65 with M12 data and power connectors**
- **9 – 30 V DC power input**

WLAN/Bluetooth adapter – external antenna

FL EPA 2 RSMA
Order no. 1005957

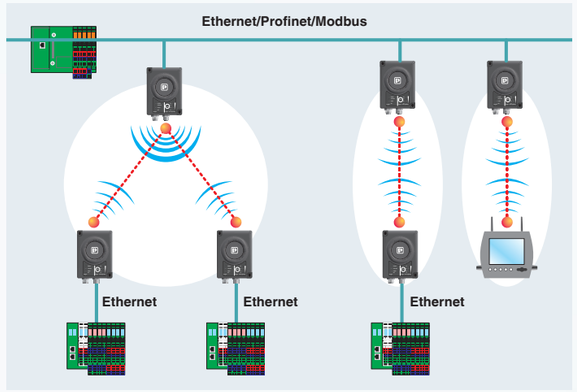
- **802.11 a/b/g AP (up to seven connections) or client**
- **Bluetooth NAP or PANU**
- **50 mW Tx power**
- **IP65 with M12 data and power connectors**
- **9 – 30 V DC power input**

Bluetooth adapter – internal antenna

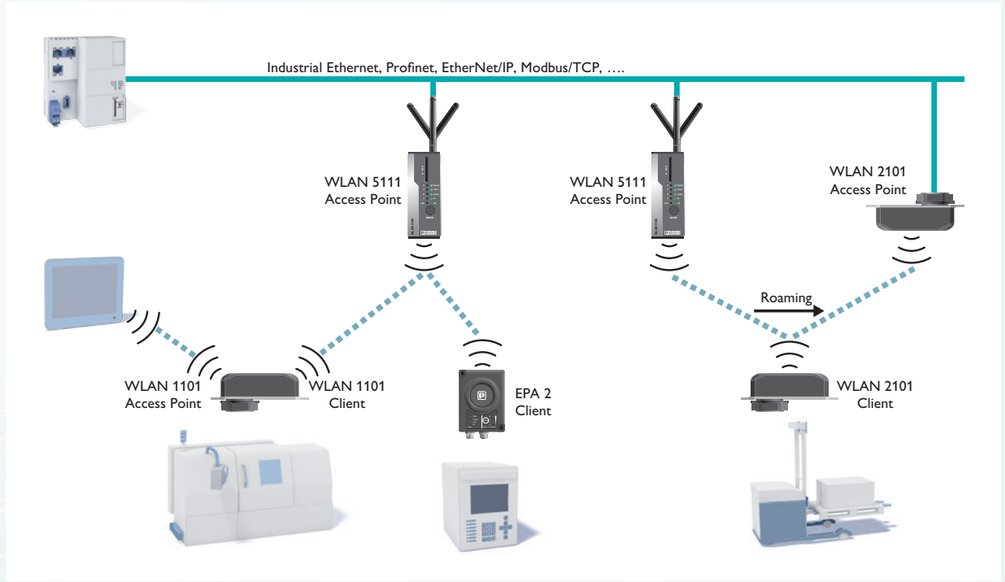
FL BT EPA 2
Order no. 1005869

- **Bluetooth NAP or PANU**
- **13 mW Tx power**
- **IP65 with M12 data and power connectors**
- **9 – 30 V DC power input**

Industrial Bluetooth



Industrial WLAN



Wireless Ethernet

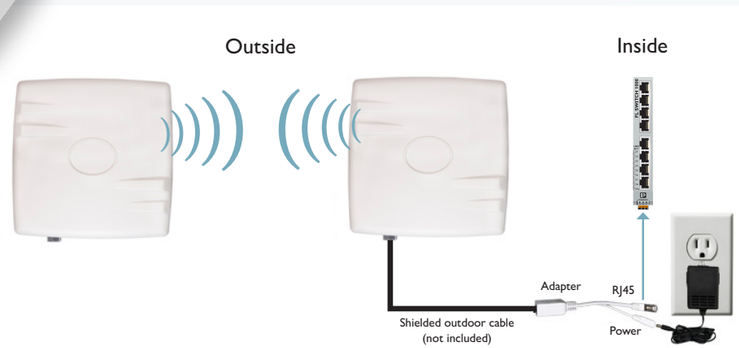
Point-to-point Ethernet bridge

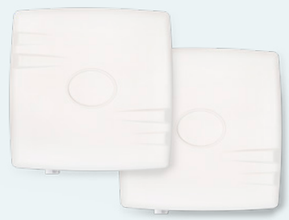
The FL WLAN 4321 is a pre-configured point-to-point wireless Ethernet bridge. It provides a wireless connection to remote locations to a distance of 2 miles.

Start-up is easy. Simply, unpack the hardware, mount the radios, apply power using the included POE injectors, and line up the units using the built-in alignment LEDs.

The FL WLAN 4321 offers many advantages

- One order number – all hardware included
- Pre-configured kit supports a fast start-up and reduces labor
- Passive POE power and data transmission with one Ethernet cable
- Outdoor housing rated for IP67, UV, temperatures -40C to +75C
- Save space in your control cabinet; FL WLAN 4321 includes pole mounting hardware





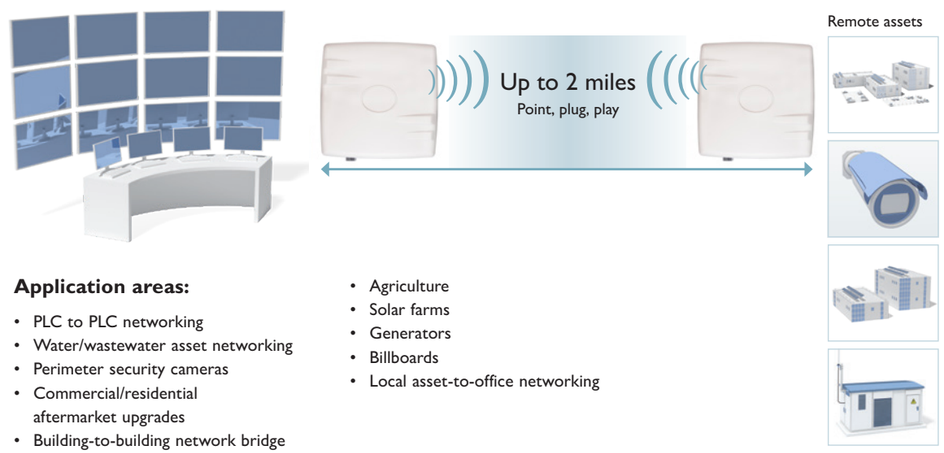
Wireless Ethernet bridge kit

FL WLAN 4321
Order no. 1194423

- **2.4 GHz radio, and 11 dBi panel antennae**
- **Passive POE power, 8-30 V DC**
- **Up to 300 Mbps**
- **Transmission distance two miles**
- **256-bit AES encryption**
- **IP67 housing**
- **Temp. range -40°C to +75°C**

Kit includes:

- **Two (2) pre-paired radios**
- **Two (2) mounting hardware kits for ¼ to 2 inch diameter pole**
- **Two (2) passive POE supplies**
- **Two (2) IP67 cable grommets**



Application areas:

- PLC to PLC networking
- Water/wastewater asset networking
- Perimeter security cameras
- Commercial/residential aftermarket upgrades
- Building-to-building network bridge
- Commercial and light-industrial machine builders
- Agriculture
- Solar farms
- Generators
- Billboards
- Local asset-to-office networking

Wireless Ethernet

Cellular routers – worldwide network access

TC Cloud Clients and mGuards enable secure 4G LTE connection to the mGuard Secure Cloud. Communication is established via internet or mobile network. While the TC Cloud Client can be connected only to the mGuard Secure Cloud, the mGuards also offer peer-independent VPN tunnel, NAT and Firewall.

