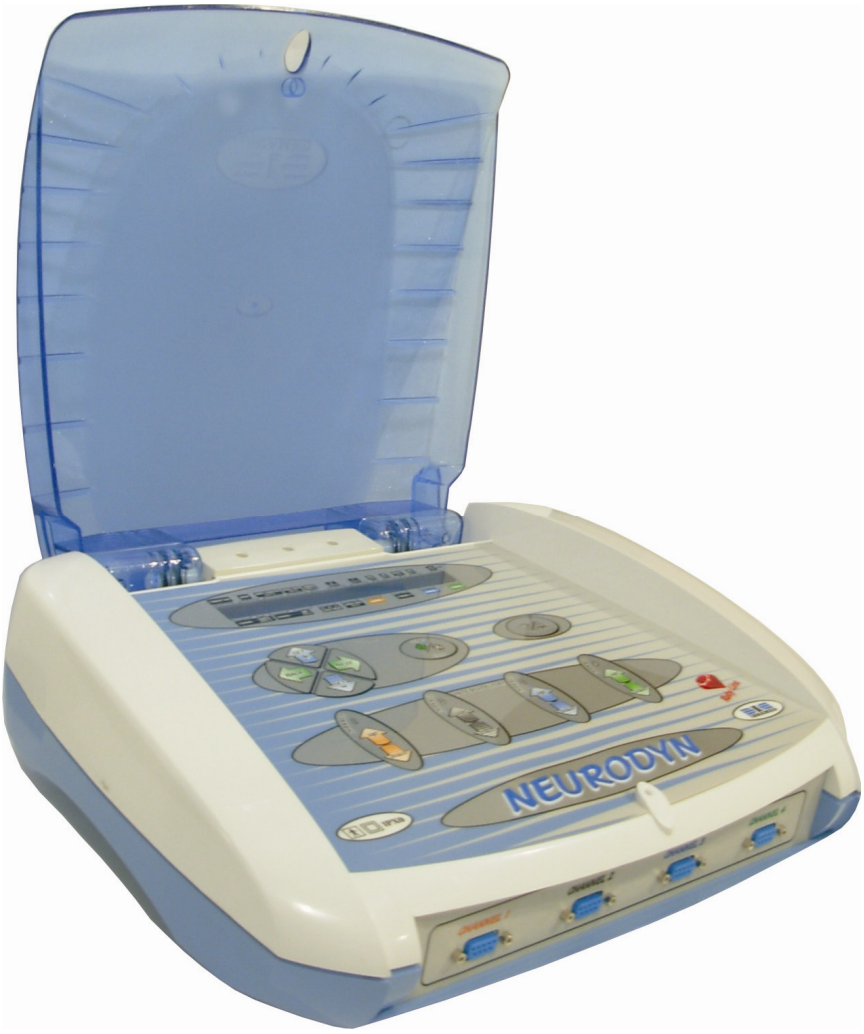
NEURODYN V2.0
- Manual of Operation



5ª edition

(07/2009)

Therapy Equipment for Nervous Electrical Transcutaneous Stimulation

(Anvisa Registration nº 10360310001)

ATTENTION:

THIS MANUAL OF INSTRUCTIONS REFERS TO **NEURODYN V2.0** EQUIPMENT MANUFACTURED BY IBRAMED

PLEASE READ THIS MANUAL CAREFULLY BEFORE USING THE EQUIPMENT AND ALWAYS REFER TO IT WHENEVER DIFFICULTIES APPEAR. KEEP THIS MANUAL ALWAYS AT HAND.

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ATTENTION
RISK OF ELECTRICAL SHOCK
DO NOT OPEN IT

The lightning bolt symbol inside a triangle is a warning about the presence of “dangerous voltage”, without insulation in the internal part of the equipment which may be strong enough to cause risk of electrical shock.

An exclamation mark inside a triangle alerts the user about the existence of important operation and maintenance instructions (technical service) for this equipment.

ATTENTION: To prevent electrical shock do not use the equipment plug attached to an extension cable or to any other type of plug except that the terminals fit perfectly in the receptacle. Disconnect the input plug from socket when not using the equipment for a long period of time.

General care with the equipment:

NEURODYN V2.0 does not need special installation provisions or care. We suggest that you:

- Avoid places subject to vibrations.

- Install the equipment on a firm and horizontal surface, in a site with perfect ventilation.

- In case of a built-in cupboard, make sure that there is no obstacle for the free air circulation on the back of the equipment.

- Do not lay it on carpets, rugs, cushions or other soft surfaces that can obstruct the ventilation.

- Avoid humid, hot and dusty places.

- Place the cable in order to leave it free, out of places where it can be trodden on, and do not place any furniture over it.

- Do not insert objects into equipment orifices and do not place recipients with liquid on it.

- Do not use volatile substances (benzene, alcohol, thinner and solvents in general) to wipe the equipment cabinet because they can damage the finishing. Use only a soft, dry, and clean piece of cloth.

Explanation of the symbols used

 - **ATTENTION!** Check and follow the instructions in this manual.

 - Equipment CLASS II. The protection against electric shock is not based only in the basic insulation but also incorporates additional safety precautions, such as double or reinforced insulation, not holding grounding resources protection or depending on installation conditions.

 - Equipment with BF type applied part.

 - Risk of electrical shock.

IPX0 - Equipment not protected against harmful water dripping.

 - Indicates electrostatic discharge sensibility

 - Indicates the starting of the action (START)

 - Indicates the end of the action (Stop)

 - Indicates: Off (without electrical power supply)

 - Indicates: On (with electrical power supply)

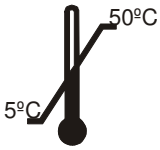
V~ - Volts in Alternate Current

~ line - Alternate current power line

In the Transportation Box:

-FRAGILE: The content in this package is fragile and should be handled with care.

-THIS SIDE UP: Indicates the correct position to ship the package.



- TEMPERATURE LIMITS: Indicates the limit temperatures for transportation and storage the package.

- KEEP IT AWAY FROM THE RAIN: This package should not be shipped under rain.

- MAXIMUM STACKING NUMBER: The maximum number of identical packages which can be stacked. For this equipment, the limit stacking number is 5 units.

Preliminary Observations:

This equipment is a transcutaneous neuromuscular stimulator used in therapies with TENS currents. **RUSSIAN** (medium frequency modulated in bursts), **FES** (Functional Electrical Stimulation), **TENS** (Nervous Transcutaneous Electrical Stimulation), **AUSSIE** (medium frequency modulated in bursts), **INTERFERENTIAL** (medium frequency modulated in amplitude), **POLARIZED** and **MICROCURRENT.** These techniques are noninvasive, without systemic effects, they do not cause dependency and do not have undesirable side effects.

As for the type and degree of protection against electrical shock, the NEURODYN V2.0 corresponds to a **CLASS II EQUIPMENT with BF** type of safety and protection. It must be operated only by qualified professionals and in properly authorized medical departments. *The use of these units is not intended for rooms with risk of explosion such as anesthesia departments or the presence of an anesthetic flammable mixture with air; oxygen or nitric oxide.*

POTENTIAL ELECTROMAGNETIC INTERFERENCE: *As for the limits regarding electromagnetic disturbance, Neurodyn V2.0 is eletro-medical equipment that belongs to Group 1, Class A. The simultaneous connection of the patient to the NEURODYN V2.0 stimulator and to surgical equipment of high frequency can cause burns in the application area of the electrodes and it may damage the stimulator. The operation at a short distance (1 meter, for example) of a short wave or microwave therapy equipment can produce instability in the output of the equipment. - In order to prevent electromagnetic interference, we suggest that one group of power supply line is used for NEURODYN V2.0 and another separate group for the short wave and microwave equipment. We also suggest that the patient, o NEURODYN V2.0 and the connection cables are placed at least at a distance of 3 meters away from the shortwave or microwave therapy equipment*

Mobile or portable radio frequency communication equipment may produce interference and affect the performance of Neurodyn V2.0.

Description of NEURODYN V2.0:

The **NEURODYN V2.0** was designed following the existing technical manufacturing standards for medical equipment (NBR IEC 60601-1 NBR IEC 60601-1-2 and NBR IEC 60601-2-10).

BASIC OPERATION: *Neurodyn V2.0 is equipment for the application of electrical current via electrodes in contact with the patient.* It is a transcutaneous muscular stimulator with microcomputer technology, this means, it is **microcontrolled.**

Neurodyn V2.0 produces the following currents:

RUSSIAN – carrier with a medium frequency of 2,500 Hz modulated by a variable low frequency from 1Hz to 100Hz.

TENS – low frequency with pulse duration (T) variable from 50uS to 500uS and variable repetition pulse frequency from 0,5Hz to 250Hz.

FES – low frequency with pulse duration (T) variable from 50uS to 500uS and variable repetition pulse frequency from 0,5Hz to 250Hz modulated in gradients (rise, on, off and decay).

INTERFERENTIAL – carrier with a medium frequency of 2,000Hz, 4,000Hz or 8,000 Hz modulated in amplitude by a low variable frequency from 1Hz to 100Hz.

MICRO CURRENT – carrier with a medium frequency of 15,000Hz modulated by a variable low frequency from 1Hz to 500Hz.

AUSSIE (also called Australian Current) – a “new generation” of electrical current for stimulation, with a medium frequency carrier of 1,000 Hz or 4,000Hz modulated in bursts of low frequency variable from 1Hz to 120Hz and a duration of 2mS or 4mS.

POLARIZED – medium frequency of 15,000 Hz.

The technique is noninvasive, without systemic effects, it does not cause dependency and it does not have undesirable side effects. The current intensity necessary for the treatment depends on the type of dysfunction to be treated as well as the thresholds of every patient. Thus, the treatment should start with minimum intensity levels (very low), increasing the level carefully until achieving the effects adequate for the procedure and according to each patient's sensory, motor and pain reaction.

When an individual is submitted to an electric stimulation, he/she will have an itching feeling in the stimulation location or in the areas between the electrodes. Generally this feeling is comfortable to most of the persons. The degree of feeling is controlled by the adjustment of the equipment parameters (controls).

Due to the fact that the utilized technology is the same microcomputer technology, these controls operate using the touch screen. All the information regarding the parameters chosen by the professional therapist will be shown in the alphanumeric liquid crystal screen.

The NEURODYN V2.0 enables the following stimulation modes:

RUSSIAN Current:

- CONTINUOUS MODE
SYNCHRONIZED MODE
- ALTERNATE MODE
- SEQUENTIAL MODE

FES Current:

SYNCHRONIZED MODE
SYNCHRONIZED MODE VIF (variation of frequency and intensity)
- ALTERNATE MODE
ALTERNATE MODE VIF (variation of frequency and intensity)
- SEQUENTIAL MODE
SEQUENTIAL MODE VIF (variation of frequency and intensity)

TENS Current:

- NORMAL MODE (tens: conventional, acupuncture, brief and intense)
- BURST MODE (pulse trains modulation)
VIF MODE (variation of frequency and intensity)

AUSSIE CURRENT:

- CONTINUOUS MODE
SYNCHRONIZED MODE
- ALTERNATE MODE
- SEQUENTIAL MODE

INTERFERENTIAL Current:

- NORMAL TETRAPOLAR MODE (manual vector)
- AUTOMATIC TETRAPOLAR MODE (automatic vector)
- BIPOLAR CONTINUOUS MODE
- SYNCHRONIZED BIPOLAR MODE
- BIPOLAR ALTERNATE MODE
- SEQUENTIAL BIPOLAR MODE

POLARIZED Current:

- P+ POSITIVE MODE
P- NEGATIVE MODE (polarity inversion)

MICRO CURRENT:

- CONTINUOUS MODE

The equipment allows for the selection of the following parameters:

CHANNEL 1 – regulates the intensity of channel 1

CHANNEL 2 – regulates the intensity of channel 2

CHANNEL 3 – regulates the intensity of channel 3

CHANNEL 4 – regulates the intensity of channel 4

TIMER – Allows for the selection of an application time from 1 to 60 minutes. At the end of the selected time, a sound will be heard the passing of current to the patient will stop. The selected value will decrease at the same time in which such time is elapsed.

Type of current:

TNS (TENS) – Stimulation Mode: **NML** (normal)

R (pulse repetition frequency) - variable from 0.5 Hz to 250 Hz in "steps" of 1 Hz.

T (pulse duration) – variable from 50useg to 500useg in "steps" of 25 us.

TNS (TENS) – Stimulation Mode: **BST** (Burst - Pulse trains)

R (pulse repetition frequency) – in this case the equipment automatically selects the highest frequency (250Hz) and will perform a low frequency modulation (2 Hz). Consequently, it is a high current of 250 Hz with an enveloping low current of 2 Hz. Thus, when in tens burst, it is not possible to alter this parameter R, only T.

T (pulse duration) – variable from 50useg to 500useg in "steps" of 25 us.

TNS (TENS) – Stimulation Mode: **VIF** (variable frequency and intensity)

R (pulse repetition frequency) – automatic scanning; decreasing from 247 Hz to 1 Hz and increasing from 1 Hz to 247 Hz passing through all the intermediary frequencies.

T (pulse duration) – automatic scanning; increasing from 50 us to 500 us and decreasing from 500 us to 50 us, passing through all the intermediary pulse widths.

FES (FES) – Stimulation Mode: **SIN** (synchronized).

R (pulse repetition frequency) - variable from 0.5 Hz to 250 Hz in "steps" of 1 Hz.

T (pulse duration) – variable from 50useg to 500useg in "steps" of 25 us.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

FES (FES) – Stimulation Mode: **REC** (alternate)

R (pulse repetition frequency) - variable from 0.5 Hz to 250 Hz in "steps" of 1 Hz.

T (pulse duration) – variable from 50useg to 500useg in "steps" of 25 us.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

FES (FES) – Stimulation Mode: **SEQ** (sequential)

R (pulse repetition frequency) - variable from 0.5 Hz to 250 Hz in "steps" of 1 Hz.

T (pulse duration) – variable from 50useg to 500useg in "steps" of 25 us.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

FES (FES) – Stimulation Mode: **SVF** (synchronized with VIF)

R (pulse repetition frequency) – automatic scanning; decreasing from 247 Hz to 1 Hz and increasing from 1 Hz to 247 Hz passing through all the intermediary frequencies.

T (pulse duration) – automatic scanning; increasing from 50 us to 500 us and decreasing from 500 us to 50 us, passing through all the intermediary pulse widths.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

FES (FES) – Stimulation Mode: **RVF** (alternate with VIF)

R (pulse repetition frequency) – automatic scanning; decreasing from 247 Hz to 1 Hz and increasing from 1 Hz to 247 Hz passing through all the intermediary frequencies.

T (pulse duration) – automatic scanning; increasing from 50 us to 500 us and decreasing from 500 us to 50 us, passing through all the intermediary pulse widths.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. It regulates the speed with which the contraction decreases, namely, the time from the

maximum contraction until the muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

FES (FES) – Stimulation Mode: **QVF** (secuential with VIF)

R (pulse repetition frequency) – automatic scanning; decreasing from 247 Hz to 1 Hz and increasing from 1 Hz to 247 Hz passing through all the intermediary frequencies.

T (pulse duration) – automatic scanning; increasing from 50 us to 500 us and decreasing from 500 us to 50 us, passing through all the intermediary pulse widths.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum
muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

Observations:

Once the FESS – FES SYNCHRONIZED is selected, the four channels work together at the same time, this means, the channels simultaneously execute the selected Rise, ON, Decay and Off times.

When selecting the **FES REC** (ALTERNATE FES) or **FES RVF** (ALTERNATE FES WITH VIF), channels **1** and **3, 2 and 4,** work alternately, namely, while channels 1 and 3 execute the Rise and On time, the other 2 and 4 execute the Decay and Off

When **FES SEQ** (SEQUENTIAL FES) or **FES QVF** (SEQUENTIAL FES WITH VIF) the four channels work sequentially, namely, channel 1 executes the chosen Rise time, On, Decay and Off, then channel two executes the chosen Rise, On Decay and Off time, then channel three executes the chosen Rise, On, Decay and Off time and finally, channel four executes the chosen Rise, On, Decay and Off time.

In synchronized, alternate and sequential modes, an arrow indicates which gradient (Rise, On, Decay and Of time) is being executed.

RUS (RUSSIAN) **–** Stimulation Mode: CONT (continuous)

BURST FREQ (burst repetition frequency) – in this case the equipment automatically selects the highest frequency (2,500 Hz) and will perform a low frequency modulation (1 to 100 Hz). Consequently, it is a high current of 2500 Hz with an enveloping low current from 1 to 100 Hz.

BURST DURATION (burst or lenght duration) - variable from 10%, 30% ou 50%, namely:

10%= 2 milliseconds On and 18 milliseconds Off.
30%= 6 milliseconds On and 14 milliseconds Off.
50%= 10 milliseconds On and 10 milliseconds Off.

RUS (RUSSIAN) **–** Stimulation Mode: **SIN** (synchronized).

BURST FREQ (burst repetition frequency) – in this case the equipment automatically selects the highest frequency (2,500 Hz) and will perform a low frequency modulation (1 to 100 Hz). Consequently, it is a high current of 2500 Hz with an enveloping low current from 1 to 100 Hz.

BURST DURATION (burst or lenght duration) - variable from 10%, 30% ou 50%, namely:

10%= 2 milliseconds On and 18 milliseconds Off.
30%= 6 milliseconds On and 14 milliseconds Off.
50%= 10 milliseconds On and 10 milliseconds Off.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

RUS (RUSSIAN) **–** Stimulation Mode: **REC** (alternate)

BURST FREQ (burst repetition frequency) – in this case the equipment automatically selects the highest frequency (2,500 Hz) and will perform a low frequency modulation (1 to 100 Hz).
- Consequently, it is a high current of 2500 Hz with an enveloping low current from 1 to 100 Hz.

BURST DURATION (burst or lenght duration) - variable from 10%, 30% ou 50%, namely:

10%= 2 milliseconds On and 18 milliseconds Off.
30%= 6 milliseconds On and 14 milliseconds Off.
50%= 10 milliseconds On and 10 milliseconds Off.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

RUS (RUSSIAN) **–** Stimulation Mode: **SEQ** (sequential)

BURST FREQ (burst repetition frequency) – in this case the equipment automatically selects the highest frequency (2,500 Hz) and will perform a low frequency modulation (1 to 100 Hz). Consequently, it is a high current of 2500 Hz with an enveloping low current from 1 to 100 Hz.

BURST DURATION (burst or lenght duration) - variable from 10%, 30% ou 50%, namely:

10%= 2 milliseconds On and 18 milliseconds Off.
30%= 6 milliseconds On and 14 milliseconds Off.
50%= 10 milliseconds On and 10 milliseconds Off.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

Observations:

When the RUSSIAN **CNT** (continuous) is selected, the Rise, On, Decay and Off parameters will be deactivated. Consequently, there will be a continuous, constant stimulation.

Once the RUSSIAN **SYNC** (SYNCRONIZED) is selected, all 4 channels work together at the same time, i.e., all channels simultaneously execute the selected Rise, ON, Decay and Off times.

When selecting the RUS (RUSSIAN) **REC** (alternate), channels **1** and **3, 2 and 4,** work alternately, namely, while channels 1 and 3 execute the Rise and On time, the others 2 and 4 execute the Decay and Off.

When RUS (RUSSIAN) or **SEQ** (sequential) the four channels work sequentially, namely, channel 1 executes the chosen Rise time, On, Decay and Off, then channel two executes the chosen Rise, On Decay and Off time, then channel three executes the chosen Rise, On, Decay and Off time and finally, channel four executes the chosen Rise, On, Decay and Off time.

In synchronized, alternate and sequential modes, an arrow indicates which gradient (Rise, On, Decay and Of time) is being executed.

AUS (AUSSIE) **–** Stimulation Mode: CONT (continuous)

BURST DURATION (burst duration or length) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

BURST FREQ (burst repetition frequency) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

CARRIER - in this case the equipment generates a carrier medium frequency of 1,000 Hz or 4,000 Hz.

AUS (AUSSIE) **–** Stimulation Mode: **SIN** (synchronized).

BURST DURATION (burst duration or length) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

BURST FREQ (burst repetition frequency) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

CARRIER - in this case the equipment generates a carrier medium frequency of 1,000 Hz or 4,000 Hz.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. Long times produce a slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

AUS (AUSSIE) **–** Stimulation Mode: **REC** (alternate)

BURST DURATION (burst duration or length) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

BURST FREQ (burst repetition frequency) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

CARRIER - in this case the equipment generates a carrier medium frequency of 1,000 Hz or 4,000 Hz.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. Long times produce a slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

AUS (AUSSIE) **–** Stimulation Mode: **SEQ** (sequential)

BURST DURATION (burst duration or length) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

BURST FREQ (burst repetition frequency) – in this case the equipment generates a medium frequency Carrier current modulated in bursts of low frequency with a duration of 2mS or 4mS.

CARRIER - in this case the equipment generates a carrier medium frequency of 1,000 Hz or 4,000 Hz.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. Long times produce a slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

Observations:

When the AUS (AUSSIE) **CNT** (continuous) is selected, the Rise, On, Decay and Off parameters will be deactivated. Consequently, there will be a continuous, constant stimulation.

Once the AUS (AUSSIE) **SIN** (synchronized) is selected, all 4 channels work together at the same time, i.e., all channels simultaneously execute the selected Rise, ON, Decay and Off times.

When selecting the AUS (AUSSIE) **REC** (alternate), channels **1** and **3, 2 and 4,** work alternately, namely, while channels 1 and 3 execute the Rise and On time, the others 2 and 4 execute the Decay and Off time.

When AUS (AUSSIE) **SEQ** (sequential) is selected the four channels work sequentially, namely, channel 1 executes the chosen Rise time, On, Decay and Off, then channel two executes the chosen Rise, On Decay and Off time, then channel three executes the chosen Rise, On, Decay and Off time and finally, channel four executes the chosen Rise, On, Decay and Off time.

In synchronized, alternate or sequential modes, an arrow indicates which gradient (Rise, On, Decay and Of time) is being executed.

ITP (INTERFERENTIAL TETRAPOLAR) - Stimulation Mode: **NML** (normal)

CARRIER - in this case the equipment generates a carrier medium frequency of 2,000Hz, 4,000 Hz or 8,000Hz.

AMF (modulation or pulsating frequency) – variable from 1 Hz to 100 Hz in “steps” of 1 Hz.

SWEEP MODE : **DES,** , or 

SWEEP FREQ. (ΔAMF) – sweeping range of AMF: variable from 1 Hz to 100 Hz in “steps” of 1 Hz.

"ROTATIONAL"or **DYNAMIC VECTOR –** possibility of manual rotation o the interferential field.

ITP (INTERFERENTIAL TETRAPOLAR) - Stimulation Mode: **AUT** (automatic)

CARRIER - in this case the equipment generates a carrier medium frequency of 2,000Hz, 4,000 Hz or 8,000Hz.

AMF (modulation or pulsating frequency) – variable from 1 Hz to 100 Hz in “steps” of 1 Hz.

SWEEP MODE : **DES,** , or 

SWEEP FREQ. (ΔAMF) – sweeping range of AMF: variable from 1 Hz to 100 Hz in “steps” of 1 Hz.

"ROTATIONAL"or **DYNAMIC VECTOR –** possibility of manual rotation o the interferential field (automatic vector).

IBP (INTERFERENTIAL BIPOLAR or PREMODULATED) – Stimulation method: CONT (continuous)

CARRIER - in this case the equipment generates a carrier medium frequency of 2,000Hz, 4,000 Hz or 8,000Hz.

AMF (modulation or pulsating frequency) – variable from 1 Hz to 100 Hz in “steps” of 1 Hz.

SWEEP MODE : **DES,** , or 

SWEEP FREQ. (ΔAMF) – sweeping range of AMF: variable from 1 Hz to 100 Hz in “steps” of 1 Hz.

IBP (INTERFERENTIAL BIPOLAR or PREMODULATED) – Stimulation method: **SIN** (sinchronized or surge)

CARRIER - in this case the equipment generates a carrier medium frequency of 2,000Hz, 4,000 Hz or 8,000Hz.

AMF (modulation or pulsating frequency) – variable from 1 Hz to 100 Hz in "steps" of 1 Hz.

SWEEP MODE : **DES,** , or 

SWEEP FREQ. (ΔAMF) – sweeping range of AMF: variable from 1 Hz to 100 Hz in "steps" of 1 Hz.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. Long times produce a slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

IBP (INTERFERENTIAL BIPOLAR or PREMODULATED) – Stimulation method: **REC** (alternate)

CARRIER - in this case the equipment generates a carrier medium frequency of 2,000Hz, 4,000 Hz or 8,000Hz.

AMF (modulation or pulsating frequency) – variable from 1 Hz to 100 Hz in "steps" of 1 Hz.

SWEEP MODE : **DES,** , or 

SWEEP FREQ. (ΔAMF) – sweeping range of AMF: variable from 1 Hz to 100 Hz in "steps" of 1 Hz.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. Long times produce a slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

IBP (INTERFERENTIAL BIPOLAR or PREMODULATED) – Stimulation method: **SEQ** (sequential)

CARRIER - in this case the equipment generates a carrier medium frequency of 2,000Hz, 4,000 Hz or 8,000Hz.

AMF (modulation or pulsating frequency) – variable from 1 Hz to 100 Hz in "steps" of 1 Hz.

