Electromagnetic Protection

IEEE 299-2006

Doors, gates & windows | Security | Metalworks
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ICOMET Group

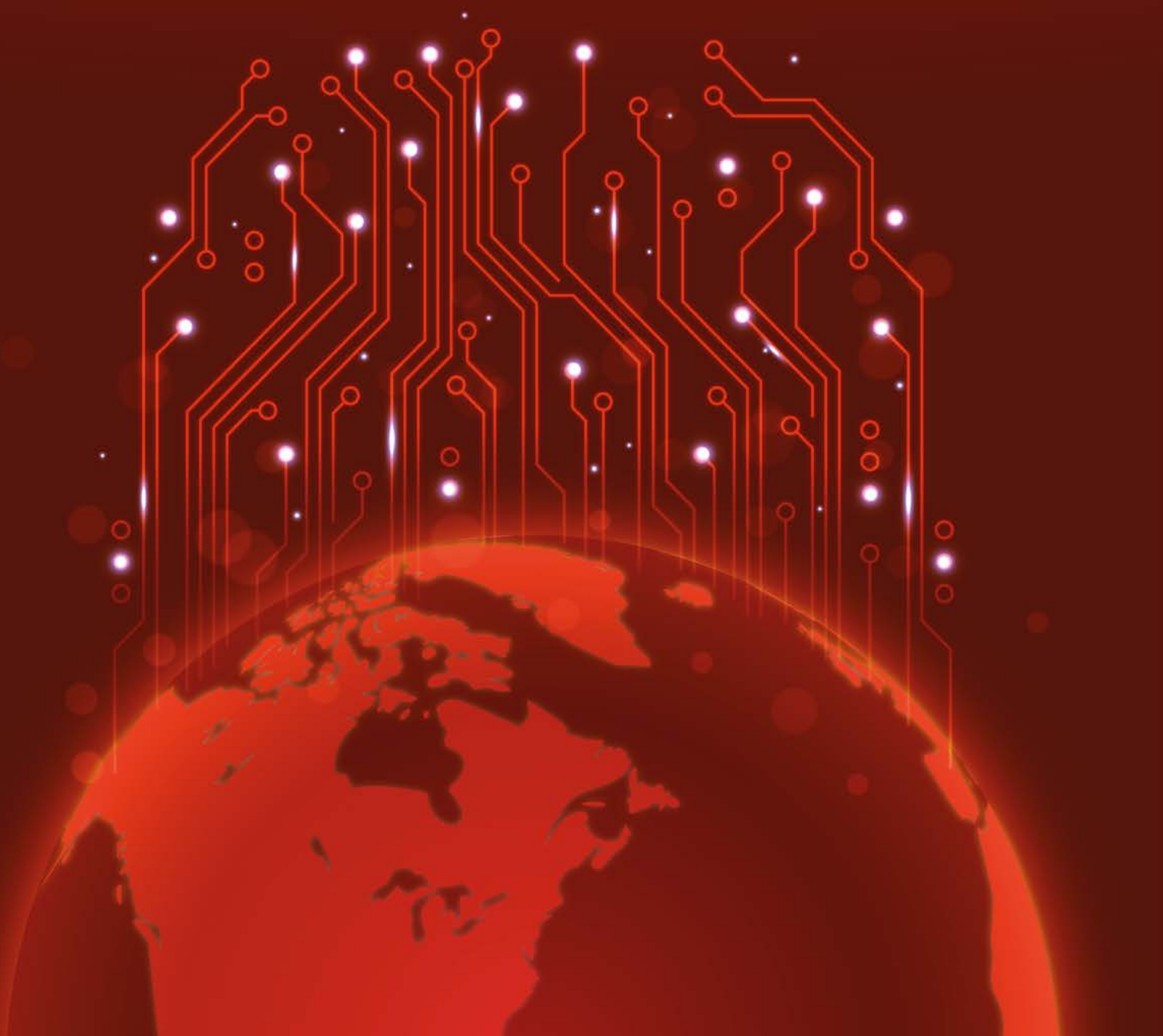
Introduction

Let's start with a riddle. What surrounds us wherever we go? Something we use every day, every hour, every minute? What is odorless, tasteless, mostly invisible, and silent, yet indispensable to us? Without it, the world as we know it would not exist.