TC Router reliably provides 4G LTE high-speed connection to the cellular network. The TC Router enables reliable cellular connection to the most demanding environments to allow data access where it is needed most.

Features:

- mGuard Secure Cloud-compatible for remote maintenance
- Verizon and AT&T support
- Firewall and VPN reliably protect against unauthorized access
- Cloud-capable and dedicated modem variants

4G LTE product overview

TC Router 4G LTE for remote secure SCADA

TC Router 3002T-4G
Order no. 2702533 – AT&T
Order no. 2702532 – Verizon
Order no. 2702528 – EU

- **Basic modem functionality**
- **Data rates up to 150 Mb/s**
- **Integrated VPN and firewall**

TC Cloud Client 4G LTE for remote access

TC Cloud Client 1002-4G
Order no. 2702888 – AT&T
Order no. 2702887 – Verizon
Order no. 2702886 – EU

- **Dedicated connection to the mGuard Secure Cloud**
- **Data rates up to 150 Mb/s**

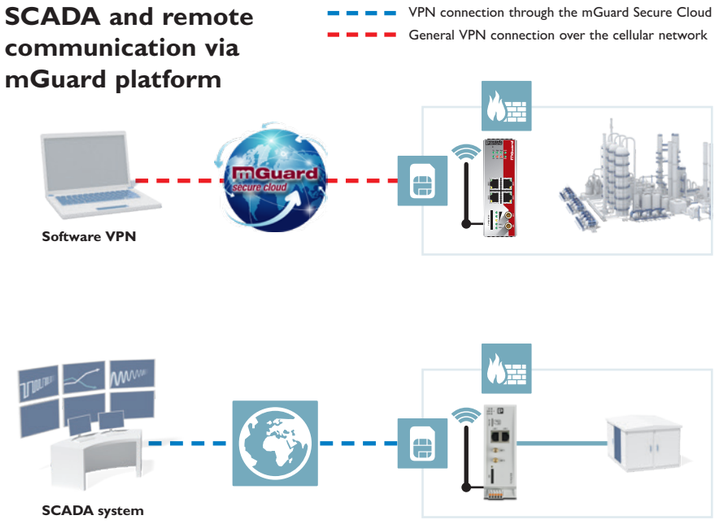
TC mGuard 4G LTE VPN Router with integrated firewall and redundancy

TC mGuard RS2000 4G
Order no. 1010464 – AT&T
Order no. 1010462 – Verizon
Order no. 2903588 – EU

TC mGuard RS4000 4G
Order no. 1010463 – AT&T
Order no. 1010461 – Verizon
Order no. 2903586 – EU

- **mGuard Secure Cloud and standalone functionality**
- **Data rates up to 150 Mb/s**
- **Dual WAN via wired and cell for redundancy applications**
- **DMZ functionality**
- **10+ VPN tunnels**

SCADA and remote communication via mGuard platform



Remote maintenance and support
Access remote machines at any time to easily and securely support your customers with Phoenix Contact's mGuard Secure Cloud infrastructure.

Secure SCADA
When networking with critical infrastructure, a higher level of security and reliability is necessary. The TC Router provides an active firewall, VPN technology, and vulnerability updates to support applications to address these security concerns.

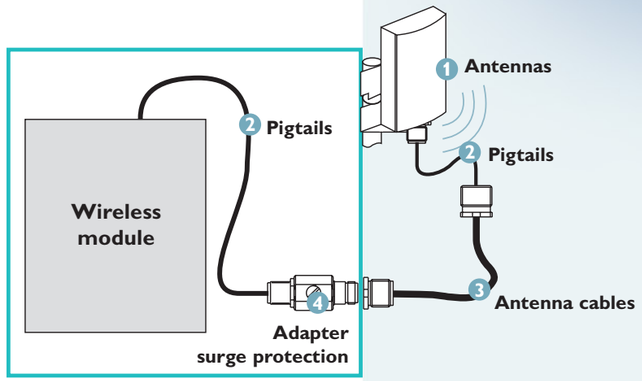
Wireless accessories

Cables and adapters

A wireless system is only as strong as its weakest component. High-quality antennas, cables, and adapters are a necessity to ensure a reliable wireless link.

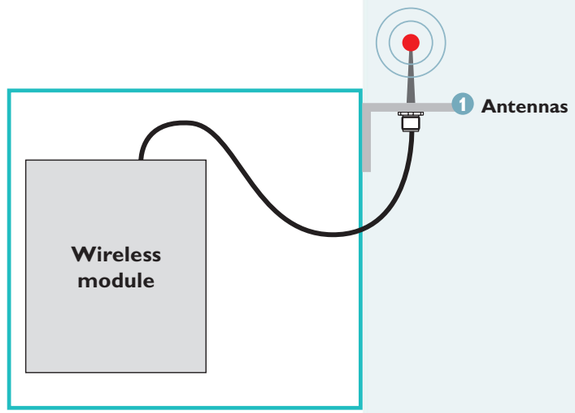
Control cabinet/ control box

For antennas with extension cable



Control cabinet/ control box

For antennas without extension cable and without surge protection



900 MHz

Omnidirectional antenna

RAD-900-ANT-OMNI-2-2-RSMA
Order no: 2904801
RSMA (M) connector

- **1/4 wave antenna**
- **Gain: 2 dBi**
- **2 m cable**

900 MHz

Omnidirectional antenna

RAD-ISM-900-ANT-OMNI-5
Order no. 2867199

- **Gain: 7.15dBi**
- **N(F) connector**

900 MHz

Omnidirectional fiberglass antenna

RAD-ISM-900-ANT-OMNI-FG-3-N
Order no. 2867791

- **Gain: 5.15dBi**
- **N(F) connector**

RAD-ISM-900-ANT-OMNI-FG-6-N
Order no. 2885579

- **Gain: 8.00dBi**
- **N(F) connector**

2.4 GHz

Omnidirectional antenna

RAD-ISM-2400-ANT-OMNI-6-0
Order no. 2885919

- **Gain: 6 dBi**
- **N(F) connector**

RAD-ISM-2400-ANT-OMNI-9-0
Order no. 2867623

- **Gain: 9 dBi**
- **N(F) connector with mounting brackets**

5 GHz

Omnidirectional antenna

ANT-OMNI-5900-01
Order no. 2701347

- **- 5 Ghz band**

- Gain: 5 dBi
N(F) connector

2.4 GHz

Low-profile omnidirectional antenna

RAD-ISM-2400-ANT-VAN-3-0-RSMA
Order no. 2701358

- **Gain: 3 dBi**
- **RSMA (M) connector with 1.5 m cable**

RAD-ISM-2459-ANT-FOOD-6-0-N
Order no: 2702898

- **Gain: 6 dBi at 2.4 GHz, 8 dBi at 5 GHz**
- **N(F) connector (no cable)**

Wireless accessories

Antennas

900 MHz

Yagi antenna

RAD-ISM-900-ANT-YAGI-3-N
Order no. 2867801

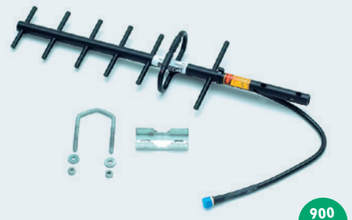
- **Gain: 5.15 dBi**
- **N (F) connector with 0.6 m of cable and mounting brackets**

900 MHz

Yagi antenna

RAD-ISM-900-ANT-YAGI-6.5-N
Order no. 2867814

- **Gain: 8.5 dBi**
- **N (F) connector with 1.5 m cable**



900 MHz

Yagi antenna

RAD-ISM-900-ANT-YAGI-10-N
Order no. 5606614

- **Gain: 12.15 dBi**
- **N (F) connector with 2-foot cable**

LTE

Omni antenna

TC ANT MOBILE WALL 0,5M
Order no. 2702274

- **4G LTE omni antenna**
- **0.5 m cable with SMA (m) connector**

LTE

Omni antenna

TC ANT MOBILE WALL 5M
Order no. 2702273

- **4G LTE omni antenna**
- **5 m cable with SMA (m) connector**

2.4/5 GHz

Yagi antenna

ANT-DIR-2459-01
Order no. 2701186

- **Gain 9 dBi**
- **N (F) connector with mounting brackets**

Engineering insight

Contact us during the first phase of planning your project and get the combined benefit of Phoenix Contact's technological know-how and extensive experience.

