Considerations for wireless range

One of the first questions one asks when evaluating a wireless system is “what range will it get?”

The answer to the wireless range question is somewhat complicated. The range of a wireless system is dependent on several interdependent factors. Some are internal to the design of the product and some are external. There are ways of estimating the wireless range of a system by taking into account several factors. The first factors in determining wireless range are internal to the design of the system.

Internal Factors

Transmitter Output Power

Transmitter output power is the amount of power produced by the transmitter’s output stage. Essentially, this is how loud the transmitter is.

Receiver Sensitivity

Receiver sensitivity is how low a signal level the receiver can pick up and output the data with an acceptable number of errors. Essentially, this is how well the receiver can hear.

Frequency-Hopping Technology

The term *frequency hopping* refers to data signals hopping between narrow channels.

Pyronix utilise two-way wireless technology with high output, high sensitivity transceivers that have dual antennas to help reduce dead spots. We also utilise frequency hopping technology for added reliability.

External Factors

Radio Signal

Looking at external factors, the primary factor that affects wireless range is the radio signal that spreads out as it travels from the transmitter to the receiver. This means that the farther the signal travels, the weaker it gets. This effect is frequency dependent, so higher frequency signals get weaker faster. This is due to the physics of electromagnetic propagation and there is nothing that can be done about it.

Interference

Interference is always a concern when it comes to wireless range. Other transmitters on the same frequency in the same area at the same time will interfere with a transmission in most cases.

Propagation Path

The propagation path is the path that the signal takes from the transmitter to the receiver. If there is nothing in the path, then the signal will not be attenuated. If there is a massive building in the way, then the signal will be attenuated and get weaker much faster.

Multipath

Finally there is something called multipath. This refers to the fact that as a transmitted wave spreads out, it can reflect off of things in the environment. This can be the ground, trees, buildings, mountains, walls or anything else. The reflected signal can make its way to the receiver, but will get there later than a part of the signal that travelled a direct path. Multiple reflections can get to the receiver from multiple directions. These reflected signals can interfere with the direct signal and even cancel it out to the point that the receiver does not pick up any good data.

Estimating Wireless Range

With all of this, you can see how it could be difficult to figure out a system's wireless range. The following are some factors that cause interference:

- **Physical objects:** Trees, masonry, buildings, and other physical structures are some of the most common sources of interference. The density of the materials used in a building's construction determines the number of walls the RF signal can pass through and still maintain adequate coverage. Concrete and steel walls are particularly difficult for a signal to pass through. These structures will weaken or at times completely prevent wireless signals

- **Radio frequency interference:** Devices that share or that are close to the channel can cause noise and weaken the signals. If a receiver is near to a powerful transmitter then, even though they are operating on different frequencies, the strength of the electrical fields from the transmitter can block or reduce the range of the receiver. Mobile Networks, military jamming, Television Broadcasting or other high output wireless devices can cause this issue.

- **Electrical interference:** Electrical interference comes from devices such as computers, refrigerators, fans, lighting fixtures, or any other motorized devices. The impact that electrical interference has on the signal depends on the proximity of the electrical device to the transceiver. Advances in wireless technologies and in electrical devices have reduced the impact that these types of devices have on wireless transmissions.

- **Environmental factors:** Weather conditions can have a huge impact on wireless signal integrity. Lightning, for example, can cause electrical interference, and fog can weaken signals as they pass through.

Wireless Obstacles Found Indoors

Obstruction	Obstacle Severity	Sample Use
Wood/wood panelling	Low	Inside a wall or hollow door
Drywall	Low	Inside walls
Furniture	Low	Couches or office partitions
Clear glass	Low	Windows
Tinted glass	Medium	Windows
People	Medium	High-volume traffic areas that have considerable pedestrian traffic
Ceramic tile	Medium	Walls
Concrete blocks	Medium/high	Outer wall construction
Mirrors	High	Mirror or reflective glass
Metals	High	Metal office partitions, doors, metal office furniture
Water	High	Aquariums, rain, fountains

Radio Site Survey - To be wireless or not to be wireless then?