If you thought of the air we breathe, you're off track—although what we're looking for envelops us just as much: electromagnetic radiation.

Electromagnetic radiation (EM) is a naturally occurring phenomenon that humans have extensively harnessed, forming the foundation of the information age and our modern world. Whether you're reading this document on your computer screen, a mobile phone, or even printed on paper, you are utilizing electromagnetic radiation. The light emitted by your screens consists of EM waves. Likewise, the light reflected off your sheet of paper is also made up of EM waves! If your radio is on, you're using even more EM waves. At this very moment, you are probably being traversed by EM waves from your Wi-Fi, your phone, and the GPS systems of passing cars.

There is an entire chaotic array of EM waves with different characteristics, properties, and applications that deserve our attention, understanding, and sometimes... our protection.



Electromagnetic waves

PRINCIPLES AND FOUNDATIONS

Electromagnetic waves are a means of transporting energy, distinct from mechanical waves. Unlike mechanical waves (e.g., sound waves or water waves), electromagnetic waves do not require a medium to travel: they can move through air, solid materials, and even the vacuum of space.

In the 1860s and 1870s, Scottish physicist James Clerk Maxwell revealed the connection between electricity and magnetism. He demonstrated that electric and magnetic fields can combine to produce electromagnetic waves, summarizing this discovery in what are now known as Maxwell's Equations.

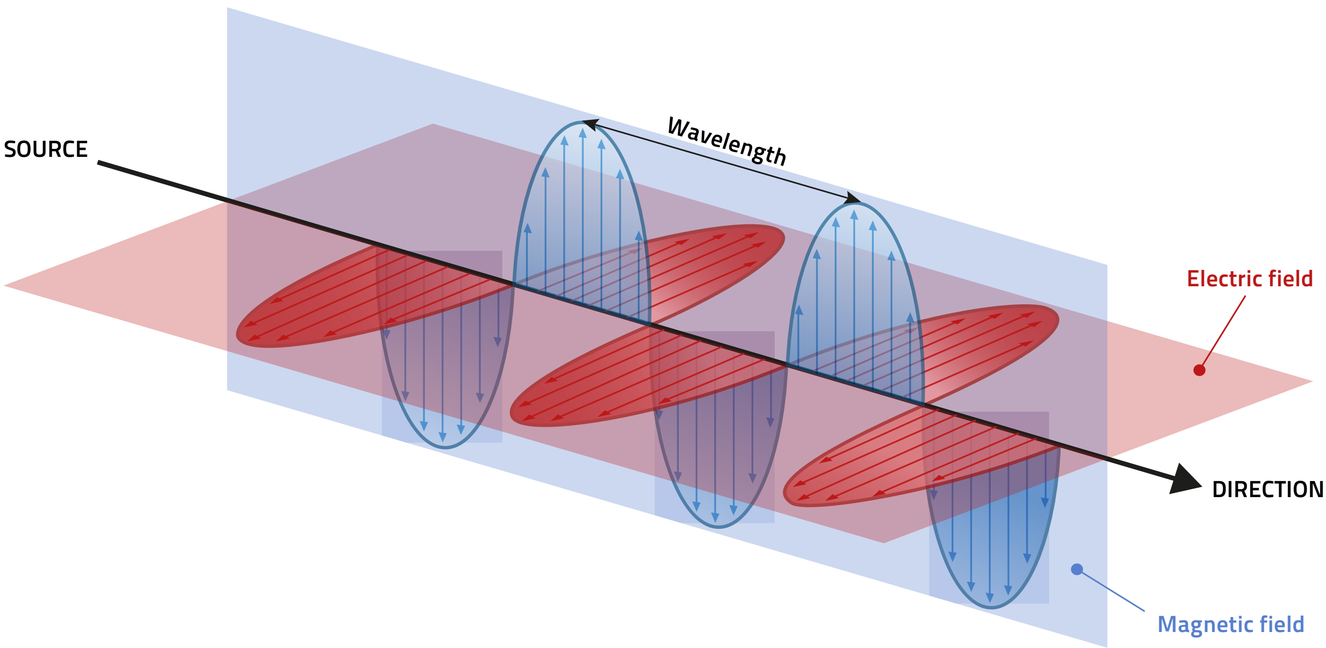
Electromagnetic fields (EM) behave differently depending on their frequency. At low and very low frequencies, the electric and magnetic fields of a source are distinct and must be considered separately.

