

SignalFire Antenna Mounting and RF Interference Mitigation

Overview

Good radio reception depends on several factors including antenna/system mounting and interference from outside/other RF sources. This technical paper will explain how to mount SignalFire radio modules in order to obtain the best possible reception and ways to mitigate interference from other radio sources.

Antenna Placement

The rules for antenna placement are simple (in theory) but often difficult to deploy in the field. What you should do is try to do the best you can for each and everything will likely work well.

The following rules should be followed as closely as possible:

- Height – The higher (within reason) the better. It is good to get the antenna off the ground at least 3 feet. Above 10 feet, there are diminishing returns unless there is something in the way you are trying to get over.
- Proximity to Metal Objects – Try and keep the antenna away (from the side) from piping, conduit, or any metal object (at least 8”), further is better.
- Other Antennas – Try and mount the SignalFire antenna/module out of the way of other antennas.
- Line of Sight – Try and mount the unit so it has the best possible link to the Gateway or a routing neighbor.

Close-In Operation

The Stick and A2 family nodes have high power radios that can suffer from being too close to one another and overdriving the receiver resulting in poor or no communications. This is only a problem between high power nodes communicating directly to each other, for example a node and the Gateway.

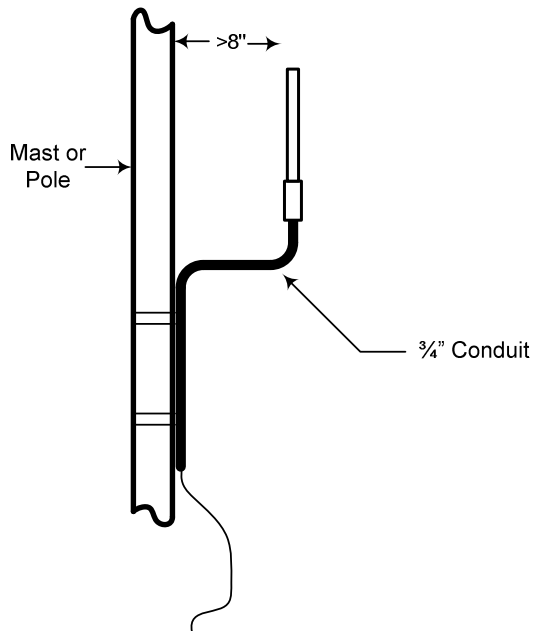
It is recommended that nodes in direct communication be located at least 20 feet apart. Remote nodes can be located in close proximity to one another. For example two Modbus Sticks can be located close to one another as long as they are a distance from the Gateway as the Modbus Sticks will not be directly communicating to one another.

SignalFire Stick Mounting

SignalFire Stick Antenna/Systems are designed to be mounted using 3/4" conduit screwed into the base of the Stick. The 6-conductor wire can be routed out through the conduit.

Keep the Stick away from any metal mounting pole by at least 8" – see figure below.

Good:



Not Good:



Interference

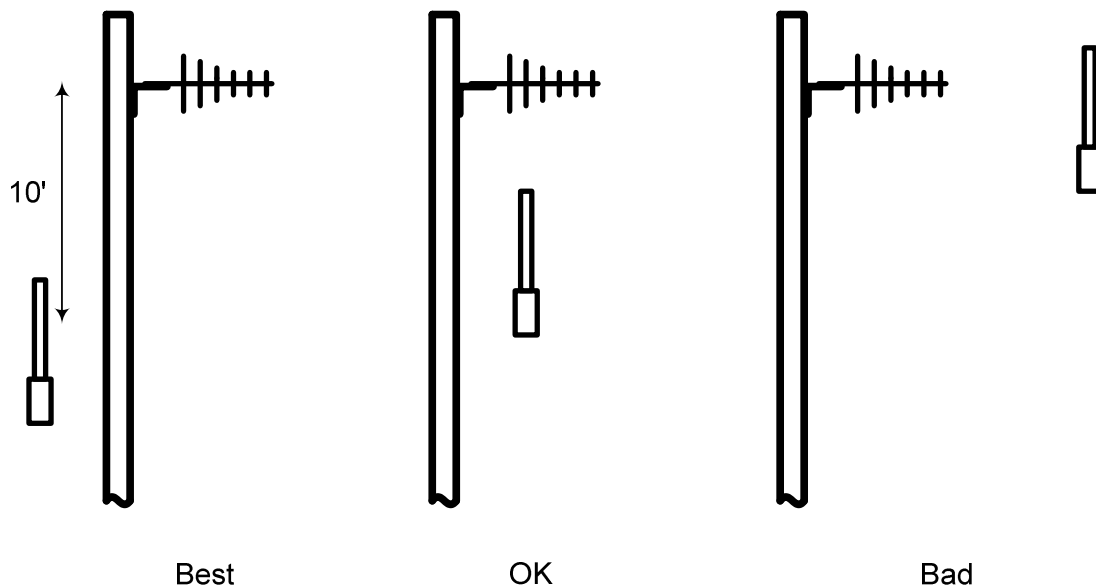
The SignalFire Radio System only communicates when necessary. It does not transmit continually in order to preserve bandwidth for other systems.