SWEEP MODE : **DES,**  ,  or 

SWEEP FREQ. (ΔAMF) – sweeping range of AMF: variable from 1 Hz to 100 Hz in "steps" of 1 Hz.

RISE (pulse increase gradient) – pulse increase time, variable from 1 to 9 seconds. Regulates the contraction speed, this means the time from the start through the maximum muscular contraction. Long times produce a slow, more gradual contraction. Low times produce a more sudden contraction (ascending).

DECAY (pulse decrease gradient) – pulse decrease time, variable from 1 to 9 seconds. Regulates the speed through which the contraction is reduced, this means the time from maximum contraction through muscular relaxation. High times produce slow relaxation. Low times produce a sudden relaxation. (sudden)

ON TIME (connection time) – maximum muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current circulates through the electrodes during each stimulation cycle.

OFF TIME (disconnection time) – rest muscle contraction time, variable from 1 to 60 seconds. Regulates the time that the current does not circulate through the electrodes during each cycle.

Observations:

When the IBP (INTERFERENCIAL BIPOLAR) **CNT** (continuous) is selected, the Rise, On, Decay and Off parameters will be deactivated. Consequently, there will be a continuous, constant stimulation.

Once the IBP (INTERFERENCIAL BIPOLAR) **SIN** (synchronized) is selected, all 4 channels work together at the same time, i.e., all channels simultaneously execute the selected Rise, ON, Decay and Off times.

When selecting the IBP (INTERFERENCIAL BIPOLAR) **REC** (alternate), channels **1** and **3, 2 and 4,** work alternately, namely, while channels 1 and 3 execute the Rise and On time, the other2 2 and 4 execute the Decay and Off time.

When IBP (INTERFERENTIAL BIPOLAR) **SEQ** (sequential) is selected the four channels work sequentially, namely, channel 1 executes the chosen Rise time, On, Decay and Off, then channel two executes the chosen Rise, On Decay and Off time, then channel three executes the chosen Rise, On, Decay and Off time and finally, channel four executes the chosen Rise, On, Decay and Off time.

In synchronized, alternate or sequential modes, an arrow indicates which gradient (Rise, On, Decay and Of time) is being executed.

POL (POLARIZED) – **P+** (positive) stimulation mode

CARRIER - in this case the equipment generates a carrier medium frequency of 15,000Hz or 4,000 Hz.

P+ POLARITY: This (P+) symbol indicates the galvanic current polarity, which at this moment is positive. The connection cables of the electrodes, which will be placed on the patient used for the application of polarized current has alligator clips. One clip is red and the other is black. When the polarity is P+ (positive), the wire with the red claw is positive and the wire with the black claw is negative.

P- POLARITY: This (P+) symbol indicates the galvanic current polarity, which at this moment is positive. The connection cables of the electrodes, which will be placed on the patient used for the application of polarized current have alligator clips. One clip is red and the other is black. When the polarity is P- (negative), the wire with the red claw is positive and the wire with the black claw is negative. Consequently there was a polarity inversion.

uC (micro current) **–** CNT stimulation mode (continuous)

R (repetition frequency two pulses) – in this case the equipment transitions to operate in medium frequency (15,000 Hz) and will execute the low frecuency modulation (1 to 500 Hz), with polarity inversion (positive and negative) each 3 seconds.

- The values of the Duration of the pulses and pulse repetitions Frequencies described here were measured at 50% of the maximum output amplitude.

NEURODYN V2.0 AC INPUT

Neurodyn V2.0 is a CLASS II monophasic equipment with BF applied part of safety and protection. Neurodyn V2.0 works with voltages at a range of 100 - 240 volts 50/60 Hz. Just plug in the equipment to the "power outlet" and the equipment will perform te voltage selection. The connection cable to the electric line is detachable.

The equipment uses the line plug as a resource to separate electrically the circuits of the power line in all the poles.

***ATTENTION*:**

The protection fuses are located on the rear part of the NEURODYN V2.0. To replace them, turn the equipment off, unplug it from the power outlet and, with a small screwdriver, take the protective lid off, disconnect the fuse, perform the replacement and put the lid back to its original place.

Always use fuses recommended by IBRAMED:

Use fuse of 5 A (20 AG)

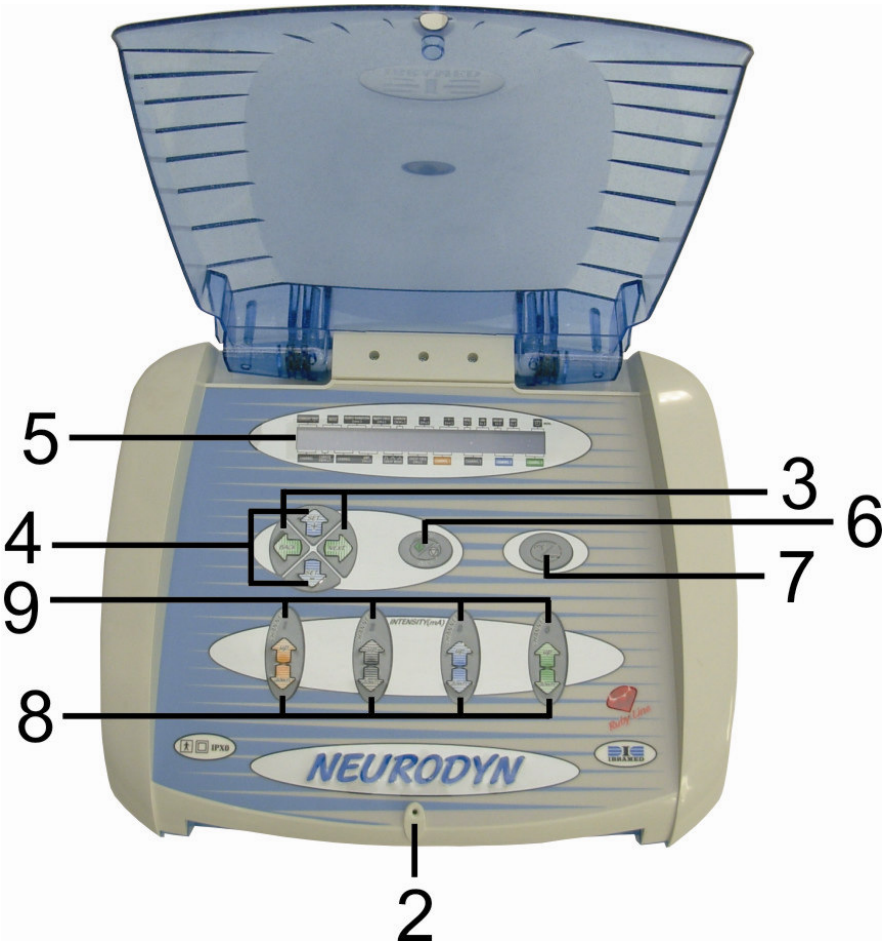
SECURITY RISKS MIGHT OCCUR IF THE EQUIPMENT IS NOT PROPERLY INSTALLED.

NOTE:

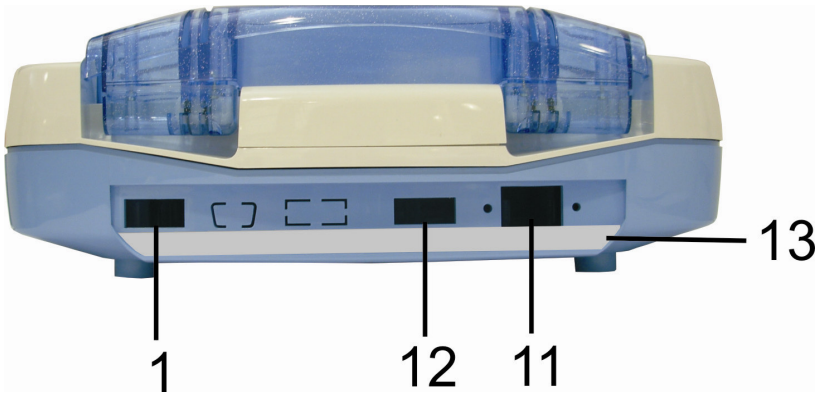
- There are dangerous voltages inside the equipment. *Never open the equipment.*
- ***Attention: The application of the electrodes close to the thorax may increase the risk of cardiac fibrillation.***

NEURODYN V2.0 Controls, indicators, and operation

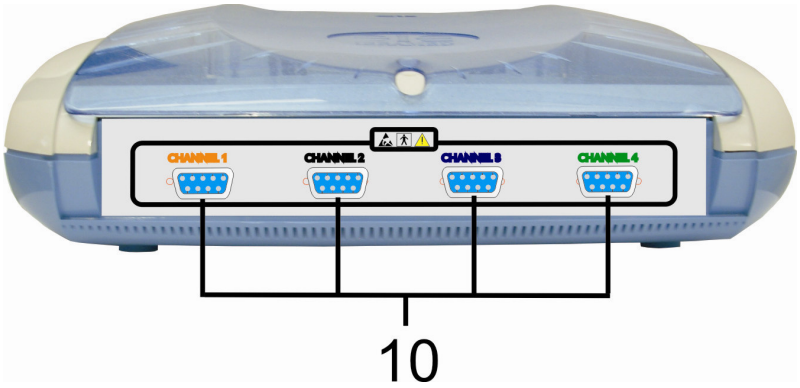
UPPER VIEW



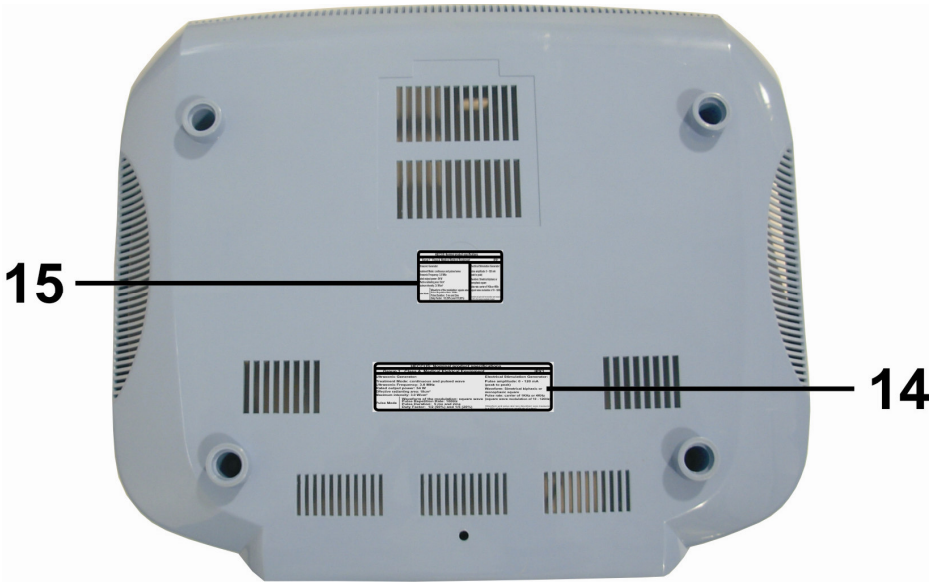
REAR VIEW



FRONT VIEW



LOWER VIEW



1-
ON/OFF switch.

2- Light Indicator (green) of ON condition.

3- **BACK/NEXT** keys.

4- SET+ and **SET-** control keys.

5- Alphanumerical liquid crystal **DISPLAY**

6- START/STOP control keys The same key has two functions: START – beginning the treatment. STOP – stop the treatment.

7- **PROG/MENU** control keys – This key has two functions: *selection of programs (treatment protocols) and menu.* Consequently, according to the function, we can call it PROG or MENU key.

8- **UP and DOWN** control keys **–** Intensity from channel 1 to channel 4.

9- Luminous indicators (yellow) of channel 1, channel 2, channel 3 and channel 4, of the presence of a current intensity to the patient which can deliver a charge resistance of 1000 ohms, with a tension higher than 10 V or a current higher than 10 mA. Whenever the equipment is at a TENS intensity and type of current, this indicator will be continuously on. When the stimulation mode synchronized or alternate, this indicator will "flicker" according to the On Time and Off Time durations. We suggest to always increase the intensity during the On Time cycle, indicator on (maximum contraction).

10- Patient cable connections (channel 1 - orange color, channel 2 - black color, channel 3 - blue color and channel 4 - green color).

11- Connections of the power cable to be connected to the local AC input. See chapter Neurodyn V2.0 – AC Input.

12-  Fuse rack - See chapter Neurodyn V2.0 – Electrical AC Input.

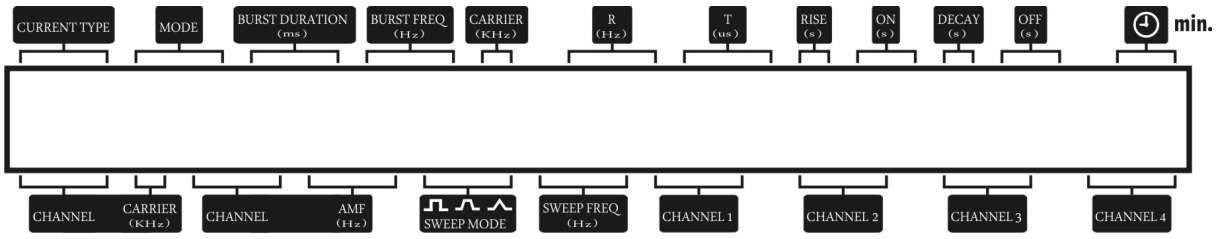
13- Network voltage characteristics plate.

14- Tag with the characteristics of the output current of NEURODYN V2.0.

15- General characteristics tag.

How to use Neurodyn V2.0*:*

All the parameters are programmed by touch keyboard and indicated on the liquid crystal display. Descriptions and the necessary steps to operate this equipment are shown below:



CURRENT TYPE

Field designed for the selection of the ***TYPE of CURRENT:*** **TNS** – TENS Current, **FES** – FES Current , **RUS** – RUSSIAN Current, **AUS** – AUSSIE Current , **ITP** – INTERFERENTIAL TETRAPOLAR Current, **IBP** – INTERFERENTIAL BIPOLAR Current, **POL** – POLARIZED Current and **uC** – MICRO CURRENT

MODE

Field designed for the selection of the ***Stimulation MODE:*** **NML –** NORMAL, **BST** – BURST, **VIF** – VIF (Variation of Intensity and Frequency), **CNT** – CONTINUOUS, **SIN** – SYCHRONIZED, **REC** – ALTENATE, **SEQ** - SEQUENTIAL, **SVF -** SINCHRONIZED with VIF, **RVF –** ALTERNATE with VIF, **QVF –** SEQUENTIAL with VIF, **AUT** – AUTOMATIC vector, **P+** - POSITIVE polarity e **P-** - NEGATIVE polarity (inverted)

BURST DURATION (ms)

Field destined for the selection of the parameter **BURST DURATION** When in AUSSIE current **2ms or 4ms** are selectable. When in RUSSIAN current 50%, 30% or 10% are selectable.

BURST FREQ (Hz)

Field destined for the selection of the parameter **BURST DURATION** (repetition burst frequency): When in AUSSIE current, it varies from **1Hz to 120Hz.** When in RUSSIAN current, it varies from **1Hz to 100Hz.**

CARRIER (Khz)

Field destined to the selection of the parameter **FREQUENCY of the CARRYING FREQUENCY: 1KHz** (1,000 Hz) or **4KHz** (4,000 Hz) Enabled only when the Type of Current is Aussie Current.

R (Hz)

Field designed for the selection of the **R** (Hz) parameter – pulse repetition frequency. Enabled only when the type of currents is TEENS, FES or MICRO CURRENT. Variable from 0.5 Hz to 250 Hz when the type of current is TENS or FES. When the type of current for MICRO CURRENTS varies from 1 Hz to 500 Hz.

T (us)

Field designed for the selection of the **T**(uS) paramenter- duration of the pulse varible from 50 useg to 500 useg. Enabled only when the type of currents is TEENS or FES.

RISE (s)

Field designed to selection of ***PULSE ASCENDING TIME*** (time to go from rest to maximum contraction parameter – pulse ascending ramp), variable from 1 to 9 seconds. Enabled only when the Type of Current is Synchronized FES, alternate, sequential, synchronized with VIF alternate with VIF and sequential with RUSSIAN Synchronized VIF, alternate and sequential, Synchronized alternate AUSSIE, BIPOLAR Synchronized INTERFERENTIAL, alternate and sequential.

Field designed for the selection of the parameter ***CONNECTION TIME*** (time of sustentation of the maximum muscle contraction), variable from 1 to 60 seconds. Enabled only when the Type of Current is Synchronized FES, alternate, sequential, synchronized with VIF alternate with VIF and sequential with RUSSIAN Synchronized VIF, alternate and sequential, Synchronized alternate AUSSIE, BIPOLAR Synchronized INTERFERENTIAL, alternate and sequential.

Field designed for the selection of the parameter ***PULSE DESCENT TIME*** (time to go from maximum contraction to rest – pulse decrease gradient), variable from 1 to 9 seconds. Enabled only when the Type of Current is Synchronized FES, alternate, sequential, synchronized with VIF alternate with VIF and sequential with RUSSIAN Synchronized VIF, alternate and sequential, Synchronized alternate AUSSIE, BIPOLAR Synchronized INTERFERENTIAL, alternate and sequential.

Field designed for the selection of the parameter ***REST TIME*** (time of the muscle contraction), variable from 1 to 60 seconds. Enabled only when the Type of Current is Synchronized FES, alternate, sequential, synchronized with VIF alternate with VIF and sequential with RUSSIAN Synchronized VIF, alternate and sequential, Synchronized alternate AUSSIE, BIPOLAR Synchronized INTERFERENTIAL, alternate and sequential.

Field designed for the selection of the parameter ***APPLICATION TIME*** (TIMER). Allows for the selection of an application time of 1 to 60 minutes.

CHANNEL.- Fields designed for the selection of the channels for Interferential therapy. When the ITP (Interferential Tetrapolar) mode is chosen in CHANNEL 1 the interference will occur between channel 1 and channel 2 (endogenous) When CHANNEL 3 is chosen, the interference will be made between channel 3 and 4 (endogenous).
When in IBP mode (Interferential Bipolar) the four channels work equally (Heterodyne)
CARRIER - Field designed for the selection of the carrying frequency. When in ITP mode (Interferential Tetrapolar) or IBP (Interferential Bipolar) we will be able to independently select carrier frequencies of 2 KHz (2.000 Hz), 4 KHz (4.000 Hz) or 8 KHz (8.000 Hz) for channel 1 and 3 (ITP) and for channel 1 to 4 (IBP).

CHANNEL – Field designed to indicate the channel in which a value for AMF will be selected.

AMF – Fields designed for the selection of the modulation frequency (pulsating frequency): 1 to 120Hz.

SWEEP MODE Field destined to the choice of SWEEP mode:

SWEEP FREQ (Hz) Fields designed for the selection of the SWEEP frequency range (▲AMF) 1 to 200Hz.

CHANNEL 1 Field designed for the selection and indication of the intensity of the current of channel 1.

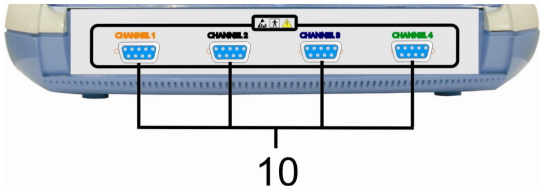
CHANNEL 2 Field designed for the selection and indication of the intensity of the current of channel 2.

CHANNEL 3 Field designed for the selection and indication of the intensity of the current of channel 3.

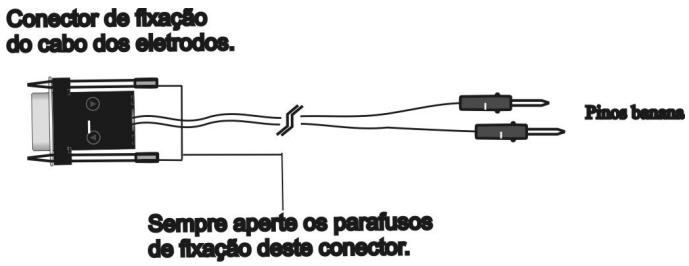
CHANNEL 4 Field designed for the selection and indication of the intensity of the current of channel 4.

1º step: Remove the equipment from the transport box and the plastic bag protection . Connect the detachable power cable (11) and connect the equipment to the local electrical network socket.

2º step: Place the connection cables on the patient into the output (10) connector located on the front part of the equipment. The orange cable is channel 1, the black cable is channel 2, the blue cable is channel 3 and the green cable is channel 4.

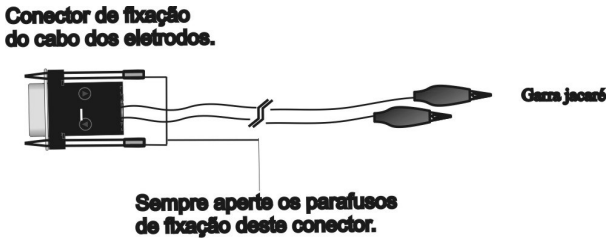


3º step: Place the conductive silicon rubber electrodes on the banana clips located at the end of the connection cable to the patient.
The cables used for TENS, FES, Russian, Aussie, Interferential and Micro Current have **pins** at the ends, as shown below:



Note: There are four cables with pins at the ends to be used with the silicone rubber conductive electrodes. These were made to be used from channel 1 to channel 4 (according to the colors on the equipment panel) and only for TENS, FES, Russian, Aussie, Interferential an Micro Current.

The cables used in Polarized current have **alligator clips** at the ends, as shown below:



Note: These are four cables with two threads with alligator pins at the ends to be used with an aluminum electrode wrapped by a chamex coating (vegetable sponge).

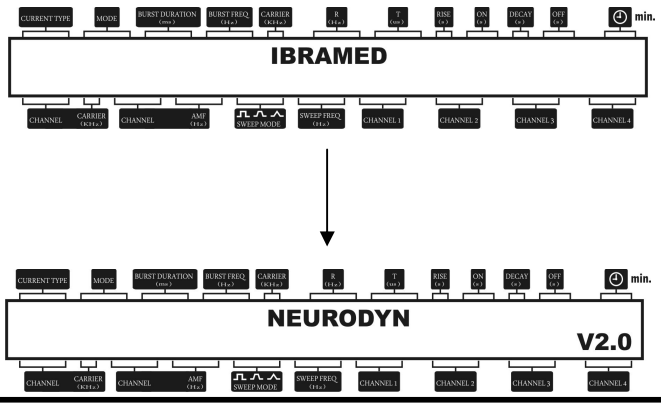
These were made to be used from channel 1 to channel 4 (according to the colors on the equipment panel) and only for TENS, FES, Russian, Aussie, Interferential an Micro Current.

Attention:

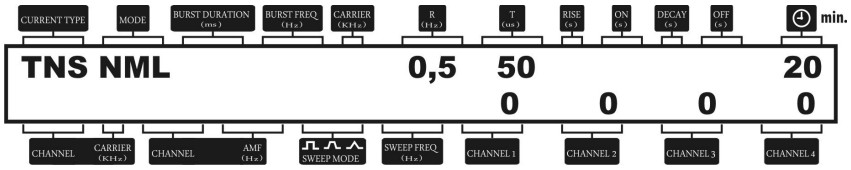
1- The fixed connector of the electrode cable has screws that must be fastened to the output connector (10) located on the equipment panel. *Always tighten the screws of this connector for a perfect electrostimulation.*

2- To remove the banana plugs from the electrodes, just pull them using their protection cover. *Never pull them from their cable.*

4º step: Turn on – turn off key (1). When connecting the equipment, the liquid crystal screen (5) will show the following display messages for several seconds.



After this presentation, the display (5) will start its operation indicating the equipment programming “default” page:

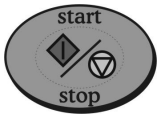


Note that the parameter field CURRENT TYPE is shown with a blinking cursor on top of the letter T of the word TENS. This is the cursor used to select the parameters. It will always be present when the equipment is being programmed.

5º step: BACK and NEXT (3) control keys: These keys are used to select the parameters necessary for the treatment. When pressing the NEXT key you will be taken to the next parameter. When pressing the BACK key you will be taken back to the previous parameter. Note that after each selection performed through the BACK and NEXT keys the chosen parameter will remain flickering.

6º step: SET + and SET - (4) control keys: These keys are used to choose the marks of each necessary parameter to the therapy.
SET+ → increasing values. SET- → decreasing values.

7º step: START / STOP (6) control key.



Once the parameters and their values are respectively selected (as described in the previous paragraphs), press the START key. Now note that the cursor of the parameter selection stops flickering.

At this moment the program will start. Now choose the current intensity necessary for the treatment. If you wish to interrupt the application, just press the STOP key. The emission of current Will be interrupted and the parameter will flicker again to perform a new programming. At the end of the scheduled time you will hear a sound signal (several "beeps") and the emission of current will be interrupted. Press the STOP key to turn off the sound beep and the equipment will return to the programming condition again. As you can see, there are two functions in the same key. START – beginning the treatment. STOP – stop the treatment.
Note: Always press the centre of this key.

