

# PEMF (Pulsed Electro Magnetic Fields) in a nutshell



An electromagnetic field (also EMF or EM-field) is a physical quantity produced by electrically charged objects. The four crucial parameters defining the exposed signal structure are:

● **Waveform**

● **Frequency**

● **Field intensity**

● **Resonance**

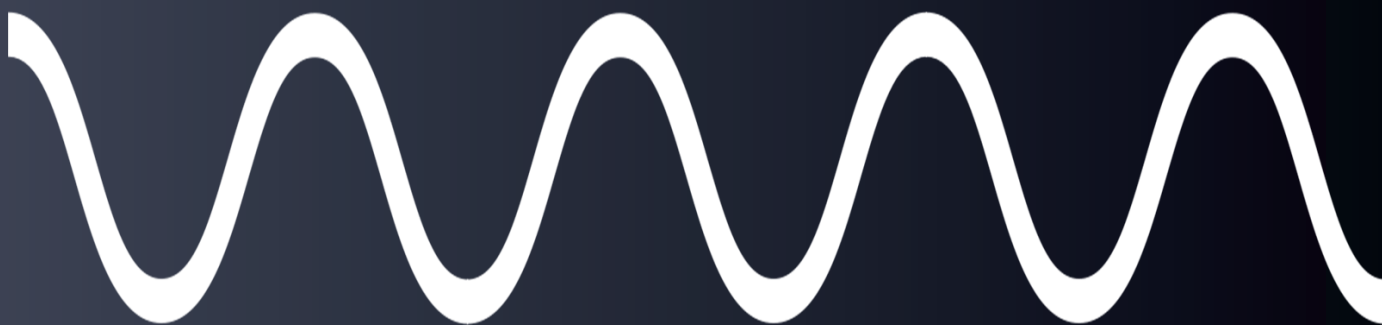
In theory those 4 components must be carefully arranged in mutual balance (coherence) and introduced into the body in order to produce the optimum health-promoting effect, and in the same time to avoid negative effects. The exposed composition of the basic parameters differentiates whether an electromagnetic signal is harmful (e.g., from computer systems, cell phones, WIFI, Bluetooth, microwaves, power lines etc.) or health-promoting, e.g., low-frequency, pulsed electromagnetic fields (PEMF) utilized in health care, for prophylaxis and overall wellbeing.



# Waveform

A wave is a disturbance traveling through space, transferring energy from one point to the next. Those of us who studied physics or algebra are familiar with the graphic depiction of sine waves. Mathematically, sine waves can be drawn on a coordinate system consisting of “x” and “y” axis. The y-axis contains both positive and negative values. A sine wave varies cyclically both above and below the y-axis, and is symmetrical about the zero-axis (or x-axis). The most positive value is at the “peak” of the sine wave. This is called the “peak amplitude” and represents the point of maximum displacement of the magnetic signal from zero. In bioelectromagnetic medicine, peak amplitude, or wave intensity, is usually measured in microTesla (previously: Gauss).