Detailed information about this and other services can be found on our website: **www.phoenixcontact.com**

Wireless accessories

Pigtails

RAD-PIG-RSMA/…
…N-0.5; Order no. 2903263 – 0.5 m
…N-1; Order no. 2903264 – 1 m
…N-2; Order no. 2903265 – 2 m
…N-3; Order no. 2903266 – 3 m

- **Connections: N (M) to RSMA (M)**
- **Compatible with 900 MHz, 2.4/5.2/5.8 GHz**

Antenna cables

RAD-CAB-PFP…
…240-10; Order no. 5606124 – 10 foot
…400-20; Order no. 5606125 – 20 foot
…500-25; Order no. 5606126 – 25 foot

- **Connections: N (M) at both ends**
- **Compatible with 900 MHz, 2.4/5.2/5.8 GHz**

RAD-CAB-PFP…
...400-80; Order no. 2867393 – 80 foot
...400-100; Order no. 2867238 – 100 foot

For a full list of cable lengths, contact your Phoenix Contact representative.

- **Connections: N (M) at both ends**
- **Compatible with 900 MHz**

900 MHz

Surge suppressor

CN-UB-70DC-6-SB
Order no. 2803153

- **N (M) to N (F) 0 Hz to 6 GHz**

CN-UB-70DC-6-BB
Order no. 2803166

- **N (F) to N (F) 0 Hz to 6 GHz**

900 MHz

Surge suppressor

CN-UB-280DC-3-SB
Order no. 2801051

- **N (M) to N (F) 0 Hz to 6 GHz**

CN-UB-280DC-3-BB
Order no. 2801050

- **N (M) to N (F) 0 Hz to 6 GHz**
- **This version has an external grounding connection**

2.4/5.2/5.8 GHz

Surge suppressor

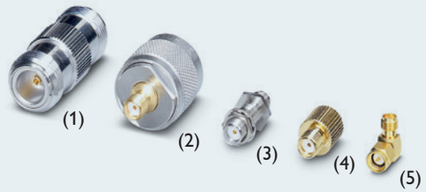
CN-LAMBDA/4-5,9-BB
Order no. 2838490

- **N (F) to N (F) connector**
- **2.4/5.2/5.8 GHz frequency compatible**

Weather protection tape

RAD-TAPE-SV-19-3
Order no. 2903182

- **Self-vulcanizing**
- **For outside protection of adapters, splitters or cable connections; waterproof**



Adapters

(1) RAD-ADP-N/F-N/F
Order no. 2867843
- **N (F) > N (F)**

(2) RAD-ADP-N/M-SMA/F
Order no. 2917036
- **N (M) > SMA (F)**

(3) RAD-ADP-RSMA/F-SMA/F
Order no. 2884538
- **RSMA (F) > SMA (F)**

(4) RAD-ADP-SMA/F-SMA/F
Order no. 2884541
- **SMA (F) > SMA (F)**

(5) RAD-ADP-SMA/F-SMA/M-90
Order no. 2917324
- **SMA (F) > SMA (M)**

RTU ready enclosure

RTU Ready 161408
Order no. 1094594
16 in. x 14 in. x 8 in.

RTU Ready 181610
Order no. 1094595
18 in. x 16 in. x 10 in.

Pre-wired NEMA enclosure including power supply, power distribution, power and antenna surge suppression. Two size boxes available.

RTU ready enclosure with UPS

RTU Ready UPS 161408
Order no. 1094596
16 in. x 14 in. x 8 in.

RTU Ready UPS 181610
Order no. 1068258
18 in. x 16 in. x 10 in.

Pre-wired NEMA enclosure including power supply and UPS, power distribution, power and antenna surge suppression. Two size boxes available.

RTU ready enclosure with UPS Class I Division 2

RTU Ready EX UPS 161408
Order no. 1100665
16 in. x 14 in. x 8 inches

RTU Ready EX UPS 181610
Order no. 1100666
18 in. x 16 in. x 10 in.

Pre-wired NEMA enclosure including power supply and UPS, power distribution, power and antenna surge suppression. Two size boxes available. All components have Class I Division 2 certification.

Wireless technology for today's industrial challenges

Phoenix Contact is a leading global provider of industrial wireless solutions. Our 12+ years of experience in providing industrial data and I/O communication products, combined with the most robust, reliable, and advanced wireless technologies available, translates to wireless success in the harshest of industrial applications. Today, with more than 50,000 installed units, Phoenix Contact's wireless products provide dependability and security while monitoring and controlling signals such as level, temperature, frequency, and digital alarms.

Whether relaying serial data, I/O data, fieldbus, or Ethernet communications, Phoenix Contact offers the ideal solution for every application, utilizing technologies ranging from Bluetooth to WLAN, cellular or proprietary Trusted Wireless. Additionally, our award-winning technical support is available 24/7 to assist with product selection, RF surveys, start-up assistance, and system troubleshooting to ensure that your wireless connections are always as strong as wire!

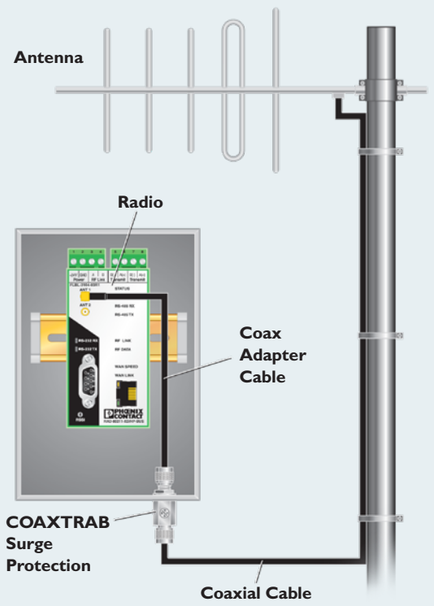
STEP 1 **Determining your technology** *(Page 39)*
Use the application criteria and the distance over which the wireless system must communicate to determine the best Phoenix Contact wireless technology.

STEP 2 **Determining the right product** *(Pages 40 – 42)*
Locate the technology found in Step 1 and select a radio within the technology group that is best suited for your application.

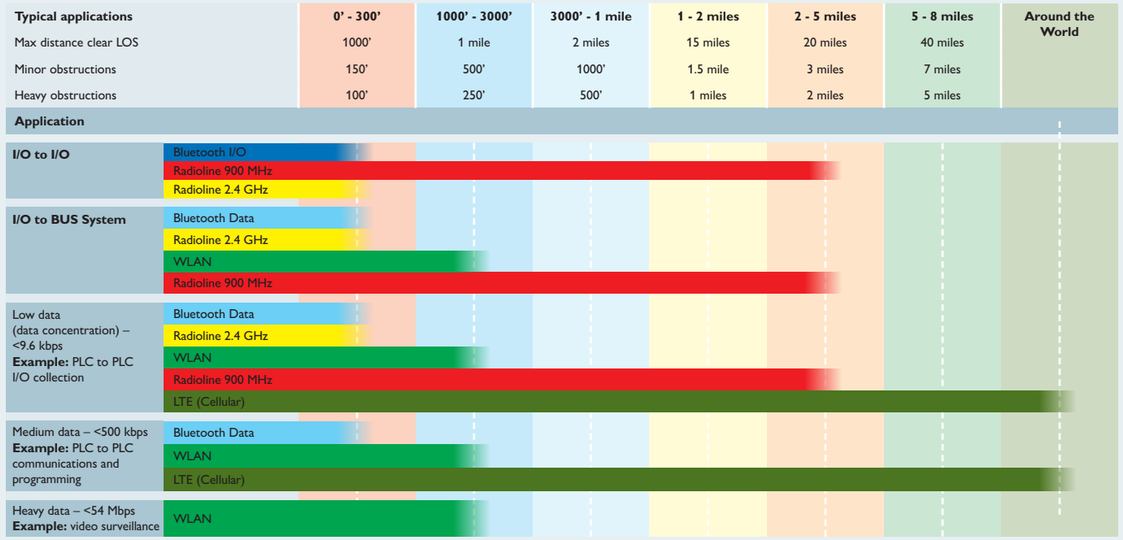
STEP 3 **Determining the accessories** *(Pages 40 – 42)*
Select the appropriate adapter cables, antenna surge protection, antenna cables and antennas for the distance that the system must communicate.