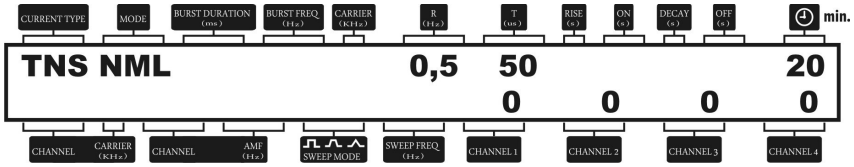
8º step: Control key **UP / DOWN (8) -** INTENSITY; once you press the START key, the equipment executes the parameters selected by the operator. At this moment these UP/DOWN keys will start operating increasing or reducing the current intensity of channels 1, 2, 3 and 4.

As it has been seen up to this point, the Neurodyn V2.0 panel is self-explanatory, only a few minutes of use are enough to become familiarized with its programming.

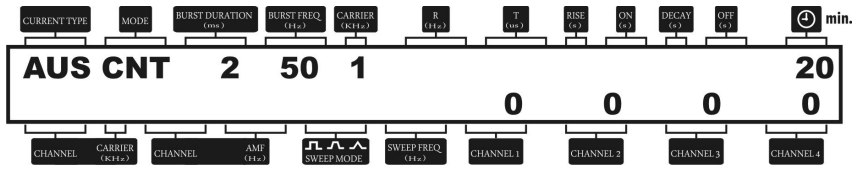
NOTE: We suggest that the patient preparation procedures and application of the electrodes are performed before turning on and program the equipment.

Example 1: Let us suppose that the clinical practice or existing literature suggests the synchronized Aussie current type with the following parameters for a certain pathology:
- carrying frequency – 4 KHz
- Burst repetition frequency = 20 Hz
- Burst duration = 4ms
- rise = 2 seconds
- on = 5 seconds
- decay = 2 seconds
- off = 10 seconds
- treatment time = 15 minutes

Switch on the equipment and the "default" programming described in the previous page will be executed. Note the cursor blinking in the Current Type field:

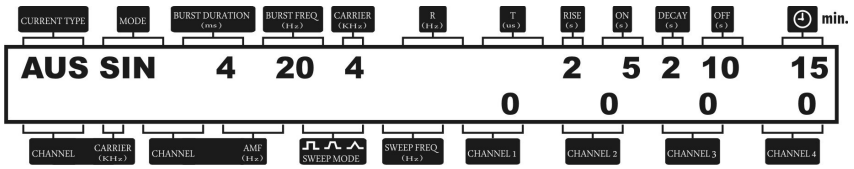


1- Selecting the synchronized stimulation mode:
Press the SET+ key until the CURRENT FIELD displays AUSSIE. At this time the LCD indicates:



2- Using the NEXT/BACK and SET+/SET- you can go through the remaining parameters selecting the values indicated on the example above.

Very well, if the programming of all the necessary parameters was selected, the liquid crystal screen will display:



Now press the START key to begin and execute the program that was entered. Nothe that the “flickering”cursor disappears and the liquid crystal screen indicates the gradient (Rise< On, Decay and Off) in execution (lateral arrow).

Now press the UP or DOWN keys of the channel that is being used to select the current intensity necessary for the treatment.

At the end of the programmed time, the emission of current will be interrupted and a sound alarm will indicate the end of the treatment.

Press the STOP key to stop the alarm. At this moment, the equipment will be able to be disconnected or will be ready to repeat the entered program or perform a new program.

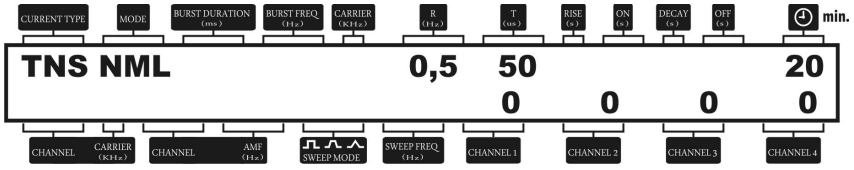
Example 2: Let us suppose that the clinical practice or existing literature suggests the Interferential Tetrapolar Normal current (normal vector) for a certain condition, with the following parameters:

- carrying frequency – 4 KHz
- modulation frequency (AMF) = 20 Hz
- sweep mode = ⩓

Sweep frequency range (sweep freq. or ▲AMF) = 50 Hz

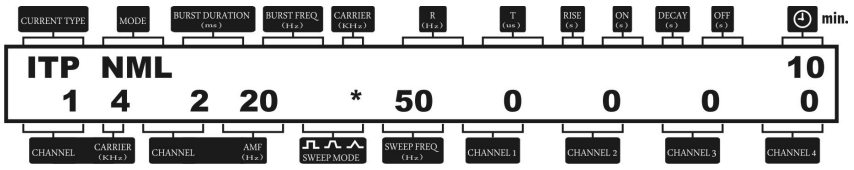
- treatment time = 10 minutes

Switch on the equipment and the “default” programming described in the previous page will be executed. Note the cursor blinking in the Current Type field:



When the current type is Tetrapolar Interferential, the equipment allows for interference on channel 1 and 2 or channel 3 and 4. Actually, it works as if there were two interferential equipment in one. Using the NEXT/BACK and SET+/SET- keys, go through the parameters selecting CURRENTE TYPE = ITP, MODO = NML, CHANNEL 1, SWEEP MODE (asterisk above the symbol), etc, actually, all the values indicated in the example above.

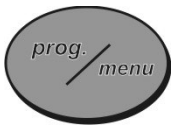
Very well, if the programming of all the necessary parameters was selected, the liquid crystal screen will display:



Now press the START key to begin and execute the program that was entered.

Note that the "flickering" cursor disappears. Now press the UP or DOWN keys of channels 1 and 2 that is being used to select the current intensity necessary for the treatment.

At the end of the programmed time, the emission of current will be interrupted and a sound alarm will indicate the end of the treatment. Press the STOP key to stop the alarm. At this moment, the equipment will be able to be disconnected or will be ready to repeat the entered program or perform a new program.

Additional information regarding the **PROG./MENU** key. 

PROG/MENU control key – This key has two functions: *selection of programs (treatment protocols) and menu.* Consequently, according to the function, we can call it PROG or MENU key.

1- Operating as a **PROG.** key: This PROG key is used to select treatment protocols, this means, set programs that are saved in the memory of the equipment.

Turn on your equipment as described in the previous paragraphs. Press the PROG key quickly. The LCD will indicate the pre-programmed treatment protocols. **You will be able to select 40 fast treatment programs (protocols) or create and save 10 more programs (particular) programs using the SET+/SET- key. Below there is a description of the 39 ready programs (protocols):**

Prog: 1 -> TNS
Red. dor PGs
1 – Reduction of Pain in Triggering Points: F=10Hz T=500µs. Only one channel of electrodes must be used by directly positioning one electrode of the muscular trigger point and the other electrode at a distance of 7cm from the main electrode. The treatment time must be equal to 2 minutes. The intensity must be an intense sensorial stimulation.

Prog: 2 -> TNS
Severe pain
Severe pain (Protocol for severe pain): T= 50us, f=170hz. The positioning of the electrodes must consider the area of the pain, the use of only one channel is enough for the procedure. The intensity used must be intense sensorial stimulation and the treatment time must be the same as a second therapeutic intervention simultaneously used, such as for example, a functional displacement of the soft tissue.

Prog: 3 -> TNS

Chronic Pain

Chronic pain (Protocol for chronic pain). F=40Hz T= 150µs. For this type of therapy the used intensity of the treatment must be equal to the intense sensorial stimulation, with one electrode **channel,** this means, two electrodes must be positioned on the dermatome corresponding to the pain at a maximum distance of 7cm between them. The second electrode channel, this means the other two electrodes must be positioned on the nerve root corresponding to the dermatome in which the pain is localized.

Example: in the modulation of the pain of a patient with a lateral epicondylitis, two electrodes (channel 1) must be positioned in a way to cover the lateral epicondylus and the other two electrodes (channel 2) must be positioned in the paravertebral region on the same side of the target higher limb, encircling the c6 medullar nerve root, which corresponds to the dermalgic innervation of the region pf the lateral epicondylus. The stimulation time must be equal to 20 minutes. The stimulation must be preferentially performed at the end of the treatment session, since the residual effect of the endorphin release can last for 2 to 3 hours from the end of the intervention. Cryotherapy should be avoided within the same treatment session if the T.E.N.S. acupuncture is the chosen resource for modulation of patient's pain.

For the correct use of the application technique of the resource, two electrode channels must be used in the following manner: one channel, this means, two electrodes should encompass the pain location. The other two electrodes must be positioned on the nerve root corresponding to the dermatomo of the pain. For example, if the patient complains of pain and discomfort in the rear area of the shoulder close to the rear deltoid muscle, a channel must be positioned covering the affected painful area and the second channel on the homolateral paravertebral area in relation to the pain, exactly on the C5 and C6 nerve roots. In this situation the treatment time must be equal to 20 minutes. The utilized intensity must be an intense sensorial stimulation, during the therapy it is not uncommon or incorrect to present muscle contractions under the electrodes, mainly if the channel has been positioned on the pain area that presents anatomical correlation with one or more large muscles. The nervous fibers to be stimulated so that the modulatory effect may occur are the A-delta.

Prog: 4- > FES

Rec fuctional PC

Functional recovery post-surgery (Protocol for post-surgery functional recovery). T= 250us, F=50Hz, modulation in gradient of 3s increase, 8s maintenance and 1s decrease. The intensity will be a motor stimulation. Electrodes applied in the muscular centre or in the motor muscular point. Treatment time equal to 25 minutes or the desired number of muscle contractions. The intensity should be a strong motor stimulation and should be a high one within the same session and at each session of treatment.

Prog: 5- > FES
Increase of muscular strength in athletes 1
FM Athletes Increase - 1 (Increase of muscle strength for athletes / conditioned muscle – initial phase): F=60Hz, T=350µs, T*on* = 12 seconds, Rise = 3 seconds, decay = 1 second and t*off* = 20 seconds. Electrodes applied in the muscular centre or in the motor muscular point. Treatment time equal to 25 minutes or the desired number of muscle contractions. The intensity should be a strong motor stimulation and should be a high one within the same session and at each session of treatment.

Prog: 6- > FES
Increase of muscular strength in athletes 2
FM Athletes Increase - 2 (Increase of muscle strength for athletes / conditioned muscle – initial phase): F=60Hz, T=350µs, T*on* = 15 seconds and Rise= 3 seconds.

decay = 1 second and t*off* = 15 seconds. Electrodes applied in the muscular centre or in the motor muscular point. Treatment time equal to 25 minutes or the desired number of muscle contractions. The intensity should be a strong motor stimulation and should be a high one within the same session and at each session of treatment.

Prog: 7- > FES
Increase of muscular strength in athletes 3
FM Athletes Increase - 3 (Increase of muscle strength for athletes / conditioned muscle – advanced phase). F=60Hz, T=350µs, T*on* = 18 seconds, Rise = 3 seconds, decay = 1 second e t*off* = 18 seconds.

Electrodes applied in the muscular centre or in the motor muscular point. Treatment time equal to 25 minutes or the desired number of muscle contractions. The intensity should be a strong motor stimulation and should be a high one within the same session and at each session of treatment.

Prog: 8- > FES
Increase of Muscle Strength for LCA 1
FM after Lesion Increase LCA - 1 (Increase of muscle strength in patients with LCA lesion with or without ligamentoplasty / initial phase): F=60Hz, T=350µs, T*on* = 6 seconds, Rise = 3 seconds, decay = 1 second e t*off* = 12 seconds. Electrodes applied on the centre of the motor point of the retho femoral muscles, long lateral vast, obliquous lateral vast and obliquous medial vast. Treatment time = 25 minutes The intensity should be a strong motor stimulation and should be a high one within the same session and at each session of treatment.

Prog: 9- > FES
Increase of Muscle Strength for LCA 2
FM post Injury Increase LCA - 2 (Increase of muscle strength in patients with LCA lesion with or without ligamentoplasty / intermediate phase): F=60Hz, T=350µs, T*on* = 10 seconds, Rise = 3 seconds, decay = 1 second e t*off* = 15 seconds. Electrodes applied on the centre of the motor point of the retho femoral muscles, long lateral vast,

obliquous lateral vast and obliquous medial vast. Treatment time = 25 minutes The intensity should be a strong motor stimulation and should be a high one within the same session and at each session of treatment.

Prog: 10- > FES
Increase of Muscle Strength for LCA 3
FM after Lesion Increase LCA - 3 (Increase of muscle strength in patients with LCA lesion with or without ligamentoplasty /advanced phase): F=60Hz, T=300µs, T*on* = 15 seconds, Rise = 3 seconds, decay = 1 second e t*off* = 15 seconds. Electrodes applied on the centre of the motor point of the retho femoral muscles, long lateral vast, obliquous lateral vast and obliquous medial vast. Treatment time = 25 minutes The intensity should be a strong motor stimulation and should be a high one within the same session and at each session of treatment.

Prog: 11- > FES
Increase of muscular strength knee endoprothesis 1
FM knee endoprosthetic increase - 1 (Increase of muscle strength in patients subject to surgery for implanting of knee prosthetics / initial phase): F=40Hz, T=250µs, T*on* = 6 seconds, Rise = 5 seconds, decay = 2 second e t*off* = 15 seconds. Electrodes positioned on the center of the motor points of the rheto femoral muscles, vastus long lateral, vastus obliquous and vastus medialis obliquous. Treatment time = 35 minutes The intensity must be a low motor stimulation and must be elevated during the same treatment session.

Prog: 12- > FES
Increase of muscular strength knee endoprothesis 2
FM knee endoprosthetic increase - 2 (Increase of muscle strength in patients subject to surgery for implanting of knee prosthetics / initial phase): F=40Hz, T=250µs, T*on* = 10 seconds, Rise = 5 seconds, decay = 2 seconds and t*off* = 15 seconds. Electrodes positioned on the center of the motor points of the rheto femoral muscles, vastus long lateral, vastus obliquous and vastus medialis obliquous. Treatment time 35 minutes The intensity must be a low motor stimulation and must be elevated during the same treatment session.

Prog: 13- > FES
Increase of muscular strength knee endoprothesis 3
FM knee endoprosthetic increase - 3 (Increase of muscle strength in patients subject to surgery for implanting of knee prosthetics / initial phase): F=40Hz, T=250µs, T*on* = 15 seconds, Rise = 5 seconds, decay = 2 second and t*off* = 15 seconds. Electrodes positioned on the center of the motor points of the rheto femoral muscles, vastus long lateral, vastus obliquous and vastus medialis obliquous. Treatment time 35 minutes The intensity must be a low motor stimulation and must be elevated during the same treatment session.

Prog: 14- > FES
Post LPN 1 muscular strength increase

FM post LNP Increase - 1 (Increase of muscle strength in patients with peripheral nervous lesions / initial phase). F=65Hz, T=300µs, T*on* = 3 seconds, Rise = 5 seconds, Decay = 2 seconds and t*off* = 20 seconds per 30 minutes. Electrodes applied on the muscular centre of the denervated muscles. The intensity must be a low motor stimulation increased during the sessions. The treatment frequency must be 5 to 6 times per week.

Prog: 15- > FES
Post LPN 2 muscular strength increase
FM post LNP Increase - 2 (Increase of muscle strength in patients with peripheral nervous lesions / intermediary phase): F=65Hz, T=300µs, T*on* = 6 seconds, Rise = 5 seconds, Decay = 2 seconds and t*off* = 18 seconds per 30 minutes. Electrodes applied on the muscular centre of the denervated muscles.

The intensity must be a low motor stimulation increased during the sessions. The treatment frequency must be 5 to 6 times per week.

Prog: 16- > FES
Post LPN 3 muscular strength increase
FM post LNP Increase 3 (Increase of muscle strength in patients with peripheral nervous lesion / advanced phase). F=65Hz, T=300µs, T*on* = 10 seconds, Rise = 5 seconds, Decay = 2 seconds and t*off* = 18 seconds per 30 minutes. Electrodes applied on the muscular centre of the denervated muscles.

The intensity must be a low motor stimulation increased during the sessions. The treatment frequency must be 5 to 6 times per week.

Prog: 17- > FES
AVC subluxed shoulder 1
FM AVC Increase for the treatment of a subluxated shoulder – 1(Increase of muscle strength and muscular facilitation in patients with central nervous injury (AVC) / initial phase): Ideal for use in subluxated shoulder. F=40Hz, T=300µs, T*on* = 8 seconds, Rise = 5 seconds, Decay = 2 seconds and t*off* = 18 seconds per 30 minutes. Electrodes positioned on the centers of the supraspinal muscles and medial deltoid fibers or on the muscle centers of the muscles to be moved during functional activity. The intensity must be motor stimulation. The stimulation time must be the same as voluntary muscle contraction time produced during functional activity.

Prog: 18- > FES
AVC subluxed shoulder 2
FM AVC Increase for the treatment of a subluxated shoulder – 2(Increase of muscle strength and muscular facilitation in patients with central nervous injury (AVC) / initial phase): Ideal for use in subluxated shoulder. F=40Hz, T=300µs, T*on* = 10 seconds, Rise = 5 seconds, Decay = 2 seconds and t*off* = 18 seconds per 30 minutes. Electrodes positioned on the muscle centers to be moved during functional

activity. The intensity must be over the motor threshold. The stimulation time must be the same as voluntary muscle contraction time produced during functional activity.

Prog: 19- > FES
AVC subluxed shoulder 3
FM AVC Increase for trreatment of subluxated shoulder – 3(Increase of muscle strength and muscular facilitation in patients with central nervous injury (AVC) / advance phase): Ideal for use in subluxated shoulder. F=40Hz, T=300µs, T*on* = 12 seconds, Rise = 5 seconds, Decay = 2 seconds and t*off* = 18 seconds per 30 minutes. Electrodes positioned on the muscle centers to be moved during functional activity. The intensity must be over the motor threshold. The stimulation time must be the same as voluntary muscle contraction time produced during functional activity.

Prog: 20- > FES
Spasticity control 1
Spasticity control - 1 (Reduction of muscle spasticity in patients with central nervous system / higher motoneuronal lesions – initial phase. F=60Hz, T=300µs, T*on* = 12 seconds, Rise = 5 seconds, decay = 2 second e t*off* = 17 seconds. Electrodes positioned on the muscle centre or on the motor muscular point of the opposite muscle in relation to the spastic muscle. Treatment time equal to 15 minutes or the desired number of muscle contractions. The intensity must be a medium motor stimulation and must be increased during the same treatment session.

Prog: 21- > FES
Spasticity control 2
Spasticity control 2 (Reduction of muscle spasticity in patients with central nervous system / higher motoneuronal lesions – intermediary phase). F=50Hz, T=300µs, T*on* = 15 seconds, Rise = 5 seconds, decay = 2 seconds e t*off* = 17 seconds. Electrodes positioned on the muscle centre or on the motor muscular point of the opposite muscle in relation to the spastic muscle. Treatment time equal to 15 minutes or the desired number of muscle contractions. The intensity must be a medium motor stimulation and must be increased during the same treatment session.

Prog: 22- > FES
Spasticity control 3
Spasticity control- 3 (Reduction of muscle spasticity in patients with central nervous system / higher motoneuronal lesions – advanced phase). F=50Hz, T=300µs, T*on* = 17 seconds, Rise = 5 seconds and t*off* = 17 seconds. Electrodes positioned on the muscle centre or on the motor muscular point of the opposite muscle in relation to the spastic muscle. Treatment time equal to 15 minutes or the desired number of muscle contractions. The intensity must be a medium motor stimulation and must be increased during the same treatment session.

Prog: 23- > FES
Increase of local muscular resistance 1
Local Muscular Resistance Increase - 1 (Increase of the localized muscle resistance / initial phase). F=20Hz, T=300µs, T*on* = 25 seconds, Rise = 5 seconds, Decay = 2

seconds e t*off* = 45 seconds. Electrodes applied in the muscular centre or in the motor muscular point. Treatment time equal to 40 minutes, 3 times per day. The intensity must be a low motor stimulation and it must be increased in each treatment session on different days. Gradient modulation.

Prog: 24- > FES
Increase of local muscular resistance 2
Local Muscular Resistance Increase - 2 (Increase of the localized muscle resistance / intermediary phase). F=20Hz, T=300µs, T*on* = 35 seconds, Rise = 5 seconds, decay = 2 second e t*off* = 50 seconds. Electrodes applied in the muscular centre or in the motor muscular point. Treatment time equal to 40 minutes, 3 times per day. The intensity must be a low motor stimulation and it must be increased in each treatment session on different days.

Prog: 25- > FES
Increase of local muscular resistance 3
Local Muscular Resistance Increase - 3 (Increase of the localized muscle resistance / advanced phase). F=20Hz, T=300µs, T*on* = 40 seconds, Rise = 5 seconds, Decay = 2 seconds e t*off* = 55 seconds. Electrodes applied in the muscular centre or in the motor muscular point. Treatment time equal to 40 minutes, 3 times per day. The intensity must be a low motor stimulation and it must be increased in each treatment session on different days.

Prog: 26 -> IBP
(Display = Immediate P.O. edema treatment).
Immediate ontrol and reduction of post-surgical edema. The total therapy time Will be 20 minutes; carrying frequency F=4kHz, AMF 5 Hz, ΔAMF 5Hz, Sweep 6/6. The intensity must be a strong sensorial stimulation. The technique used can be the bipolar of tetrapolar and the electrodes should be positioned on the region of the edema.

Prog: 27 -> IBP
Mod. Acute pain for functional move).
Modulation of acute pain for facilitation of functional move (The therapy time will be equal to the time required for execution of the therapeutic technique directed to the functional move facilitation, such as for example, increase of move amplitude after a period of immobilization): carrying frequency F=2KHz, AMF 75Hz, ΔAMF 75Hz, Sweep 6/6. The intensity should be the strong sensorial stimulation. The positioning technique to be used can be the bipolar or tetrapolar and the pain dermatome should be the point for electrodes fixing.
OBS: The activated mechanism in this case is the theory of the pain gate through fiber stimulation at β.

Prog: 28 -> IBP
Modulation of chronic pain
Modulation of chronic pain F=2,4 or 8KHz, AMF 5Hz, ΔAMF 20Hz, Sweep 6/6. The intensity should be a strong sensorial stimulation. The positioning technique to be used can be the bipolar or tetrapolar and the pain dermatome should be the point for electrodes fixing. The intensity should be the strong sensorial stimulation and the

treatment time equal to 20 minutes. *Note: The activated mechanism in this case is the production of endogenous opioids through Δ fiber stimulation .*

Prog: 29 -> IBP
Type I Fiber Muscles Functional Recovery
Functional recovery for muscles with type I fiber predominance (Type I pred. muscle FR): carrying 2KHz, AMF 5Hz and ΔAMF 7Hz, Sweep 1/1, pre-modulated, intensity above threshold time motor equal to 20 minutes or the number of required contractions. The modulation in gradient should be of 3 second in rise, 25 second in contraction, 3 second in fall and 50 seconds in off time.

Prog: 30 -> IBP
Type IIa Fiber Muscle Functional Recovery
Functional recovery for mixed muscles IIa and IIb (IIa and IIb mixed muscles FR): carrying 2KHz, AMF 35Hz and ΔAMF 15Hz, Sweep 1/1, pre-modulated, intensity above threshold time motor equal to 20 minutes or the number of required contractions. The modulation in gradient should be of 3 second in rise, 8 second in contraction, 3 second in fall and 20 seconds in off time.

Prog: 31 -> IBP
Type Iib Fiber Muscle Functional Recovery
Functional recovery for muscles with type IIb fiber predominance (Type IIb pred. muscle FR): carrying 2KHz, AMF 50Hz and ΔAMF 20Hz, Sweep 1/1, pre-modulated, intensity above threshold time motor equal to 20 minutes or the number of required contractions. The modulation in gradient should be of 3 second in rise, 8 second in contraction, 3 second in fall and 20 seconds in off time.

Prog: 32 -> AUS
Muscular Strengthening for Athletes
Muscular Strengthening for Athletes The objective of this program is to provide the increase of the muscular strength in normal individuals, this means, without neuro-osteomioarticular system dysfunction. The parameters for stimulation are alternate current with frequency equal to 1kHz with a *Burst* duration equal to 2 ms. The *Burst* frequency should be equal to 50 Hz. Thus, the maximum muscular contraction will be produced. The modulation in gradient should be of 1 second in rise, 9 second in contraction, 1 second in fall and 50 seconds in off time. The gradient is similar to the one used in the Russian current, however, the torque production is greater and the muscular fatigue smaller. Positioning of electrodes should be made on the motor point and the intensity should be the motor stimulation that the patient can bear. The stimulation can be made on a daily basis during 20 minutes or by the number of required contractions. It is important that the stimulation combine with voluntary exercises.

Prog: 33 -> AUS

Motor reeducation

Motor reeducation This program should be used with the objective of motor facilitation and motor re-learning. For stimulation, the carrying frequency of 4 kHz is used with a *Burst* duration equal to 4ms. The *Burst* frequency should be equal to 50 Hz. The gradient is used with 1 second of rise time, 3 seconds of contraction, 1 second of fall and 3 seconds of rest time or *off* time. For stimulation the electrodes should be positioned in the muscular motor points or in the center of the skeletal muscles. The stimulation should be strong enough to provoke the muscular contraction, this means, the stimulus should be given above the motor threshold. The stimulation frequency can be daily and the duration time of each session can vary from 10 to 15 minutes.