## Sine Wave



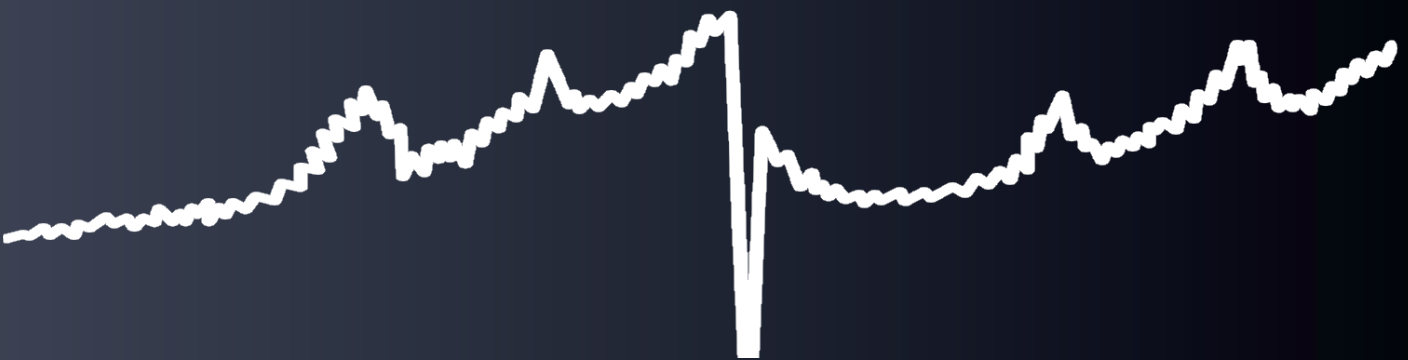
A magnetic wave that has alternating polarities (e.g., both positive and negative peaks or cycles), is called a bipolar wave. Magnetic signal shapes and behaviors can be manipulated by altering the electrical currents that generate them. This is usually done by computerized controls. By combining cycles of electrically generated magnetic pulsations, “pulse trains” can be created which enhance biological effects of the magnetic stimulus. The most critical component of the waveform is its rise time and fall time. According to Liboff, the therapeutic value of a given pulsed signal is highly dependent on how rapidly the rise time and fall time happen. This signal characteristic cannot be underemphasized, and is perhaps the most important parameter of an electromagnetic signal. The abrupt fall time represents a high peak voltage value that is responsible for ion displacement in the body. Greater ion displacement exerts a stronger biological effect. More effective than a simple sine wave or a static magnetic, the iMRS prime and Omnium1 systems generate very complex physical waveforms for overall health-promoting results. The so-called sawtooth signal shape and also the square waveform create rise and fall times that are far more abrupt comparing to a simple sine wave, leading to a greater biological effect.

Overall, the waveform or shape of the electromagnetic signal, is something to which very close attention needs to be paid. The most effective, complex waveform for holistic health-promoting results is hereby the sawtooth wave.

## Square Wave



## Sawtooth Wave



Clinical evidence of the sawtooth waveform was first published by researcher Bassett in 1974. Dr. Bassett observed that changes in the electromagnetic signal induce an electrical current within the treated tissue. Maximum current could be measured whenever the applied signal was abruptly falling from its peak value to its lowest value (fall time). This “piezoelectric” induction within bone structures accelerates bone healing. As a result of Bassett’s work, this waveform has been FDA approved in the United States since 1979 for the treatment of non-union fractures and to aid in spinal fusion operations.