STEP 4 **System planning** *(Page 43)*
Using the selected products, create a system and a diagram, and define system topology.

Note: *When selecting parts for a radio system, be sure to select an antenna for all locations.*



STEP 1 Determining your technology



Technologies

Radioline 900 MHz/2.4 GHz *(page 38)*

Radioline uses Trusted Wireless FHSS technology, which provides a high degree of reliability and security. It is designed to communicate simple I/O and serial data reliably over long distances in noisy environments. Radioline is available in 900 MHz and 2.4 GHz in the USA.

Bluetooth *(page 40)*

Bluetooth (IEEE 802.15.1) is a standardized wireless technology capable of high-speed serial and I/O communications. Following the frequency-hopping spread-spectrum method (FHSS) in the 2.4 GHz ISM band, Bluetooth has high transmission reliability. It is suitable for worldwide use in applications where cable-based circuits are too costly to install or to change.

WLAN *(page 39)*

WLAN uses the IEEE 802.11 (Wi-Fi) public standard for high-speed connections that increases productivity, heightens safety and lowers cabling costs. The 802.11 standard operates in the 2.4 GHz and 5 GHz license-free ISM bands and utilizes the highest level of security, WPA2.

Cellular *(page 40)*

LTE cellular technology is used to send data over the cellular network. Cellular is a great medium for applications where panels are located in remote locations. Cellular takes advantage of infrastructure built by carriers to provide access to processes traditionally incommunicable.

Note: *Distances are intended as an achievable guideline with minimal RF path engineering and design required.*

Radioline

STEP 2
Determining the right product

Radioline modules	Part number	Description	Product details
	2901540	RAD-900-IFS	Radio module for 900 MHz communication with expandable I/O BUS, RSMA(f) connection
	2702877	RAD-900-DAIO6	Radio module for 900 MHz communication with onboard I/O. Antenna included for up to 1,000 ft communication, N(f) antenna connection
	2901541	RAD-2400-IFS	Radio module for 2.4 GHz communication with expandable I/O BUS, RSMA(f) connection
	2902828	RAD-Memory	900 MHz/2.4 GHz – CONFSTICK – blank
	2702122	RAD-900-CONF-RF1	900 MHz RF band 1 CONFSTICK
	2902814	RAD-CONF-RF3	2.4 GHz RF band 3 CONFSTICK
	2903447	RAD-CABLE-USB	Programming cable
Expansion IO modules	**Part number**	**Description**	**Product details**
	2901533	RAD-DAIO6-IFS	2-channel digital in/out, 1 channel analog in/out
	2901537	RAD-AI4-IFS	4-channel current analog input
	2702290	RAD-AI4-U-IFS	4-channel voltage analog input
	2901538	RAD-AO4-IFS	4-channel analog output
	2901535	RAD-DI4-IFS	4-channel digital input
	2901536	RAD-DOR4-IFS	4-channel digital (relay) output
	2901539	RAD-DI8-IFS	8-channel digital input
	2902811	RAD-DO8-IFS	8-channel transistor output
	2316275	RAD-NAM4-IFS	4-channel NAMR input
	2904035	RAD-PT100-4-IFS	4-channel PT100 input

STEP 3
Determining the right accessories

Adapter cables	Part number	Description	Product details
	2903263	RAD-PIG-RSMA/N-0.5	0.5 meter RSMA(m) to N(m) adapter cable
	2903264	RAD-PIG-RSMA/N-1	1.0 meter RSMA(m) to N(m) adapter cable
	2903265	RAD-PIG-RSMA/N-2	2.0 meter RSMA(m) to N(m) adapter cable

Surge arresters	Part number	Description	Product details
	2803166	CN-UB-70DC-6-BB	Antenna surge protection for 0 – 6 GHz N(f)-N(f)
	2803153	CN-UB-70DC-6-SB	Antenna surge protection for 0 – 6 GHz N(m)-N(f) Use when adding antenna cable to 2702877

Antenna cables	Part number	Description	Length	Connector type	Cable loss	
					900 MHz	2.4 GHz
900 MHz/2.4 GHz 	5606124	RAD-CAB-PFP240-10	10 feet	N(m)-N(m)	0.8 dB	1.3 dB
	5606125	RAD-CAB-PFP400-20	20 feet	N(m)-N(m)	0.8 dB	1.3 dB
	5606126	RAD-CAB-PFP500-25	25 feet	N(m)-N(m)	0.8 dB	1.4 dB
900 MHz 	2867380	RAD-CAB-PFP400-60	60 feet	N(m)-N(m)	2.4 dB	
	2867393	RAD-CAB-PFP400-80	80 feet	N(m)-N(m)	3.1 dB	
	2867238	RAD-CAB-PFP400-100	100 feet	N(m)-N(m)	3.9 dB	
	2885171	RAD-CAB-PFP600-125	125 feet	N(m)-N(m)	3.2 dB	
	2885184	RAD-CAB-PFP600-150	150 feet	N(m)-N(m)	3.8 dB	

Determining the right antennas

Antennas					
	Master/Repeater				
900 MHz 	Part number	Description	Distance	Connector type	Gain
	2904801	RAD-900-ANT-OMNI-2-2-RSMA	< 0.5 mile	RPSMA(m)	2 dBi
	2904802	RAD-900 ANT-OMNI-2-N	< 0.5 mile	N(f)	2 dBi
	2867199	RAD-ISM-900-ANT-OMNI-5	3 miles	N(f)	7 dBi
	2885579	RAD-ISM-900-ANT-OMNI-FG-6-N	> 5 miles	N(f)	8 dBi
2.4 GHz 	Part number	Description	Distance	Connector type	Gain
	2701362	RAD-ISM-2400-ANT-OMNI-2-1-RSMA	< 1,500 feet	RPSMA(m)	2 dBi
	2885919	RAD-ISM-2400-ANT-OMNI-6-0	< 3,000 feet	N(f)	6 dBi
	2867623	RAD-ISM-2400-ANT-OMNI-9-0	> 1 mile	N(f)	9 dBi
900 MHz 	Remote/Slave				
	Part number	Description	Distance	Connector type	Gain
	2904801	RAD-900-ANT-OMNI-2-2-RSMA	< 0.5 mile	RPSMA(m)	2 dBi
	2904802	RAD-900 ANT-OMNI-2-N	< 0.5 mile	N(f)	2 dBi
	2867801	RAD-ISM-900-ANT-YAGI-3-N	3 miles	N(f)	5 dBi
	2867814	RAD-ISM-900-ANT-YAGI-6.5-N	5 miles	N(f)	8.5 dBi
	5606614	RAD-ISM-900-ANT-YAGI-10-N	> 10 miles	N(f)	12 dBi
2.4 GHz 	Part number	Description	Distance	Connector type	Gain
	2701362	RAD-ISM-2400-ANT-OMNI-2-1-RSMA	< 1,500 feet	RPSMA(m)	2 dBi
	2701186	ANT-DIR-2459-01	> 1 mile	N(f)	9 dBi

For more accessory options, please visit: **www.phoenixcontact.com/wireless**
For help selecting accessories, please contact technical service at 800-322-3225.

