



TENS VS. TENNANT BIOMODULATOR® TECHNOLOGY COMPARISON

Tennant Biomodulator® devices are often mistaken for conventional TENS (Transcutaneous electrical nerve stimulation). Tennant Biomodulator® devices are FDA cleared as micro-current devices for the symptomatic relief and management of chronic, intractable pain, and adjunctive treatment in the management of post surgical and post-traumatic pain. The output signature of the Tennant device is unique and is the basis for the Tennant Biomodulator® superior performance. Conventional TENS do not have this unique signature and therefore not perform the same as the Tennant Biomodulator®. Compare the difference.

Technical Comparison

TENNANT BIOMODULATOR® TECHNOLOGY	CONVENTIONAL TENS
21st Century Technology	1970's Technology
High intensity, very low current, burst pulses	Low intensity, higher current, long duration pulses
Voltage Range: 20-600 volts	Voltage Range: 0-40 volts
Amperage Range: Microamps (10^{-6} Amps)	Amperage Range: Milliamps (10^{-3} Amps)
Signals in the frequency range of 1Hz to 1500 Hz	Signals in the frequency range of 1Hz to 100 Hz
Damped asymmetrical biphasic sinusoidal waveform	Square waveform, mono-phasic or biphasic symmetrical or asymmetrical
Signaling always varies based upon changes in impedance of the tissue	Signaling is typically the same continuous pattern.
The TENNANT BIOMODULATOR® device forms a somatic feedback loop between the device and the tissue	NO BIOFEEDBACK

Performance Comparison

TENNANT BIOMODULATOR® TECHNOLOGY	CONVENTIONAL TENS
Somatic feedback loop prevents neurological habituation and accommodation, for more effective pain management.	Develops neurological habituation and accommodation, which severely limits effectiveness of pain management.
Effectiveness lasts several hours after treatment	Effectiveness often stops when treatment ends

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In –Depth Comparison

TENNANT BIOMODULATOR® TECHNOLOGY	CONVENTIONAL TENS
<p>Signals in the frequency range of 1 Hz to 500Hz, high intensity pulses, direct effect on secretory C fibers, also significant CNS effects via C afferents to spinal ascending and opioid mediated descending inhibitory pathways.</p>	<p>Signals in the frequency range of 1 Hz to 100Hz, low intensity pulses, activation of Type J and AB afferent fibers based upon Gate control theory mechanism and signal blocking or diversion</p>
<p>Damped asymmetrical biphasic sinusoidal waveform</p>	<p>Mono-phasic or asymmetrical biphasic waveform</p>
<p>High intensity, short duration pulses, induces Neuropeptide release, initiates long-term cascading effects and up-regulation of NP, endorphin, serotonin, and enkephalin synthesis</p>	<p>Low intensity activates large muscle (type J) and large skin A-B nerves for Gate effect.</p>
<p>Non-segmental and segmental effects: neuropeptide cascade initiated by small C fibers act generally as well as locally: in spine, brainstem, and CNS.</p>	<p>Segmental effects based on Gate Theory: large diameter fibers inhibit pain from small fibers.</p>
<p>Analgesia starts within moments and lasts up to twelve hours with both local and systemic pain relief.</p>	<p>Analgesia starts within a few moments of stimulation and disappears within seconds of switching the machine off. TENS must be used for long periods of time for sustained relief.</p>
<p>TENNANT BIOMODULATOR® micro-ampere output current reduces chance of burns or irritation.</p>	<p>High intensity of most TENS devices can cause burning of skin.</p>
<p>No Pads are necessary as the electrode on the unit both transmits and receives. The unit can be placed on acupuncture points or over subcutaneous large diameter nerves as well as directly on areas of interest or pain. Electrodes for point source delivery are available. For convenience, pads and conductive garments are attachable.</p>	<p>Pads are placed near the site of pain as large diameter fibers are widely distributed.</p>
<p>Because of dynamic waveform and cybernetic feedback, habituation or accommodation is avoided.</p>	<p>Tolerance (accommodation and habituation phenomenon) develops over time.</p>
<p>Short duty cycle with Tennant Biomodulator®. Typical unit is "off" over 99% of the time and emits burst signals less than 1 % of the treatment time.</p>	<p>Prolonged duty cycle, long durations of "on" operation compared to "off" condition</p>
<p>Tennant Biomodulator® delivers signals with voltages and currents varying as the impedance of the skin changes as result to prior stimulation pulses.</p>	<p>TENS is constant voltage signal with variable changes in current and resistance/ impedance over the pulse interval.</p>
<p>Cybernetic loop whereby Tennant Biomodulator® and the patient's neurological system form a mutually interacting communication and control system via automatic biofeedback and impedance signaling of affected tissues.</p>	<p>External control with no bio-feedback modulation of the output signal. TENS signaling is constant although some models have a fixed external program that varies signaling to resist accommodation or habituation.</p>

