

Frequency Band Applications of the Electromagnetic Spectrum

The table is based on the ITU frequency band subdivisions in the field of radio communication (RF), and has been extended to include the whole electromagnetic spectrum

Source: [ITU-International telecommunication Union: Recommendation ITU-R V.431-7](#)

Nomenclature of the Frequency and Wavelength Bands used in Telecommunications

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Non-ionizing radiation (RF radiation)

Frequency Band	Band group ITU	Frequency range	Wave length range	Bands subdivided by ranges Examples of uses and designations according to ITU
ELF Extremely (Super) Low Frequency		30 - 300 Hz	1,000-10,000 km	<p>Sources of exposure to electric and magnetic fields (ELF)</p> <ul style="list-style-type: none"> • 50-60Hz <ol style="list-style-type: none"> (1) High tension cables – above-ground, underground, under water. (2) Relay and transformer stations and transformers – peripheral and local (3) Electric grids – domestic and in complexes of industrial and commercial buildings (4) Household electrical equipment (5) Electrical equipment in industrial factories and large, medium or small production lines • 50-300Hz (or higher frequencies). <ol style="list-style-type: none"> (6) Electrically powered transport – Hybrid vehicle, magnetic levitation trains, electric trains/trams/underground railways • 30 Hz or lower <ol style="list-style-type: none"> (7) Submarine communications
ULF Ultra Low Frequency		300Hz - 3kHz	100-1,000 Km	<ul style="list-style-type: none"> • Submarine or mining communications • As in (6) above: Electrically powered transport - Hybrid vehicle, magnetic levitation trains, electric trains/ trams/ underground railways.








Power lines – urban electricity supply







Hybrid car

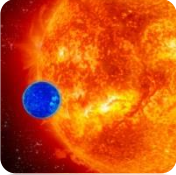


Non-ionizing radiation (RF radiation)

Frequency Band	Band group ITU	Frequency range	Wave length range	Bands subdivided by ranges Examples of uses and designations according to ITU
VLF Very Low Frequency	4	3 - 30 kHz	10-100 Km	<ul style="list-style-type: none"> Navigation, time signals, submarine communication, wireless heart monitoring, geophysics  <p style="text-align: center;">Marine periscope antenna</p>
LF Low Frequency	5	30-300 KHz	1-10 Km	<ul style="list-style-type: none"> Navigation, time signals, long wave AM broadcasting (Europe and part of Asia), RFID, amateur radio  <p style="text-align: center;">Antenna for broadcasting weather monitoring data</p>
MF Medium Frequency	6	300KHz- 3 MHz	100-1000 m	<ul style="list-style-type: none"> AM medium wave broadcasting, amateur radio, tremors, snow avalanches, marine patrol, coast-to-sea communications  <p style="text-align: center;">Marine control tower</p>
IF Intermediate Frequency		300 Hz- 10 MHz	30-1000 m	<ul style="list-style-type: none"> Tactical military communications, industrial and military RF generators, heating units in industrial radio solders Electronic identification and tracking systems, Near Field Communication- NFC Diagnostic and therapeutic tools in medicine, cochlear implant (helical implant in auditory canal), cardiac pacers  <p style="text-align: center;">Automatic soldering apparatus</p>
HF High Frequency	7	3 - 30 MHz	10- 100 m (short wave)	<ul style="list-style-type: none"> Short wave broadcasting, amateur and civic radio, flight communications beyond the horizon, RFID, radar communication beyond the horizon, sky waves, mobile marine communications  <p style="text-align: center;">Communication beyond the horizon</p>

Non-ionizing radiation (RF radiation)

Frequency Band	Band group ITU	Frequency range	Wave length range	Bands subdivided by ranges Examples of uses and designations according to ITU
VHF Very high frequency	8	30 - 300MHz	1- 10 m	<ul style="list-style-type: none"> FM radio, television broadcasting, line of vision communication - ground to aircraft or between aircrafts, mobile land and marine communication, amateur radio, weather radio
 <p>Deployment of radio broadcast antennas</p>				
UHF Ultra High Frequency	9	300 MHz - 3 GHz	100 mm to 1m	<p>Divided according to main technological generations – 300 MHz -3GHz</p> <p>Networks and communications devices:</p> <ol style="list-style-type: none"> G2 G3 G3+ G4, LTE, etc. <p>Various additional applications:</p> <ol style="list-style-type: none"> TV broadcasts, microwave ovens, microwave instruments and communication, radio astronomy, cellular devices, wireless LAN, Bluetooth, GPS, two-way FRS and GMRS radio, and amateur radio.
 <p>Cellular site</p>				
SHF Super High Frequency	10	3 – 30 GHz	10 - 100 mm	<ul style="list-style-type: none"> Radio astronomy, modern radars, broadcasting satellites, TV broadcasting satellites, DBS, amateur radio Wireless LAN, Wi-Fi, Wi-Max at high frequency (3GHz+), microwave devices and communication, modern communications technologies.
 <p>Communication and TV satellite</p>				
EHF Extremely High Frequency	11	30- 300 GHz	1 - 10 mm	<ul style="list-style-type: none"> Radio astronomy, high frequency microwave relays, remote sensing at microwave frequency, amateur radio, guided energy weapons, millimeter wave scanner.
 <p>Modern navigation satellite</p>				