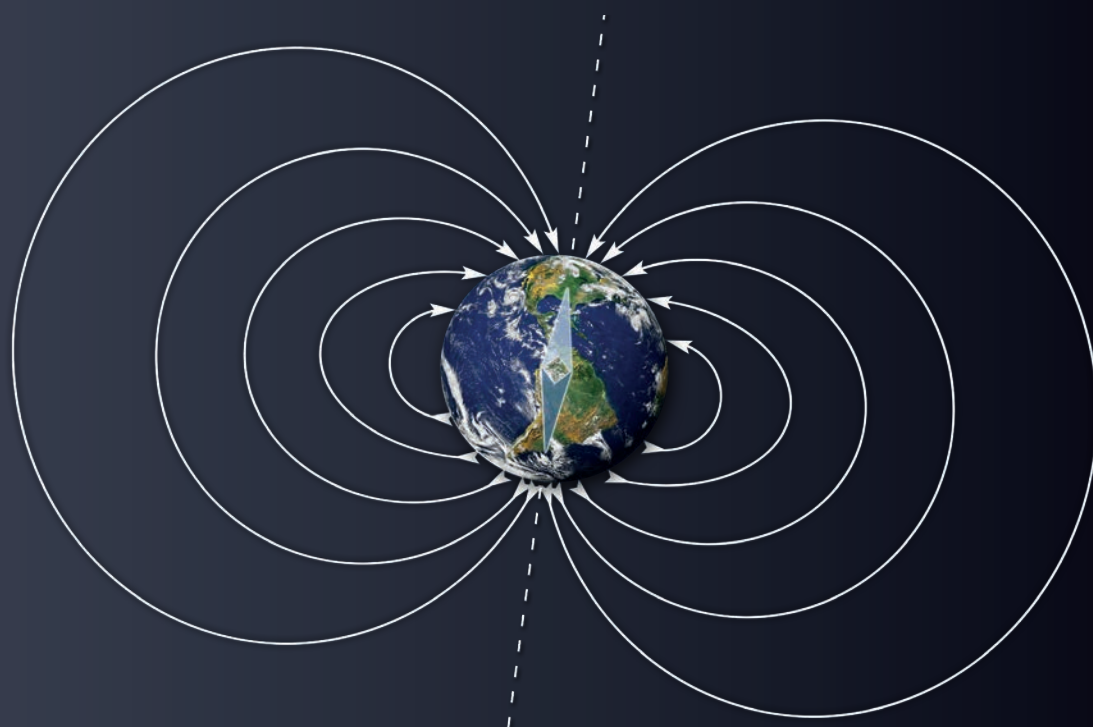
The iMRS prime and Omnium1 systems come both with a whole-body mat applicator. The signal shape delivered by the mat is a triple-sawtooth waveform. This waveform is a composite of a large number of harmonious, non-sinusoidal waves in the low-frequency range. The sawtooth pulse of the iMRS prime and Omnium1 whole-body mat applicator supplies a carrier frequency range between 0.5 and 15 HZ, which is 100% within

the so-called “biological window”. Unlike simple sine waves or static, externally worn magnets, the sawtooth signal changes continuously, producing constant induction of electromagnetism into the body’s tissues, maximizing ion displacement and preventing cellular membrane fatigue. This means that the cell membrane remains responsive to the signals, enhancing and optimizing the beneficial effects of electromagnetic stimulation. Research has shown that the complex triple-sawtooth carrier waveform, utilized by the iMRS prime and Omnium1 whole body mats, provide the highest resonance probability of electromagnetic stimulation in living tissues and therefore superior health and wellness benefits.

## Field Intensity

Field Intensity (also known as amplitude or flux density) is a quantitative description of an electromagnetic field that depends on current flow and direction and has been given the unit Tesla (T), after Nikola Tesla, a Serbian born, American scientist who is best known for many revolutionary contributions in the field of electricity and magnetism in the late 19th and early 20th centuries. “Gauss” is an older unit for flux density, which is still used as a standard in several countries world-wide (1 Gauss = 100 microTesla).

The determinants of field intensity (amplitude) are the length of the magnetic coil wire, its wire diameter, the number of turns (or “windings”) of the coil, and the strength of the electrical current (Ampère) applied to the coil. Together with the induction constant and the specific physical resistance of the material, the field intensity (or flux density) of an electromagnetic field can be calculated.





Diagnostic systems such as Magnetic Resonance Imaging (MRI) use field strengths in the Tesla range (1.5 – 3 T), iMRS prime and Omnim1-Systems expose extremely low field strengths within the lower, three-figure microTesla range. Since the target of signaling is the cell membrane, extremely low intensities are quite adequate in producing highly beneficial biological response. This thesis is based on the principle of the “biological window,” a study design developed, explored and published by Dr. Ross Adey. Adey discovered specific, narrow ranges of electromagnetic frequencies to which the body responds more likely. This principle can equally be applied to field intensity -- there is a “biological window” of electromagnetic intensities to which the human body responds best and contributes to active cell regeneration and enhanced oxygen delivery. The respective research of Goodman and Blank has proven, that human cells most readily express a cell-preserving gene, heat shock protein 70 (hsp70), at 7-8 microTesla rather than at stronger field intensities above 70-100 microTesla.

The native “mind” of a human cell, from an electromagnetic perspective, reacts rather on a subtle and gentle “whisper”.