WLAN

STEP 2
Determining the right product

Wireless Ethernet radios	Part number	Description	Product details	Operation mode
	1043201	FL WLAN 5111	100 mW, 802.11 a/b/g/n radio, up to 300 Mbps, 24 V DC; cluster management, SD card slot	Access point, repeater, client
	2702538	FL WLAN 1101	100 mW, 802.11 a/b/g/n radio, up to 300 Mbps, 24 V DC; dual internal antennas, IP54 housing	Access point, repeater, client
	2702540	FL WLAN 2101	100 mW, 802.11 a/b/g/n radio, up to 300 Mbps, 24 V DC; dual internal antennas, IP68 housing	Access point, repeater, client
	1005955	FL EPA 2	100 mW, 802.11 a/b/g radio, up to 54 Mbps, 24 V DC; single internal antenna, IP65 housing, M12 data and power connectors	Access point, repeater, client
	1005957	FL EPA 2 RSMA	100 mW, 802.11 a/b/g radio, up to 54 Mbps, 24 V DC; single included external antenna, IP65 housing, M12 data and power connectors	Access point, repeater, client

STEP 3
Determining the right accessories

Adapter cables	Part number	Description	Product details
	2903263	RAD-PIG-RSMA/N-0.5	0.5 meter RSMA(m) to N(m) adapter cable
	2903264	RAD-PIG-RSMA/N-1	1.0 meter RSMA(m) to N(m) adapter cable
	2903265	RAD-PIG-RSMA/N-2	2.0 meter RSMA(m) to N(m) adapter cable
	2903266	RAD-PIG-RSMA/N-3	3.0 meter RSMA(m) to N(m) adapter cable

Surge arresters	Part number	Description	Product details
	2838490	CN-LAMBDA/4-5.9-BB	Antenna surge protection for 2.4 – 5.9 GHz; N(f)-N(f)
	2800023	CN-LAMBDA/4-5.9-SB	Antenna surge protection for 2.4 – 5.9 GHz; N(m)-N(f)

Antenna cables	Part number	Description	Cable length (ft)	Connector type	Cable Loss	
					2.4 GHz	5 GHz
	5606124	RAD-CAB-PFP240-10	10	N(m)-N(m)	1.3 dB	1.9 dB
	5606125	RAD-CAB-PFP400-20	20	N(m)-N(m)	1.3 dB	2.1 dB
	5606126	RAD-CAB-PFP500-25	25	N(m)-N(m)	1.4 dB	2.1 dB

FL Rugged box	Part number	Product details
	2701204	IP66 rated box for FL WLAN 5111 radio complete with grommets and din rail
	2701430	Includes three 0.5 m adapter cables and three 5 dB omni antennas
	2701439	Includes three 0.5 m adapter cables and three 5 dB omni antennas, power supply and terminal blocks
	2701440	Includes one 0.5 m adapter cable, and one 9 dB panel antenna, power supply and terminal blocks

Determining the right accessories

Antennas					
	Master/Repeater				
2.4 GHz radios 	Part number	Description	Distance	Connector type	Gain
	2701362	RAD-ISM-2400-ANT-OMNI-2-1-RSMA	< 500 feet	RPSMA(m)	2 dBi
	2885919	RAD-ISM-2400-ANT-OMNI-6-0	0.5 mile	N(f)	6 dBi
	2867623	RAD-ISM-2400-ANT-OMNI-9-0	1 mile	N(f)	9 dBi
	Remote/Slave				
	Part number	Description	Distance	Connector type	Gain
	2701362	RAD-ISM-2400-ANT-OMNI-2-1-RSMA	< 500 feet	RPSMA(m)	2 dBi
	2701186	ANT-DIR-2459-01	1 mile	N(f)	9 dBi
5 GHz 	Master/Repeater				
	Part number	Description	Distance	Connector type	Gain
	2701347	ANT-OMNI-5900-01	< 0.5 mile	N(f)	5 dBi
	Remote/Slave				
	Part number	Description	Distance	Connector type	Gain
	2701186	ANT-DIR-2459-01	0.5 mile	N(f)	9 dBi

Bluetooth and Cellular

STEP 2
Determining the right product

Bluetooth radios	Part number	Description	Product details
I/O 	2884208	ILB BT ADIO MUX-OMNI	Paired Bluetooth I/O radios, 2 dBi omnidirectional antennas (up to 650-ft transmission distance), 1.5 m antenna cable, 16 digital (In/Out) and 2 analog (In/Out)
	2702875	ILB BT ADIO MUX	Paired Bluetooth I/O radios, no antennas, 16 digital (In/Out) and 2 analog (In/Out) Consisting of two paired modules, no antennas, RSMA (F) antenna connector
Bluetooth data 	1005869	FL BT EPA 2	Bluetooth NAP or PANU, internal antenna, IP65 housing, supports up to 7 clients as a NAP

Cellular modems	Part number	Description	Product details
	2702533	TC ROUTER 3002T-4G ATT	Basic modem functionality, data rates up to 150 Mb/s, integrated VPN and firewall, AT&T network
	2702532	TC ROUTER 3002T-4G VZW	Basic modem functionality, data rates up to 150 Mb/s, integrated VPN and firewall, Verizon network
	2702528	TC ROUTER 3002T-4G	Basic modem functionality, data rates up to 150 Mb/s, integrated VPN and firewall, International network
	2702888	TC Cloud Client 1002-4G ATT	Dedicated connection to the mGuard Secure Cloud, data rates up to 150 Mb/s, AT&T Network
	2702887	TC Cloud Client 1002-4G VZW	Dedicated connection to the mGuard Secure Cloud, data rates up to 150 Mb/s, Verizon Network
	2702886	TC Cloud Client 1002-4G	Dedicated connection to the mGuard Secure Cloud, data rates up to 150 Mb/s, International Network
	1010464	TC mGuard RS2000 4G ATT	mGuard Secure Cloud and standalone functionality, Data rates up to 150 Mb/s, 2 VPN tunnels, AT&T network
	1010462	TC mGuard RS2000 4G VZW	mGuard Secure Cloud and standalone functionality, Data rates up to 150 Mb/s, 2 VPN tunnels, Verizon network
	2903588	TC mGuard RS2000 4G	mGuard Secure Cloud and standalone functionality, Data rates up to 150 Mb/s, 2 VPN tunnels, International networks
	1010463	TC mGuard RS4000 4G ATT	mGuard Secure Cloud and standalone functionality, data rates up to 150 Mb/s, dual WAN via wired and cell for redundancy applications, DMZ functionality, 10+ VPN tunnels, AT&T network
	1010461	TC mGuard RS4000 4G VZW	mGuard Secure Cloud and standalone functionality, data rates up to 150 Mb/s, dual WAN via wired and cell for redundancy applications, DMZ functionality, 10+ VPN tunnels, Verizon network
	2903586	TC mGuard RS4000 4G	mGuard Secure Cloud and standalone functionality, data rates up to 150 Mb/s, dual WAN via wired and cell for redundancy applications, DMZ functionality, 10+ VPN tunnels, International networks

STEP 3
Determining the right accessories

Adapter cables	Part number	Description	Product Details
mGuard 4G 	2867403	RAD-CON-SMA-N-SS	SMA(m) to N(m), 4 ft
FL BT EPA and WirelessHART gateway 	2903263	RAD-PIG-RSMA/N-0.5	0.5 meter RSMA(m) to N(m) adapter cable
	2903264	RAD-PIG-RSMA/N-1	1.0 meter RSMA(m) to N(m) adapter cable
	2903265	RAD-PIG-RSMA/N-2	2.0 meter RSMA(m) to N(m) adapter cable
	2903266	RAD-PIG-RSMA/N-3	3.0 meter RSMA(m) to N(m) adapter cable