- Example of a static electric phenomenon: Rubbing a balloon against hair creates a charge that makes the hair stand on end.
- Example of static magnetism: a refrigerator magnet sticking to a metal surface.

As the frequency increases, these two fields begin to interact and influence each other. Eventually, they merge into a single electromagnetic field, **consisting of an electric component and a magnetic component**. When a magnetic field changes, it creates a changing electric field, and vice versa. This interplay of varying fields produces electromagnetic waves.

The electric field, measured in **volts per meter (V/m)**, arises from the presence of electric charges in space. The magnetic field, on the other hand, is generated by the motion of electrons creating an electric current and is measured in **amperes per meter (A/m)** or in **teslas (T)**.

Each of these fields - electric or magnetic - oscillates regularly and periodically. In electromagnetic radiation, an electric wave and a magnetic wave, both of the same frequency, oscillate perpendicularly to one another.

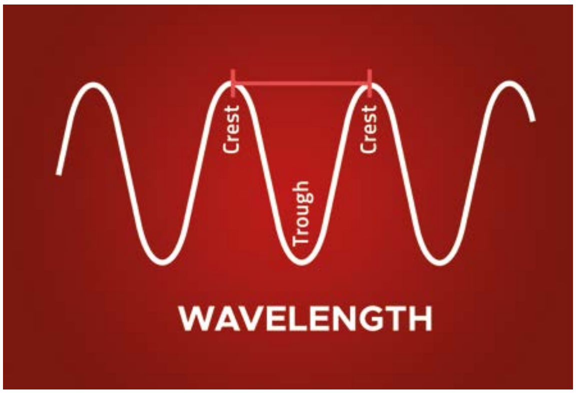


Later, the German physicist Heinrich Hertz put these theories into practice with radio waves. He demonstrated that radio waves travel at the same speed as light, proving that they are also a form of light. Hertz also managed to release electromagnetic waves by disconnecting them from conductive wires, enabling energy to be transmitted in the form of waves through space.

Starting at a frequency of approximately 30,000 Hz (or 30 kHz), EM fields acquire enough energy to «detach» from their source, such as an antenna, and **propagate freely at the speed of light** (about 300,000 kilometers per second). This property of EM fields is what enables the transmission of information over long distances—a fundamental principle for technologies like broadcasting, television, mobile telecommunications, and wireless data transfer. Today, the frequency of a wave, measured in cycles per second, is called the «**hertz**» in honor of Heinrich Hertz.

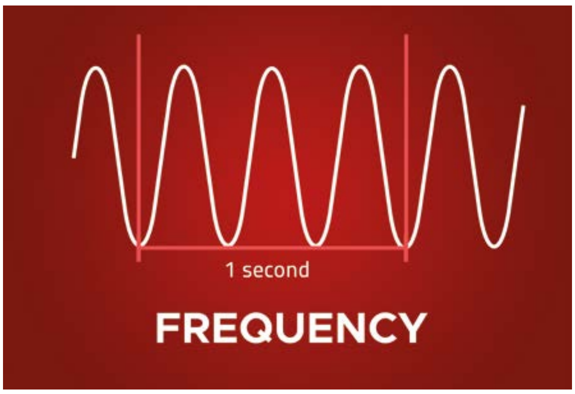
CHARACTERISTICS

Electromagnetic energy (also called electromagnetic waves or radiation) is characterized by its wavelength, frequency, and energy level.



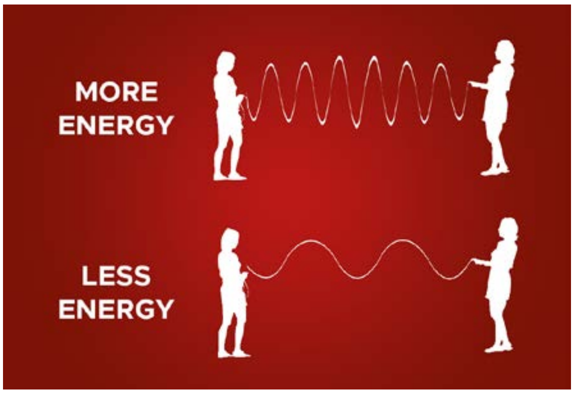
- **WAVELENGTH (m)**

Electromagnetic waves have «peaks or crests» and «troughs,» similar to the waves seen on the ocean. The distance between two successive peaks is called the wavelength. These wavelengths can vary dramatically: the shortest ones are much smaller than an atom (measured in nanometers), while the longest can exceed the diameter of the Earth.



