HEALTHCARE PRODUCT hpcs COMPARISON SYSTEM

September 1996

Stimulators, Peripheral-Nerve-Block Monitor

Scope of this Product Comparison

This Product Comparison includes line- and battery-powered portable peripheral nerve stimulators used to monitor neuromuscular block during surgery and recovery and to locate peripheral nerves during regional anesthesia. Evoked response units and electromyographs are excluded, as are devices designed primarily for research (see the Product Comparisons on **ELECTROMYOGRAPHS** and **EVOKED POTENTIAL UNITS**).

UMDNS information

This Product Comparison covers the following device term and product code as listed in ECRI's Universal Medical Device Nomenclature System™ (UMDNS™):

- Stimulators, Peripheral-Nerve-Block Monitor [16-252]

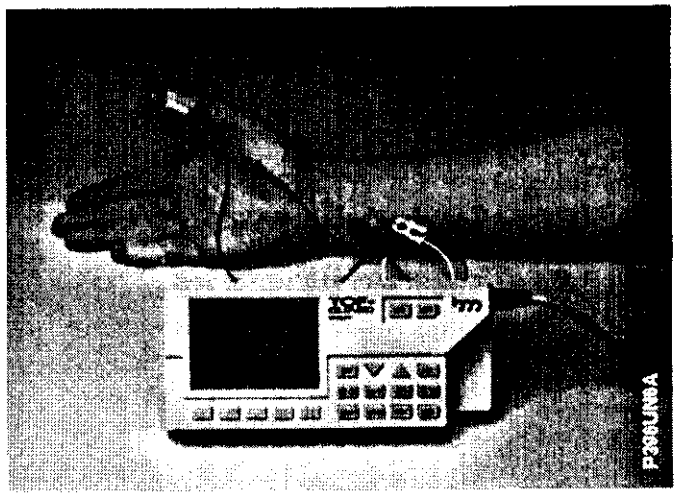
Purpose

Peripheral nerve stimulators help clinicians (typically anesthetists or anesthesiologists) detect and monitor neuromuscular function. They are also used to assess the adequacy of neuromuscular block during surgery and its reversal during the recovery period. By observing muscular response to different patterns of electrical nerve stimulation, the clinician can determine the effects of neuromuscular blocking drugs and adjust the dosages accordingly. (The degree of neuromuscular relaxation is also important in determining the timing of intubation and extubation.) Anesthesia personnel also use these devices to precisely locate peripheral nerves when performing regional anesthesia.

Principles of operation

Peripheral nerve stimulators deliver electrical current to a peripheral nerve designated for testing, typically the ulnar nerve at the wrist; the facial nerve or nerves of the lower extremities can also be used. When the clinician stimulates the peripheral nerve with sufficient intensity ("maximum force"), all the muscle fibers supplied by the nerve 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. These techniques may not be reliable for determining neuromuscular block in people with central nervous system lesions (e.g., spasticity or muscle weakness after stroke).

Peripheral nerve stimulators are battery or line powered and typically use four types of stimulation: twitch, train-of-four (TOF), double-burst, and tetanic.



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These techniques produce specific responses or patterns of muscle contraction. The clinician then assesses the level or type of block by observing visually or tactilely the degree to which the affected muscle contracts. Neuromuscular block can also be measured objectively by using mechanomyographic, electromyographic, or accelerometric equipment to quantify the tension produced in a specific muscle.

Twitch, or single-twitch, stimulation 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 (msec) 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 second type, TOF stimulation, consists of four supramaximal stimuli (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. The TOF stimuli can be repeated every 8 to 12 seconds.

Some neuromuscular blocks cannot be evaluated using single-twitch or TOF stimulation because the associated response disappears for 5 to 100 minutes or longer during deep relaxation. However, at least a part of this period can be quantified by applying a third and very sensitive type of stimulation, tetanic, and observing post-tetanic responses. Tetanic stimulation consists of pulses at a much higher rate (30 to 100 Hz). Stimulation at 50 Hz applied for 5 seconds is commonly used in clinical practice, and greater sensitivity is possible at higher frequencies. For example, at 100 Hz for 5 seconds, a lack of appropriate response develops when 50% of the receptors are blocked; at 200 Hz for 5 seconds, there is insufficient response when only 30% of the receptors are blocked. Tetanic stimulation can be painful, however, and under certain conditions may influence the course of the neuromuscular block in the investigated muscle.

Double-burst stimulation consists of either two trains of three pulses 0.75 msec apart (designated 3.3) or a train of three pulses followed by a two-pulse train (designated 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 curarization (drug-induced muscular relaxation).