Surge arrestors	Part number	Description	Product details
	2803166	CN-UB-70DC-6-BB	Antenna surge protection for 0 – 6 GHz N(f)-N(f)

Antenna cables	Part number	Description	Cable length (ft)	Connector type
	5606124	RAD-CAB-PFP240-10	10	N(m)-N(m)
	5606125	RAD-CAB-PFP400-20	20	N(m)-N(m)
	5606126	RAD-CAB-PFP500-25	25	N(m)-N(m)

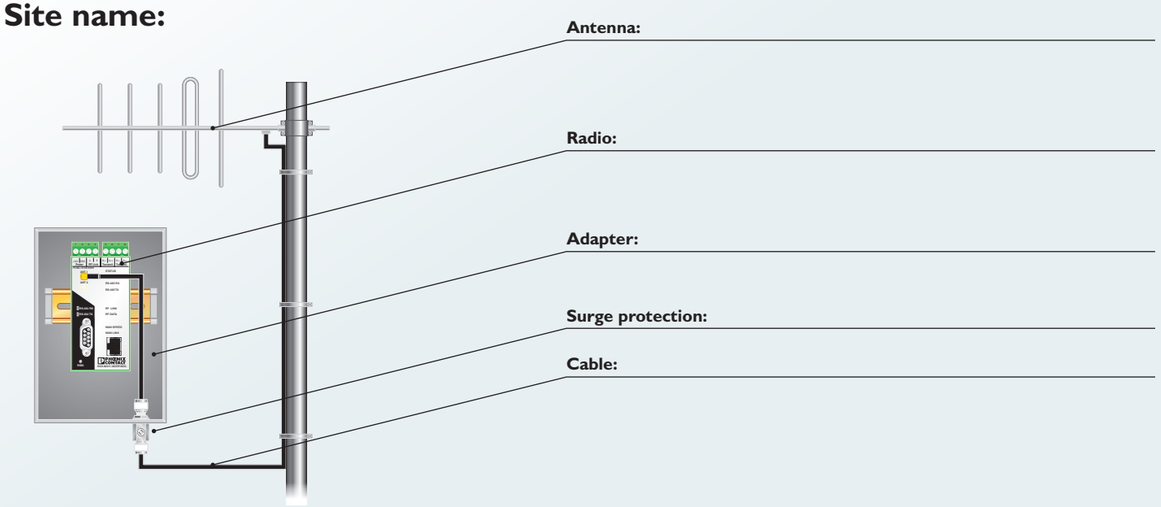
Bluetooth antennas	Part number	Description	Distance	Connector type	Gain
	2885919	RAD-ISM-2400-ANT-OMNI-6-0	1000'	N(f)	6 dBi

Cellular antennas	Part number	Description	Product details
	2702274	TC ANT mobile Wall 0,5M	Outdoor pipe mounting antenna, 5 meters of cable, SMA(m) connector
	2702273	TC ANT Mobile Wall 5M	Outdoor pipe mounting antenna, 5 meters of cable, SMA(m) connector
	2901561	RAD-ANT-GSM/UMTS-QB-YAGI-8	Directional high-gain antenna, with N(f) connector

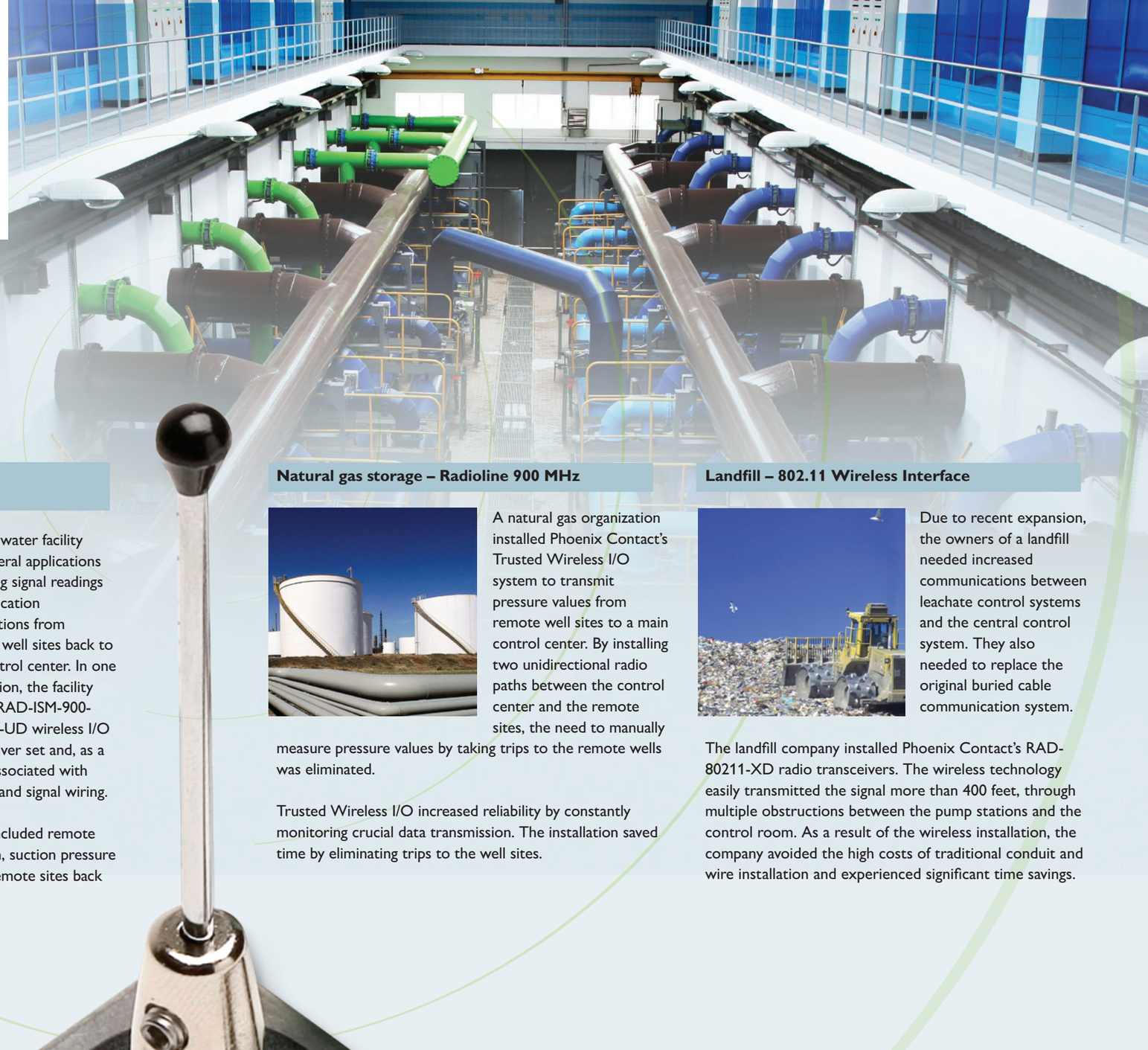
For more accessory options, please visit: **www.phoenixcontact.com/wireless**
For help selecting accessories, please contact technical service at 800-322-3225.

STEP 4 System planning

Site name:



Industrial applications



As wireless technology continues to develop in the industrial world, the number of transmission protocols and network topologies grows. Once only a point-to-point cable replacement device, wireless now has increasing capabilities in speed, distance, cost, transmission method and networking. End-device connectivity now ranges from the network component to the sensor level.

Oil refinery – Radioline 900 MHz

A major oil refinery needed wireless technology to increase timer monitoring capabilities and overall efficiency.