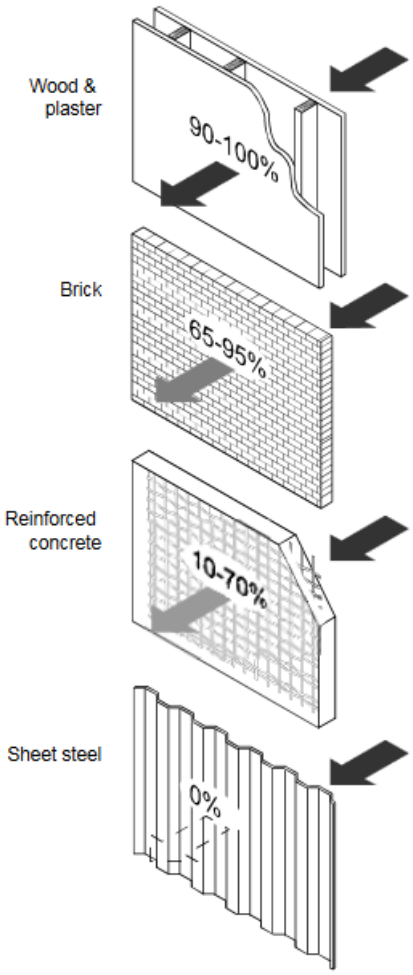
It very much depends on your property, its layout, how it was constructed and what type of detection you're looking to achieve. Generally, radio waves travel in straight lines in the same way as visible light. Like visible light, radio waves are absorbed by materials. But, radio waves are absorbed by different materials to visible light, and can pass through some things that visible light cannot

The need and complexity of a wireless site survey will vary depending on the facility. For example, a small three-room house built of wood and drywall material may not require a site survey.

A house built of concrete or a larger facility, such as an office complex or warehouse, or requiring outdoor area protection generally requires an extensive wireless site survey. Without a survey, users will probably end up with inadequate coverage and suffer from low performance in some areas.

The diagram to the right gives you some idea of how well different materials absorb radio waves.

You also have to allow for the fact that the Earth itself will absorb radio waves. To lessen this effect you should mount the transceivers as high as possible. At the very least, you should mount the panel or the RIX32 WE more than one meter above floor level.



Transmitting Between Buildings

If you want to site the transceivers in separate buildings then pay special attention to problems caused by absorption and reflection by walls, especially those with exterior metal cladding or re-enforced concrete.