Surface or needle electrodes transmit the electrical pulses from the stimulator to the nerve. Conventional ECG electrodes are most commonly used, but many models are also equipped with bipolar surface electrodes (ball electrodes) mounted on the stimulator or use them exclusively. Needle electrodes, sterile probes, and alligator clips attached to needles are typically used to locate peripheral nerves during regional anesthesia; needle electrodes and alligator clip electrodes can be helpful in monitoring neuromuscular block in obese patients. 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.

Reported problems

Tests have shown that output currents in peripheral nerve stimulators decrease slightly at higher impedance levels. This variability could result in erroneous assessment of neuromuscular block. Some manufacturers recommend the use of saline solution or electrode gel to improve electrode contact. When using any type of electrical stimulator, precautions should always be taken to prevent burns and electric shocks. However, such incidents seem unlikely to occur with peripheral nerve stimulators because they use low current and have only brief contact with the skin.

Problems have been reported with use of peripheral nerve stimulators during surgical procedures. A case has been reported in which a peripheral nerve stimulator interfered with the function of a patient's pacemaker during orthopedic surgery. Pacemaker function returned to normal upon cessation of peripheral nerve stimulation. Low batteries can also cause stimulator problems, but most units have charge-level indicators.

Purchase considerations

When making purchasing decisions, buyers should consider the capabilities they want in a peripheral nerve stimulator. Depending on the complexity of the device, the price range is from a few hundred dollars to several thousand dollars. Models that feature computer capabilities with extensive options, such as printers and memory storage, are considerably more expensive. Simple battery-operated devices can cost as little as $100. The cost of disposable accessories, such as surface electrodes, should also be considered when estimating the lifetime cost of the device.

Stage of development

Peripheral nerve stimulators are commonly used for locating peripheral nerves during regional anesthesia, in addition to their customary use for assessing neuromuscular block. New features on some models include internal memory and interfaces for computers and printers.

Bibliography

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Dankle JA, Wiegand DA. Investigation of a coaxial bipolar nerve stimulator for intraoperative motor nerve monitoring. *Laryngoscope* 1994 May;104(5 Pt 1):619-22.

Gravenstein JS, Paulus DA. *Monitoring practice in clinical anesthesia.* 2nd ed. Philadelphia: JB Lippincott; 1987:178-91.

Mylrea KC, Hameroff SR, Calkins JM, et al. Evaluation of peripheral nerve stimulators and relationship to possible errors in assessing neuromuscular blockade. *Anesthesiology* 1984 May;60(5):464-6.

O'Flaherty D, Wardill M, Adams AP. Inadvertent suppression of a fixed rate ventricular pacemaker using a peripheral nerve stimulator. *Anaesthesia* 1993 Aug; 48(8):687-9.

Sansome AJ, de Courcy JG. A new dual function nerve stimulator. *Anaesthesia* 1989;44:494-7.

Citations from other ECRI publications

Health Devices Alerts

This Product Comparison lists *Health Devices Alerts (HDA)* citations published since the last update of this report. Each *HDA* abstract is identified by an Accession Number. Recalls and hazard reports include descriptions of the problem involved; abstracts of other published articles are referenced by bibliographic information. *HPCS* subscribers can call the Hotline for additional information on any of these citations or to request more extensive searches of the HDA database.

A2574 FDA Class II Recall No. Z-1216-4 for certain ConMed unprotected lead wires used with Neuro Technology peripheral nerve stimulators. Product labeling on the units does not provide adequate directions for safe use. Neuro Technology initiated a recall by letter dated June 14, 1994, requesting that customers return a questionnaire, affix labels to the lead wires, and notify staff members of the potential hazards. **Source:** *FDA Enforcement Rep* 1994 Aug 17; Neuro Technology.

A2918 FDA Class II Recall Nos. Z-1039/1040-5 for certain Life-Tech unprotected cables/leads used or included with Dual Stim and Dual Stim Plus peripheral nerve stimulators. The cables/leads do not provide adequate directions for use. The manufacturer initiated a recall by letter dated August 4, 1995, requesting that customers apply warning labels to all affected cables/leads. **Source:** *FDA Enforcement Rep* 1995 Oct 25; Manufacturer.

D1313 Harper NJ, Martlew R, Strang T, et al. Monitoring neuromuscular block by acceleromyography: comparison of the Mini-Accelograph with the Myograph 2000. *Br J Anaesth* 1994 Apr;72(4):411-4.