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History of TENS Technology

TENS technology can be divided into four generations : early TENS; second generation TENS; third generation (interferential) TENS; and interactive biofeedback neuromodulation.

First Generation - Early TENS: TENS devices developed in the 1930s had mono-phasic square-wave signals and worked at 10 to 500 mA (milliAmpere). This technology has serious drawbacks: habituation (it treated pain for several weeks, after which time the body accommodated or habituated to the stimulation and no longer blocked pain). The other serious drawback was its short period of pain relief (less than one hour). Even though this technology is obsolete, it is still used today and frequently is the only experience patients have with TENS.

Second Generation TENS: The technology for this group, developed in the 1970s, has an asymmetrical biphasic square wave output. Biphasic means the signal goes plus and minus relative to a reference voltage. Asymmetrical means the plus and minus signals are not equal in time of application and/or voltage. The improvement over early TENS is that habituation is reduced. Even so, pain relief still is brief (less than an hour). Again, this obsolete technology is still widely available and used today.

Third Generation - Interferential TENS: This technology was subsequently developed with asymmetrical, biphasic, and irregular shaped, microcurrent wave outputs. These waveforms result in partial opioid mode and partial pain gate mode. Opioid mode means that the electrical stimulation results in the production by the body of endogenous opioid peptides which mitigate pain. Pain gate mode means the A and B nerve fibers are stimulated to inhibit an individual's perception of pain. This technology improves the duration of pain relief while reducing the likelihood of habituation. This technology is widely used today.

Fourth Generation - Interactive Biofeedback Neuromodulation: This technology, implemented by Senergy Medical Group in its premier line of Biomodulator® products, incorporates the latest understanding in microcurrent and neuromodulation. Research and observations concluded:

- Pulsed high voltage (>250 volts), low-duty cycle «10%), microcurrent signals are more effective in stimulating the thin C fibers of the nervous system than square wave signals.
- An asymmetrical wave form reduces habituation.
- The use of electrical biofeedback to adjust the waveform as the electrical properties of the tissue being treated changes further reduces habituation and allows the technology to measure the progress of the treatment and provides information to the medical practitioner.
- Sine wave signals more closely approximate the natural signals in the nervous system.



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Summarized Characteristics of Three Generations of TENS versus TENNANT Interactive Biofeedback Neuromodulation

	TENS DEVICES			TENNANT PRODUCTS
Characteristics	1 st Generation Early Tens	2 nd Generation TENS	3 rd Generation Interferential	Interactive Biofeedback Neuromodulation
Wave Form	Square Wave	Square Wave	Square Wave w/Spikes	Damped Sinusoidal
Biphasic or Monophasic	Monophasic	Biphasic	Biphasic	Biphasic
Treatment Current	Milliampere	Milliampere	Milliampere	Microampere
Voltage	Low Voltage	Low Voltage	Pulsed High Voltage	Pulsed High Voltage
Interactive Biofeedback	NO	NO	NO	YES
Habituation	Serious Problem	Reduced	Greatly Reduced	Eliminated
Principle Treatment Effects	Gate Mode	Gate Mode	Pain Gate + Opioid Mode	Pain Gate + Opioid Mode
Lengths of Pain Relief (hrs)	< 1 Hour	< 1 Hour	< 1 Hour	6 to 8 hours
Diagnostic Indication	NO	NO	NO	YES

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