With the re-education program through the *AUSSIE* current, a comfortable activation of the skeletal muscles will occur as well as the propagation of afferent stimuli promoting sensorial inputs to the central nervous system. In case of pain due to tissue lesion, the central nervous system will inhibit automatically a specific muscle or a group of muscles. After recovery of the structure, if the inhibition persists, use of the electric stimulation will be needed through the *Aussie* current so that the functional motor activities can occur again normally. The muscular fatigue can easily occur, thus, short sessions of treatment should be prioritized.

To help in training, the patient should maintain the concentration in visualization of the motor task, thus, the voluntary involvement will be mandatory for the success of the treatment.

Prog: 34 -> AUS

Strengthening after atrophy due to lack of use

Strengthening after atrophy due to lack of use This protocol should be used in patients that present muscular atrophy due to lack of use. The frequency parameters used are 1 kHz of frequency with *Bursts* with duration of 4 ms and frequency equal to 15 Hz. The gradient modulation should be constructed with a rise time equal to 1 second, followed by 9 seconds of contraction, and fall time of 1 second and 9 seconds off. The electrodes should be positioned at the muscular motor points or on the muscular center and the intensity should be higher than the motor threshold however tolerable by the patient. The treatment can be provided daily respecting the muscular fatigue levels generated by each individual stimulation session and the duration time of each session should be of 20 minutes. It is important to highlight that the selected *Bursts* frequency (15 Hz) is recommended to stimulate the motoneurons of muscular fibers resistant to the fatigue. This stimulation standard can revert the metabolic and structural changes that occur in the skeletal muscles as a result of the lack of use (I to IIA) *Bursts* frequencies higher than 20 Hz may strengthen the muscles but do not revert the transformation muscular fiber types. The low frequency of *Bursts* (15 Hz) allow the gradient modulation to have a short total time without increasing the fatigue risk, and thus, the muscle is stimulated for a greater period of time during the treatment session.

Prog: 35 -> AUS

FES after AVC
(Electrical Functional Stimulation After Cerebral Vascular Accident (AVC)) This program should be used to prevent the muscular atrophy due to the lack of use, prevent the shoulder sub-luxation after occurrences of AVC and also to facilitate the motor re-learning. For the stimulation the frequency should be 4 kHz, with *Bursts* duration of 4 ms. These stimulation parameters will provide a more comfortable stimulation to the patient. The *Burst* frequency should be equal to 15 Hz. The stimulus intensity should be the motor stimulus and the gradient modulation should present a rise time of 1 second, the contraction time of 9 seconds, and fall equal to 1 second and 9 seconds of off. The *Bursts* low frequency allows that the *off* period be short but the fatigue risk is low due to the parameters of the carrying current and duration of *Bursts*. For execution of stimulation, the electrodes should be positioned at the muscular motor points or in the centers of the dysfunctional muscles. The stimulation time is 15 minutes. The *Bursts* frequency can be modified by the therapist. 10 Hz frequencies can be adopted if the physiotherapist notices that a functional muscular contraction exists with the value of 15 Hz. If the same 15 Hz cannot elicit muscular contractions, the frequency should be increased to 20 Hz.

Values above 20 should be avoided as they can reduce the conversion between the muscular fiber types in patients subject to AVC or patients that present medullary lesions.

Prog: 36 -> AUS
Reduction of edema and lymphatic drainage
Reduction of edema and lymphatic drainage This protocol covering use of AUSSIE current should be used to control and reduce the edema as well as for the lymphatic drainage procedures. The stimulation will promote a subtle and repeated muscular contraction producing an action of muscular pumping. For stimulation the AUSSIE current should be used with a frequency of 4kHz and *Bursts* duration equal to 4 ms. The *Burst* modulation frequency should be equal to 35 Hz. As the muscular contraction intensity will be low, the fatigue caused to the muscle will not be significant. The gradient modulation should be performed with a rise time equal to 1, contraction time equal to 5 seconds, fall time equal to 1 second and off time equal to 4 seconds. Thus, the muscular pumping action will be optimized. The electrodes for stimulation should be positioned in the center of the skeletal muscles that correlates directly with the edema, for example, if the edema is located in the side region of the ankle, one channel of the electrodes should be positioned in the medial and lateral gastrocnemius. The stimulation intensity should be the light muscular contraction. The sessions should have a maximum duration of 20 minutes. When lower is the stimulation frequency, higher will be the changes of activation of the slow contraction muscular fibers.

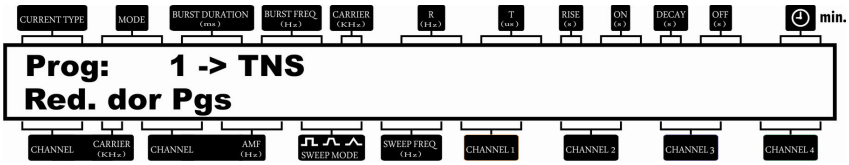
Prog: 37 -> AUS
Mod. Of pain through an ascending mechanism

Modulation of pain through activation of the ascending mechanism: The objective of the use of this protocol is to promote the analgesia by activation of the pain gate. For the stimulation, the frequency of 4kHz with *Bursts* duration equal to 4 ms is used. The *Bursts* frequency should be equal to 100 Hz and the stimulation should be applied in an on-going manner this means, without the gradient modulation. The electrode positioning should be made in the dermatome related to the referred pain and the stimulation intensity should an intense sensorial. Treatment duration should be short and preferably equal to the time of a second intervention performed to the patient, such as for example, exercises of kinesiotherapy. The stimulation parameters should be selected so as to activate the A-beta neural fibers. The objective is to produce the gate effect in the pain as described several years ago by *Melzac & Wall* (1965). The pain gate mechanism involves activation of the sensorial fibers of quick conduction which activate the inhibiting interneurons at level of the spinal medulla inhibiting transmission of the nociceptive stimuli in direction to the central nervous system. These stimuli are conducted by A-Delta and C fibers.

Prog: 38 -> AUS
Mod. Of pain through an descending mechanism
Modulation of pain through activation of the descending mechanism: This protocol has the capacity to promote the analgesia by stimulation of the descending mechanism related to release of endorphins. To do this, the Aussie current is used in the 1kHz frequency, with *Bursts* duration equal to 2 ms, the *Bursts* frequency should be equal to 100 Hz. The stimulation should be applied in an on-going manner, this means, gradient modulation is not required. For stimulation two electrode channels should be used, whereas one pair of electrodes positioned on the pain point and the other pair of electrodes on the neural root corresponding to the pain point. The intensity must be an intense sensorial stimulation. The theory says that the stimulation should be able to activate the enkephalinergic interneurons in the medullary grayish substance, releasing the enkephalins in specific layers of the spinal medullary grayish substance, thus preventing the passage of the nociceptive pulses to the SNC. The stimulation time should be 20 minutes and the effects of the analgesia can prevail for two years after the end of the stimulation.

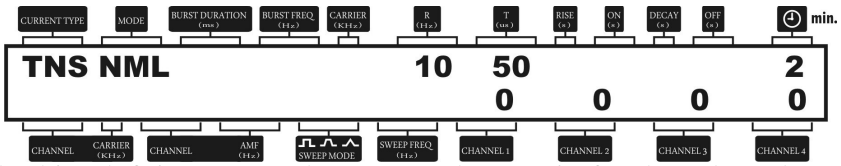
Prog: 39 -> RUS
ORIGINAL RUSSIAN
Muscular stimulation through Russian current: Carrying frequency of 2500Hz, *burst* duration equal to 10 ms, *burst* frequency equal to 50Hz, synchronized mode with gradient modulation of 3 seconds rise, 8 seconds of contraction, 3 seconds descending and 16 seconds resting time… Positioning of the electrodes should be made locating the motor point of the muscles or in the center of the muscles to be stimulated. Therapy time is 25 minutes.

Example of selection of a protocol: Turn on your equipment as described in the previous paragraphs. Press the PROG key quickly. The following information will appear in the screen of the equipment:



This is the first program treatment protocol that is in the memory of the equipment. You can select other protocols using the SET+ and SET- keys. Supposing that this is the selected protocol. Press the PROG key one more time.

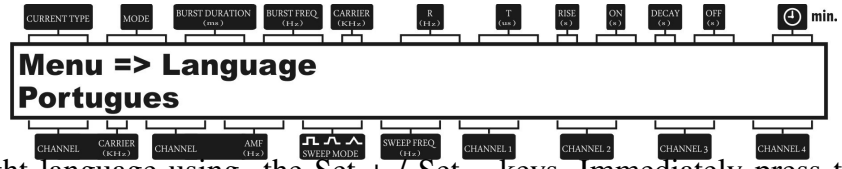
The screen of the equipment will indicate the already ready parameters for the treatment in question.



Now the only thing left is to press the START key again for the selected program to be executed. Now the only thing left to do is to select the desired current intensity.

NOTE: The procedure to select any of the 40 protocols is the same. It is necessary to follow the abovementioned steps.

2- *Functioning as MENU key*: This MENU key is used to select the language of the text indicated in the LCD. The following are the language options: Portuguese, English and Spanish. To access the language menu, press the menu key for several seconds until 3 beeps are heard. For example, the LCD will display:



Select the right language using the Set + / Set – keys. Immediately press the Menu key for the selected language to be saved. Whenever the equipment is turned on, the last selected language will be executed.

TENS CURRENT:

Transcutaneous Electrical Nervous Stimulation (TENS), alone or in combination with analgesics relieves severe and chronic pain. It is soft electrical stimulation on body areas affected by pain. This stimulation is conducted through electrodes that produce a blockage of the pain signal from these areas to the central nervous system.

Operation Principles - The "Theory of the Gates", proposed by Doctors Ronald Melzack and Patrick D. Wall in 1965, in summary, stated that the transmission of the sensation is controlled by a balance of the number of impulses through small diameter sensory fibers and large diameter fibers. Taking into consideration data demonstrated in animal trials, there are differential effects in colateral axions of afferent fibers of large diameter, mediating touch and pressure and in the afferent
fibers of small diameter, which conduct nociceptive stimuli to the interneurons of the jelly-like substance These interneurons can be treated through afferent impulses of the collaterals of large diameters and inhibited through collateral axons of the small diameter system. In addition, the interneurone is inhibitorious for termination of both classes of afferent fibers.

Consequently, when the afferent fibers with thicker diameter have higher intensity frequency than the pulses of fibers with thinner diameter, the inhibitorious interneurones are activated to inhibit in a pre-synaptic manner the central transmission of the stimulations, whether noxic or non-noxic.

The gate would be closed. It is clear that the opposite effect must occur, in case there is a higher transmission through the small diameter system.

The fundamental structure of this theory establishes the basis for many more contemporary explanations regarding pain relief using TENS. The acknowledgment regarding the fact that the perception of the pain can be modulated in some area of the neuroaxis using the Melzack-Wall model, surprised scientists and doctors.

Applications of the TENS

- Post-Operation Pain
- Cervical Pain, Cervicobrachialgias.
- Lumbar Pain, Sciatalgia
- Headaches, Face, Dental pain and ATM.
- Pain related to Joints, Arthritis, Bursitis, Luxations and Sprains.
- Muscles Pain, Contusions, Myositis, Tendonitis, Myofascial
- Cancer Pain
- Visceral Abdominal Pain
- Back and Thorax Pain
- Pain in Amputation cuts and Phantom Limbs
- Thalamic and Medullar Lesion Pain
- Neuropathy and Neuritis, Occipital, Post-Herpetic, Trigeminal, Diabetic and Traumatic.
- Sympathetic Reflexive Distrophias, Causalgias

STIMULATION PARAMETERS

There are fundamentally five main types of stimulation with TENS.

Conventional (Normal) - TENS-Accupuncture

Short and Intense TENS - Pulse trains (Burst)

VIF TENS

Neurophysiological Action of TENS and Parameters:

CONVENTIONAL TENS:

PULSE FREQUENCY: High / approximately 50-100Hz
PULSE TIME: Short / approximately 45-80 us.
INTENSITY: Perceptible, higher paresthesia but without causing fasciculation or significant muscle contraction.

ANALGESIC AREA: Segmental, on the rear medullary horn.
REVERSIBILITY: Non reversible by neurohumoral antagonists.
MECHANISMS: Theory of Gates; anti-irritation; Theory of the inhibiting cortical enveloping; Breaking of the thalamic pain pattern.

TENS ACUPUNCTURE:

PULSE FREQUENCY: Low / approximately 10-20 Hz
PULSE TIME: Long / approximately 150-250 us.
INTENSITY: High, up to the bearable limit; with strong rhythmic muscle contractions.
ANALGESIC AREA: Segmental and extrasegmental supraspinal and on the medullary dorsal horn.
REVERSIBILITY: Reversible with naloxone.
MECHANISMS: Neuro-humoral serotoninergic

BRIEF AND INTENSE TENS:

PULSE FREQUENCY: High / approximately 100-150 Hz
PULSE TIME: Long / Approximately 150-250 us.
INTENSITY: High, up to the bearable limit; it may cause tetonizing muscle contractions or irregular fasciculations.
ANALGESIC AREA: Segmental and extrasegmental, on the medullary rear horn (DNC), peripheral and mesenphalic nerve.
REVERSIBILITY: Reversible by antagonists to serotonin.
MECHANISMS: blockage of chemical , ischemic or anodic conduction; anti-irritation; Theory of the inhibiting cortical enveloping; Breaking of the thalamic pain pattern; Serotoninergic.

PULSE TRAINS (BURST):

PULSE FREQUENCY: High or low carrier / approximately 50-160 Hz; low enveloping / approximately 2 Hz.
PULSE TIME: Long / Approximately 100-200 us.
INTENSITY: High, up to the bearable limit; with strong rhythmic muscle contractions besides paresthesia.
ANALGESIC AREA: Segmental and extrasegmental supraspinal and on the medullary dorsal horn.
REVERSIBILITY: Reversible with naloxone.

MECHANISMS: Neuro-humoral serotoninergic; Therory of the inhibiting cortical enveloping; breaking of the thalamic pain pattern.

VIF TENS

R (pulse repetition frequency) – automatic scanning; decreasing from 247 Hz to 1 Hz and increasing from 1 Hz to 247 Hz passing through all the intermediary frequencies.

T (pulse duration) – automatic scanning; increasing from 50 us to 500 us and decreasing from 500 us to 50 us, passing through all the intermediary pulse widths.
INTENSITY: High, up to the bearable limit; it may cause tetonizing muscle contractions or irregular fasciculations.
ANALGESIC AREA: Segmental and extrasegmental, on the medullary rear horn (DNC), peripheral and mesenphalic nerve.
REVERSIBILITY: Reversible by antagonists to serotonin.
MECHANISMS: blockage of chemical , ischemic or anodic conduction; anti-irritation; Theory of the inhibiting cortical enveloping; Breaking of the thalamic pain pattern; Serotoninergic. Recruitment of a wide range of muscle fibers, also preventing the accommodation of the muscles due to the electrical stimulation.

FES CURRENT:

Electrical stimulation has been used for a long time to treat atrophies due to lack of use, especially those caused by long periods of immobilization. For immobilized patients, FES can help by delaying and treating atrophies due to a lack of use, by maintaining or increasing the range of joint movements and fighting contractures, thus reducing the functional recovery time of the patient. On hemiplegic patients and patients with medullar lesions, a daily electrical stimulation program may help to minimize neuronal and muscular degeneration. It aids in the neuromuscular improvement and helps in the control of spasticity. In all cases, Functional Electrical Stimulation (FES) is an auxiliary resource in the strengthening of muscles, increase in the locoregional circulatory flux and the reduction of muscular fatigue.

INDICATIONS:

- Neuromuscular Improvement
- Muscular Strengthening
- Increasing or maintaining joint movement range
- Fighting contractures or soft tissues
- Controlling Spasticity
- To be used as Orthesis

Main indications – stimulation applied to early walking in hemiplegics, in patients with sequels of medullar lesions and in neuropraxic peripheral nervous lesions. In order to maintain the functional alignment of a sub-luxated shoulder.

Objectives – substituting more conventional ortheses, mainly as a clinic therapeutic resource and it can also be used as a permanent functional aid.

Stimulation characteristics – depends on the desired type of orthotic assistance; whether stabilizing or for the improvement of a specific movement.

GENERAL PROGRAMS USING FES

NEUROMUSCULAR IMPROVEMENT

Objective: increase movement and improve motor relearning.
Intensity: enough to produce a "trigger" stimulus, to aid in the start of the movement or to complete its total cycle, amplifying the voluntary effort of the patient.
ON time: variable in the "trigger" phase: It can be manually triggered by the physiotherapist or patient in order to manage to start or complete the movement.
OFF time: sufficiently large to allow for a new active participation of the patient.
Duration (session): short, several times per day (maximum 15 minutes).

Placing of the Electrodes: on the parethic muscles agonist to the movement that is intended to be improved.
Indications: hemiplegic patients; patients with cranial traumatism; patients with incomplete raqui-medullar traumas; patients with peripheral nervous lesions, without degeneration reaction; orthopedic patients that have had their musculature submitted to prolonged periods of disuse.
The patient must visualize the muscular action, because their cooperation is mandatory and crucial to the treatment.

MOVEMENT AND CONTRACTURE RANGE:

Objective: allow for a joint to move in its entire possible range.
Intensity: enough to produce a wide and uniform contraction of the muscle, it must move the joint in its complete range.
Frequency: higher than 20 Hz.

ON time: approximately 6 seconds.
OFF time: approximately 12 seconds.
ON/OFF relationship: ½ (50%)
Duration (session): to maintain ADM – 30 to 60 minutes; to increase ADM – 1 to 2 hours, performed in several short sessions, during the day (15 to 30 minutes).
Placing of the Electrodes: on the muscles agonist to the limited movement.
Indications: limitations and joint contracture of any nature.
Caution: avoid producing excessive contractions, in the functional limits of the joint. It can cause inflammation, edema and joint pain.
The technique does not require the active cooperation of the patient and the joints that best respond to this technique are the elbow and the knee.

MUSCULAR STRENGTHENING:

Objective: strengthening a muscle or muscle group weakened by disuse.

Intensity: enough to surpass an adequate charge.
Frequency: between 20 and 50 Hz.
ON time: approximately 4 to 6 seconds.
OFF time: approximately 12 to 18 seconds.
ON/OFF relationship: 1/3
Duration (session): 30 to 60 minutes, twice per day.
Placing of the Electrodes: Close to the motor points of the muscles.
Indications: Atrophies due to disuse caused by orthopedic problems, including arthritis, old lesions of the higher motoneuron, lesions with reinnervation of the peripheral nerves, incomplete medullar lesions.
Caution: avoid muscular fatigue. The results appear from 2 to 10 weeks, depending on the cause and degree of the atrophy. The active cooperation of the patient may be minimal. 30 minutes of stimulation can be intercalated with 30 minutes of active exercise; if there are no signs of fatigue, this time should be increased up to 60 minutes. In the treatment sequence, the on cycle may be altered to 16 seconds and the off cycle to 4 seconds, establishing a 4/1, on/off relationship.

SPASTICITY CONTROL:

Objective: spasticity control, even temporarily will allow for the design of functional training programs, improving muscular strengthening.

Intensity: moderate.
ON time: from 10 to 15 seconds, moving the joint in its complete range.
OFF time: 40 to 60 seconds, to avoid fatigue.
ON/OFF relationship: 1/5.
Duration (session): 30 minutes, 3 times per day during one month.
Indications: spastic hemiplegic patients.

Caution: interrupt the treatment if a paradoxical response is observed (presence of antagonistic movements by the stimulated muscle group).

The results appear during the treatment, this may continue for a variable time after interruption.

The statements regarding spasticity control are still very poor and scarce. There is a need for more research before the formulation of a definitive statement regarding the effectiveness of the stimulation on spasticity.

AUSSIE CURRENT (AUSTRALIAN CURRENT) -

In recent years, the use of electrical currents for the treatment of different tissue dysfunctions and their symptoms has greatly increased.

The inflammatory symptoms can be controlled and reduced, the pain can be modulated until the cause of localized pain is eliminated, tissue repair can be achieved quickly and muscle function can be recovered. Reports of the use of excitomotor currents in professional athletes included side effects and the improvement of ***performance*** as well as neurophysiological alterations, morphological and biochemical reported by researchers.

Commercially the currents, RUSSIAN, Interferential and FES ***(Functional Electrical Stimulation)*** are classic, however so far, there has been no real concern regarding the development and production of new treatment options using electrical currents that provide a comfortable sensory stimulation without compromising the electrophysiological efficiency as well as a powerful motor stimulation without the pain threshold being reached and thus, the development of neuromuscular electrical training limited in function by the presence of pain.

Recently, studies suggests that modulated alternating electrical currents in ***Bursts*** of long duration produced by traditional currents such as Russian and Interferential are not the best currents to minimize discomfort during sensorial electrostimulation and produce high levels of muscle torque during motor stimulations.

The frequency of 4,000Hz (4 kHz) for modulated alternating currents in ***Bursts*** of short durations offers less discomfort during sensorial stimulation. Interferential therapy uses this value of carrier current; therefore its modulation in ***Bursts*** is very long.

Aussie current or **Australian current** has a capacity of performing a sensorial stimulation with minimum discomfort because it is also a medium frequency current of (4,000Hz or 4 kHz) and also in function of the use of modulation in ***Burst*** of short duration, thus becoming even more comfortable when compared to interferential therapy and Russian current.

Studies also suggest that for intense and efficient motor stimulation and for minimum discomfort, a frequency of 1,000 Hz (1 kHz) should be used combined with a modulation in ***Bursts*** with duration of 2 ms. This is **Aussie current** or **Australian current** for functional recovery of skeletal muscle.

Comparative studies suggest higher production of torque for Aussie Current or Australian current when compared with RUSSIAN stimulations and performed through FES.

The explanation why the modulation in ***Bursts*** of short duration in medium frequency alternating currents provide higher efficiency for sensorial as well as motor stimulation, this is based on the principle proposed by Gildemeister, also known as ***'Gildemeister effect'***.

In the 40s, Gildemeister reported that when ***Bursts*** of alternating current are used for stimulation, the nervous fiber trigger threshold decrease in a directly proportional manner to the increase of duration of the ***Bursts***.

Gildemeister explained that this occurs in function of a phenomenon known as the summation of sub-threshold depolarization.

In this phenomenon, in each pulse of modulated alternating current in ***Bursts***, the nervous fiber is partially depolarized and approaches the threshold of depolarization will only occur after a sufficient number of pulses. Thus, if the duration of ***Bursts*** were too long, a low intensity stimulus will be necessary, requiring the occurrence of a higher summation in order that the threshold can be reached.

However, Gildemeister suggests that there is a value of maximum duration of pulses in which the summation can occur and Gildemeister called this the nervous fiber utilization time phenomenon.

Recent research suggests that the time of use is higher for smaller nervous fibers. Nervous fibers of large diameter such as motor neurons Alpha (motor) and A beta (sensorial) present short utilization periods and the summation phenomenon occurs rapidly, while small diameters A Delta and C (pain) present much slower summation periods. This explains the fact that Australian Current is more comfortable for clinical use when compared with other currents such as Russian, Interferential Therapy and FES. Thus, ***Bursts*** of short duration of medium frequency alternating current is used, nervous fibers of smaller diameters do not have time to complete the summation phenomenon, and however the fibers of larger diameter do have time. In this manner, there will be less nociceptive fiber activation in detriment to a higher activation of the sensorial fibers with the use of Aussie Current (Australian current). However, this also explains the fact that it is possible to achieve a more comfortable motor stimulation through Aussie Current (Australian current). The Alfa motor neurons are preferentially attracted by Aussie Current (Australian current) in detriment to A delta fibers and C fibers. Thus, if alternating currents with frequency in kHz are modulated in ***Bursts*** of long duration, there will be a higher activation of nociceptive nervous fibers. It is traditionally known that Russian current and Interferential current work with ***Bursts*** of long duration, the opposite does not occur with Aussie Current (Australian current), making it more comfortable in relation to the first.

Resistance to Fatigue – Resistance to muscle fatigue is an extremely important factor within the rehabilitation procedures including recovery of skeletal muscles,

particularly when an excitomotor current is used (FES, Russian, Interferential). For FES, it is important to minimize muscle fatigue. The summation may become a problem when using medium frequency alternating currents, especially if the modulation in ***Burst*** is for long periods.
In this case, the nervous fibers can undergo summation and reach the threshold and after that, undergo repolarization and depolarization again during the same ***Burst***.

Thus, the summation can result in depolarization of the neural fiber at the start of the ***Burst*** and therefore, the nervous fiber cannot recover sufficiently and be triggered again. If the ***Bursts*** have long duration, there will be a high potential for the nervous fiber to undergo several triggers within the same ***Burst***. Therefore, if the ***Bursts*** are too long as it occurs in Interferential Therapy and Russian current, there is a high risk of several triggers occurring or depolarization of Alfa motor neurons within a same ***Burst***. It is therefore suggested that modulation frequencies in ***Bursts*** of 40Hz be used. Higher values can lead to premature muscle fatigue.

The use of Aussie Current (Australian current) for motor stimulation allows for higher levels of muscle torque and even lower occurrence of muscle fatigue. The duration of the ***Bursts*** is kept short in order to avoid multiple triggers of the Alfa motor neurons.

Density of the Current

When a medium frequency current (kHz) is used as a stimulus, there is the risk of irritations or other cutaneous complications if the density of the average current is raised. When we talk about pulsed currents such as T.E.N.S. and FES, the risk is lower because the pulses are short and separated by smaller time intervals, therefore the average electrical current used during the treatment is lower.

