

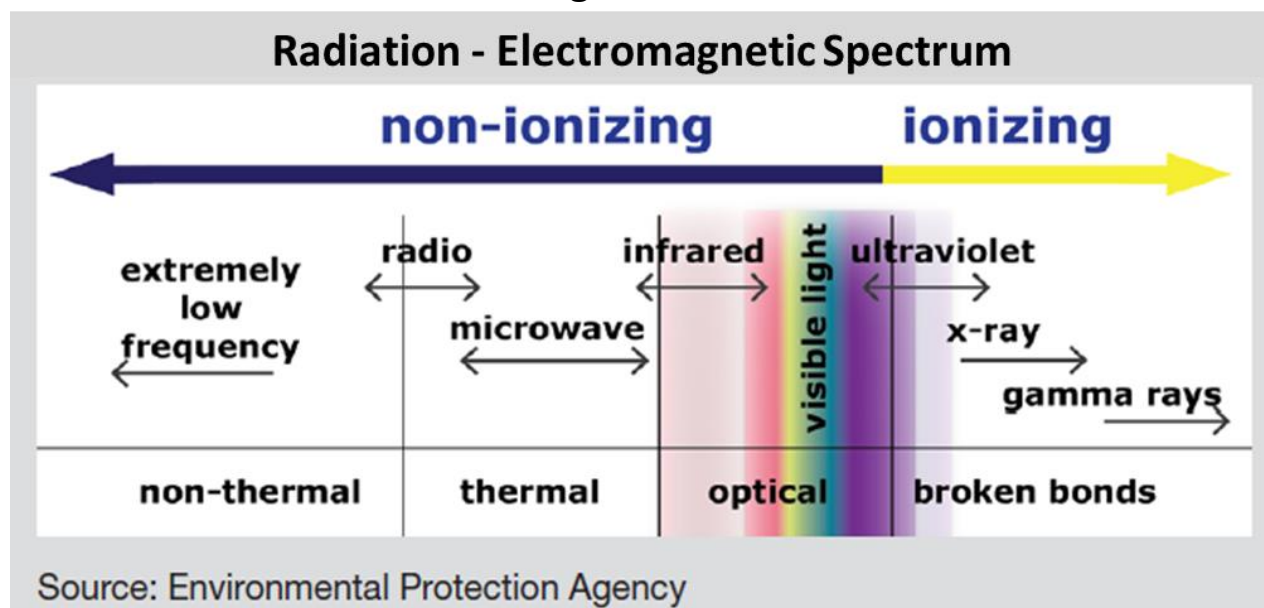
# 1. What is Radiofrequency (RF) Radiation?

There are two types of radiation – **ionizing** radiation and **non-ionizing** radiation. Both are forms of electromagnetic energy, but ionizing radiation has more energy than non-ionizing radiation.

**Ionizing** radiation, like x-rays or gamma rays, has enough energy to cause chemical changes by breaking chemical bonds. Sources of this type of radiation can be found in hospitals, nuclear energy plants, and nuclear weapons facilities.

**Non-ionizing** radiation causes molecules to vibrate, which generates heat. **RF radiation is a type of non-ionizing radiation and the focus of this Guide.**

Figure 1-A



The diagram in Figure 1-A shows the electromagnetic spectrum from extremely low frequency (non-ionizing) to gamma rays (ionizing). There are different types of non-ionizing radiation. At one end is “extremely low frequency” or ELF radiation, which can be emitted through electric currents from overhead power lines and equipment powered by electricity.

At the other end is radiofrequency (RF) radiation. According to the Centers for Disease Control and Prevention (CDC), “Even though [ELF and RF] are both non-ionizing radiation, RF radiation is much higher frequency than ELF radiation and therefore potentially more harmful.”<sup>1</sup>

<sup>1</sup> *Frequently Asked Questions about Cell Phones and Your Health*, accessed April 28, 2016. [http://www.cdc.gov/nceh/radiation/factsheets/224613\\_faq\\_cell-phones-and-your-health.pdf](http://www.cdc.gov/nceh/radiation/factsheets/224613_faq_cell-phones-and-your-health.pdf)

RF radiation collectively refers to **radio waves** and **microwaves** and is characterized by wavelength and frequency. The **frequency** of each wave is measured in Hertz (Hz) – cycles per second. KiloHertz (KHz) are low frequency – 1,000 cycles per second. **Megahertz** (MHz) are 1 million cycles per second, and gigahertz (GHz) are at the high end – 1 billion cycles per second.

**The RF and microwave parts of the electromagnetic spectrum** are generally defined as that part of the spectrum where electromagnetic waves have frequencies in the range of about 3 kilohertz (3 kHz) to 300 gigahertz (300 GHz). As shown in Figure 1-A, microwave radiation has higher frequencies than radiofrequency, but the two are often grouped together.

In general, signals with longer wavelengths travel a greater distance and penetrate through and around objects better than signals with shorter wavelengths. Low frequencies have longer wavelengths. Higher frequencies have shorter wavelengths.

**Frequency** matters because, when it comes to the health effects, different frequencies affect humans differently. According to the FCC, frequencies between 30 and 300 megahertz appear to be the most harmful to humans because it is the range where humans absorb RF radiation most efficiently.<sup>2</sup>

**Distance** is also important because the power density decreases farther away from the source. The amount of **RF power** generated is measured in watts and a common measure of RF radiation **power density** is milliwatts per square centimeter (mW/cm<sup>2</sup>).<sup>3</sup>

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<sup>2</sup> FCC OET Bulletin 65 page 8

[https://transition.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet65/oet65.pdf](https://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf)

<sup>3</sup> *How To Understand The Different Measurement Units That Are Used To Measure EMFs*, accessed April 28, 2016.

<http://www.electricsense.com/3772/how-to-understand-the-different-measurement-units-that-are-used-to-measure-emfs/>