D2088 Henneman EA, Bellamy P, Togashi C. Peripheral nerve stimulators in the critical care setting: a policy for monitoring neuromuscular blockade. *Crit Care Nurse* 1995 Jun;15(3):82-8.

25319 Lekowshi RW, Johnston JF. Clinical use of the Relaxograph NMT-100. *Anesthesiol Rev* 1994 Jan-Feb; 21(1):22-6.

27459 Newell S, Brimacombe J. Measurement of neuromuscular blockade — a comparison between a new "homemade" force displacement transducer and the accelerometer. *Anaesth Intens Care* 1995 Apr;23(2):203-5.

Vendor information

Anesthesia Associates
Marketed worldwide

Anesthesia Assoc Inc [104588]
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San Marcos CA 92069-4363
Phone: (619) 744-6561
Fax: (619) 744-0054

Biometer
Marketed worldwide

Organon Teknika NV [137900]
Veedijk 58
B-2300 Turnhout
Belgium
Phone: 32 (014) 404040
Fax: 32 (014) 421600

Dakmed
Marketed in Canada, Europe, New Zealand, and the United States

Dakmed [174626]
693 Seneca St
Buffalo NY 14210-1324
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Fax: (716) 852-3831

Datex-Engstrom
Marketed worldwide

Datex
Div Instrumentarium Corp [150972]
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FIN-00510 Helsinki
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Phone: 358 (0) 39411
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International sales office

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2 Highwood Dr
Tewksbury MA 01876-1100
Phone: (508) 640-0460, (800) 635-6099
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Dupaco

Marketed in Canada and the United States

Dupaco Inc [104946]
2620 Temple Heights Dr
Oceanside CA 92056-3512
Phone: (619) 758-4550, (800) 546-4550
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Fisher & Paykel

Marketed worldwide

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HSE

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Fax: 49 (07665) 920090

Neuro Technology

Marketed worldwide

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Fax: (713) 776-2445

Organon Teknika NV [137900]
Veedijk 58
B-2300 Turnhout
Belgium
Phone: 32 (014) 404040
Fax: 32 (014) 421600
Markets the DigiStim 3 Plus and MicroStim Plus outside the United States

Professional Instruments

Marketed worldwide; the EZ-Stim ES100 and Maxi-Stim ST4 are pending FDA 510(k) clearance

Life-Tech Inc [102834]
PO Box 36221
Houston TX 77236-6221
Phone: (713) 495-9401, (800) 231-9841
Fax: (713) 495-7960

Viamed

Marketed worldwide

Viamed Ltd [153295]
15 Station Rd
Cross Hills
Keighley, West Yorkshire BD20 7DT
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Phone: 44 (01535) 634542
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Zenex

Marketed in Europe, the Middle East, and the United States

Zenex Corp [101871]
850 Elmhurst Rd
Elk Grove Village IL 60007-2612
Phone: (847) 390-0700
Fax: (847) 390-0706

About the chart specifications

The following terms are used in the chart:

Train-of-four: A stimulation pattern consisting of 4 supramaximal stimuli at 2 Hz.

Double-burst 3.3/3.2: A stimulation pattern consisting of either two trains of three pulses (designated 3.3) at approximately 50 Hz, separated by approximately 0.75 sec, or an initial train of three pulses followed by a train of two pulses (designated 3.2).

Typical current into 1,000 Ω, mA: The current measured against 1,000 ohms of resistance. Note: Some of the listed currents may also be valid for higher resistances.

Terminal polarity indication: Indicates the positive and negative bipolar electrodes.

Abbreviations:

EMG — Electromyograph

TOF — Train-of-four

Note: The data in the charts derive from vendors' specifications and have not been verified through independent testing by ECRI or any other agency. Because test methods vary, different products' specifications are not always comparable. Moreover, products and specifications are subject to frequent changes. ECRI is not responsible for the quality or validity of the information presented or for any adverse consequences of acting on such information.

When reading the charts, keep in mind that, unless otherwise noted, the list price does not reflect vendor discounts. And although we try to indicate which features and characteristics are standard and which are not, some may be optional, at additional cost.

For a more detailed discussion of the chart data, please see the Policy Statement on the back of the title page in Volume 1 of the *HPCS* binders, as well as "How to Use the *Healthcare Product Comparison System,*" located behind the "About *HPCS*" tab in the same volume.

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Our full-time staff includes a wide range of specialists in healthcare technology, hospital administration, financial analysis, risk management, and information and computer science, as well as hospital planners, attorneys, physicists; biomedical, electrical, electronic, chemical, mechanical, and registered engineers; physicians; basic medical scientists; epidemiologists and biostatisticians; and writers, editors, and communications specialists.