When Interferential current in its quadripolar form is used, the transcutaneous electrodes transmit the pulses in a constant manner, thus as the average density of the electrical current becomes higher, there is a certain risk of cutaneous irritation.

This risk can be minimized through the use of larger electrodes, which automatically causes the reduction in local current density.

The current density is measured in mA per centimeter of area, therefore, if the area automatically increases, the current density is reduced.

Aussie Current (Australian current) is made up by ***Bursts*** of short duration, separated by long time intervals and in this manner, the risk of cutaneous irritations is low, the electrical current density is reduced. In any case, larger electrodes are ideal in terms of providing less discomfort by reducing the electrical current density and lowering nociceptive stimulation.

*What is **Aussie Current (Australian Current)** really?*

Aussie current (Australian current) is alternating therapeutic electrical current with frequencies in the range of kHz with some similarity to Interferential therapy and Russian current.
- The difference is in the value of the current in kHz used as well as in the shape of the wave. Traditionally, Interferential Therapy is modulated with amplitude in sinusoidal

shape (figure 1ª) and Russian current is formed by ***Bursts*** with 50% of the working cycle (time 'on' and 'off' – figure 1b).

Aussie current (Australian current) presents short pulse duration (figure 1c) and it is exactly this fact that makes the stimulation provided by Aussie Current (Australian current) more efficient compared with other electrical current therapies.

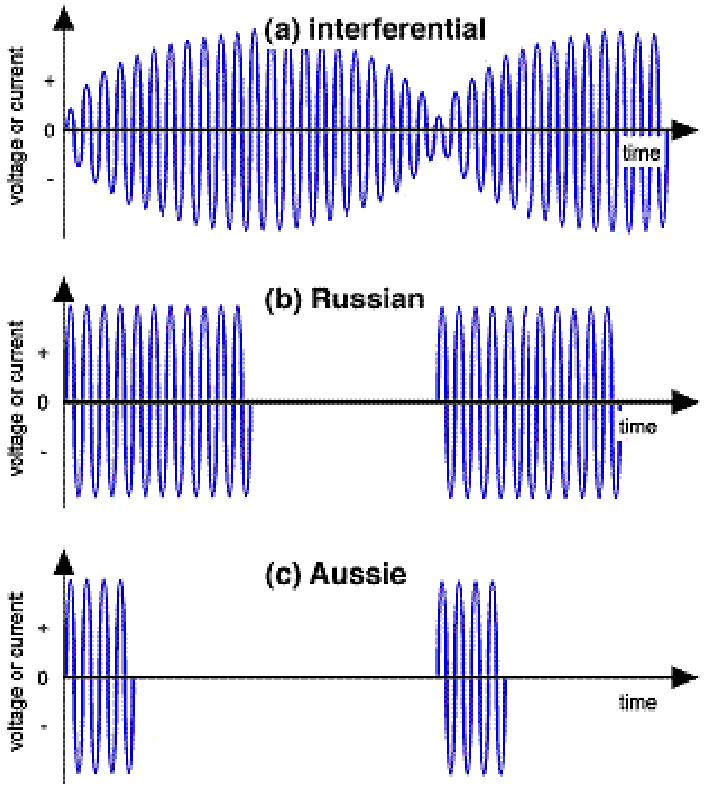


Figure 1 **–** Wave shape of the stimuli provided by (a) Interferential Current, (b) Russian Current and (c) Aussie Current (Australian current), illustrating the different durations of the ***Bursts***.

Clinically, it is well accepted that Interferential Current is very comfortable and able to be well tolerated by the patients. Russian Current is also accepted as a comfortable current and able to produce powerful muscle contractions, therefore it can be used to reduce muscle atrophy by disuse and general muscle strengthening. Interferential Current as well as Russian Current is accepted as being more efficient when compared with pulsed currents of
low frequency (T.E.N.S. and FES). Today, the T.E.N.S. or Interferential Current are the selected therapeutic methods for the modulation of pain, while in general, Russian Current is the option when the objective is the functional recovery of skeletal muscles. So far, there is little scientific evidence against these options or choices of treatments involving the use of electrical current therapies.

The scientific research conducted throughout the years, especially over the past two decades, has compared Interferential Current, Russian Current and Pulsed Current such as T.E.N.S. with stimulation in terms of comfort, muscle contraction strength and efficiency in analgesic procedures. The results suggest that all the currents present their advantages and disadvantages, however none of them should be considered optimal for the proposed treatments. Strong scientific evidence suggests that alternating current of frequencies in the range of kHz, modulation in ***Bursts*** of short duration, this means, Aussie Current (Australian current) is more comfortable and efficient in the production of muscle and analgesic torque.

Short duration pulses of Aussie Current (Australian current) provide stimulation that:

Is more efficient than FES, Interferential Current and Russian Current stimulating muscle contraction;

-Is as efficient as the T.E.N.S. and Interferential Current for the control and modulation of pain.

Stimulation history through alternating currents

In 1894 D'Arsonval was the first to report the effects of transcutaneous stimulation through alternating electrical currents on the human body. The researchers used alternating currents variable frequency ranges of 1kHz to 5kHz and observed that the tetany was reached between the frequencies 10 to 15 Hz, that neuromuscular excitement became intense with frequencies between 1,250 - 1,500 Hz, constant with frequencies between 1,500 and 2,500 Hz and finally decreased with frequency values of 5000 Hz (higher value than your device can generate). D'Arsonval also noted that current with a frequency of 1,500 Hz was more uncomfortable when compared with current with a frequency value equal to 5,000 Hz, however, the same frequency of 1,500 Hz was more comfortable when compared with a current of 1,000 Hz. Therefore, their studies brought us the theoretical and scientific basis so that the use of alternating current with frequency in kHz could be used in daily clinical practices. His conclusion was that alternating currents in the range of kHz could produce a higher stimulation level with less discomfort with the adequate selection of current frequency in kHz.

In the 50s, Nemec proposed the therapeutic use of Interferential Current. The basis used by Nemec was abandoned by D'Arsonval.

However, at that time, it seemed that the greatest interest of the scholars was concentrated on comfortable sensorial stimulation with little concern related to skeletal muscle activation and recruitment, because for this, lower frequencies such as 1.5 kHz to 2.5 kHz are necessary.

For the creation of Interferential current, Nemec stated that two alternate currents in the range of kHz frequency with a short difference between their two carrying frequencies were applied using two pairs of electrodes, these will undergo

interference in the tissue, producing maximum stimulation on the area of the intersection of the

two pairs of electrodes, resulting on higher stimulation depth and the presence of amplitue modulation with a pulse frequency equal to the difference between the values of the two carrying currents on the kHz range.

The pre-modulated Interferential Current is an electrical therapeutic current which is already modulated and therefore, can be used with only a pair of electrodes.

In the 70s, Kots suggested the use of an alternating current with frequency in the range of 2.5 kHz for the first time, applied in rectangular ***Bursts*** of 10ms with frequency of 50 Hz. Kots reported, that with the use of electrical current, the strength gain was higher than 40% in elite Russian athletes.

The suggested protocol presented 'on' period of 10 seconds and 'off' period equal to 50 seconds during period of 10 minutes. Training through electrical current was applied for several consecutive weeks. Kots and his colleagues compared constant alternate current of 10 ms, 50 Hz of ***Bursts*** with frequency varying between 100 Hz to 5 kHz and reported a maximum production of torque at 1 kHz when the electrodes were positioned above the nervous trunk and 2.5 kHz when the electrodes were position on the stomach muscle. Kots findings also suggest that despite their small size, there is a higher production of torque with ***Bursts*** of alternating current when compared with other forms of alternating current. Therefore, stimulation with ***Bursts*** of 10 ms is more efficient in comparison to stimulation through constant alternating current. At the time the researchers did not compare the current with other currents with ***Bursts*** of short duration.

As shown in figure 1, interferential current presents a modulation in ***Bursts*** of long duration. Already the Russian current presents less duration of its ***Bursts*** when compared to interferential therapy and finally, Aussie Current (Australian current), within the world of alternating currents with the frequency range in kHz is the current that presents ***Bursts*** with the shortest duration. In the 80s, a Russian scientist called Bankov, compared in a study performed by himself that, pre-modulated interferential current with ***Bursts*** of alternating current with a period of rest between themselves.

The researcher found that, modulation in ***Bursts*** with a period of rest between themselves was more comfortable during the production of muscle contraction.

Regarding the wave shape of the ***Bursts***, the researcher also suggested that the rectangular shape of the ***Bursts*** would be more comfortable when compared with ***Bursts*** of sinusoidal shape.

Recent evidence on Aussie Current (Australian current)

More recently, Ward et al. (2004) measured the production of torque as well as the discomfort produced by alternating currents with frequency in kHz (500 Hz to 20 kHz). The authors also compared changes in ***Bursts*** to individual pulse cycles of alternating current (biphasic pulsed current) with ***Bursts*** of maximum duration (constant alternating current).

The authors found that, for the production of maximum torque, the pulse frequency of 1 kHz and duration of ***Bursts*** of 2-2.5 ms was the best.

The results are shown in figure 2.

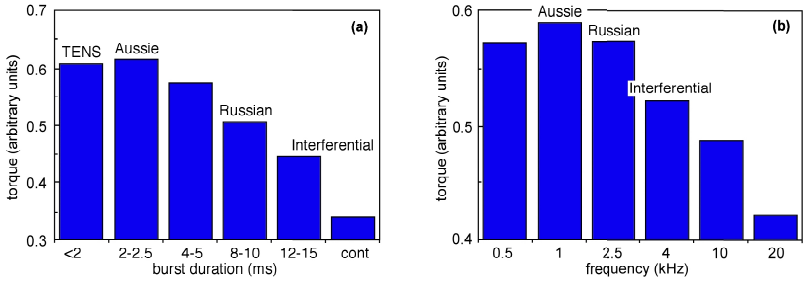


Figure 2 – (a) duration of ***Bursts*** and (b) ideal frequency for the production of torque. The current used in the experiment was T.E.N.S., Australian current (AUSSIE), Russian current and Interferential current. Aussie current (Australian current) was the most efficient.

Therefore, Aussie Current (Australian current) used a frequency of 1 kHz combined with ***Bursts*** of duration equal to 2ms. Consequently, the production of torque is maximum. Gradient modulation must be used with the objective of avoided early muscle fatigue.

Ward et al. (2007) also found after some research that, for minimum discomfort, a frequency of 4 kHz with 4-5 ms duration of ***Bursts*** are the best parameters. Figure 3 shows the number of complaints of discomfort during the stimulation. It is important to note that the discomfort depends essentially on the duration of ***Bursts*** and current frequency.

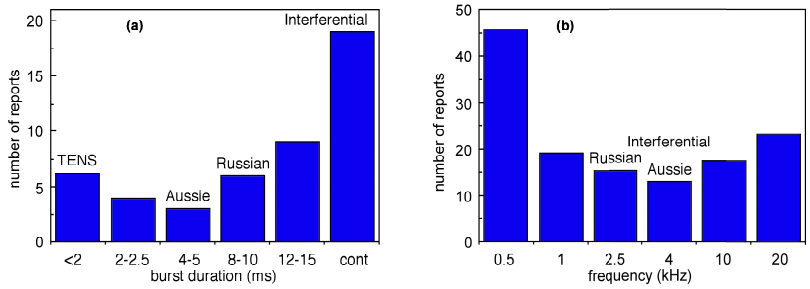


Figure 3 – (a) duration of ***Bursts*** and (b) ideal frequency for comfortable stimulation. The currents used in the experiment was T.E.N.S., Australian current (Aussie current), Russian current and Interferential current. Australian current was the most efficient.

Therefore, it can be noted that Aussie Current (Australian current) should be used when the therapeutic objective was sensorial stimulation and in this case, the

modulation of pain can be achieved as well as obtain efficient motor stimulation through activation of the motor neurons. For sensorial stimulation, a frequency of 4 kHz and modulation in ***Bursts*** with duration of 4 ms should be used.

Already for motor stimulation, a frequency of 1 kHz and modulation in ***Bursts*** with duration of 2 ms should be selected.

It is important to note that the frequency used for interferential therapy (4 kHz) is also used for sensorial stimulation with the main objective to decrease discomfort during stimulation. However, the efficiency in this type of stimulation is not maximum due to the long duration of modulation in ***Bursts***.

Regarding stimulation through Russian current, we must also be critical in perceiving that alternating current with frequencies in the range of kHz does not provide the optimum frequency for motor stimulation. Additionally, Russian current provides modulation in ***Bursts*** of very long duration, which makes it inefficient for the production of maximum torque and still relatively uncomfortable regarding sensorial stimulation.

The two manners in which Aussie Current (Australian current) is used are extremely efficient and faithful to what they propose. For the production of maximum torque using Australian current with a frequency of 1 kHz and modulation in ***Bursts*** with duration of 2 ms must be used. For sensorial stimulation with minimum discomfort, and consequently, higher acceptance by the patient, Aussie current (Australian current) must be used with a frequency of 4 kHz with modulation in ***Bursts*** of duration equal to 4 ms.

Australian Current for pain modulation

Traditionally, the therapeutic modulation selected for pain modulation work is T.E.N.S. with pulse frequency that can vary between 10 to 180 Hz, traditionally a frequency of 100 Hz and short pulse duration of a maximum value between 100 and 150 µs is selected. Interferential current of 4,000 Hz can also be selected as a treatment option. A study by Shanahan et al. (2006) compares the hypoalgesic effect of interferential current with pulse current of low frequency (T.E.N.S.).

According to the obtained results, the two currents used provide positive effects, however interferential current seems to be more comfortable when compares with T.E.N.S.

A more recent study by McCarthy (2007) compares Aussie Current (Australian current) with pulsed current and found that the first was more comfortable and also more efficient. A small duration of the ***Bursts*** of Aussie Current (Australian current) results in a higher efficiency during the analgesic procedure without compromising the more agreeable sensation during the therapy.

A similar study performed by Ward and Oliver (2007), compares low frequency pulsed current with Australian Current for analgesia and once again observed higher

efficiency with less discomfort when using Australian Current compared to that of T.E.N.S (figure 4b).

Thus, the evidence suggests that when an alternating current with frequency in the range of kHz, modulated in ***Bursts*** of short duration is used, the analgesic effect is better when compared with T.E.N.S.

Stimulation is more comfortable and the tolerance level of the patient increases greatly, which makes treatment more efficient.

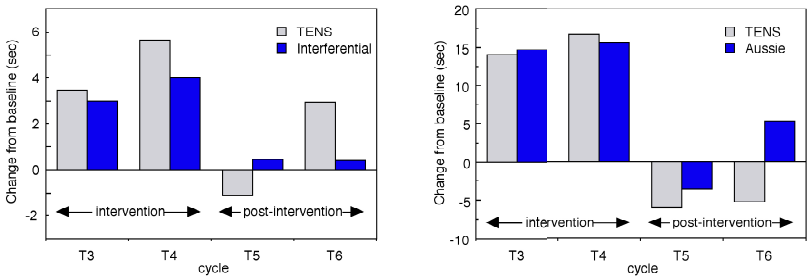


Figure 4 – Change in time of pain tolerance (time in which the volunteer can keep their hand immersed in cold water). Cycles T1 and T2 indicate the pre-intervention period. Cycles T3 and T4 indicate the duration of the intervention and T5 and T6 indicate the period immediately after the intervention.

In relation to what has been presented in the abovementioned paragraphs, we can note that Aussie Current (Australian current) is a physical therapy that has come to add value to the clinical care provided to patients who require physical rehabilitation in different areas of specialized physiotherapy.

It is important to emphasize that dozens of scientific publications support the unquestionable efficiency of use of Aussie Current (Australian current), which was not the case during the verification of other electrotherapeutic resources throughout the years. All the physical values attributed to Aussie Current (Australian current) for muscle strengthening as well as sensorial stimulation has a wide scientific basis besides its values and thus, for this therapeutic method, the practice based on evidence is an incontestable reality.

INTERFERENTIAL CURRENTS:

"Interferential Current" is the phenomenon that occurs when two or more oscillations are simultaneously applied on the same point.

In interferential current, two stimuli of medium frequency altenate current (for example: 4.000 Hz to 4.100 Hz), are applied at the same time on the same point.

One of these stimuli of alternate current is set at 4,000 Hz, while the other stimulus can be selected from 4,001 Hz to 4,100 Hz. A third frequency called "Pulse Frequency"or "Modulated Amplitude Frequency" (MAF)" is created where these two medium frequency pulses intersect each other.

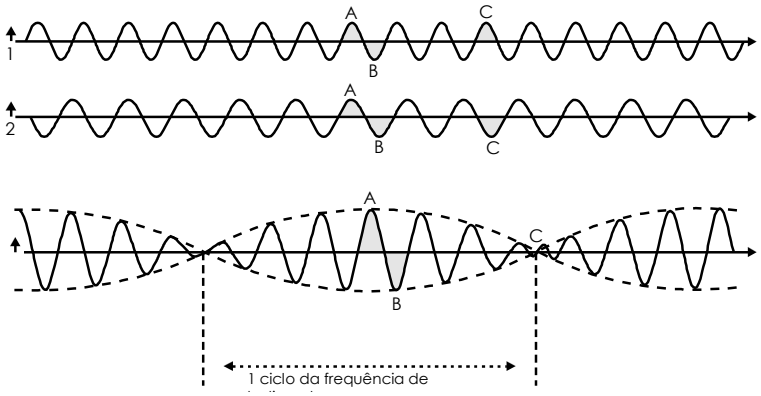
For example: An interferential current device has two output channels. Channel 1 is set at 4,000 Hz and channel 2 is variable from 4.001 Hz a 4.100 Hz,
namely, this frequency of channel 2 is selected by the operator within this range from 4.001 Hz a 4.100 Hz.

Consequently, supposing that the selected frequency in channel 2 is 4,050 Hz and as the frequency of channel 1 is set at 4,000 Hz, a third frequency (MAF) of 50 Hz will be generated at the point of intersection of these two currents generated in one channel. In interferential therapy, MAF (treatment frequency) corresponds to the frequencies normally used in low frequency electrotherapy. Consequently, we have the advantages of medium frequencies (4,000 Hz-low skin resistance), and we are within the biological range 0.1 to 200 Hz (MAF).

AMF = f2 - f1

f2= 4,050 Hz and fl= 4,000 Hz

MAF – 4,050 – 4,000 = 50 Hz (treatment frequency)



Fugure 1 – On the diagrams above, 1 is the channel set at 4,000Hz and 2 is the channel where the frequency of 4,050Hz was selected. In certain points, the two phases will be identical (A and B) and in such situations, the resulting sum will produce a total increase of the amplitude. On point (C) the two currents are equal and opposite,

cancelling each other out. The “envelope” (pointy line) shows the shape of the cicle of the pulse frequency. The number of envelopes per second represents the MAF, namely, 4,050Hz – 4,000 Hz = 50 Hz (treatment frequency).

STATIC INTERFERENTIAL FIELDS (Normal or standard tetrapolar)

In the interferetial treatment known as normal or standard tetrapolar, four electrodes (two per channel) are necessary. These four electrodes are usually applied to the patient as shown on figure 2.

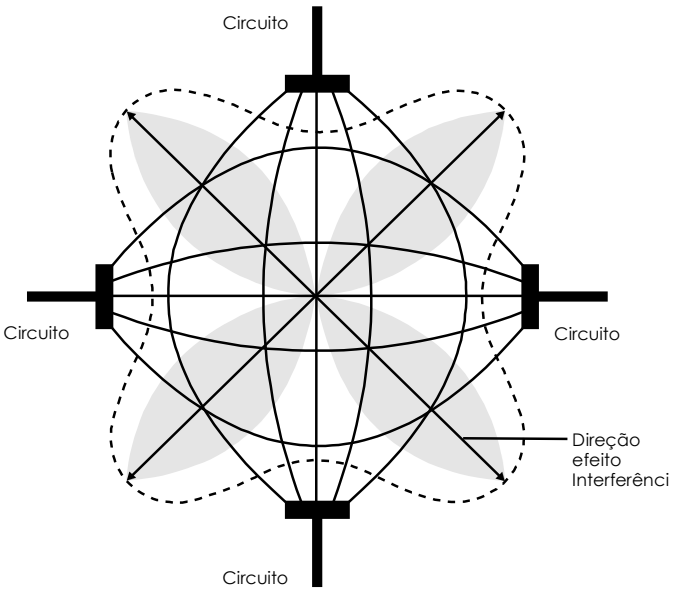


Figure 2 – The two cicuits are set on the diagonal sectio in the best possible way. The interference effect occurs only on the shady areas. However, the shady areas in the figure are only applied on homogenous tissues.

In most clinical situations, the tissues of the patients are homogenous and the area represented in the figure will probably be modified.

The field seen on figure 2 is known as ***Interferential Static Field.*** At this point, it is important to state certain considerations regarding the application of the electrodes on interferential therapy. An effective treatment only occurs when the patient feels a dominating concentrated sensation on the are where the problem is present. In other words, the patient will feel a significant prickling sensation around and in the area where the problem is present.

Na adjustment in the position of the electrodes is important in order to get the best results. One of the reasons found when the result is not satisfactory in the interferential therapy is the incorrect position of the electrodes. The patient must feel a pricking sensation, preferably pleasant (such as “soft needles”). It is possible for the

patient to feel a sensation under the electrode; however, this pricking sensation should occur as soon as possible on the area where the problem is located.

The "leave-shapped" model shown in figure 2 represents the so called ***Static Interferential Field*** and is commonly used to describe the area of where the effect of the interference occurs.

However, there are other aspects in the way and distribution of this field. As there is no practical way of measuring the effect of the interference, the professional has to count on the report of the patient regarding the surface area where the stimulation is being applied.

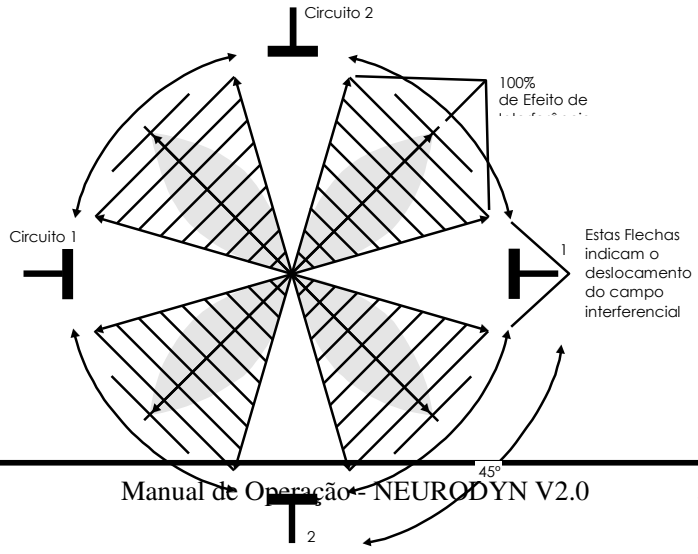
It is relatively easy to locate the effect when the four electrodes are close from one another; but this helps to compare the surface of the treatment. There are mathematical methods to describe the effect of the interference and its distribution, but its use is clinically limited due to certain situations encountered by the patient.

DYNAMIC INTERFERENTIAL FIELD (Tetrapolar with manual or automatic vector)

The Static Interferential Field described above represents the normal-tetrapolar or standard mode of application of interferential currents. Throughout the years, this basic process underwent interesting developments. The best one of them was called "Manual Vector"and "Automatic Vector". This Manual or Automatic Vector mode is nothing but the flow of current produced, vectorially increasing the two circuits (channels) together. A better technical description would be the concept of ***"rotational"***or ***"dynamic"*** vector system. The concept of "dynamic" vector system is basically simple, namely, it is based on rotation of the Static Interferential Field from zero to approximately 45 degrees, turning back to zero again. The area of influence of the field on the tissue becomes larger than the Static Interferential Field.

This "movement" is produced rhythmically by the unbalance of currents, altering the position of the area of maximum stimulation.

Figure 3 below illustrates this principle.



In the case where the patient presents symptoms that are not well located, the dynamic vector system (automatic vector) can be a useful means for this problem. However, it should be understood that, as the influence field is “sweeping” the tissues, a part of the treatment time cannot be spent on the lesion.

The “automatic vector”system (dynamic vector) cannot be considered as a shortcut in order to allow for the therapist to treat the problem without locating it correctly. Once the electrodes are correctly placed before starting the treatment, the dynamic vector systems will increase the effectiveness of the treatment. Consequently, this treatment effectiveness depends a lot on the correct placement of the electrodes. At this point, it should be emphasized that the effects seen in figure 3 occur in a homogenous environment. It is difficult and almost impossible to accurately predict the interferential effect pattern in a patient subject ot static or dynamic interferential fields. There is no certain evidence as to whether the “manual or automatic vector” mode is significantly better than the "normal or standard mode”.

EQUILIBRIUM OF THE CIRCUITS (“BALANCE OF THE CHANNELS”)

The “Balance of the Channels” is used in the Tetrapolar Interferential mode (static interferential field). In order to achieve a maximum therapeutic effect, it is necessary to ensure that the current that flows through the channels is the same. As the tissues of the body are homogenous, it is necessary to adjust the current of the channels so that they are equilibrated (“balanced”) Some equipment perform this “balance” automatically; in other equipment the adjustment must be performed externally by the therapist through a control denominated balance or adjusting the same current in the two channels.