Non-ionizing radiation – Infra-red light

Band frequency	Frequency range	Wave length range	Bands subdivided by ranges Examples of uses and designations
Terahertz (THz) or Tremendously High Frequency (THF) (Far Infrared -FIR)	300GHz-3THz	100 micron (μ) – 1 mm	<ul style="list-style-type: none"> Terahertz frequency imaging – potential alternative to X-ray, ultra-rapid molecular dynamics, solid state physics, terahertz space-time spectroscopy, terahertz computability and communication, sub-millimetric sensing FIR  <p style="text-align: center;">The sun – source of IR light</p>
IR Long infrared light	3 - 30 THz	100 micron (μ) –10 μ	<ul style="list-style-type: none"> Thermal infra-red, infra-red laser, LWIR  <p style="text-align: center;">Hand-held IR laser</p>
IR Medium, and Short High infrared light	30 - 300 THz	1 - 10 μ	<ul style="list-style-type: none"> MWIR (or IIR): guided missiles, guidance of objects at temperatures higher than the environment. SWIR – area of increased absorption of IR -the 1.53-1.56μ band is used for long-range communication. NIR – the 0.75-1.4μ range is greatly affected by absorption in water. Used in optic fiber telecommunication due to small signal loss in silica (SiO₂) material. Signal amplifiers have higher frequency sensitivity in this range. Used for night vision instruments and eyeglasses.  <p style="text-align: center;">IR guided anti-aircraft missile</p>

Non-ionizing radiation – visible light

Band frequency	Frequency range	Division into sub-ranges Examples of uses and designations
Very short – infra-red Visible light	300 THz - 3 PHz	<p>Visible light is the 390-700nm wave length range, corresponding to the 430-790 THz frequency range. The infra-red ranges of NIR, MWIR, LWIR are outside the range of visible light to humans, while some animals are able to perceive objects in the infra-red range. The human eye has a maximal sensitivity around 555nm (540 THz).</p>
Long ultraviolet (UVA)		<p>At the higher range, which is also outside the range of human visibility (UVA) – 315-400nm, birds and other animals are able to see, but they are unable to see in the red range.</p> <ul style="list-style-type: none"> • Hygiene – bacterial purification of drinking water, sewage, sterilization in medicine and the laboratory • Esthetic treatments – sun beds, devices for drying nail polish. • Tools for treatment – teeth, skin, pain relief • UV-based solar cells • Ultraviolet lasers in industry and research – spectrophotometry, astronomy, chemical compound analysis, examination of internal composition of objects (non-destructive)



Solar cell



Device for drying nail polish



Ionizing radiation – range of transition from non-ionizing radiation

Band frequency	Frequency range	Division into sub-ranges Examples of uses and designations
UV Ultra Violet light Short wave or extremely short wave	3 - 30 PHz	<ul style="list-style-type: none"> • Generally divided into 9 energy bands, including UVB ,UVC, medium ultraviolet, distant ultraviolet and extreme ultraviolet (10-315nm)



Pool water purification

Ionizing radiation

Band frequency	Frequency range	Division into sub-ranges Examples of uses and designations
X-rays	30 PHz - 30 EHz	<ul style="list-style-type: none"> X rays (also called Roentgen rays, after their discoverer) are used for medical diagnosis, such as bone fractures or internal organ, using contrast media such as barium and iodine. They are also used in engineering, to discover cracks in materials, for instance in aircraft, and in scientific research as in crystallography, solid state research, etc. Ionizing radiation is considered dangerous to humans, and its utilization in medicine is performed using minimal doses, as required. <div style="text-align: right;">  <p>X-ray equipment</p> </div>
Gamma rays	30 EHz - 300 EHz	<ul style="list-style-type: none"> Gamma (γ) radiation is electromagnetic radiation emitted by disintegration of radioactive atoms (nuclear fission). In radioactive fission, alpha radiation is also emitted (ionized Helium atoms) as well as beta radiation (electrons). Gamma radiation consists of photon energy in the shortest range of wavelengths of the electromagnetic spectrum. In interactive processes between elementary particles (e.g. the electron-positron annihilation process), photons of the gamma type are released. The wavelength of this radiation is 5 picometers to 10 nanometers. Gamma radiation is in the range of ionizing radiation, of extremely high energy, and consequently very dangerous to humans. The strength of penetration and ionization of gamma photons is of the strongest type (apart from cosmic radiation), and they can penetrate living tissues 10 cm or more in thickness, and even a few centimeters of solid lead. Exposure to a small quantity may cause cancer through DNA damage, or mutations and biological deformations (e.g. in neonates), and sustained exposure is definitely fatal. It is used in medicine for sterilization, for causing intentional experimental mutations, in radiotherapy for treatment of tumors, and in industry as radioactive tracers, smoke detectors, measuring sensors, etc. <div style="text-align: right;">  <p>Nuclear power station</p> </div>