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The scope of ECRI's resources extends far beyond technology. ECRI keeps healthcare professionals, manufacturers, legal professionals, information specialists, and others aware of the changing trends in healthcare, healthcare standards and regulations, and the best ways to handle environmental and occupational health and safety issues. ECRI also advises on management issues related to healthcare cost containment, accreditation, risk management, human resources, quality of care, and other complex topics.

ECRI has more than 35 publications, databases, software, and services to fulfill the growing need for healthcare information and decision support. They focus on three primary areas: healthcare technology, healthcare risk and quality management, and healthcare environmental management.

Product Comparison Chart

MODEL	ANESTHESIA ASSOCIATES 100-A	ANESTHESIA ASSOCIATES AA 1050	BIOMETER Myograph 2000	BIOMETER TOF-Guard
WHERE MARKETED	Worldwide	Worldwide	Worldwide	Worldwide
OUTPUT MODES				
Twitch, Hz	0.1 (1 per 8 sec standby)	0.1 (1 per 8 sec standby, 2 per sec continuous)	0.1, 1	0.1, 1
Train-of-four, Hz	2 (2 cycles)	2, automatic	2	2
Repeat time, sec	Manual	8	11.5	15; 5 min
Double burst,				
3.3/3.2	No/no	No/no	Yes/yes	Yes/yes
Repeat time, sec	NA	NA	20	Not specified
Tetanus, Hz	50 or 100 (switch selectable)	50 or 100 (switch selectable)	50	50
Post-tetanic count	No	No	Yes *	Yes **
TYPICAL CURRENT INTO 1,000 Ω, mA	35	24	0-60 (up to 3.6 kΩ)	0-60 (up to 5 kΩ)
PULSE WIDTH, msec	0.3	0.6	0.2 or 0.3	0.2 or 0.3
PULSE INDICATOR	Visual	Visual	Visual	Visual
TERMINAL POLARITY INDICATION	No	Yes, red and black	Yes	Yes
BATTERY TYPE	9 V	9 V	1.5 V alkaline (4); 120/220 VAC	9 V alkaline (2)
Charge level indicator	Yes	Yes	Yes	Yes
Capacity, hr	1,000	1,000	150, minimum	100, minimum
H x W x D, cm (in)	14 x 3.8 x 2.3 (5.5 x 1.5 x 0.9)	14 x 7.6 x 2.5 (5.5 x 3 x 1)	14 x 45 x 25 (5.5 x 17.7 x 9.8)	8.5 x 19.5 x 3.5 (3.3 x 7.7 x 1.4)
WEIGHT, g (oz)	147 (5.2) with battery	310 (11) with battery	8 kg (17.6 lb)	550 (19.4)
PURCHASE INFORMATION				
Price	$98	$215	$13,870	$1,550
Warranty	1 year	1 year	1 year	1 year
Delivery time, ARO	Stock	Stock	Not specified	Not specified
Year first sold	1986	1981	Not specified	Not specified
Number sold to date				
USA	Not specified	Not specified	Not specified	Not specified
Worldwide	Not specified	Not specified	Not specified	Not specified
Vendor fiscal year	January to December	January to December	Not specified	Not specified
OTHER SPECIFICATIONS	Battery and ball electrodes are standard; other leads optional.	Battery and ball electrodes are standard; other leads optional.	Monitor has force and acceleration transducers; chart recorder.	Automatic monitor with automatic calibration and a memory card to record muscle relaxant data during operation; temperature sensor; acceleration transducer; hardware and software; optional Card Reader package to download data into PC.

Colons separate data on similar models of a device.
* With 6 min inhibition timer.
** Automatic with 2 min inhibition timer.