Technicians measured the oil level at the selected testing location using an ultrasonic level meter with an analog 4 – 20 mA output and a high-level digital alarm. They installed a RAD-IFS-900 radio transceiver with a connected I/O module to communicate with both the level meter and another radio transceiver in the control room. The master radio was tied into the plant's Honeywell TDC3000 DCS system via an RS-232 connection. The remote radio was programmed for Modbus emulation mode, which allows the DCS system to poll the remote radio's connected I/O as if it were a conventionally hard-wired remote I/O block.

Following this successful installation, 15 crude oil tanks in the plant were fitted with similar radio transceivers, and additional wireless systems were installed at several other company-owned plants.

Water/wastewater management – Wireless I/O monitoring

A large water facility had several applications requiring signal readings and indication notifications from remote well sites back to the control center. In one application, the facility used a RAD-ISM-900-SET-AC-UD wireless I/O transceiver set and, as a result, avoided the high cost and delays associated with cutting into the streets to install conduit and signal wiring.

Several other applications at the facility included remote tanks that needed to send level indication, suction pressure and well flow information from various remote sites back to the central control center.

Natural gas storage – Radioline 900 MHz

A natural gas organization installed Phoenix Contact's Trusted Wireless I/O system to transmit pressure values from remote well sites to a main control center. By installing two unidirectional radio paths between the control center and the remote sites, the need to manually measure pressure values by taking trips to the remote wells was eliminated.

Trusted Wireless I/O increased reliability by constantly monitoring crucial data transmission. The installation saved time by eliminating trips to the well sites.

Landfill – 802.11 Wireless Interface

Due to recent expansion, the owners of a landfill needed increased communications between leachate control systems and the central control system. They also needed to replace the original buried cable communication system.

The landfill company installed Phoenix Contact's RAD-80211-XD radio transceivers. The wireless technology easily transmitted the signal more than 400 feet, through multiple obstructions between the pump stations and the control room. As a result of the wireless installation, the company avoided the high costs of traditional conduit and wire installation and experienced significant time savings.

Best practices for antenna installation

1. Antenna gain
A high antenna gain does not automatically mean a better connection. The high gain generates a small angle of radiation, which requires a more precise alignment.

2. Antenna selection
Think about selecting the correct antenna characteristics, particularly on the receiver side. While doing so, pay attention to the correct polarization.

3. Assembly height
An antenna, particularly outside, should be positioned as high as possible. This allows you to improve the range. This keeps the Fresnel zone clear – the higher, the better.

4. Antenna cable as short as possible
The antenna cable should be as short as possible to keep signal loss on the cable as low as possible. Bring the radio module closer to the antenna, e.g., in a small box.

5. Correct protection of antenna connections
Always protect connections on the outside cables, junctions and antennas with protective tape.

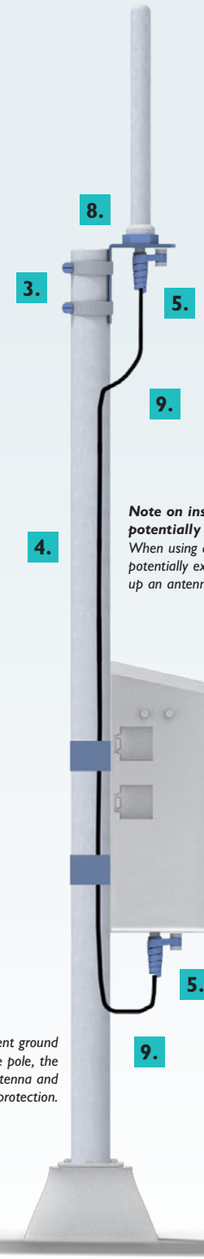
6. Antennas are not lightning arresters
Antennas on buildings are not used as lightning arresters. Select the position of the antenna carefully, use surge protection and do not route the antenna cable parallel to the lightning arrester.

7. Correct mounting
In the case of insufficient stability, the quality of your antenna alignment can be reduced. When mounting the antenna, also think about wind and other outside influences.

8. The right distance
Install the antenna in an open area, as far away as possible from any obstacles such as buildings, trees, other antennas or metal objects.

9. Connection to antenna from below
Outdoor antenna cables should always be connected to the antenna from below. Also use a conduit, if necessary.

10. Weather influences
Fog and rain have nearly no influence on the wireless path.
In the case of ice and snow, on the other hand, you must make sure that the antennas are not covered with ice.



Note on installation in potentially explosive areas:
When using antennas in potentially explosive areas, set up an antenna barrier.

Establish a sufficient ground connection to the pole, the devices, the antenna and surge protection.

Best practices for antenna installation

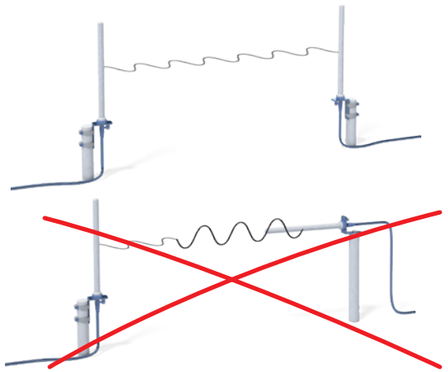
For 2: Antenna selection

Areas of application for omnidirectional antennas

- Numerous devices in different directions (repeater or mesh networks)
- Versatile applications
- Applications without visual communication (in the case of a reflective environment, the signal can be received via alternate lines)

Areas of application for directional antennas

- Bridging large distances
- Point-to-point connections
- Stationary or linear applications
- Decoupling due to directivity and different polarization planes in the case of multiple point-to-point paths



Make sure the antennas have a uniform polarization plane.

Tip:

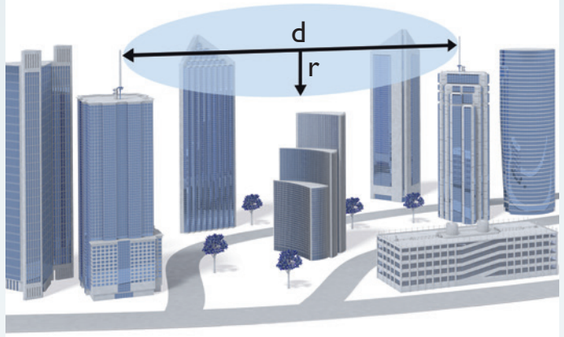
The characteristics of an antenna can be compared with various light sources:

- Bulb → Omnidirectional antenna
- Flashlight → Directional antenna
- Laser pointer → Strong directional antenna; e.g., Yagi or parabolic

You can also combine omnidirectional and directional antennas. While doing so, make sure the antennas have a uniform polarization plane.

For 3: The assembly height (Fresnel zone)

The wireless path may also work if obstacles are within the Fresnel zone (house, trees, etc.). The decisive factor is the number of obstacles and the area they occupy in this zone. In practice, lower frequencies (e.g., 868 MHz) are better at penetrating obstacles.



Tip:

Use antennas with circular polarization in a strongly reflective environment. This type of antenna prevents polarization loss, allowing you to achieve higher gain in this environment. To improve the signal strength, you can also combine circularly and vertically polarized antennas.

