# Microstim Stimulator General Theory

Peripheral nerve stimulators have been designed to aid anesthetists detect and monitor neuromuscular function. They are used to assess the neuromuscular block during surgery and the reversal of neuromuscular block during the recovery period. By using a nerve stimulator a clinician can determine the effects of neuromuscular-blocking drugs and adjust the dosages accordingly by observing muscular response to different patterns of electrical nerve stimulation, The degree of neuromuscular relaxation is important in determining the timing of intubation and extubation.

**Principles of operation**
The Microstim delivers electrical current to a peripheral nerve, typically the ulnar nerve at the wrist; When the peripheral nerve is stimulated sufficiently the muscle fibres contract. If the intensity is increased further, the stimulus is described as supramaximal, but muscular contraction does not increase. By delivering the same amount of supramaximal stimulation before and after administration of neuromuscular-blocking drugs, the clinician can determine the effect of the neuromuscular block.

The Microstim supramaximal nerve stimulator is battery powered
It is similar to other stimulators in offering four types of stimulation:
Twitch, Train-of-four (TOF), Tetanic, Double burst.
These techniques produce specific responses or patterns of muscle contraction. The level or type of block is assessed by observing visually or tactilely the degree to which the affected muscle contracts.
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**Twitch**:
Consists of a single supramaximal current and is applied repetitively at a frequency of 0.1 to 2 Hertz (Hz). The pulses are typically rectangular and have durations of 0.2 millisecond or less to avoid repetitive nerve firing. Single-twitch stimulation is the least sensitive method of demonstrating a partial neuromuscular block. The twitch response is not reduced until at least 75% to 80% of the nerve endings are blocked, and it disappears completely when 90% are blocked.
The Microstim applies Hz with a pulse duration of milliseconds

**Train of Four TOF**:
Consists of four supramaximal stimuli at 2 Hz: at half-second intervals. The amplitude of the fourth response in relation to the first gives the TOF ratio, which begins to decrease when more than 70% of the receptors are blocked. TOF stimulation can be repeated every 8 to 12 seconds.
The Microstim applies Hz at intervals

Some neuromuscular blocks cannot be evaluated using Single-twitch or TOF stimulation during deep relaxation. because the associated response can disappears for extended periods e.g greater than 5 minutes

**Tetanic** :
Can consist of pulses at a much higher rate (30 to 100 Hz).
Greater sensitivity is possible at higher frequencies. but at 100 Hz for 5 seconds a lack of appropriate response develops when 50% of the receptors are blocked; and at 200 Hz for 5 seconds there is insufficient response when only 30% of the receptors are blocked.
Tetanic stimulation can be painful and under certain conditions may influence the course of the

neuromuscular block in the investigated muscle.
The Microstim supplies 50Hz applied for 5 seconds then 1Hz for 30 seconds

**Double-burst**:
Consists of either two trains of three pulses at approximately 50 Hz, separated by approximately 0.75 milliseconds, (3.3)
or an initial train of three pulses followed by a train of two pulses (3.2).
The neuromuscular response consists of two short muscle contractions, the second of which is significantly less forceful than the first. The ratio of these contractile forces indicates the degree of patient drug-induced muscular relaxation.
The Micostim consists of 3 pulses at 50Hz followed by a 0.75 second pulse then 2 pulses at 50Hz

**Application of the stimuli**
Motor fibres are stimulated before pain fibres and as low stimulating currents are used for regional anesthesia the patient feels minimal discomfort
Conventional EKG disposable electrodes are most commonly used for applying the stimulation as they provide good contact with low impedance.
**Ball Electrodes**
Some competitive models are also equipped with ball electrodes mounted on the stimulator This method was rejected due to the possibility of varying skin impedance caused by the small to area of application and the conductive properties of the skin . Intermittent conductivity could cause inadvertent large jumps in the energy levels being applied.
Burns are unlikely to occur with peripheral nerve stimulators because they use low current and typically only briefly impart electrical energy through the skin.
The Microstim was designed to be battery driven as this eliminates many of the perceived risks in relation to burns particularly with earth leakage currents and alternative paths via electrosurgical units

**Microstim Specifications**
Typical current mA into 1000 ohms
Pulse width
Pulse Indicator LED
Battery type MN1604 9volt
Battery state indicator 3 colour LED
Battery capacity
Height
Width
Depth
Weight gms oz

**Terminal polarity indication:**
Indicates the positive and negative bipolar electrodes.
Leads comply with FDA “protected” lead set requirements

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**Pacemakers**

Problems have been reported with use of peripheral nerve stimulators during surgical procedures. E.g pacemaker during surgery. Pacemaker function returned to normal upon cessation of peripheral nerve stimulation. Suitable warnings are given in the instructions

## Associated Papers


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**Existing International Standards**


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Medical electrical equipment — part 1: general requirements for safety. Amendment 1 [standard]. IEC 60601-1-aml (1991-11). 1991.

Medical electrical equipment — part 1: general requirements for safety. Amendment 2 [standard]. IEC 60601-1-am2 (1995-03). 1995.

# Microstim Stimulator General Theory

Medical electrical equipment — part 1: general requirements for safety. Section 2. Collateral standard: electromagnetic compatibility — requirements and tests, IEC 60601-1-2 (1993-04). 1993.
Medical electrical equipment — part 2: particular requirements for the safety of nerve and muscle stimulators [standard]. JEC 60601-2-10 (1987-12). 1987.

**The Anaestim**

This version can be used to accurately locate peripheral nerves when performing regional anesthesia.
Needle electrodes connectect by crocodile clips transmit the electrical pulses from the stimulator to the nerve.
The correct application of electrodes is very important because even slight displacements can result in considerable changes in stimulation current requirements. In addition, the electrodes must be placed so that the device stimulates the nerve, not the muscle.

Many stimulators deliver a constant current set by the operator. Current settings typically range from 0.5 to 10 milliamperes (mA) — levels that can stimulate or depolarize a nerve without causing tissue trauma. The stimulator compensates for variations in tissue resistance and includes a digital meter to monitor the current and allow the operator to adjust the current output manually.