The state of the art iMRS prime and Omnim1-Systems are equipped with this native “language” and use extremely low field intensities that communicate most effectively with the cell membrane. The result is the best possible holistic health effect on all body cells.

## Frequency

Just as our cells can be signaled to perform new and different functions by stimulation with chemicals (e.g., nutrients or drugs), they can also be signaled energetically with electromagnetic waves. In fact, some very desirable cellular functions are stimulated more robustly by energy than by chemistry. The healthy band width of electromagnetic frequencies is scientifically proven. These ranges of frequencies are called “biological windows.” As long as the frequency being delivered falls within this window it will confer benefit to the cell in terms of intake of nutrients, elimination of waste products of metabolism, and overall cellular function. That’s precisely what iMRS prime and Omnim1 systems do; they deliver the correct frequency patterns within the biological windows of health!

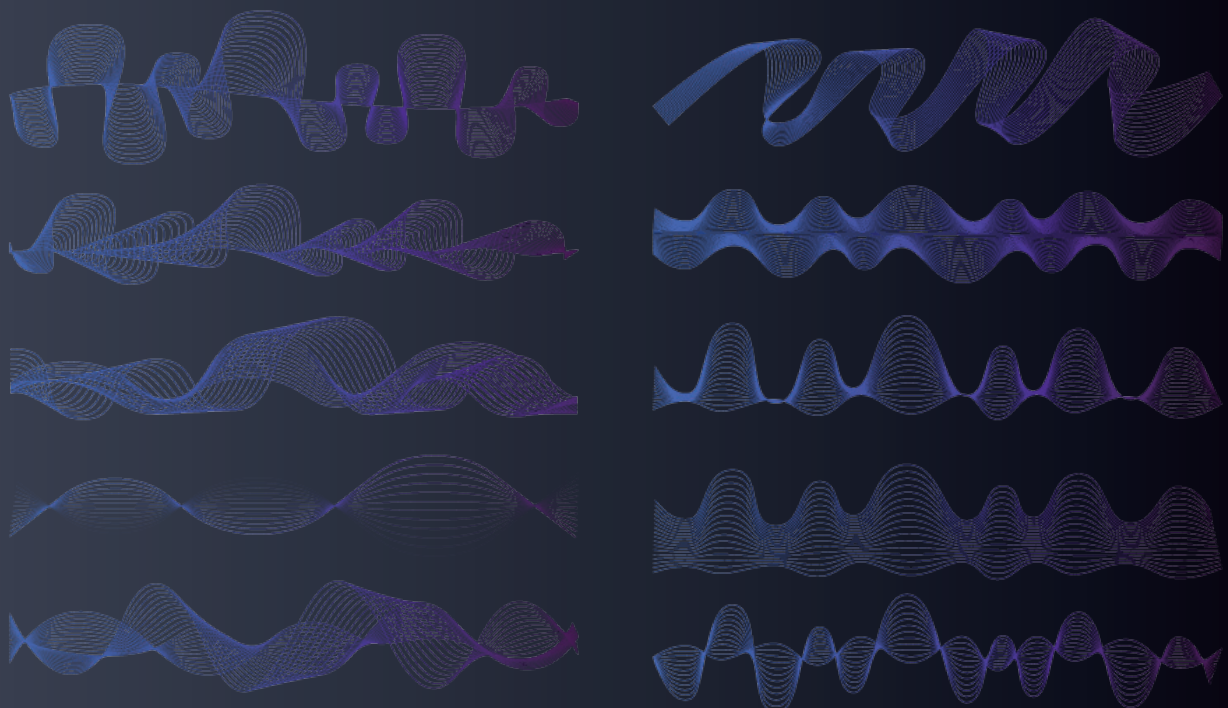
An analogy would be acoustic frequencies. Some sounds are too loud to enjoy, some are too soft to be heard. There is a tiny “window” of volume within, which creates a pleasant and even healthful, hearing experience. The same principle applies to electromagnetism. There are pleasant, healthful electromagnetic frequencies; others that are too soft to be assimilated or perceived by the body, and others that are so “loud” that the cells are negatively impacted by such signals. Those noxious and harmful signals are called “electrosmog”.