Product Comparison Chart

MODEL	DAKMED	DATEX-ENGSTROM	DUPACO	DUPACO
	750	AS/3 NMT Module	54120	Sparkie 54130
WHERE MARKETED	Canada, Europe, New Zealand, USA	Worldwide	Canada, USA	Canada, USA
OUTPUT MODES				
Twitch, Hz	0.01, 0.02, 1	0.2 at 1, 10, 20 sec with 500 msec pause	0.1, 2	2
Train-of-four, Hz	2	See footnote *	2	2
Repeat time, sec	Not specified	See footnote **	Continuous	Continuous
Double burst,				
3.3/3.2	No/no	Yes/no	No/no	No/no
Repeat time, sec	NA	See footnote **	NA	NA
Tetanus, Hz	50, pulse interval 0.02 sec; 100, pulse interval 0.01 sec	50 for 5 sec	100, continuous	50, continuous
Post-tetanic count	Not specified	Yes	No	No
TYPICAL CURRENT INTO 1,000 Ω, mA	0-70	10-70	0-20	0-30 high, 0-18 low
PULSE WIDTH, msec	0.2	100, 200, 300	0.6	0.3
PULSE INDICATOR	Visual, audible	Visual, audible	Visual	Visual
TERMINAL POLARITY INDICATION	Yes	Yes	Yes	Yes
BATTERY TYPE	9 V	NA	9 V	9 V
Charge level indicator	Yes	NA	No	No
Capacity, hr	Not specified	NA	Not specified	Not specified
H x W x D, cm (in)	8 x 17.8 x 8 (3.25 x 7 x 3.25)	Not specified	10.2 x 5.1 x 5.1 (4 x 2 x 2)	2.5 x 10.2 x 5.1 (1 x 4 x 2)
WEIGHT, g (oz)	430 (15.5)	NA	281 (9.9)	128 (4.5)
PURCHASE INFORMATION				
Price	$400	$2,800	$286	$140
Warranty	1 year	3 years	1 year	1 year
Delivery time, ARO	1 week	Not specified	1 week	1 week
Year first sold	1990	Not specified	Not specified	Not specified
Number sold to date				
USA	2,000	Not specified	Not specified	Not specified
Worldwide	5,000	Not specified	Not specified	Not specified
Vendor fiscal year	July to June	January to December	October to October	October to October
OTHER SPECIFICATIONS	9 V battery, lead wires, and electrodes are standard; optional mounting bracket.	Integrated module displays twitch and TOF percentage, bar graph and count, trend page; Plexus stimulation mode for regional block nerve location.	Locking pin allows a continuous TOF stimulation; 5 ft cable with banana plugs at each end and 2 alligator clips; optional ball electrodes.	Remains in off position except when activated; two 2 ft cables with banana plugs on one end and alligator clips on the other; ball electrodes included.

Colons separate data on similar models of a device.
* 2 Hz with 0.2 msec duration and 500 msec pause.
** Repeat time is 10, 15, 20 sec and 1, 3, 15 min.

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Product Comparison Chart

MODEL	FISHER & PAYKEL	FISHER & PAYKEL	FISHER & PAYKEL	HSE
	NS242	NS252	NS272	NEUROSTIM LA II
WHERE MARKETED	Worldwide	Worldwide	Worldwide	Worldwide
OUTPUT MODES				
Twitch, Hz	0.1, 0.2, 1; 1 and 10 sec repeat	0.1, 0.2, 1; 1 and 10 sec repeat	0.1, 0.2; 1 sec repeat interval	1
Train-of-four, Hz	2	2	2	No
Repeat time, sec	12	12	12	NA
Double burst,				
3.3/3.2	Yes/yes, selectable	Yes/yes, selectable	Yes/yes, selectable	No/no
Repeat time, sec	Not specified	Not specified	Not specified	NA
Tetanus, Hz	50	50 or 100 (user selectable)	50 or 100 (user selectable)	No
Post-tetanic count	No	Yes	Yes	No
TYPICAL CURRENT INTO 1,000 Ω, mA	0-80	0-160, external; 0.2-10, internal	0-160, external; 0.2-10, internal	10
PULSE WIDTH, msec	0.2	0.2	0.2	1
PULSE INDICATOR	Visual, audible	Visual, audible	Visual, audible	Visual, audible
TERMINAL POLARITY INDICATION	Color and symbol	Color and symbol	Color and symbol	Yes
BATTERY TYPE	1.5 V AA (3) LR6	1.5 V AA (3) LR6	1.5 V AA (3) LR6	9 V
Charge level indicator	Yes	Yes	Yes	Yes
Capacity, hr	>300	>300	>300	500
H x W x D, cm (in)	17 x 7.3 x 4.3 (6.7 x 2.9 x 1.7)	17 x 7.3 x 4.3 (6.7 x 2.9 x 1.7)	17 x 7.3 x 4.3 (6.7 x 2.9 x 1.7)	6 x 10.5 x 3 (2.4 x 4.1 x 1.2)
WEIGHT, g (oz)	180 (6.3)	180 (6.3)	180 (6.3)	160 (5.6)
PURCHASE INFORMATION				
Price	~$310	~$385	~$475	$555
Warranty	1 year	1 year	1 year	1 year
Delivery time, ARO	Not specified	Not specified	Not specified	Not specified
Year first sold	Not specified	Not specified	Not specified	Not specified
Number sold to date				
USA	Not specified	Not specified	Not specified	Not specified
Worldwide	Not specified	Not specified	Not specified	Not specified
Vendor fiscal year	Not specified	Not specified	Not specified	Not specified
OTHER SPECIFICATIONS	Constant current; LED display; accessories include safety leads; brackets; electrodes; carry case; diagnostic probes; combinations of pulses at variable time intervals.	Constant current; LED display; accessories include safety leads; brackets; electrodes; carry case; diagnostic probes; combinations of pulses at variable time intervals.	Constant current; LED display; accessories include safety leads; brackets; electrodes; carry case; diagnostic probes; combinations of pulses at variable time intervals.	Stimulator for nerve location in regional anesthesia.