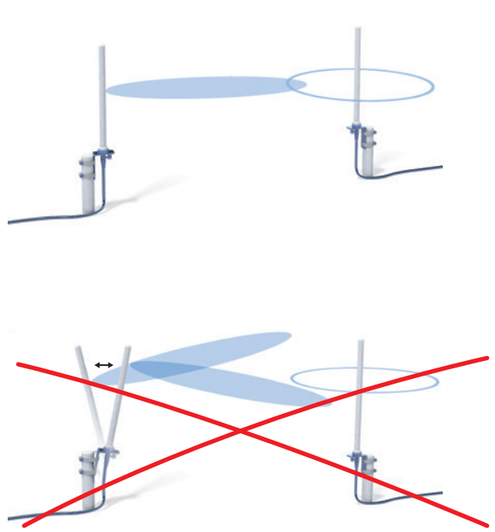
Wireless path distance (d)	Antenna height (r)		
	868/900 MHz	2.4 GHz	5 GHz
200 m	4.0 m	2.5 m	1.5 m
500 m	6.5 m	4.0 m	2.5 m
1000 m	9.0 m	5.5 m	4.0 m
2000 m	13.0 m	8.0 m	5.5 m
4000 m	18.5 m	11.0 m	8.0 m
10,000 m	29.0 m	–	–
20,000 m	41.5 m	–	–
30,000 m	50 m (900 MHz only)	–	–

Radius of the Fresnel zone depending on the frequency and distance. This yields the mounting height for antennas.

For 7: The correct mounting

Note: Always tighten all screw connections so they are secure, ideally using a torque spanner. In particular, when using directional antennas with a small apex angle, you should ensure that the antenna cannot be shifted by the wind.

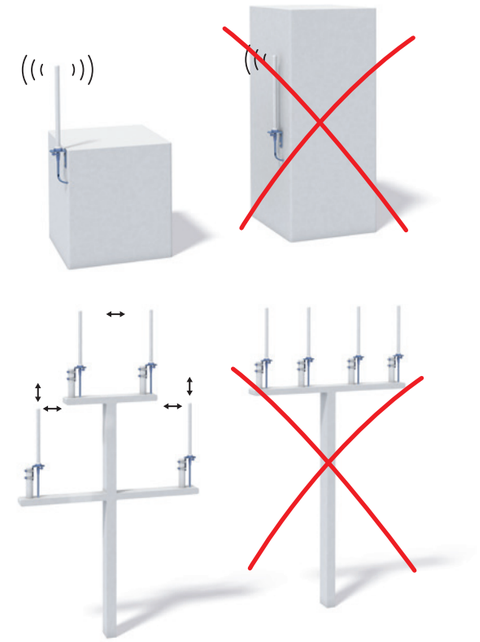
If the antenna is moved by just 1 cm from its original position, this may result in a partial loss of the wireless signal, especially in the case of a long transmission path.



For 8: The right distance

An omnidirectional antenna must always be installed at a sufficient distance from obstacles (poles, building walls or metal walls).

If multiple radio modules are used, you have to make sure the antennas are spread out at sufficient distances from one another.



It is best to install the antennas above each other on a pole.

Frequency	Minimum distance (vertical and horizontal)
868/900 MHz	1.5 – 2.5 m
2.4 GHz	0.5 – 1.0 m
5 GHz	0.5 – 0.8 m

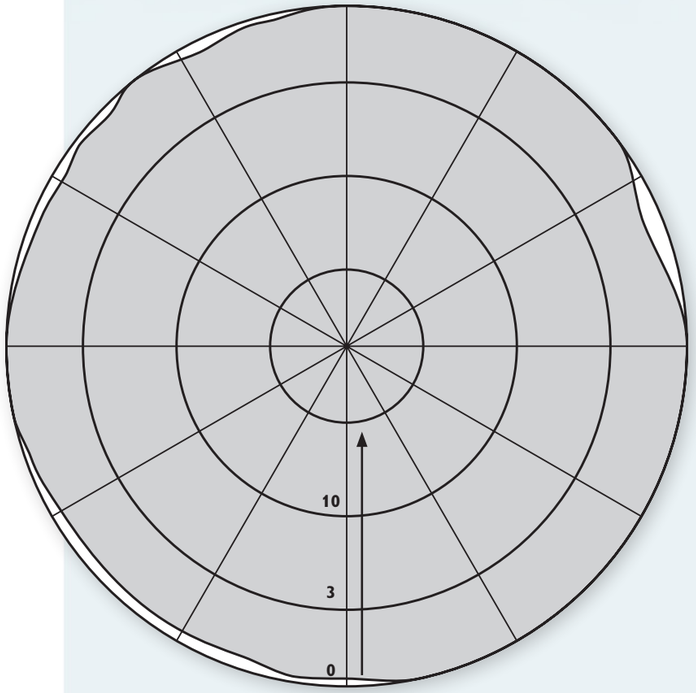
Best practices for antenna installation

The single most important item affecting radio performance is the antenna system. Careful attention must be given to this part of an installation, or the performance of the entire system will be compromised. Antennas are specifically designed for use at the intended frequency of operation and with matching impedance. Select an antenna with an appropriate gain for the intended path.

Omnidirectional antennas

Omnidirectional antennas (known as rod antennas) are typically used if the position between the transmitter and the receiver can change, as in moving applications. The use of omnidirectional antennas is also recommended for applications with no line of sight. In such cases, the signal travels from the transmitter to the receiver via reflections, and their path and direction cannot be predicted.

The ideal installation location is the top of a mast or on a control cabinet so that the antenna has the greatest possible free space in all directions.



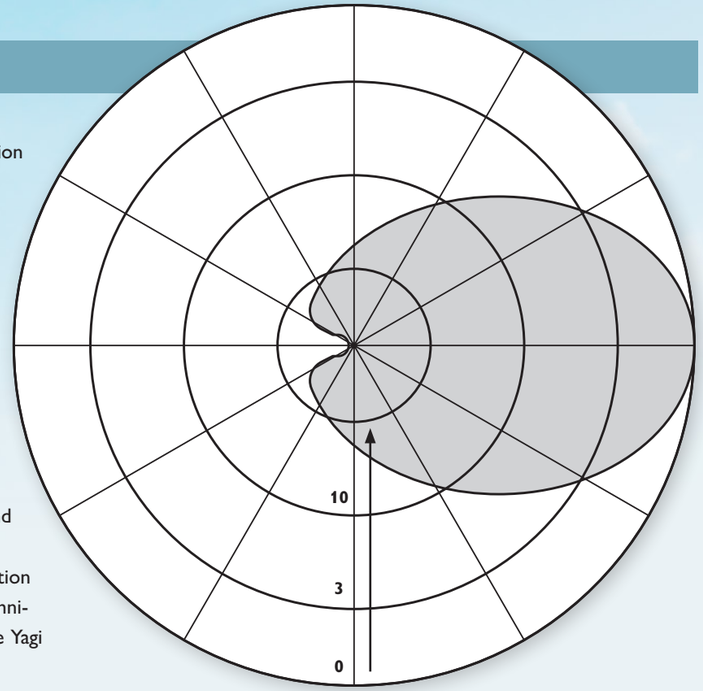
This is a typical omnidirectional antenna coverage area.

Yagi directional antennas

Yagi antennas emit the transmission power in a preferred direction, allowing greater communication range and reducing the chances of interference from other users outside the pattern. A sample radiation pattern is shown to the right. The existing transmission power of a radio does not need to be amplified, but simply focused to gain distance. It is necessary to aim these antennas in the desired direction of communication — that is, at the master station.

The use of a directional antenna is recommended at remote fixed stations when covering large distances with line of sight. The end of the antenna (farthest from the support mast) should face the associated station. A master location with multiple slave radios must always have an omni-directional antenna, and the slave radios may have Yagi antennas to increase distance possibilities.

Final alignment of the antenna heading can be accomplished by orienting it for maximum signal strength; as the gain of a Yagi antenna increases, the beam width decreases, making proper alignment more critical.



This is a typical Yagi antenna coverage area.

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Phoenix Contact is a global market leader based in Germany. We are known for our future-oriented components, systems, and solutions in the fields of electrical engineering, electronics, and automation. With a global network reaching across more than 100 countries with over 17,400 employees, we stay in close contact with our customers, something we believe is essential for success.

Our wide variety of innovative products makes it easy for our customers to find future-oriented solutions for multiple applications and industries. We focus predominantly on the fields of energy, infrastructure, process, and factory automation.

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