Neurodyn V 2.0 uses constant output current technology for the patient. Thus, the balance is achieved by setting the same current (mA) in the two channels. It should be remembered that the current level to be applied can be different for each patient. Consequently, the intensity must be “felt”, however, as pleasant by the patient.

Even in Tetrapolar mode, Neurodyn V 2.0 allows for manual exploration (MANUAL VECTOR), where the therapist manually rotates the interferential field “trying to locate” the exact location of the problem according to the reports of the patient.

For this, it is only necessary to unbalance the channels, namely, leaving a channel with more current than the other. For example: Supposing that you have a current intensity of 30 mA in channel 1 and 30 mA in channel 2 (equilibrated, balanced circuit). If you decrease or increase only channel 2, you will be “totating” the vector. With Neurodyn V 2.0 you can also select the aumatic vector stimulation mode,

where the equipment will be performing the “rotation of the vector” automatically. Remember that the "manual vector" or "automatic vector" technique is valid only in Tetrapolar Interferential mode.

BIPOLAR INTERFERENTIAL CURRENTS (pre-modulated)

It is possible to emit interferentials to the patient using two electrodes instead of four conventional electrodes. In this system, the two currents are mixed in the equipment and transmitted to the patient through two electrodes. There is a significant difference between this technique and the tetrapolar mode that uses four electrodes. In the conventional mode (tetrapolar) the interferential current is produced endogenously (inside, deeply) in the patient. In bipolar mode (premodulated) the interferential current is applied through the electrodes into the skin of the patient. It is slightly probable that there is a clinical difference between the two methods, as the facility of the application of the premodulated module is not obvious. In many situations, the premodulated mode is mostly selected, for example: in the stimulation of a muscle.

The equipment that have Bipolar mode (premodulated), normally require the use of only two channels. The terms “two poles”or "bipolar” can be misguiding, as they may be used in two different poles. As alternate currents are used in interferential therapy (without fixed polarity), the term “premoludated” or “pre-mixed” describes the application technique more clearly.

MAF CONTROL – Treatment frequency (pulse frequency)

The MAF, also known as pulse frequency or treatment frequency can be controlled in two basic ways, being known as “Continuous" (constant) mode and “Sweep”mode (ΔAMF). In Continuous (constant) mode, the equipment generates only one pulse frequency that can be selected by the operator. In this method, the equipment generates a constant difference in the frequency between the two channels.

Example: as it has been already mentioned, the frequency of a channel is 4,000 Hzl; and the frequency of the other varies from 4.001 Hz to 4.100 Hz. In Continuous mode (constant) if the operator selects a frequency of 4,050 Hz the equipment generates the difference between the two channels (4.050 - 4.000), namely, a fixed treatment frequency MAF (pulse frequency) of 50 Hz.

A more useful method to control the pulse frequency is the "Sweep" MAF mode . In this case, the equipmet automatically generates the pulse frequency within a preselected range. This preselected range is known as “frequency extension”. The word extension can be interpreted as a treatment frequency range. These frequency range is automatically and rhythmically increased and decreased within a pre-established MAF range.

Example: A MAF (basic treatment frecuency) of 20 Hz is selected and and extension (range), namely, Sweet of 50 Hz is required. The current released to the patient starts with a MAF (treatment frequency) of 20 Hz and (with an extension of 50 Hz) passes successively through the other frequencies until reaching a

frequency of 70 Hz, then gradually decreasing to 20 Hz. This process is automatically repeated.

The "SWEEP" mode is used to prevent accommodation. A "long" extension will prevent accomodations more efficiently than a "narrow" extension. Using a long frequency extension, noticeable sensations and or contractions will occur.

Selection of MAF or Treatment Treatment: The selection of the MAF depends of the nature, state, seriousness and the location of the problem. The sensations felt by the patients in the different MAF must be considered. High frequencies are felt such as "pleasant and softer". High MAF (75 Hz to 200 Hz) are suggested for severe problems, acute pain, hypersensitivity. When the patient shows a certain fear to electrical stimulation, a high MAF must be used at the start of the treatment. In low frequencies the sensation is "rougher and heavier". Frequencies between 25 Hz and 50 Hz tend to cause contractions (tetanic). A low MAF is very advisable for muscle contractions, chronic or sub-acute problems. Frequencies below 50 Hz cause pulsed and fibrillated contractions.

Bipolar Interferential Mode:

Sweep or **MAF** (MAF sweeping range) – With time, a patient subject to electrical stimulation will feel it with less intensity after a few days, they can even stop feeling the sensation caused by such a current. This process is called "accommodation" and it occurs because the stimulated sensors transmit information relative to the external changes in a decreasing scale. The accommodation can be prevented by the variation of the MAF (treatment frequency).

SWEEP MAF mode:

The **MAF** remains in the basic frequency for a second and then it changes abruptly for the highest frequency, in which it also remains for a second. This is repeated automatically. This treatment method has an invasive effect and it becomes even more invasive if a "long" MAF sweeping extension is selected. Na effect that can be observed after completing the treatment with this type of program is superficial hyperemia. This program is recommended for chronic and subacute problems.

Example: If the basic MAF selected is 20 Hz and the selected extension (sweep) is 50 Hz, then using this program, the MAF remains at 20 Hz for a second, it suddenly

changes to 70 Hz, it remains at 70 Hz for a secong, it suddenly changes to 20 Hz and then it restarts a new cycle.

The **MAF** remains at the basic frequency for five seconds, it goes through all the other frequencies (within the selected extension) in a second until reaching the highest frequency in which it also remains for five seconds. This is repeated automatically. This type of treatment has broader charcteristics and widely tolerated by the patient in severe disorders.

Example: If the basic MAF selected for 20 Hz and the selected extension is 50 Hz, then using this program, the MAF remains at 20 Hz for five seconds, it goes through all the frequencies within the selected section (21 to 69 Hz) in a second, to reach a frequency of 70 Hz, it remains at 70 Hz for five seconds, it goes back through all the frequencies again (66 to 21 Hz) in a second until reaching 20 Hz again and it restarts a new cycle again.

The MAF is never “stopped” like in other programs. It varies continuously, namely, it increases in the firsr six seconds, going through all the frequencies within the selected extension until reaching the highest frequency and it immediately decreases in the next six seconds. This is repeated automatically. This is the most pleasant from the three types of programs. This mode is used to prevent accommodation.

Example: If the basic selected MAF is 20 Hz and the selected extension is 50 Hz, then using this program, the “sweep” of the frequency starts at 20 Hz, increasing and going through all the frequencies within the extension in six seconds until reaching the highest frequency of 70 Hz and it immediately decreases for more than six seconds, going through all the frequencies again down to 20 Hz and the cycle starts again.

Bipolar Interference: **MODE** (stimulation mode):

CNT (Continuous) – Constant MAF: the equipment generates only one pulse frequency that can be selected by the operator. In this method, the equipment generates a constant difference in the frequency between the two channels. In this stimulation mode (continuous) you can also use the Sweep programs:

SIN (Synchronized) – Once the MAF and or SWEEP is selected, during SIN stimulaitno mode the equipment introduces the known rise, on, decay and off "gradients".

REC (Alternate) – Once the MAF and or SWEEP is selected, during SIN stimulation mode the equipment introduces the known rise, on, decay and off "gradients".

SEQ (Sequential) – Once the MAF and or SWEEP is selected, during SIN stimulation mode the equipment introduces the known rise, on, decay and off "gradients" in a sequential manner (first channel 1, then channel 2, then channel 3 and finally channel 4)

Note: It should be remembered that the Continuous, Synchronized, Alternate and Aequential modes work only in the technique with two electrodes (Bipolar) and is generally used for muscular strengthening.

Carrier frequency:

Frequencies of 2KHz, 4KHz and 8KHz can be selected. The clinical use has demonstrated that frequencies approximatd to 2,000Hz produce higher motor activity. The current is stronger and it causes maximum stimulation at a muscular level. The 2KHz frequency must be used only in painful conditions. Generally, a frequency of 4KHz (4,000Hz) or 8KHz (8,000Hz) is used in all other applications.

Tetrapolar Interference:

MAF and **Sweep** (MAF) equal to bipolar mode.

Tetrapolar Interference: **MODE** (stimulation mode):

NML (normal) for static or dynamic interferential field with manual vector.

AUT (automatic) for dynamic interferential fields with automatic vector.

Notes: Remember that in order to execute the Tetrapolar mode with Manual Vector, you must disbalance the channels (different current intensities). It is the different current intensity in the channels which “rotates” the vector. In order to execute the Tetrapolar mode with Automatic vector, you must balance the channels (same current intensities)

In interferential current therapy the bipolar mode is preferential, because in this case, the modulation in depth is always 100%. In tetrapolar mode the modulation in depth may vary from 100% to 45 %. In interferential therapy, 100% of the modulation in depth is very important, becase it endures an optimum stimulation effect. In the practice, it is easier to place two electrodes rather than four. For these reasons, the bipolar mode is preferred.

The tetrapolar method is use for large areas. The vector technique produces effective stimulation within a large área. If the location of the problem is clear, the manual vector method is preferred. Thus, the disbalancing of channels is used to obtain a modulatin in depth of 100% in the are in question. If the location is not completely clear, the automatic vector method is used, which will remain “passing” through the location in question.

RUSSIAN CURRENT:

Before the 70's electrical stimulation was used mainly for the recovery of skeletal muscle of patients suffering from neurological diseases. Already in the 70's, the stimulation of skeletal muscle started being used for the improvement of *performance* related to the increase of muscular strength in healthy individuals as well as athletes with significant functional losses of the muscular system.

Russian current is an electrotherapeutical modality often used in rehabilitation regimes in different areas of physiotherapy with the aim of recovering and/or increasing the fuction o the skeletal muscle. Such a resource was introduced in the therapeutic world in the 70's by scientist Yakov Kots, who was also responsible for the first experiment involving the use of RUSSIAN current. However, the material produced by Kots is limited in its disclosure, mainly due to the difficulties in understanding the Russian language, as the information was not translated into other languages such as English. Thus, this material intends to provide scientific literature information which support the use of Russian current on the basis of the findings of the original experiments conducted by the group of Yakov Kots and translated into other more common languages.

Application Indications of RUSSIAN current

Strengthening of skeletal muscle, significantly increasing motor control as well as the morfology of the muscle cells through the increase of the transversal sectio area of skeletal muscle fibers.

Original Characteristics of RUSSIAN Current

- alternate current
- 2.5kHz frequency
- *Burst* modulation at 50 Hz
- activity cycle of 50%

offered regiem of the pulses 10/50/10 – 10 seconds "*on*", 50 seconds "*off*" for a period of 10 minutes per session.

Technique for the positioning of the electrodes

Motor point: it can be located through an electrical stimulus of exciting parameters (T and f) provided to the muscle of the patient and the point on the surface of the skin on which the motor branch of the nerve penetrates into the muscle. This point is considered to have the lowest resistance to the passage of electrical current, thus allowing for higher excitability of the muscle.

Muscular center: The muscular center is located visually, requesting the patient, for example, to perform an isometric contraction, the central area and the area felt as the larger felt area corresponds to the muscular center which is intended to be stimulated using Russian current.

Contraindications in the use of the resource

- patients suffering from muscular pain of unknown etiology.
- patients suffering from severe muscular injuries.
- patients with muscular dystrophia of any kind.
- patients with significant cognitive alterations and incapable of providing *feedback* of intensity of current prescribed during the treatment.
- patients with severe conduct cardiopathies.

Selkowitz (1989) revised experimental evidence that suggest the effectiveness of the use of Russian current in the increase of muscular strength. *The author* concluded that there was sound evidence that showed the increase in muscular strength after training with Russian current, however, it is important to emphasize that according to the author, the increase in muscular strength achieved through training with the current was not higher than the increase through training using voluntary exercises or a combination of the two techniques, namely voluntary exercise and Russian current.

Some therapeutic conditions do not allow for the use of kinesiotherapy using restricted movement. Thus, a therapeutic strategy to be used would be the use of the muscular contraction induced by Russian Stimulation. Patients in post surgical cases of lesions of the osteomioarticular system, central and peripheral neurological lesions, after esthetic surgical procedures such as lipoaspiration are possible candidates to be subject to traninig sessions using Russian current.

Delitto et al. (1989), compare the increase in muscular strength caused by electrical stimulation using Russian current with the gains produced by voluntary exercise in patients subject to reconstruction surgery of the anterior crossed ligament. According to the authors, the group subject to training with Russian current presented greater muscular strength gains when compared with the group trained voluntarily.

SNYDER-MACKLER et al. (1989), compared the maximum torque values electrically induced through the 3 currents: Russian, interferential at 4kHz and a pulsed biphasic and low frequency current. The highest torque produces was attributed to Russian current, however, the difference was not statistically significant when compared with low frequency current. Já Ward & Robertson, (1998), compared the maximum torques generated electrically by modulated currents at 50Hz with frequency ranges varying between 1 and 15kHz. The maximum generated torque was obtained when the frequency at 1kHz in this experiment was useby the authors without pulsed monophasic and low frequency currents for comparison. The limitation of the study occurred when direct comparisons with Russian current were not made.

LAUFER et al. (2001) compared the maximum torques generated eletrically usaing Russian current, a monophasic pulsed current of 50Hz and a biphasic pulsed current of 50 Hz also. The only difference noted by the authors was between biphasic pulsed current and Russian current, the torque generated by the first is higher than the torque produced by Russian current.

Other scienctific studies Snyder-mackler et al. (1994, 1995) ratify the findings of Delitto et al. (1988), and also establish positive correlations between the high intensities of training and the muscular strength recovery rate.

As for the stimulation intensity given in milliamperes (mA), this must preferentially be increased every 3 to 5 minutes in the same training session for the muscular adaptations to occur, al so muscular increase after training with Russian current.

The popularity of Russian current

Dr. In aconference in 1977 Yakov Kots affirmed to have achieved gains of 40% in msximum isometric voluntary muscular strength in elite athletes. Such a fact was not documented strictly and due to this, there are still doubts about the subject.

A canadian group (St PIERRE et al. 1986) with Yakov Kots conducted a study on university students. The presence of anything related to the previous reference made by Kots was not verified in this study, however, at the time of the study an English library had a manuscript published by the scientist in Russian. The first experiments that lead to the creation of Russian current will be describes below.

The current parameters used were alternate current with a frequency os 2.5 Hz in *Bursts with a frequency of 50 Hz* and an activity cycle of 50%. offered regiem of the pulses 10/50/10 – 10 seconds "*on*", 50 seconds "*off*" for a period of 10 minutes per session.

The regime "10/50/10"was obtained by Kots from a study in which the suthors used a pulsed current of T= 1 millisecond, rectangular wavelength and frequency of 50 Hz. The second step of the experiments was to determined if the sessions would be performed on a dalily basis or alternating by 9 or 19 days of treatment. For this, the authors used 37 young athletes from 15 to 17 years of age divided into 4 groups. 3 groups received the electrical stimulation on the braquial biceps muscle and group 4 received the current of the sural triceps muscle. The maximum torque generated by the current measured by the charge cell during a maximum voluntary isometric contraction (MVIC). The level of muscular contraction was also measured using a device developed for such a purpose, only in the groups that received stimulation on the braquial biceps muscle.

In the first part of their experiments, Kots & Xvilon they applied pulse *trains* of 50 Hz for a time of 15 seconds and the muscular torque provoked was monitored.

After this, the authors compared higher stimulation times with the time of 10 seconds and did not observe a reduction in the generated torque. However, the authors

observed the occurence of electrically induced fatigue, namely, as a result of the current in a time of 12.5 seconds. On the basis of these observations, the authors concluded that 10 seconds would be an adequate stimulation to prevent muscle fatigue.

As for the enveloping current, the determination of the "on' time had only been made by authors (Kots & Xvilon), thus, the *"off"* time should be determined for muscular fatigue to be prevented between each pulse *train* offered during the treatments. The authors defined how muscular fatigue is visibly reduced in the muscular torque between 2 *consecutive p ulse trains* of ten seconds each. The following *"off"* times were compared by the authors: 10, 20, 30, 40 and 50 seconds. After the experiments, it was reported that *"off"* times lower or equal to 30 seconds reduced the average torque generated by the muscle in the second pulse *train.*

Kots & Xvilon concluded that the *"off"* time should be between 40 and 50 seconds. From this point, the authors measured the variation of the torque for 10 *trains* of consecutive pulses of 10 seconds each and thought that the *"off"* time of 40 seconds favored the occurrence of muscular fatigue, particularly in the last stimulation *trains.* When the *"off"* time equal to 50 seconds is used, the muscular fatigue did not manifest during the 10 consecutive *trains* of each 10 seconds.

Thus, the therapeutic regime was ready: 10 seconds "on", 50 seconds "off" for 10 pulse *trains.* Soon after the protocol developed by Kots and Xvilton should be subject to testing: The authors selected two groups of volunteers and applied the 10/50/10 regime daily for one of the groups and in alternate days for the other group and conducted the evaluation of the muscular torque after 9 and 19 days. The evaluation of the torque was conducted usig the MVIC. The perimetry of the stimulated lower limb was also conducted.

On the basis of their observations, the authors concluded that Russian current produced an increase in the muscular strength in excited muscles in comparison with voluntary muscular contraction. Another important observation made by the authors was that all the stimulated volunteers tolerated progressive stimulation intensities in the groups of 9 days as well as in the group of 19 days of Russian stimulation. An increase in the circumference of the stimulated limd was also verified. The authors observed no differences in the variables evaluated in relation to the performance of daily sessions for 9 days or alternate for 19 days.

Probable mechanisms that lead to the increase of muscular strength in fuction of the use of Russian current

Kots & Xvilon used a control group that completed MVIC, 6 times per day for 19 days. The authors did not observe significant increase of muscular strength before and after the training period.

The same Russian group as described above, reported the use of electrical currents in the kilohertz frequency range to increase musculat strength. The currents used for such training sessios were an alternate and constant current without

modulations and the other was an alternte current modulated in time or *bursts* at 50 Hz 10ms "on" and 10 ms "off". The authors observed the effects of direct stimulation, namely, applied on the muscular center and indirect with stimulation of the peripheral nerve corresponding to the the muscle that was intended to be trained.

The stimulated muscles were the flexors of the hand and fingers as well as the medial and lateral gastrocnemio. For the flexor muscles of hand and fingers, direct stimulation was applied using conventional electrodes of known dimensions and indirect stimulation using a percutaneous electrode implanted under the elbow. Electrodes of the same size were used for stimulation of the gastrocnemio, however, the details of the positioning are not reported in the manuscript. The study was divided into four different parts, in each part of the study the number of volunteers varied from 7 to 10.

For the first part of the study Adrinova et al. (1971) used alternate current and without modulation with frequencies from 100, 500, 1000, 2500, 3000 and 5000Hz in order to stimulate the flexor muscles of hand and fingers. The authors measured the motor threshold for each frequency, the maximum tolerated current and the voltage necessary to tigger 60% of the electrical torque induced.

The authors suggests that as the current frequency is increased, the stimulation level is also increased, however, the discomfort caused by the use of electrical stimulation decreases. The authors did not measure the discomfort in a quantitative manner, and thus, it seems that this observations are empirical and not scientific.

Despite this, nowadays the literature offers information that really verify higher comfort for the patients in the application of medium frequency currents (GUIRRO et al. 2000).

Back to the manuscript by Adrianova et al. (1971), the authors observed that for direct stimulation of the gastrocnemio muscles at a maximum strength of 92.5 kg or approximately 70% of the mximum isometric voluntary contraction was achieved with 2.5 Hz of current frequency. The maximum voltage used for the indirect stimulation of the flexor muscles of the hand and fingers was 1Khz. Muscular fatigue occurred quickly above this frequency value.

The second part of the study by Adrianova et al. (1971), objectified the measuremen of muscular strength with the different currents and frequencies used and described above. According to the authors, indirect stimulation with a current with a frequency of 1kHz was more efficient at providing the increase in muscular strength regardless of the used current (without modulation or modulate din *bursts* at 50Hz). For direct stimulatio, alternate current of 2500 Hz achieve a higher increase in muscular strength when compared to the other tested frequencies. Curiously, the authors did not test alternate current modulated in *bursts,* which is the closest to the Russian current proposed by the same group.

In the third part of the study, the authors decided to compare the 1kHz and 2500 kHz frequencies, as the first was more effective for direct stimulation and the second for direct stimulation. The results were the same as in the second part of the study, however, the current modulated in *bursts* was not used by the authors.

The authors also mentioned that the level of muscular strength generated by the two frequencies (1kHz and 2500 kHz) was quite similar, which in theory suggests that direct stimulation to the muscle may enhance the recruitment of deeper muscle fibers, which is discarded by most literature on the subject. The literature suggests that excitomotor currents would only stimulate superficial fibers.

Modulation in BURSTS

Without presenting consistent scientific background, Adrianova et al. (1971) concluded that when a current of 2500 Hz is applied in a continuous manner of in 10 ms and with *bursts* of 50 Hz, the maximum force achieved after the stimulation is not affected. The study by Soloviev E.N., (1963), also supports the findings of Adrianova et al. (1971) which reccomends a *bursts* modularion of 50Hz and in function to interrupt the current
applied to the patiend which may delay muscular fatigue of the patient during treatment.

The recent study by Wards & Robertson (2002) sustains the hypothesis submitted by Adrianova at al. (1971) and Soloviev (1963). The authors evaluated the motor threshold in frequencies that varied from 1 to 25kHz and little difference was found between the stimuli offered in continuous and modulated mode in *bursts*.

In the fourth parto their study, Adrianova et al. (1971) researched the capacity of modulation in *bursts* at 50Hz in order to avoid a possible situation of muscular fatigue without reducing the torque generated by the current.

The authors compared the constant or contínuos stimulation in relation to modulated stimulation in *bursts* through the direct stimulation of the gastrocnemio muscles and indirect stimulation of the hand and finger flexors. The observed results support the hypothesis that modulation in *bursts* at 50Hz and the activity cycle at 50% do not reduce the electrically generated torque.

In the same study, Adrianova at al. (1971) reported the increase of muscular strength in two different groups of volunteers. The first group received the current in the gastrocnemio muscles and a frequency of 2500Hz once per day for 18 days. The maximum voluntary contraction at the circumference of the limb as well as the hight of jumps performed were measured.

Half the second group received electrical stimulation on the anterior tibial muscle at 2500Hz and the other half received the current on the same muscle with a frequency equal to 1000Hz. For both stimulated groups, the regime applied was the same (10/50//10) modulation in busts at 50Hz and with activity cycle equal to 50% applied to the maximum intensity tolerated by the volunteer.

The gains in strength observed were higher than group 1 (increase of 45%). The gain in muscular strength was accompanied by an increase in the circumference of the limb of 3% and also an increase in the height of the jumps of 15%.

It is important to highlight that muscular increase was not verified only in the studies produced by Kots and his group after the use of Russian current, other groups

less interested in the Marketing than in the name "Russian", also report effectiveness regarding the resource in different populations. A doubt by scientists from correlated áreas would be in relation to the control groups used by Kots and collaborators, however, the result from other researches as mentioned, relieve this concern.

There are not many studies in the literature regarding studies which lead to evidence indicating that Russian current is more effective compared to voluntary exercise in the increase of skeletal muscle increase. The opposite is also true, namely, voluntary exercise does not seem to be more effective in relation to the current in the increase of skeletal muscle strength. Thus, if possible, a combinatio of both resources is suggested when muscular strengthening is the objective.

The use of a combination of voluntary exercise plus Russian current is a result of two different muscular recruitment patterns achieved by the different resources, consequently, it is known that voluntary exercise preferentially recruits slow contraction fibers (type I) while the recruitment with Russian stimulation would be inverse, namely, it first starts with fast contraction fibers (type II) which respond more effectively to muscular strength training and which are enervated by motoneurons of large diameter.

It is important for us to observe that most experiments conducted by the Russians for the verification of the effectiveness of the current in question was based on the observation of the application of Russian current with a variation in the original parameters and subsequent observation of the fatigue responses and generation of muscular strength after muscular training.

A second justification to avoid the isolated use of voluntary muscular contraction would be that it favors the risk of increasing the capacity to generate muscular strength, finding great modifications in the muscular contraction speed, which would negatively and directly influence the capacity of the skeletal muscle to generate muscular strength.

It is known that in certain situations, articular movement becomes invariable in function of problems such as reduction of muscular strength, edema and intrinsic limitation of articular movement and in these situations; electrical stimulation using Russian current must be applied on its own.

The material developed by Kots & Xvilon physiologically justifies the use of regime 10/15/10 (KOTS Y.M., XVILON V.A., 1971, Trenirovka mishechnoj sili metodom elektrostimuliastsii soobschenie 2, trenirovka metodom elektricheskogo razdrazenii mishechi. Teor. Pract. Fis. Cult ., 4: 66 – 72.) consequently, for the authors of Russian current to cause an increase in muscular strength could in no way lead to the occurrence of skeletal muscle fatigue, because in case this happens, there would immediately be a reduction in the capacity of muscular work and as a result of this, the adaptations to the training would be little.

The observation by the authors regarding the decrease of strength using monophasic pulsed current at 50Hz with different “on" and “off” periods for 10 minutes was the evidence that the stimulus would not lead to muscular fatigue.