Unfortunately, some other radio systems do not perform like this and can transmit continually. There are several clues as to whether this will be a problem or not.

Practical Interference Rules

- Yagi antennas generally mean slave or remote radios and these do not transmit continually and usually do not create an interference issue as the SignalFire radio system will retry the message until it receives confirmation that the message was received. These are most commonly seen in the field near SignalFire equipment. It is still a good idea to mount the SignalFire Stick in a correct location.
- Omni-directional antennas may have base-station radios attached and may pose an issue for interference. Most field antennas are not base-station radios.
- Keep SignalFire radios out of the plane of both types of antennas and directly above or below them if possible.
- If a SignalFire radio must be located close to an always-transmitting base station radio, frequency banding (having the base station transmit on one set of frequencies and the SignalFire radio transmit on a different set) can help.

SignalFire Stick Mounting Near Yagi Antenna



Most Yagi antennas are connected to remote or slave radios that do not transmit very often. This is similar operation to any SignalFire Node or Gateway. SignalFire equipment is very “frequency band friendly” and does not use up (in time) much bandwidth.

Base Station Radio Interference

Some base-station or repeating radios will transmit at all times. These systems will often hop over the entire band making communications difficult. The result of interference is greatly reduced range from the gateway to remote nodes. If you suspect an interference problem, contact SignalFire for assistance.

All SignalFire radios only transmit in short bursts infrequently. This is true of the Gateway as well. Consequently, SignalFire equipment usually does not pose an interference risk for other radio systems.

There are several ways to mitigate interference.

- Antenna Separation
- Frequency Separation

Antenna Separation

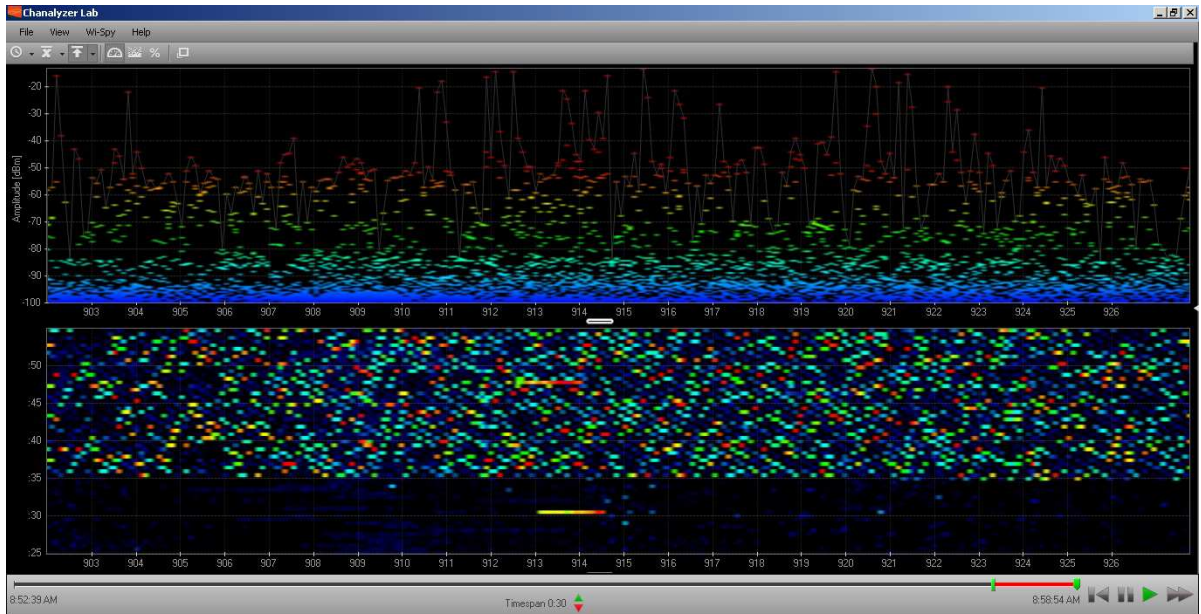
Antenna separation is simply making sure that the SignalFire antenna (usually the Gateway) is not in close proximity to the interfering antenna. For a high power base-station radio (like a GE MDS or Freewave radio), physical separation of 100 feet laterally is required or 10-20 feet vertically (this is often easier). Most GE for Freewave radios at a well site are NOT base-station radios.