The iMRS prime and Omnium1 whole body applicators use 3 pairs of uninsulated, solid copper coils of varying amounts of windings to simulate the electromagnetic frequencies and intensities of the earth's magnetic field. We know from nature that such frequencies are in perfect harmony with health and well-being. Daily use of a whole-body applicator supports the elimination of stress and tension while encouraging greater oxygen supply, increasing circulation and enhancing how your body works at the cellular level.

The rate of change in a wave is its "frequency." Waves undulate from peak to valley to peak. The time from one peak to the next peak is a cycle. One cycle encompasses one positive (above-the-line) peak and one negative peak. The most basic unit of frequency is one cycle per second. One cycle per second (cps) is also referred to as one "hertz," in honor of 19th century German physicist Heinrich Hertz, whose discovery of electromagnetic waves led to the development of radio. A frequency of 25 Hertz (Hz) represents 25 cycles per second.

The frequency rate is measured from one peak to the next peak. Sine wave application is a simple mode by which energy is transferred towards a medium (such as the body); the more cycles per second, the more energy transfer per second. We are rather aware of light energy and understand waves of light (photons). However, the visible light spectrum is only a very small portion of the electromagnetic spectrum.

Similarly, audible sound is a small slice of the sound frequency (acoustic) spectrum, and the human ear can only detect and respond to a tiny portion of the frequencies that lie within this spectrum. With reference to the transfer of bioelectromagnetic signals, the following general rule applies: The higher the frequency, the more energy is delivered to the body. But understanding Adey's principle of the "biological window", we know that just like light and sound, the human body is only capable of responding beneficially and healthfully to a small range of the electromagnetic frequency spectrum (coherence effect).



Many manufacturers of PEMF systems for home use boast about that higher power and its supposed advantage, true to the motto: "The more the merrier!". We from Swissbionic Solutions however understand that clinically applied energy medicine doesn't necessarily work like this. Natural frequencies within the proven biological windows are the most effective at supporting vibrant health and well-being - in essence: "Less is more"! In PEMF therapy, one refers to cycles as pulses. Thus, cycles per second are understood to mean pulses per second. A 25 Hz electromagnetic frequency is therefore comprised of 25 pulses per second. The human body contains many natural frequencies. Among them are the heartbeat, the cerebrospinal fluid flow, the respiratory rhythm and the electromagnetic waves of the brain. John Zimmerman, former PhD at the University of Colorado, documented that the hand of a therapeutic touch practitioner emits an electromagnetic frequency averaging between 7-8 Hz when the practitioner is actively engaged in employing healing touch. Interestingly, the Schumann resonances produced within the earth's ionosphere are scientifically valued at 7.83 Hz. The earth magnetic field has been scientifically calculated at a range between 11.75 - 11.79 Hz (Piontzik). The alpha waves of the brain appear to be very similar, if not virtually identical to the natural Schumann frequencies.

## Schumann Resonance

In 1954 Schumann and König reported on their discovery of naturally occurring electromagnetic pulsations on the Earth. Schumann resonances are natural waves excited by lightning strikes in the cavity between the Earth's surface and the ionosphere. In essence, lightnings pump energy into the cavity of the earth's atmosphere and cause it to vibrate or resonate at extremely low frequencies. Electromagnetic waves created by lightnings travel around the Earth at the speed of light, reflecting from the ionosphere to the earth and back again in cyclical fashion. These waves circumnavigate the globe at an average of 7.83 times per second. As noted above, this frequency correlates with the average frequency of alpha brain waves in human beings. The carrier frequency of the earth magnetic field is scientifically documented and valued at 11.75 - 11.79 HZ (Piontzik).