According to the authors, for a frequency of 50 Hz, the dominating mechanism in the occurrence of muscular fatigue would be related to a depletion of neurotransmitters as well as the lack of propagation of depolarization impulses through the muscle fibers, more specifically through the “T” tubes. These findings are supported

by more recent literature: JONES D.A.,1996, High and low-frequency fatigue revisited. Acta. Physiol. Scand., 156:265 – 270. Thus, the time of 10 minutes in the training regime seems to be important.

It is very important to highlight that Kots & Xvilon (1971) did not use an alternate current for the tests, nor a pulsed monophasic current!. Thus, the fact that some authors who disagree with this treatment regime cannot be ignored.

As for the frequency of 2500Hz used in Russian stimulation, there also seems to be a lack of consensus in scientific literature. In the experiments conducted by Adrianova at al. (1971) the authors only used indirect stimulation, namely, of the peripheral nerve in frequencies that varied from 100Hz to 5kHz. Ward & Robertson (1998) examined frequencies from 1 to 15kHz, modulated in bursts at a frequency of 50Hz and found that the maximum torque found for the chest expanders was a frequency of 1kHz. The stimulation conducted by the authors was direct and indirect.

According to Delitto (2002), the existing information from literature regarding the frequency of 2500Hz modulated in Bursts at 50Hz used in Russian stimulation is more adequate, however this coclusion is based more in interferences than in very well controlled experimental measurements. The author suggests for this hypothesis to be tested in an experimental manner so that other therapeutic perspectives are achived.

Adrianova et al. (1971), studied two types of different electrical currents with an alternate and modulated current in bursts and another pulsed current and of lower frequency. The authors concluded that the 2500 Hz current must be used in order to offer higher stimulation comfort to the patient.

D'ARSONVAL A., (1981) suggests that after experiments, an alternate current with fixed voltage achieved to promote a more intense neuromuscular excitement in frequencies from 1250 to 1500Hz, thus, the contraction becomes more stable in the 2500Hz frequency. From 2500Hz to 5000Hz, the muscular contraction levels decreased exponentially.

The author also suggests that the patients subject to training report higher comfort during the stimulation sessions when the applied currents present higher pulse frequencies.

Thus, in fuction of the information described above, it can be concluded that:

-The studies presented regarding the material of Kots & Xvilon and Adrianova, support the use of Russian current efficiently
-Adrianova et al. (1971) concluded that the 1kHz frequency in relation to the 2.5kHz must be preferentially used for higher production of strength when the muscles are stimulated indirectly, namely, the stimulation of the peripheral nerve. This hypothesis is supported in a recent study by Ward & Robertson (1998)
-For direct stimulaion the 2.5kHz frequency must be used.
-The question of how much better the alternate current modulated in bursts which produces Russian current is than low frequency pulsed current; new research is still pending for it.

- The characteristic10/50/10 Russian current regime was created from the use of a low frequency monophasic current and not from an alternate current modulated in bursts and of medium frequency, which supports Russian stimulation.
- The 10/50/10 regime was selected for electrical stimulation through Russian current in order not to cause a reduction in muscular strength during the 10 minutes of stimulation.
- The initial studies using Russian current support the use of the resource, however, more studies are becoming necessary for some doubts to be completely elucidated.
- As for the weekly treatment frequency, we do not think it to be adequate to take into consideration what was proposed by the authors who created Russian stimulation, as the need for the number of sessions varies from patient to patiend, depending on the type of pathology to be treated.

MENS (Microcurrent Electrical Neuromuscular Stimulation) or simply, **MICROCURRENTS**:

Becker and Nordenström provided a rational base for a new form and largely more efficient medical intervention that Joseph M. Mercola and Daniel L. Kirsch, Ph.D. (1995) called "electrical therapy by microcurrent" (MENS). An increase in surveys has revealed the efficiency of MENS in accelerating and even induce the cure.

When a bruise is dry, its bio-electric current flow is interrupted. Eaglstein and Mertz (1978) have indicated that the humid bruises renew their surfaces 40% quicker that the bruises exposed to the air. Falanga (1988) discovered that some types of occlusive bandages such as Duoderm, accelerate the cure of bruises. Probably, these bandages have such effects due to a humid environment (Kulig, Jarsky & Drewek, 1991). The humidity may allow the lesion current flow, thus facilitating the cure of the bruise.

The electric stimulation of the bruise tends to increase the quantity of receivers of the growth factor, that also increases the quantity of colagenium that is formed (Falanga, 1987). The electricity was used for the first time to treat the superficial bruises approximately 300 years ago when it was discovered that gold blades prevent scars of smallpox (Robinson, 1925). There are several recent studies proving the beneficial effects of bruise treatment using the lesion artificial current (Goldin, 1981; Jeran, 1987; Ieran, 1990; Mulder, 1991). Experimental models of bruises in animal during the decade of 1960 revealed that the electric intervention can result in an accelerated cure, with quicker superficial recovery of bruises, and a more intense formation of the cicatricial tissue. (Carey & Lapley, 1962; Assimacopoulos, 1968).

Assimacopoulos (1968) published the fist human study using the electrical direct current in cure. He documented a complete cure in three patients with chronic ulcers on the legs resulting from a vein stasis after an electric therapy of 5 days. One year later, the study cited more frequently in the history of bruise electric cure was published by Wolcott and Wheeler (1969).

They used the 200-1.000 microamperes of direct currents in 67 patients. Gault and Gatesn (1976) repeated Wolcott and Wheeler protocol in 76 additional patients, with 106 skin ischemic ulcers. Rowley and many others (1974) studied a group of patients with 250 ischemic ulcers of several types. These included 14 ulcers of symmetric control. The ulcers electrically stimulated had a quadruple healing acceleration when compared to the controls. Carey and Wainapel (1985) undertook one of the single studies on this subject, published with equal and randomized active and of control groups. All these studies documented that a significant and accelerated cure as from the electrical stimulation.

An additional and consistent observation in these studies was the inverse of the bruise contamination. All bruises that had been initially contaminated with *Pseudomonas* and/or *Proteus* were normally sterilized after several days of MENS.

Other researches also noted similar improvements and encouraged the use of this therapy as preferred treatment for painless ulcers (Kaada, Flatheim & Woie, 1991; Barron & Jacobson, 1985; Lundeberg, Eriksson & Malm, 1992; Alvarez and others, 1983). In addition, no significant contrary effects were documented resulting from electrotherapy on bruises (Weiss, 1990). A detailed report of the literature issued by Dayton and Palladino, indicates that the electric therapy using microcurrent is clearly an efficient and safe supplement for the non-surgical management of leg recalcitrating ulcers.

As mentioned above, during the 1960 decade, Dr. Becker has shown that an electric current is the trigger that stimulates the healing, the growth and the regeneration in all the organisms alive. He discovered that the repair of a lesion occurs as a reaction to the signals that come from an electric control of the system, and suggested that such system becomes less efficient when we grow old.

Dr. Becker (1985) developed this theory of the biologic control systems as from the concepts of physics, electronics and biology. He started from the assumption that the first organisms alive should have been capable of self-repair, otherwise they would have never survived. The repair process requires a system in closed circuit. A specific signal is generated creating another signal that will start the repair. The bruise sign is gradually reduced along the time through the repair process until it finally ceases when the repair is completed. Such primitive system does not require any awareness shown awareness or intelligence. In fact, several animals have really a higher cure capacity than human beings.

Science has gathered a large quantity of information on how the brain and the nervous system operate. Great part of such surveys is related to the electromotor potential of the alternate current, as the unique mechanism of the nervous pulse. This is a very sophisticated and complex system for transfer of information. It is useful to compare this process currently accepted of the nervous system with a computer.

The fundamental signal in the computer as well as in the nervous system is of the digital type. Both systems transfer the information represented by the number of pulses per time unit. The information is also encoded according to the location to which the pulses are directed and if there is or there is no more than one pulse channel

feeding the area. All our senses (ex. smell, taste, hearing, vision and touch) are based on this pulse system. Similarly to the computer, the nervous system operates with extreme quickness and can transfer great quantities of information under the form of digital data, **connected and disconnected**.

It is unlike that the first organisms alive had such a sophisticated system. Becker believes that they might have had a much easier mechanism to communicate the information, as they had no need to transmit large quantities of sophisticated data. Consequently, they probably used an analog system. The analog system operation through simple direct currents.

The information in an analog system is represented by the current intensity, its flow direction, and the short variations in its wave length value. This is a much slower system than the digital model. However, the analog system is extremely accurate and works well for the intended scope.

Becker theorizes that the first organisms alive had used for the repair this analog data transmission and control system. He establishes the assumption that we have a primitive nervous system in the perineural cells of the central nervous system. These cells cover 90% of the nervous system. The perineural cells present semi-conducting properties that allows them to produce and transmit direct current signals that do not propagate. This system works in a very different way of the law “all or nothing” of propagation of the electromotor potentials in alternate current, that Becker called it the fourth nervous system.

This analog system feels the lesion and controls the repair. It controls the cells activity producing electrical environment in its neighborhood.

It also appears to be the brain's initial primitive system, controlling the action of neurons, in their generation and receipt of nervous pulses. Consequently, while the knowledge of this aspect of our nervous system remains hidden, the mystery of the brain's physiology can be explained, including the adjustment of the processes of our conscience and of decision making. Once this understanding is assumed, the application of the correct electrical intervention is a powerful tool *in pain treatment, start of the endogenous mechanisms for the cure and the change in the states of conscience*.

Chang (1982) proposed another mechanism for the MENS. His research has shown that the stimulation through microcurrent increased generation of adenosine triphosphate (ATP) in approximately 500%. The increase in current level really reduces the results. It was also proven that the microcurrent improved transportation of the amino acid and the protein synthesis.

It would have been useful to report in details the cellular nature of a lesion to fully appreciate the importance of Chang's survey.

Becker (1985) has shown that the trauma will affect the electric potential of the cells in the damaged tissues. Initially, the region of the lesion presents a much higher resistance than the one of neighboring tissues. The fundamental physics establishes that the electricity follows the path of the minimum resistance. For this reason, the endogenous bio-electricity avoids areas of high resistance and takes the easiest path,

generally around the lesion. The reduced electric flow, passing through the bruised area, reduces the cellular electric capacity (Windsor, 1993). As a result, the cure is really jeopardized. This could be one of the reasons for the inflammatory reactions. Pain, warmth, sweating and redness are characteristics of the inflamed tissues. The electricity flows in a much quicker manner through these inflammatory and hot fluids.

The correct application of microcurrents to an insured location increase the current endogenous flow. It allows the traumatized area to recover its electric capacity. The resistance of the injured tissue is then reduced, allowing the penetration of the bioelectricity in the area, re-establishing the homeostasis. Thus, the electric therapy through microcurrent can be treated as a catalysis that helps the start and perpetuation of the numerous chemical and electric reactions that occur in the cure process.

The adenosine triphosphate is an essential factor in the cure process. Large quantities of ATP, main source of cell energy are required to control the primary functions, such as movement of the vital minerals such as sodium, potassium, and calcium towards the inner and outer part of the cell. This also sustains the movement of wastes outside of the cells. Injured tissues lack of ATP.

When the MENS increases production of the ATP, the nutrients can flow again towards the inner part of the injured cells and the residual products can exit. The ATP also provides the energy that the tissues require to increase the protein synthesis and increase transportation of ions through the membrance.

Effects of the Electric Stimulation through microcurrent (MENS):

1- Increase in production of ATP in up to 500%
2- Increase in protein synthesis
3- Increase of O2 capture in the location in question
4- Increase of amino acid transportation
5- Increase of membrane transportation
6- etc

The treatment through microcurrent is a non invasive, sub-sensorial method that does not cause any discomfort to the patient. It is biologically compatible as the electric signal is leveled to the body.

Facial Aging:

We can say that we go through five phases of facial aging:

1- *Circulation reduction* – when aging, the number and size of the capillaries that transport oxygen and nutritive substances to the derm and epiderm decrease. The function of the lymphatic vessels is reduced causing insufficiency in elimination of the cellular residues. With the reduction of cellular vitality, all remaining internal functions of the cell such as complete elimination of-
toxins and the supply of nutritional products become slow. This causes the skin cells to become progressively atrophied.

2- *Intracellular insufficiency* – the complete non elimination of the toxins together with the lack of adequate oxygenation will reflect in a transformation of the external aspect of the skin cell, and may also cause pathologic abnormalities.

3- *Muscular Atrophy* – a well invigorated facial muscular tissue reveals a young face. Now, as already seen, a bad circulation and an inadequate nutrition of the cell may cause muscular atrophy. This atrophy will cause the creation of accentuated expression lines, double chin, dark circles under the eyes and other characteristics caused by aging.

4- *Expression marks* – the marks of the facial expression are also generated due to the region, culture and natural trends of the individual. The frequency that we repeat, as the years go by, these facial expressions form what we call "character lines". Its formation is preceded by the contraction of a muscle or group of muscles and by the simultaneous relaxation of a muscle or opposite group of muscles. Thus, there will be a tension and the skin weakens causing a fold or wrinkle.

5- *Transformations due to different regions and social behavior* – these transformations may significantly change the state of the facial tissues. In some regions, the ultraviolet rays created by the sun rays may cause permanent changes in the cell operation, affecting the production of pigments. A long lasting exposure to winds may form callosities, skin hardening and dryness, and appearance of wrinkles. Inadequate food should also be taken into consideration. An incorrect diet may accelerate aging, reducing the cell functions and tissue regeneration.

Rejuvenation through Microcurrent:

The universe was originated as from electromagnetic fields with format, amplitudes and varied frequencies that bear voltage and amperage characteristics.

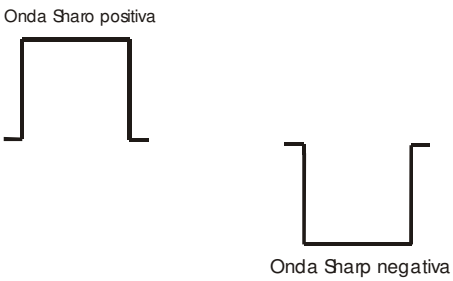
Thus, the existence and the activity of each tissue and intracellular element have some electromagnetic characteristics such as oscillations, voltage and amperage. The existence and vitality of the cells depend on the adequate electromagnetic load. The microcurrent is successfully used to reload the energy of the facial and corporal tissues. This "energetic reload" adequate for the perfect function of the tissues, favoring the blood and lymphatic circulation and provide oxygen and food to the tissues as well as eliminating toxic cellular residues. The microcurrent when appropriately applied corrects the muscular atrophy, invigorating the tissues, increasing the blood and lymphatic circulation, the ATP synthesis, and re-establishing the natural cellular process. Due to the bipolarity of the tissues cells alive, this restoration is performed with the application of microcurrent generally oscillating between negative and positive charges.

Application of microcurrent: Several microcurrent devices are available in the market, each with their own technical characteristics.

Each manufacturer or esthetic professional, school or existing literature use an application technique. This is the reason why we say a treatment suggestion.

With the technological sophistication, different forms of wave can be produced. There are square, rectangular, triangular, senoidal, etc forms of wave. The selection option of different types of wave is not available in all apparatuses.

At the beginning of the 90's appeared the Gentle (light wave), Sharp (strong wave), Mild (moderate wave), Pulse (vibrating wave) waves. Each of them has its own characteristics, however, we can say that all are rectangular monophase waves where according to the type of treatment can be of positive or negative polarity. Example:



Recently, some devices use the resource to reverse automatically the polarity. The microcurrent of the Neurodyn V2.0 operates alternating the positive and negative polarity every 3 seconds.

The basic idea of the importance of the polarization and thus of the need for polarized and inverted current at specific time are those considered by Becker, this means, polarity is needed to re-establish the change in the lesion areas due to the fact that the cell is negative and the exterior is positive.

Thus, in a lesion condition, there is an inversion of the situation and Becker currents start actuating. The cellular information that pass through the membrane requires polar currents for re-establishment of the local electric equilibrium, and thus avoid the apoptosis phenomenons, which is the scheduled death of the cells that were slightly affected by the lesion and were subject to what is called a secondary lesion. The microcurrent satisfies this type of demand and can help to re-establish the local potentials.

For facial treatments we suggest the use of metallic end pens. For corporal treatments, in addition to the pens, we can use conducting rubber electrodes. The skin should always be clean and without grease.

It is important to ask the patient to drink a liquids one hour before treatment. This helps the hydric concentration in the cellular subcutaneous tissue that offers resistance to microcurrent transit.

Ask the patient to remove rings, jewels and any other metallic object.

The electrode pen can be used wrapping it with a cotton wet with water or solution (drug) wrapped on its metallic point. Some professionals prefer to use it with conducting gel instead of wet cotton.

When using the electrode, conducting gel is normally used.

Rejuvenation technique:

Electrode pen for microcurrent application

The NEURODYN V2.0 works with conductive rubber electrodes (two pairs) or with 2 (two) electrode pens (see drawing above). In the facial or corporal rejuvenation techniques, we can use rubber electrodes or electrode pens. As from this point we will provide some application suggestions. We can schematize moving of the pens as:

⟵ ⟶ - The two pens move from the inside to the outside.

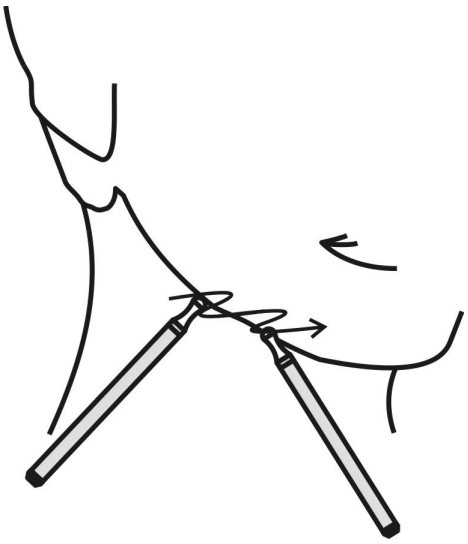
→ ← - The two pens move from the outside to the inside.

○ → - A pen remains motionless while the other moves from the inside to the outside.

○ ← - A pen remains motionless while the other moves from the outside to the inside.

In the scheme above, the moving pen can also move in the zig-zag pattern, example:

○ ~→ - A pen remains motionless while the other moves in zig-zag pattern from inside to outside.



Example of microcurrent facial application with electrode pen following the wrinkle line.

Further ahead a facial and corporal application protocol is suggested. The moves described above for facial application with electrode pens are performed in two phases. First perform fully the phase 1 and then phase 2. Each move (step with the pen should be made during approximately 10 seconds. Normally 10 sessions are required with intervals of two days between each interval. Later a maintenance session can be performed at each month.

All the application protocols and techniques herein described are suggestions and the professional can change them according to his/her evaluation, need and knowledge.

Facial Protocol – phase 1

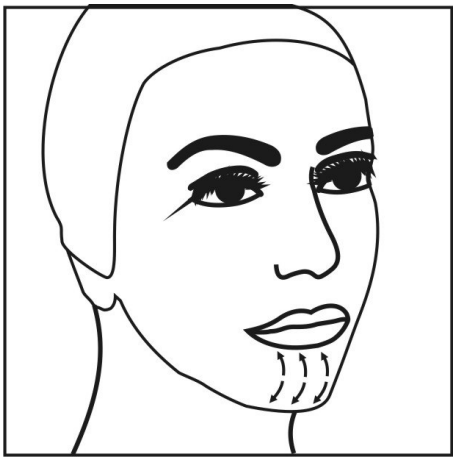
Step	Frequency (Hz)	Intensity (uA)
1 to 4	0.3	50
	0.7	80
	30	100
	200	100

Step	Frequency (Hz)	Intensity (uA)
5 to 7	0.3	50
	1.0	120
	35	160
	250	160

Step	Frequency (Hz)	Intensity (uA)
8 to 11	0.3	50
	3.0	160
	40	180
	300	180

Step	Frequency (Hz)	Intensity (uA)
12 and on	0.3	50
	5.0	200
	70	230
	400	230

Step 1



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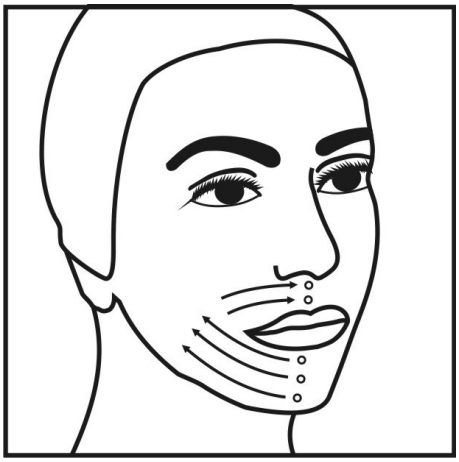

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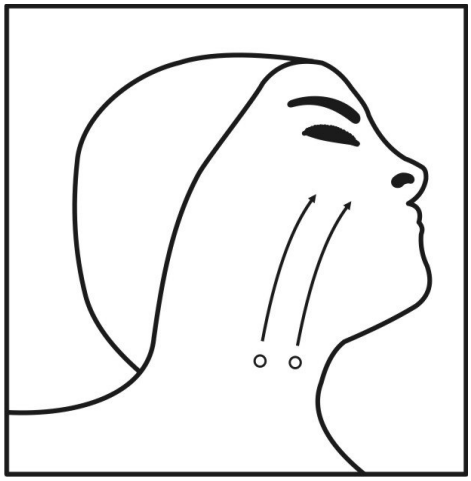
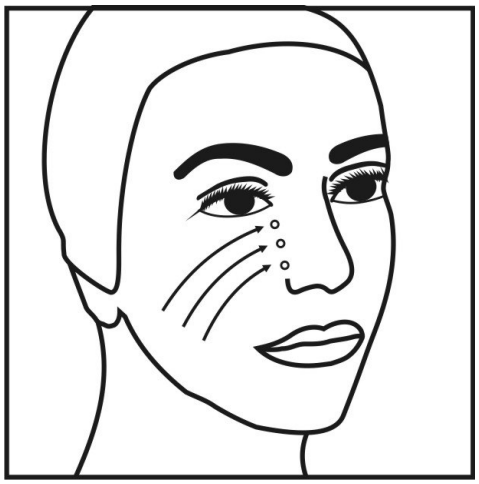
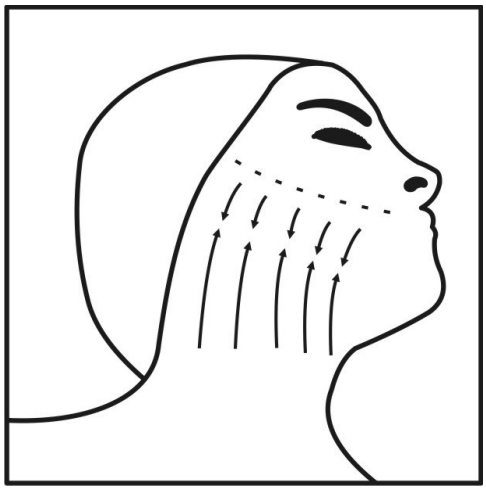


Step 4



Step 5



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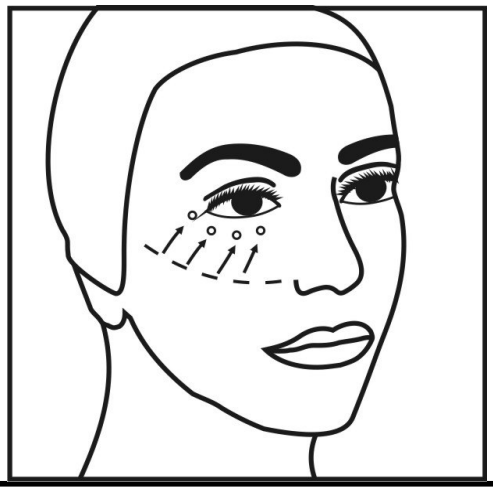

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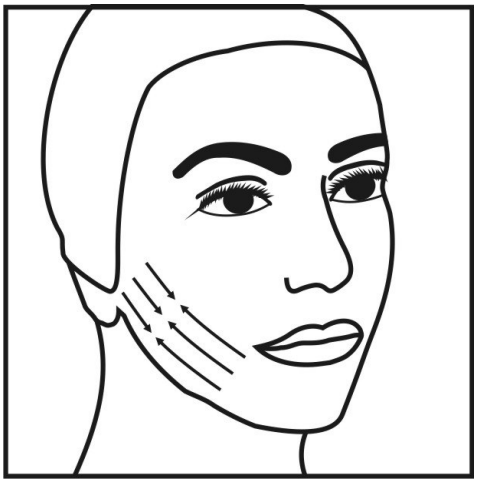

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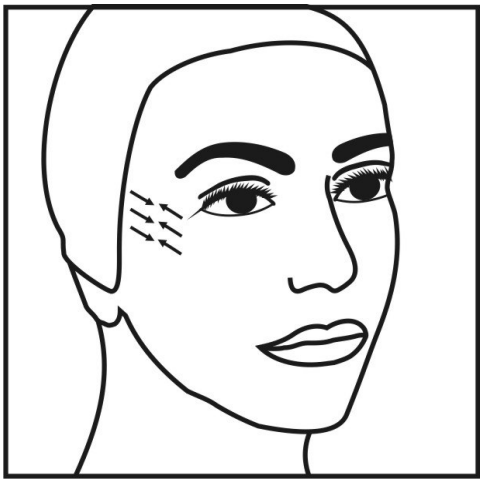