Colons separate data on similar models of a device.

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Product Comparison Chart

MODEL	HSE	NEURO TECHNOLOGY	NEURO TECHNOLOGY	NEURO TECHNOLOGY
	T4	DigiStim II : DigiStim III	DigiStim 2 Plus	DigiStim 3 Plus
WHERE MARKETED	Worldwide	Worldwide	Worldwide	Worldwide
OUTPUT MODES				
Twitch, Hz	1	0.1, 1, 2	1	1, 2
Train-of-four, Hz	2	2	2	2
Repeat time, sec	15	10	10	10
Double burst, 3.3/3.2	Not specified	No/no	Yes/no *	Yes/no *
Repeat time, sec	Not specified	NA	Single or 10 auto	10 automatic
Tetanus, Hz	50 for 5 sec	50, 100	50, 100	50, 100
Post-tetanic count	Manually possible	No	No	No
TYPICAL CURRENT INTO 1,000 Ω, mA	0-80	0-70 high, 0-6 low	0-70 high, 0-6 low	0-70 high, 0-6 low
PULSE WIDTH, msec	0.2	0.2	0.2	0.2
PULSE INDICATOR	Visual, audible	Visual, audible	Visual, audible	Visual, audible
TERMINAL POLARITY INDICATION	Yes	Yes	Yes	Yes
BATTERY TYPE	9 V	9 V	9 V	9 V
Charge level indicator	Yes	Yes	Yes	Yes
Capacity, hr	>1,000 hr	Not specified	Not specified	Not specified
H x W x D, cm (in)	6 x 12 x 5 (2.4 x 4.7 x 2)	6.4 x 15.2 x 16 (2.5 x 6 x 6.3) : 5.1 x 9.1 x 14.7 (2 x 3.6 x 5.8)	6.4 x 15.2 x 15.7 (2.5 x 6 x 6.2)	5.1 x 9.1 x 14.7 (2 x 3.6 x 5.8)
WEIGHT, g (oz)	250 (8.8)	681 : 312 (24 : 11)	681 (24)	312 (11)
PURCHASE INFORMATION				
Price	$1,295	$495 : $375	$540	$445
Warranty	1 year	1 year	1 year	1 year
Delivery time, ARO	Not specified	Not specified	Not specified	Not specified
Year first sold	Not specified	Not specified	Not specified	Not specified
Number sold to date				
USA	Not specified	Not specified	Not specified	Not specified
Worldwide	Not specified	Not specified	Not specified	Not specified
Vendor fiscal year	Not specified	April to March	April to March	April to March
OTHER SPECIFICATIONS	Integral electrodes.	Displays current delivered; IV-pole mount; low output for regional anesthesia use; DigiStim II has an optional computer interface for evoked potential and EMG applications.	IV-pole mount; auto power shutdown after 20 sec of nonuse; adjustable audio output; displays delivered current and battery voltage; low current range for regional blocks.	Auto power shutdown after 20 sec of nonuse; adjustable audio output; low current range for regional blocks; displays current delivered and battery voltage.

Colons separate data on similar models of a device.
* Two 60 msec bursts separated by 0.75 sec.