The carrier frequency of the Schumann resonances (“tonic frequency”) is exactly 7.83 Hz. An overtone is defined as a higher pitch of the basic frequency within a vibrational system. Those who sing or play guitar are familiar with the creation of overtones – frequencies of sound that are often created by superimposing one fundamental frequency upon another. Further natural pitches occur at 6.5 Hz intervals due to the Earth’s spherical geometry. Additional overtones can be detected in the background radio noise of the Earth’s energetic field as separate pitches between 14 and 35 Hz. Furthermore, these harmonics seem to be essential for our bodies.

If our bodies are separated or blocked from the natural exposure to these vibrations (e.g., due to living and working in buildings, constructed with concrete, steel and metal alloys, driving in cars on paved roads, and by the electro-pollution of ultra-high frequency radiations from cell phones, microwave ovens, cordless home phones, WIFI networks, radar/satellite signals, etc.) we are more susceptible to illnesses, loss of cell membrane integrity, lack of energy and circulation, compromised immunity and depression. Recorded fluctuations in the Earth’s Schumann resonances have had strong correlation to heart attacks, car accidents, and to a general increase in death rates (Beck 1992).

There is an enormous range of electromagnetic frequencies either already in use or suggested for use in health care. The main focus is hereby on the target-oriented application with defined indications (such as **repetitive Transcranial Magnetic Stimulation = rTMS** for depression). Frequencies in use range from the extremely low frequency (ELF) range of 3 to 300 Hz to the upper end as high as 50 billion Hz (50 GHz). For medical PEMF applications at home and for safety reasons, it is recommended to choose certified medical devices such as the iMRS prime and Omnium1 in compliance with the latest MDR norm (2017/745), delivering frequencies within the ELF (Extremely Low Frequency) range. The two systems generate waveforms (sawtooth and squarewave), which, based on their physical properties, not only deliver vast amounts of single frequencies and its relating harmonics, but also the necessary fast rise and fall times to initiate and maintain the desired resonance effects with the cells in the body.



# Resonance

Resonance is a principle that was discovered by Galileo Galilei in 1602 while he studied pendulums. Resonance is the tendency of a system to oscillate with maximum amplitude at certain frequencies.

A common example of resonance is a playground swing, which acts as a pendulum. If you push a child on a swing in time with the natural interval of the swing (its resonating frequency), the swing will go higher and higher (up to its maximum amplitude). Applying a pushing force at any other time will interfere with or dampen the resonating frequency and the swing will be lowered in amplitude, disrupted or stopped entirely. The energy (external push) absorbed by the swing is maximized whenever it is in sync (or “in resonance”) with the swing’s own oscillations.



Every cell of the human body is vibrating or oscillating. This can be visually observed in video footage under high magnification when red blood cells travel through vessels or macrophages chasing bacteria. Pulsed electromagnetic fields with an appropriate frequency spectrum are capable of producing cellular resonance = vibration at maximum amplitude. They trigger the respective carrier frequencies of receptors (neuropeptides) with the aim to stimulate a variety of functions around and within each cell. The human body consists of roughly 75 trillion cells (depending on size and weight) whereas each cell membrane holds over 1 million neuropeptide receptors. A precisely defined pulsating electromagnetic field within the biological window signals all these receptors



simultaneously at the speed of light and encourage them to resonate with the applied vibrations. This is the essential property of PEMF. The profound beneficial effects in human physiology through PEMF`s are initiated through improved inter- and intracellular communication and interaction produced by the induction of resonance within the body. Until today it is not scientifically proven, that frequencies outside the biological window are capable of creating resonating effects on cellular structures.

The higher the frequency, the more difficult it is to gauge the effect on the cell. Importantly, this applies to “unnatural” frequencies in the KHz and MHz range exposed by wireless home phones, smartphones, WIFI routers and many common household electrical devices. The newest and most effective generation of medically certified PEMF systems, the iMRS prime or Omnium1, target the extremely low frequency range – matching known tonic oscillatory vibrations of the body’s cells. They represent the gold standard of the utilization of advanced computerized stochastic resonance modeling to achieve maximum cellular resonance.