- **FREQUENCY (Hz)**

The frequency of a wave, measured in Hertz (Hz), is the number of peaks that pass a given point in one second. For example, a wave with a frequency of 2 Hz has two peaks passing a point per second.



- **ENERGY (eV)**

Electromagnetic waves can also be defined by their energy, measured in electron volts (eV). One electron volt represents the energy required to move an electron through a potential difference of one volt. In the electromagnetic spectrum, shorter wavelengths carry more energy.

Imagine a jump rope: if you move the rope ends faster to create more waves, you need to supply more energy to maintain those waves.

These three characteristics are interconnected: knowing one of them allows you to calculate the other two using mathematical formulas.

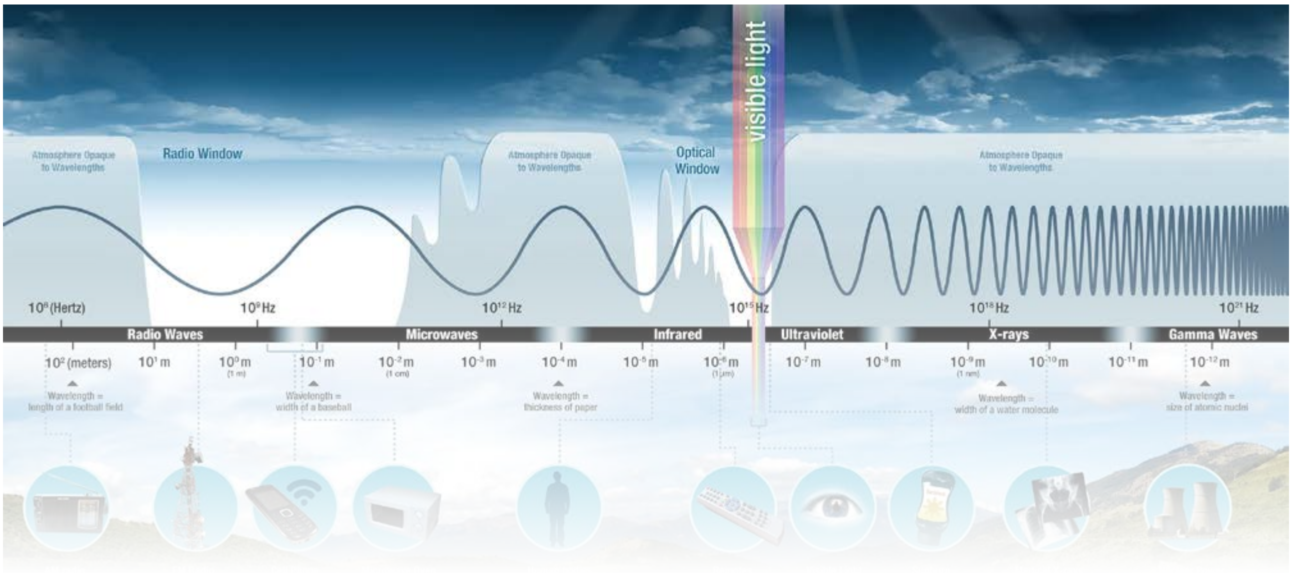
Long EM waves, such as radio waves, have low frequencies and carry little energy. As more energy is added, the frequency increases, and the wavelength decreases. Gamma rays, with their extremely short wavelengths, contain the highest energy levels and sit at the far end of the electromagnetic spectrum.

By convention, radio frequencies and microwaves are described in terms of frequency (measured in Hertz), infrared and visible light are described by their wavelength (measured in meters) and X-rays and gamma rays are described by their energy (measured in electron volts).

This scientific convention simplifies the use of practical values - neither too large nor too small - and ensures the units are appropriate for each type of wave.

