Frequencies, from low to high – What's the difference?

Frequency selection has a big impact on your ability to trace a line, and the best frequency for one job may be the worst frequency for another. In this article you'll learn about the frequencies commonly used for locating – what they are, how and why they behave differently and how to choose the best frequency for a given situation.

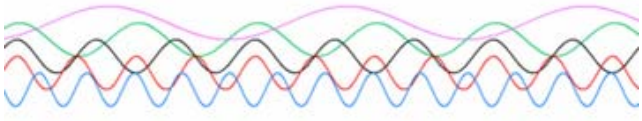
The Golden Rule of frequency selection says, **"Use the lowest frequency that will produce a traceable signal over the distance you need to cover."** After reading this article, you'll understand better how to apply this rule to get the results you want.

What is Frequency?

Electromagnetic energy is created when alternating current passes through a metallic conductor.

This electrical energy rises and falls a certain number of times per second, which in turn causes a magnetic field to build and collapse around the conductor at a regular rate. This rate is known as the frequency of the generated current and of its magnetic field.

Frequency is expressed in terms of hertz (Hz), which means cycles per second, or kilohertz (kHz), which means thousands of cycles per second.



In terms of locating, the reason for choosing one frequency over another is how it behaves when applied to a utility line. If we want to trace an underground line we need to apply a signal that can be received above ground and travel the distance we want to trace. Generally we will want to trace one line only, the line we applied our signal to.

As we learned in the article on circuits, each utility line, or circuit, we want to trace can be good (low resistance) or it can be bad (high resistance). Knowing how the frequencies behave on good or bad circuits is important to locating successfully.

Very Low to Low (128Hz – 1 kHz)

Frequencies in the 1kHz and under range need good circuits. Breaks, gaskets or bad connections increase resistance to flowing current and will stop low frequency immediately as it does not flow easily into the ground and around these breaks. Very low and low frequencies do not induce well.

If you do have a good circuit these lower range frequencies will travel very long distances and will not jump onto other pipes or cables unless they are part of the same good circuit. They follow the path of least resistance so the signal stays on the target conductors that are continuously metallic and well-grounded at both the transmitter and the far end.

Medium (8 kHz)

Frequencies in the 8kHz range are a bit stronger and less susceptible to ambient noise, (e.g. other frequency sources like power lines) then the lower frequencies but they still limit the effects of signal bleed into the surrounding earth and onto adjacent utilities.

If you do not need to trace very long distances and you have a good circuit then 8kHz is a good frequency to start with when you make a direct connection. Medium frequencies will induce weakly to moderately and high induction power is best.

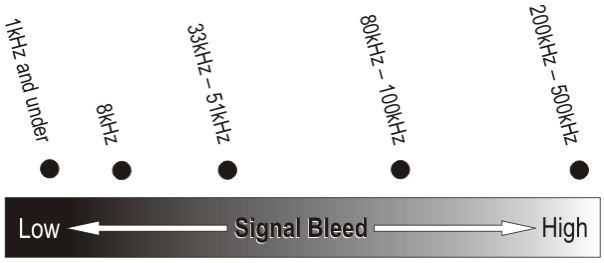
High Frequencies (33 kHz)

High frequencies can energize the parts of the utility system that typically are not energized by lower frequencies and would otherwise be unlocatable: stubs, dead-ends, and poorly grounded laterals. This frequency range can also help you locate through high resistant rubber insulating pipe joints or broken tracer wire because it can penetrate the gap and still impose signal on the further side of the conductor. They also induce well.

The drawback to this currency range is this range bleeds heavily into the ground surrounding the conductor, which significantly reduces it's range. Higher frequency signals also couple more readily onto nearby conductors. As a general rule using higher frequencies in congested areas increases signal distortion causing greater confusion. This of course could result in incorrectly marking the target utility. Care should always be taken to minimize distortion.

Very-high Frequencies (262 kHz)

Frequencies in this range are most often used as a last resort on highly resistive circuits that can't be located with a lower frequency. These frequencies penetrate the soil easily, energizing all nearby conductors. They are very good inductively but because they energize almost everything they can make the locating environment confusing. Very High frequencies also bleed heavily to ground, which significantly limits the distance they can travel.



Choosing the best frequency

The Golden Rule of frequency selection says to use the lowest frequency that will produce a traceable signal over the distance you need to cover. Your best strategy is to choose a frequency based on the resistance of your circuit and what you want to do.

- If you have a good circuit and you want to go very long distances use a low frequency.
- If you have a good circuit and do not need to travel as far then start with a medium frequency like 8kHz. Usually a good frequency range to start with in most circumstances.
- Because of the higher risk of bleed over and their limited range higher frequencies are best used on poor circuits or when lower frequencies have previously failed.
- Very high frequencies should be used as a last resort or if you want to energize as much area as you can just to see if anything is there.

Click image to play video.

Things to remember

The Golden Rule of frequency selection says **Use the lowest frequency that will produce a traceable signal over the distance you need to cover.**

	Advantages	Disadvantages
Low Frequencies	▪ Helps isolate the target line = Less Bleed-Over. ▪ Travel further down low resistance or uninsulated lines. ▪ Work well on larger diameter conductors. They make locating easier because they typically stay on one conductor, reduce possibility of signal distortion and require fewer hook ups to trace a longer line.	▪ **Can't** overcome high resistance. o Stubs, Insulated joints, Dry/Sandy soil, no far end ground, etc. ▪ Not useful for blind searches/sweeps when you just want to identify the existence of any conductors in an area. ▪ Not useful for inductive locating. ▪ Susceptible to power line interference. ▪ Lowers receivers sensitivity.
High Frequencies	▪ **Can** overcome high resistance. o Stubs, insulated joints, Dry/Sandy soil, no far end ground, etc. ▪ Useful for blind searches/sweeps when you just want to identify the existence of any conductors in an area. ▪ Useful for inductive locating.	▪ Can Bleed-Over onto other conductors so you cannot be certain if you are tracing your target line. ▪ Won't travel far down a line. ▪ Don't work as well on larger diameter conductors. They make locating possible in situations that have high resistance but they can increase signal distortion and confusion in congested areas.