## Biological Window

Dr. William Ross Adey, an Australian born professor of anatomy and physiology working at UCLA School of Medicine, coined the term “biological window.” (Bawin and Adey 1976) Adey measured the calcium output of brain cells in rabbits to demonstrate that this effect could only be triggered using very low magnetic field intensities and a specific low frequency (16 Hz). Since Dr. Adey’s initial discovery, energy medicine literature has shown strong scientific consensus that biological windows are important.





A biological window is a range or spectrum of electromagnetic energies that are readily accepted by the body and converted into positive physiological responses. Signals that fall outside the biological window have little or no effect, or in some cases even a negative or toxic effect. As an analogy, audible frequencies can be pleasant (e.g., a symphony) or can be destructive (e.g., the sound of an explosion can permanently destroy hearing). Research has proven that living tissues readily detect, absorb and utilize electromagnetic signals within certain frequency ranges and completely ignore other frequencies naturally encountered in the frequency spectrum.

## Organ Clock

The whole-body applicators of the iMRS prime and Omnium1 systems use pre-programmed frequency patterns that vary based on the time of day the device is used. The basis for this time variance of frequency is naturally observed circadian rhythms. This phenomenon is meanwhile scientifically proven and has been awarded with the Nobel prize in Medicine 2017 (Hall, Rosbash and Young: Discoveries of Molecular Mechanisms Controlling the Circadian Rhythm). According to Traditional Chinese Medicine (and other ancient healing traditions in Asia) vital energy flows through the twelve organs and completes one cycle every twenty-four hours. The Chinese Organ Clock shows the circadian flow of the vital energy (Qi – pronounced “Chi”) through various organ systems in relation to the time of day. Each organ has maximum energy for two hours. The organ has minimum energy (or lowest flow of Qi) 12 hours later.

<b>TIME</b>	<b>MAXIMUM ENERGY</b>	<b>ORGAN/MERIDIAN</b>
3 to 5 AM	4 AM	LUNG
5 to 7 AM	6 AM	LARGE INTESTINE
7 to 9 AM	8 AM	STOMACH
9 to 11 AM	10 AM	SPLEEN
11 to 1 PM	12 NOON	HEART
1 to 3 PM	2 PM	SMALL INTESTINE
3 to 5 PM	4 PM	URINARY BLADDER
5 to 7 PM	6 PM	KIDNEY
7 to 9 PM	8 PM	PERICARDIUM
9 to 11 PM	10 PM	TRIPLE WARMER
11 to 1 AM	0 MIDNIGHT	GALL BLADDER
1 to 3 AM	2 AM	LIVER



From the above chart it can be seen that the maximum energy flow through the liver is at 2 am. Therefore, the liver's lowest corresponding energy flow is at 2 pm. iMRS prime and Omnium1 systems deliver pulse packages of energy that are believed to balance cellular resonance for all the organs and body systems simultaneously by varying frequencies through 4 pre-programmed intervals:

● 5 am - 10 am

● 3 pm - 8 pm

● 10 am - 3 pm

● 8 pm - 5 am

The pulse packages delivered by the whole-body mat applicator of the iMRS prime or Omnium1 utilize the complex and highly effective triple sawtooth signal shape and are composites of a large number of single electromagnetic frequencies in the extremely low frequency (ELF) range. It allows to transfer a maximum of single frequencies and its harmonics within short application durations (8-24 min.). Every 2 minutes during this signaling the polarity is reversed to prevent cellular fatigue and accommodation to the signal. This concept is intended to maximize sustainable therapeutic success.

The smaller Pad and Spot applicators are capable of higher field intensities and are versatile in how they are applied externally to the body. There is no need for an Organ Clock adjustment for these applicators as the focus of a local PEMF application is to address an isolated indication. A specific rectangle waveform (square wave) is used to achieve the best and fastest results.

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