Frequency Separation

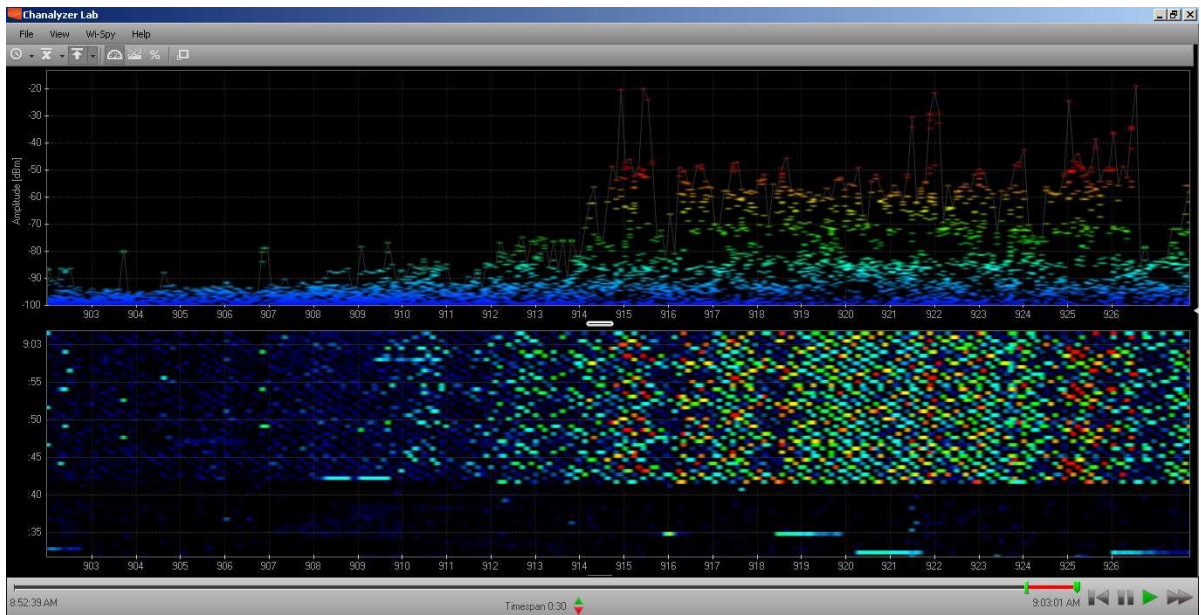
One method for reducing interference is to have the radio systems not use the same frequency band. The 915 MHz spectrum covers frequencies from 902 to 928 MHz and, often, a base station radio can be configured to use a portion of the band that SignalFire is not using.

This function is shown in the following spectrum analysis diagrams taken in the field near a GE MDS radio base station:

GE MDS Radio Spectrum with no Frequency Zone Selection



GE MDS Radio Spectrum with Lower Frequency Zones Disabled



The table below indicates the GE MDS frequency zones to block to minimize frequency overlap with the SignalFire System. Note that the zones to block depend on the network and group setting set in the SignalFire system.

SignalFire		MDS	SignalFire		MDS
Network	Group	Zones to Block	Network	Group	Zones to Block
0	0	2,3,4,5	0	4	2,3,4,5
1	0	3,4,5,6	1	4	2,3,4,5
2	0	3,4,5,6	2	4	3,4,5,6
3	0	3,4,5,6	3	4	3,4,5,6
4	0	3,4,5,6	4	4	3,4,5,6
5	0	3,4,5,6	5	4	3,4,5,6
6	0	3,4,5,6	6	4	3,4,5,6
7	0	3,4,5,6	7	4	3,4,5,6
0	1	3,4,5,6	0	5	3,4,5,6
1	1	3,4,5,6	1	5	3,4,5,6
2	1	3,4,5,6	2	5	3,4,5,6
3	1	3,4,5,6	3	5	3,4,5,6
4	1	3,4,5,6	4	5	3,4,5,6
5	1	3,4,5,6	5	5	3,4,5,6
6	1	3,4,5,6	6	5	3,4,5,6
7	1	3,4,5,6	7	5	3,4,5,6
0	2	1,2,3,4	0	6	1,2,3,4
1	2	2,3,4,5	1	6	2,3,4,5
2	2	2,3,4,5	2	6	2,3,4,5
3	2	2,3,4,5	3	6	2,3,4,5
4	2	2,3,4,5	4	6	2,3,4,5
5	2	2,3,4,5	5	6	2,3,4,5
6	2	2,3,4,5	6	6	2,3,4,5
7	2	2,3,4,5	7	6	2,3,4,5
0	3	2,3,4,5	0	7	2,3,4,5
1	3	2,3,4,5	1	7	2,3,4,5
2	3	2,3,4,5	2	7	2,3,4,5
3	3	2,3,4,5	3	7	2,3,4,5
4	3	2,3,4,5	4	7	2,3,4,5
5	3	2,3,4,5	5	7	2,3,4,5
6	3	2,3,4,5	6	7	2,3,4,5
7	3	2,3,4,5	7	7	2,3,4,5

SignalFire and GE MDS Frequency Separation Table