9/1/02

Product Comparison Chart

MODEL	NEURO TECHNOLOGY MicroStim : MicroStim Plus	NEURO TECHNOLOGY StimPen	PROFESSIONAL INSTRUMENTS DualStim	PROFESSIONAL INSTRUMENTS EZ-Stim ES100
WHERE MARKETED	Worldwide	Worldwide	Worldwide	Worldwide; pending FDA 510(k) approval
OUTPUT MODES				
Twitch, Hz	1	2	0.1, 1	1
Train-of-four, Hz	2	2	2	2
Repeat time, sec	10	Not specified	10 or on demand	10 or on demand
Double burst,				
3.3/3.2	Yes/no	No/no	Yes/no *	Yes/no
Repeat time, sec	NA	NA	NA	20
Tetanus, Hz	50 (optional), 100 : 50, 100	100	50, 100	50, 100
Post-tetanic count	No	No	No	No
TYPICAL CURRENT INTO 1,000 Ω, mA	0-70	40 fixed	0-80 high, 0-6 low	0-80 high, 0-10 low
PULSE WIDTH, msec	0.2	0.2	0.25	0.20
PULSE INDICATOR	Visual, audible	Visual, audible	Visual, audible	Visual, audible
TERMINAL POLARITY INDICATION	Yes	Yes	Yes	Yes
BATTERY TYPE	9 V	7 V mercury	9 V (2)	9 V
Charge level indicator	Yes	No	Yes	Yes
Capacity, hr	Not specified	Not specified	Not specified	Not specified
H x W x D, cm (in)	2.5 x 6.4 x 10.2 (1 x 2.5 x 4)	15.2 x 1.5 diameter (6 x 0.6 diameter)	12.7 x 10.2 x 5.1 (5 x 4 x 2)	3.6 x 9.4 x 15.8 (1.4 x 3.7 x 6.2)
WEIGHT, g (oz)	170 (6)	85 (3)	624 (22)	326 (11.5)
PURCHASE INFORMATION				
Price	$120 : $140	$115	$499	$375
Warranty	1 year	1 year	1 year	3 years
Delivery time, ARO	Not specified	Not specified	Not specified	Not specified
Year first sold	Not specified	Not specified	Not specified	Not specified
Number sold to date				
USA	Not specified	Not specified	Not specified	Not specified
Worldwide	Not specified	Not specified	Not specified	Not specified
Vendor fiscal year	April to March	April to March	December to November	December to November
OTHER SPECIFICATIONS	Belt clip; variable output; ball electrodes; lead wires.	Penlight sized to to fit in pocket.	Displays delivered current and battery voltage; adjustable alarms.	Constant current stimulator; displays the exact current delivered by adjusting the stimulus amplitude control dial; auto shut off; instrument mounting bracket available.

Colons separate data on similar models of a device.
* For 3.3, 20 sec or on demand.

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Product Comparison Chart

MODEL	PROFESSIONAL INSTRUMENTS MaxiStim ST4	PROFESSIONAL INSTRUMENTS MiniStim	PROFESSIONAL INSTRUMENTS MiniStim MS-I : MS-II	PROFESSIONAL INSTRUMENTS NeuroStim NS-3-CC
WHERE MARKETED	Worldwide; pending FDA 510(k) approval	Worldwide	Worldwide	Worldwide
OUTPUT MODES				
Twitch, Hz	1	1	2 : 1	NA
Train-of-four, Hz	2	2	NA : 2	2
Repeat time, sec	10 or on demand	On demand	On demand	10
Double burst,				
3.3/3.2	Yes/yes *	Yes/no	No/no	No/no
Repeat time, sec	20	On demand	NA	NA
Tetanus, Hz	50, 100	50, 100	50 : 50, 100	50
Post-tetanic count	Yes	No	No	No
TYPICAL CURRENT INTO 1,000 Ω , mA	0-80 high, 0-10 low	0-50	0-30 : 0-50	0-80
PULSE WIDTH, msec	0.25	0.22	0.2 : 0.25	0.25
PULSE INDICATOR	Visual, audible	Visual	Visual	Visual
TERMINAL POLARITY INDICATION	Yes	Yes	Yes	Yes
BATTERY TYPE	9 V	9 V	7 V : 9 V	9 V
Charge level indicator	Yes	Yes	No	Yes
Capacity, hr	Not specified	Not specified	Not specified	Not specified
H x W x D, cm (in)	3.6 x 9.4 x 15.8 (1.4 x 3.7 x 6.2)	10.7 x 6.1 x 2 (4.2 x 2.4 x 0.8)	7.6 x 2.5 x 2.5 (3 x 1 x 1) : 13.3 x 3.3 x 2.5 (5.25 x 1.3 x 1)	12.7 x 7.6 x 5.1 (5 x 3 x 2)
WEIGHT, g (oz)	326 (11.5)	142 (5)	85 : 142 (3 : 5)	284 (10)
PURCHASE INFORMATION				
Price	$495	$132	$112.50 : $125	$330
Warranty	3 years	3 years	3 years	3 years
Delivery time, ARO	Not specified	Not specified	Not specified	Not specified
Year first sold	Not specified	Not specified	Not specified	Not specified
Number sold to date				
USA	Not specified	Not specified	Not specified	Not specified
Worldwide	Not specified	Not specified	Not specified	Not specified
Vendor fiscal year	December to November	December to November	December to November	December to November
OTHER SPECIFICATIONS	Constant current stimulator; programmable; stores 3 programs; program can have as many as 10 steps; auto shut off; pulse widths and frequency can be varied in the program mode; instrument mounting bracket available.	Open circuit indicator; belt clip attached.	Vinyl carrying case; MS-II has an angled bipolar probe and user-variable output.	Maintains current setting over wide impedance range; current range allows stimulation of obese patients; TOF switch locks in repeat mode for intraoperative use; open-circuit indicator; displays current delivered.