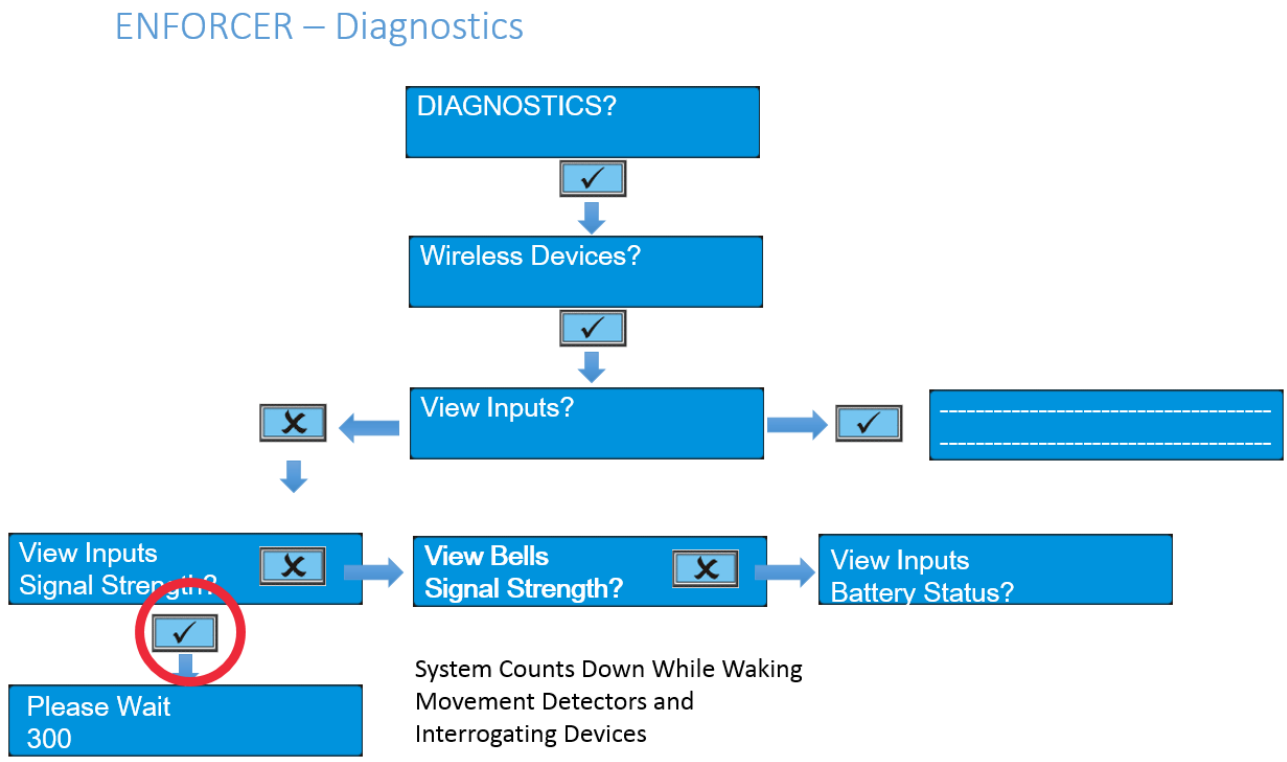
IMPORTANT

It is very difficult to predict exactly, just by looking at a site, how well the transmitters and receivers of a wireless alarm installation will perform**. Pyronix strongly recommend that you measure the radio environment at a site before you start the installation.**

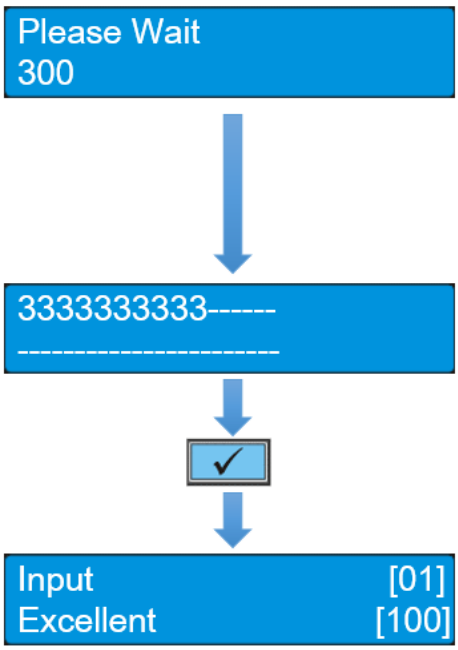
How To Carry Out A Site Survey Using The Enforcer Panel

Power up the panel in the preferred location and carry out an extensive signal strength test of all the areas that need to be covered / protected. If there are weak signal areas consider moving the panel to another location and carry out the signal stength test again of the complete installation. Also consider using the position of the Enforcer as being a RIX 32 WE that could be hard wired back to a panel location. (PCX 46).

- Do not except a signal reading less than 2.
- Do not fit the control panel or peripherals closer than 1m from any electrical device like a consumer unit or transformer.
- Do not fit the control panel or peripherals closer than 1m from any large metal structure like a boiler, radiator or water pipe.
- Do not locate the control panel in a basement or another location where it will be hard to receive good quality signals.
- Do a signal test on site before agreeing to an installation.
- Do a signal test once the installation is complete.
- **IMPORTANT** - Record all signal readings for future reference.



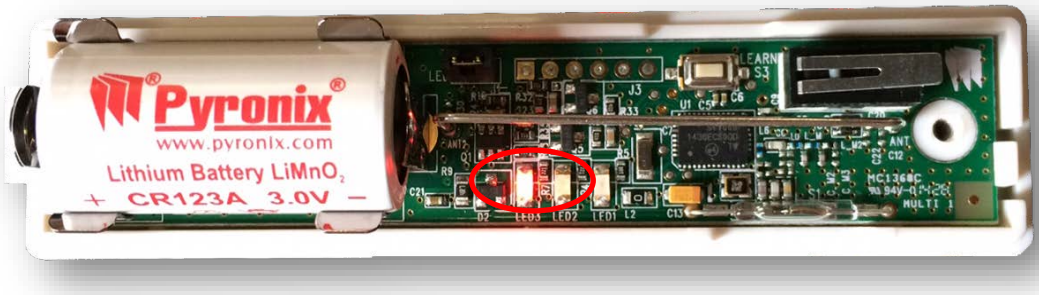
ENFORCER – Diagnostics



Signal Strength Indication:
0=Very Poor
1=Poor
2=Good
3=Excellent

Detailed Signal Strength Indication:
0-29=Poor
30-49=Good
50-100=Excellent

Check Signal Strength at the Device



Signal Strength Bad (0 or 1) **Red** LED Flashes every 16 Secs

Signal Strength Bad (0 or 1) **GREEN** LED Flashes every 16 Secs