Electromagnetic spectrum

Radiation type	Wavelength	Frequency	Human uses	Health impact	Sources
Radio Waves	From 1 mm to several m	From 10^{6} Hz to 10^{11} Hz	Television and radio communication, mobile phones, radar, Wi-Fi, Bluetooth.	Generally not considered harmful to human health at typical exposure levels, provided regulatory standards are adhered to.	Antennas (radiated propagation in free space) or transmission lines (guided propagation via wiring).
Micro-waves	Between 30 cm and 1 mm	From 10^{9} Hz to 10^{11} Hz	Cooking, satellite communication, traffic radars.	Microwaves can cause internal tissue heating.	Man-made devices or natural emissions: interstellar gas clouds, gaseous envelopes of newly formed stars.
Infrared	Between 5 mm and 1 µm	From 10^{11} Hz to 10^{14} Hz	Heat transfer through radiation (electric heaters, grilling, night vision equipment) fiber-optic communication, TV remotes, anti-theft alarms.	Infrared radiation is felt as heat and can cause skin burns.	Natural sources: sun, hot bodies, fires, lava. Artificial sources: remote controls, cameras, infrared lamps, hot plates, lasers, ...
Visible light	Between 700 and 400 nm	From 10^{14} Hz to 10^{15} Hz	Light visible to the human eye (from red to violet, each color being a wavelength of light), photography, fiber-optic communication.	Intense laser light can damage the retina at the back of the eye.	This is the main type of radiation that is emitted by the Sun, other very hot objects such as incandescent light bulbs and from excited atoms in lasers and florescent light bulbs.
Ultra-violet	Between 400 nm and 100 nm	10^{15} Hz	Tanning, counterfeit banknote detection, vitamin D synthesis, dental repair curing, night lighting to make certain reflective elements shine or to attract insects.	Ultraviolet rays can damage skin cells, cause premature aging or skin cancer, and damage the eyes.	Ultraviolet (UV) rays come mainly from the Sun or other high-temperature energy sources.
X Rays	From 10^{-8} to 10^{-11} m	From 10^{16} Hz to 10^{19} Hz	Medical imaging of bones, airport baggage scanners, and customs inspections.	X-rays damage body cells, cause dangerous ionization, and harm cellular DNA, potentially leading to cancer. Protective shields are used in medical and dental imaging.	Emitted by high-energy sources such as supernovae, radioactive materials, and X-ray machines.
Gamma Rays	$<10^{-9}$ m	$>10^{17}$ Hz	Cancer cell destruction, sterilizing medical equipment, killing bacteria to extend fruit shelf life.	Gamma rays also damage body cells, causing dangerous ionization in living cells and DNA damage, which can lead to cell death and cancer.	Emitted by extremely high-energy sources, such as nuclear explosions and gases falling into black holes.



Since the continuation of this document contains sensitive information, we kindly invite you to contact one of our representatives for obvious security reasons.

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After assessing your needs together, we will be pleased to provide you with the complete document. Below is a brief overview of the content that follows:

Electromagnetic pulse (EMP)

IMPACT ON CONNECTED DEVICES
THREATS TO CRITICAL INFRASTRUCTURE & CHALLENGES IN PROTECTION
NATURAL EMP'S

- Lightning
- Electrostatic discharge
- Magnetic storm

ARTIFICIAL EMP'S

- Nuclear electromagnetic pulse (NEMP)
- Non-nuclear eletromagnetic pulse (NNEMP)
- E-Bombs : UWB (Ultra Wide Band) & HPM (High Power Microwave)

Electromagnetic interference (EMI)

EXOGENOUS ELECTROMAGNETIC DISRUPTIONS
EAVESDROPPING AND ELECTROMAGNETIC COMPROMISE

Protection methods against EM risks

RISK DISTANCING
GENERATING INTERFERENCE NOISE
VIRTUALIZATION AND RELAY SYSTEMS
PHYSICAL PROTECTION: SHIELDING AND FILTERING
THE MODULAR FARADAY CAGE

TEMPEST Standard

IEEE 299-2006 testing Standard

Common abbreviations

Reminder of values

Outdoor Mobile Anti-Compromise Room

www.icometgroup.com
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Single doors | Double doors | Fixed frames | Automatic sliding doors

Doors & frames for prisons | Security gatehouses | Counters | Sectional doors

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