Colons separate data on similar models of a device.
* For 3.3, 20 sec or on demand.

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Product Comparison Chart

MODEL	ZENEX PNS Z-4
WHERE MARKETED	Europe, Middle East, USA
OUTPUT MODES	
Twitch, Hz	1, 0.2, 0.1
Train-of-four, Hz	2
Repeat time	Not specified
Double burst,	
3.3/3.2	Not specified
Repeat time, sec	Not specified
Tetanus, Hz	48
Post-tetanic count	Not specified
TYPICAL CURRENT INTO 1,000 Ω, mA	0-35
PULSE WIDTH, msec	100
PULSE INDICATOR	Audible, visual
TERMINAL POLARITY INDICATION	No
BATTERY TYPE	Rechargeable pack
Charge level indicator	Yes
Capacity, hr	Not specified
H x W x D, cm (in)	15.2 x 7.6 x 5.1 (6 x 3 x 2)
WEIGHT, g (oz)	454 (16)
WARRANTY	1 year
PRICE	$325
OTHER SPECIFICATIONS	Supplied with 4 rechargeable battery packs.

Colons separate data on similar models of a device.

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Product Comparison Chart

MODEL	PROFESSIONAL INSTRUMENTS Tracer NL-I	PROFESSIONAL INSTRUMENTS TriStim NS-3A	VIAMED Microstim : Microstim DB	ZENEX PNS Z-4 #600-4000
WHERE MARKETED	Worldwide	Worldwide	Worldwide	Europe, Middle East, USA
OUTPUT MODES				
Twitch, Hz	1	0.2, 1	No	1, 0.2, 0.1
Train-of-four, Hz	No	2	1 cycle	2
Repeat time, sec	NA	On demand	Manual control	Not specified
Double burst, 3.3/3.2	No/no	No/no	Available/standard	Not specified
Repeat time, sec	NA	NA	Manual control	Not specified
Tetanus, Hz	NA	50	50 *	48
Post-tetanic count	No	No	Yes, 1 Hz	Not specified
TYPICAL CURRENT INTO 1,000 Ω , mA	0-4	0-55	Variable to 90	0-35
PULSE WIDTH, msec	0.22	0.25	0.2	100
PULSE INDICATOR	Visual	Visual	Visual, audible	Audible, visual
TERMINAL POLARITY INDICATION	Yes	Yes	Yes	No
BATTERY TYPE	9 V	9 V	9V	Rechargeable pack
Charge level indicator	No	Yes	Yes	Yes
Capacity, hr	Not specified	Not specified	NA	Not specified
H x W x D, cm (in)	*13.3 x 3.3 x 2.5* (5.25 x 1.3 x 1)	*11.1 x 6 x 3.2* (4.4 x 2.4 x 1.26)	*2.6 x 6.1 x 10.2* (1.0 x 2.4 x 4.0)	*15.2 x 7.6 x 5.1* (6 x 3 x 2)
WEIGHT, g (oz)	142 (5)	284 (10)	150 (5.3), with battery	454 (16)
PURCHASE INFORMATION				
Price	$189	$300	£145	$325
Warranty	1 year	1 year	1 year	1 year
Delivery time, ARO	Not specified	Not specified	2 weeks	Not specified
Year first sold	Not specified	Not specified	1985	Not specified
Number sold to date				
USA	Not specified	Not specified	Not specified	Not specified
Worldwide	Not specified	Not specified	>2,000	Not specified
Vendor fiscal year	December to November	December to November	January to December	August to July
OTHER SPECIFICATIONS	Direct reading dial indicates 0.5 mA increments; includes leads and regional block needles; carrying case available.	IV-pole mountable; carrying case and diagnostic probe available.	Single- (either) handed operation; cannot accidentally be left switched on; all functions are "press and hold switch, replace to stop."	Supplied with 4 rechargeable battery packs.

Colons separate data on similar models of a device.

* Post-tetanic count uses 50 Hz for 5 sec, followed by a 3 sec pause, then has a continuous 1 Hz rate.

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