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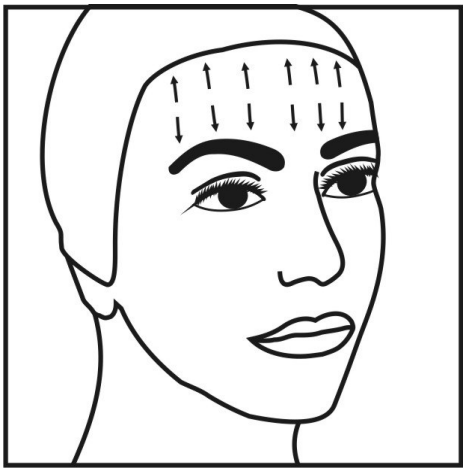
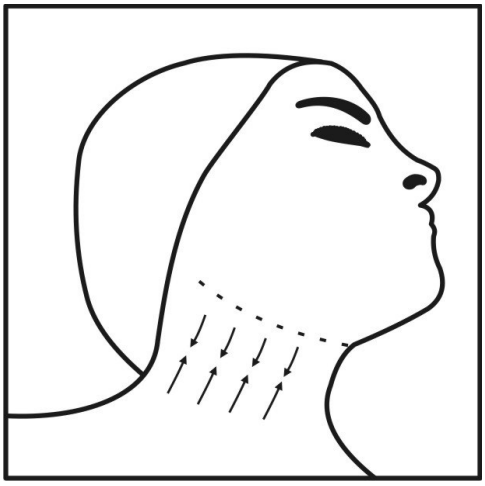


Step 10



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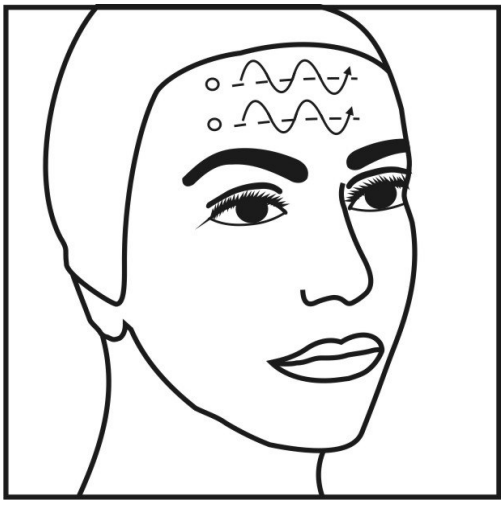

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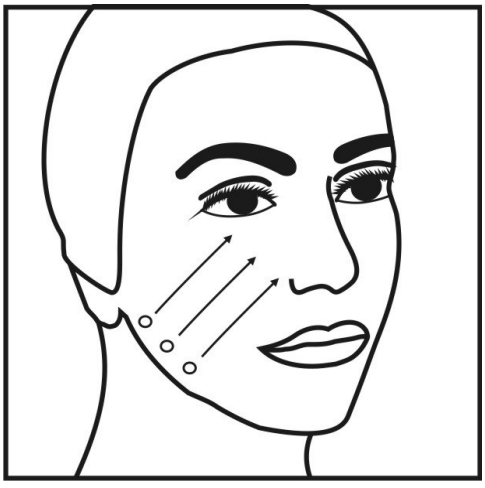
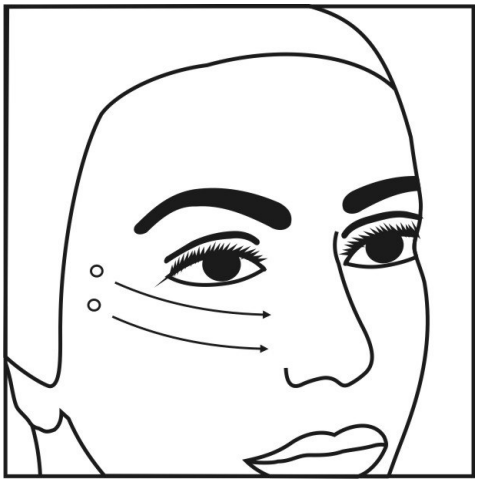


Step 13

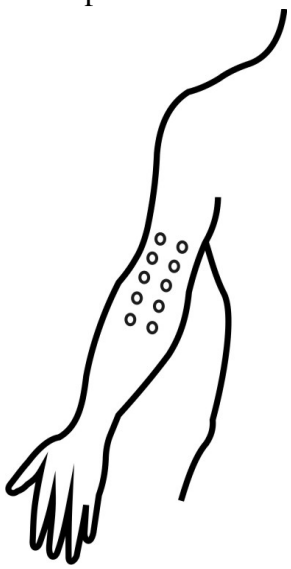


Step 14

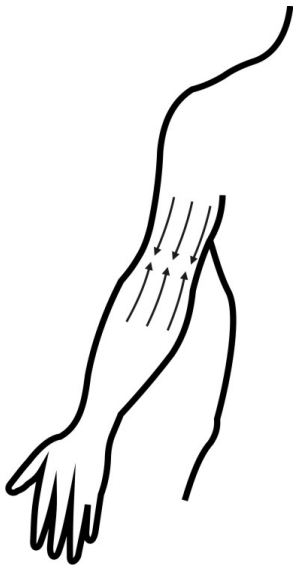
Facial Protocol – phase 2

In phase 2 repeat all the previous steps using the 300 Hz frequency and 60 uA intensity.

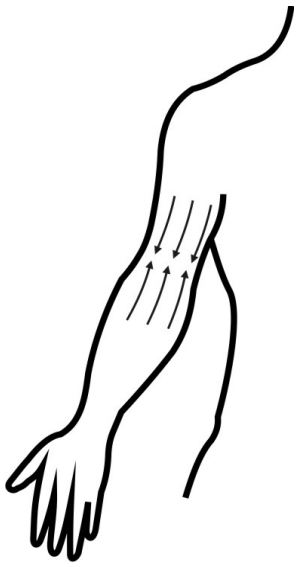
Corporal Protocol



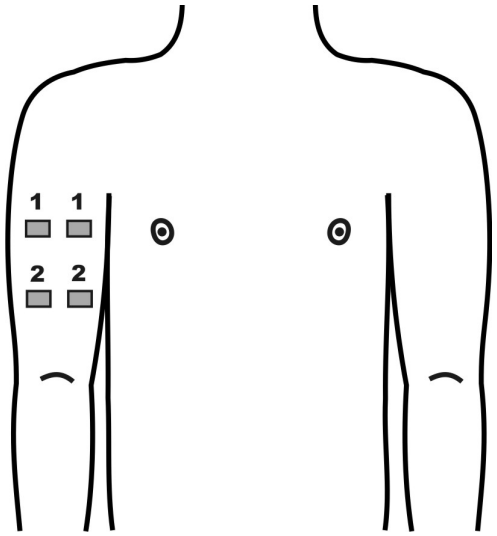
Step 1 - Use a 0.3 Hz frequency and a 100 uA intensity. The pens should be kept motionless at the spots for 10 seconds. Repeat for the other member.



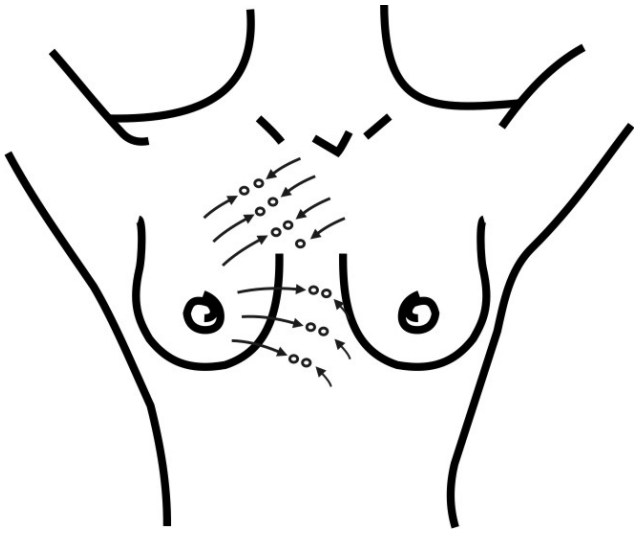
Step 2 - Use a 40 Hz frequency and a 50 uA intensity. Use the pens during 10 seconds in each move. Repeat for the other member.



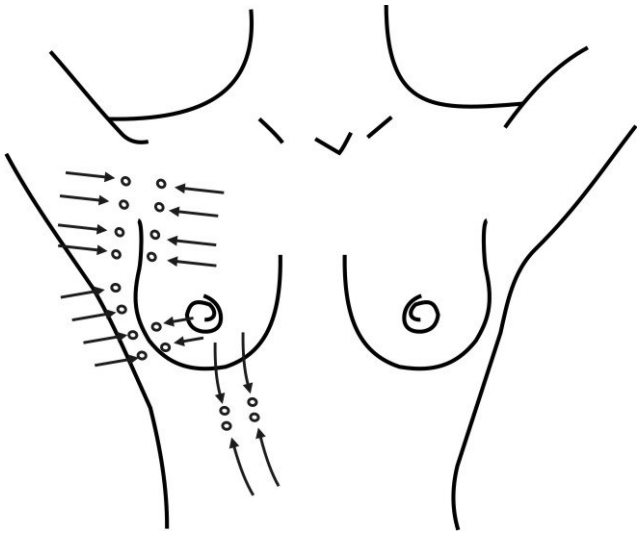
Step 3 - Use a 300 Hz frequency and a 50 uA intensity. Use the pens during 10 seconds in each move. Repeat for the other member.



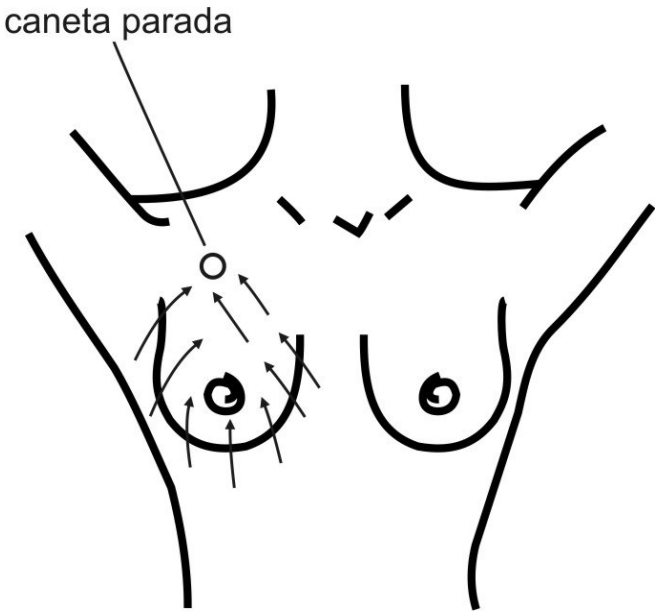
Step 4 - Use the conductive rubber electrodes with conducting gel. Frequency of 0.6 Hz frequency and 50 uA **during 5 minutes. Afterwards, 300 Hz frequency and 100 uA intensity during 5 minutes.** Repeat for the other member.



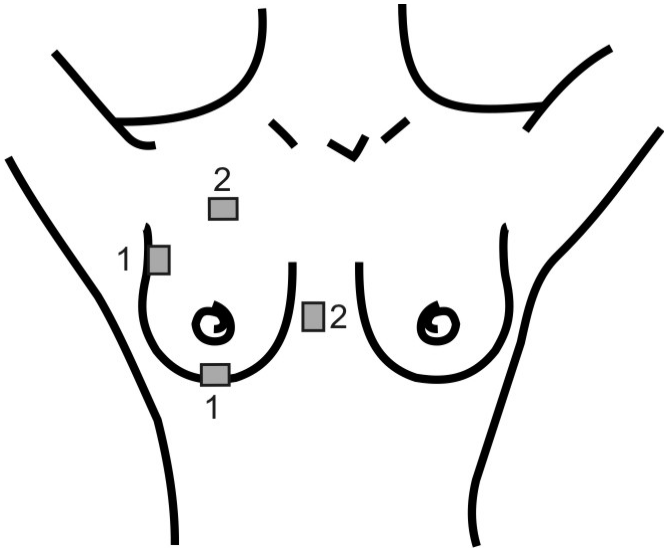
Step 1 - Use a 0.3 Hz frequency and a 50 uA intensity. Use the pens during 10 seconds in each move. Repeat for the other side.



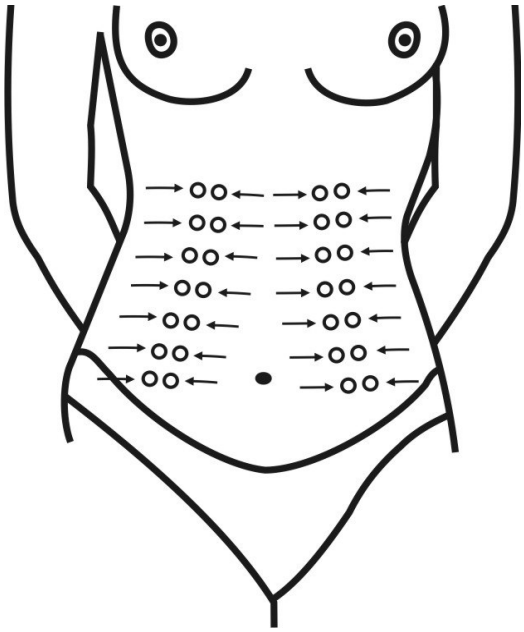
Step 2 - Use a 0.3 Hz frequency and a 50 uA intensity. Use the pens during 10 seconds in each move. Repeat for the other side.



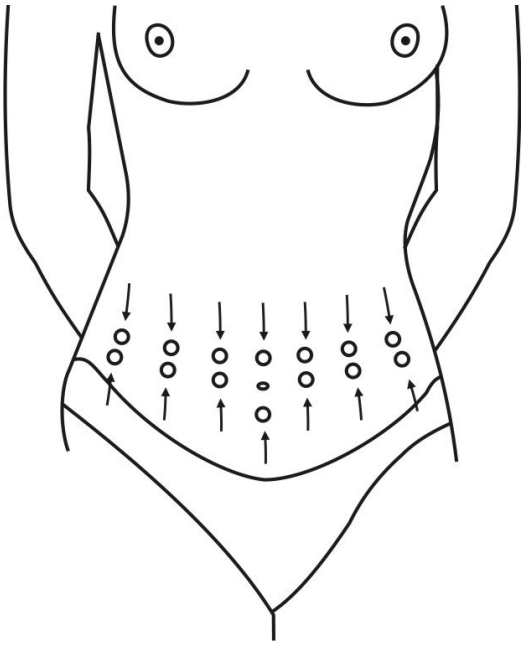
Step 3 - Use a 0.3 Hz frequency and a 50 uA intensity. Use one motionless pen and the other 10 seconds in each move. Repeat for the other side.



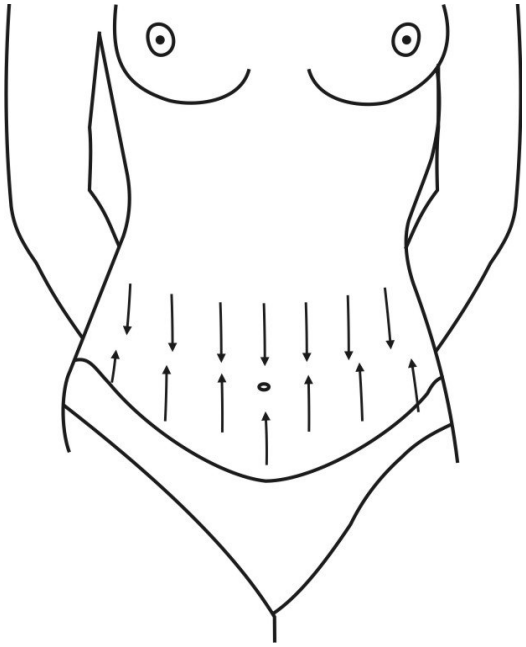
Step 4 - Use a 300 Hz frequency and a 50 uA intensity. Use the rubber electrodes with conducting gel for 5 minutes. Repeat for the other side.



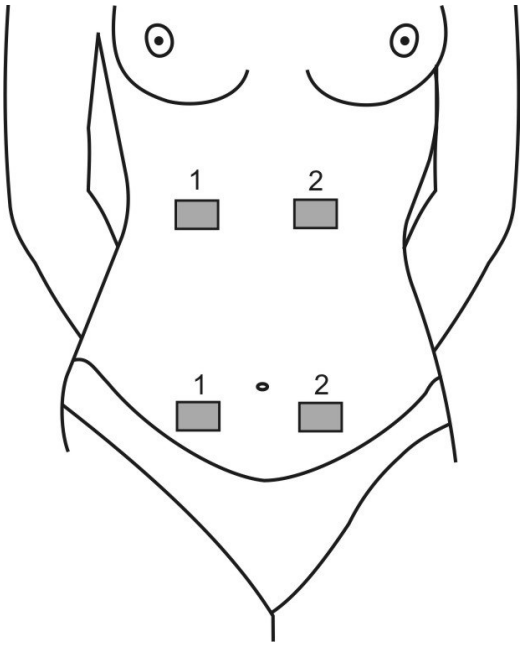
Step 1 - Use a 0.3 Hz frequency and a 50 uA intensity. Use the pens during 10 seconds in each move.



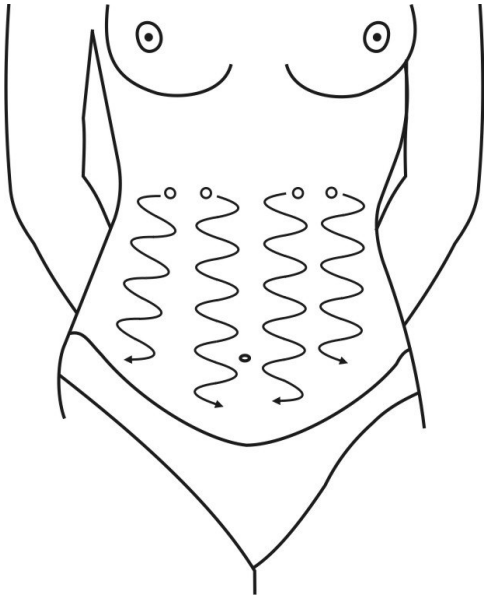
Step 2 - Use a 40 Hz frequency and a 50 uA intensity. Use the pens during 10 seconds in each move.



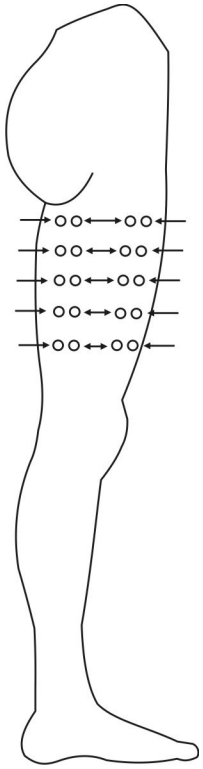
Step 3 - Use a 50 Hz frequency and a 60 uA intensity. Use the pens during 10 seconds in each move.



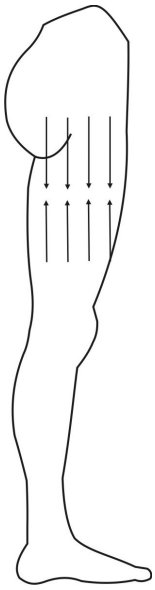
Step 4 - Use a 300 Hz frequency and a 50 uA intensity. Use the rubber electrodes with conducting gel for 5 minutes.



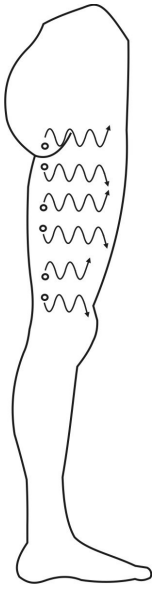
Step 5 - Use a 10 Hz frequency and a 40 uA intensity. Use the pens during 10 seconds in each move.



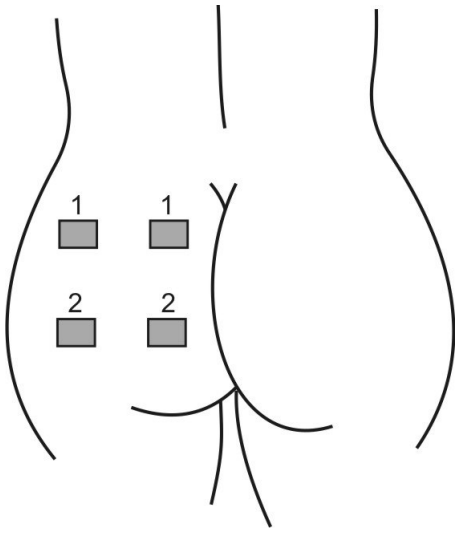
Step 1 - Use a 2 Hz frequency and a 50 uA intensity. Use the pens during 10 seconds in each move.



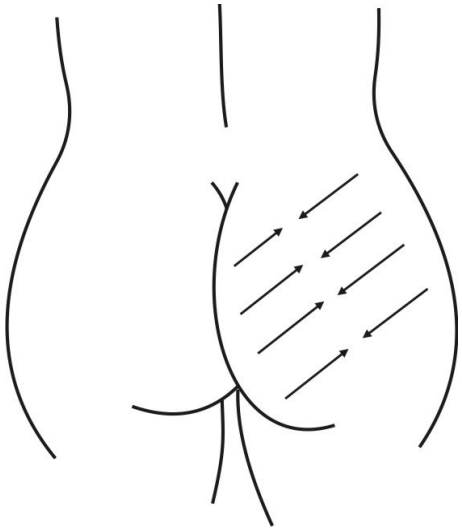
Step 2 - Use a 40 Hz frequency and a 40 uA intensity. Use the pens during 10 seconds in each move.



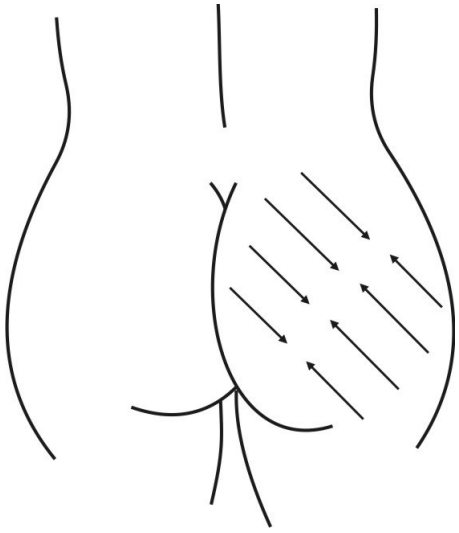
Step 3 - Use a 0.3 Hz frequency and a 80 uA intensity. Use the pens during 10 seconds in each move.



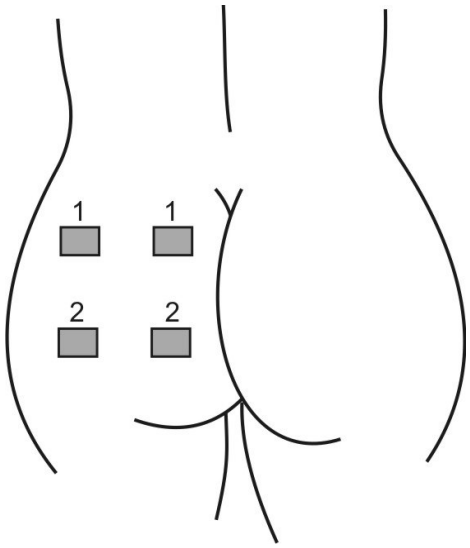
Step 1 - Use a 0.3 Hz frequency and a 200 uA intensity. Use the rubber electrodes with conducting gel for 5 minutes. Repeat on the other side.



Step 2 - Use a 40 Hz frequency and a 100 uA intensity. Use the pens during 10 seconds in each move. Repeat for the other side.



Step 3 - Use a 300 Hz frequency and a 100 uA intensity. Use the pens during 10 seconds in each move. Repeat for the other side.



Step 4 - Use a 50 Hz frequency and a 300 uA intensity. Use the rubber electrodes with conducting gel for 5 minutes. Repeat on the other side.

POLARIZED CURRENT – Polarized current, defined as that in which the movement of the loads of the same signal moving in the same direction, with a fixed intensity. The application of polarized current is called iontophorese (ionization).

Biological tissues present a large amount of positive and negative ions dissolved in body liquids, which can be put into ordered motion using a polarized electrical field, applied on the surface of the skin. This movement of the ions inside the tissues have important consequences, firstly physical and consequently chemical, they can be grouped into the following categories:

- Electrochemical effects
- Osmotic effects
- Vasomotor modifications
- Excitability alternations

Besides these ionic transference polar effects, there will be other effects denominated interpolar effects during the stimulation:

- Electrophorese
- Electrosmosis
- Vasodilation of the skin
- Electrotonus

Electrophorese – According to DUMOULIN (1980), is the migration under the influence of polarized current of colloidal solutions, blood cells, bacteria and other simple cells, this phenomenon is caused by the absorption or opposition of ions.

Electrosmosis – Under the influence of the electrical charge acquired by the membrane structures, a modification of the water contained in the tissues is produced.

Vasodilation of the skin – All chemical reactions and alterations of connections that occur in the presence of polarized current, release energy and alters the local temperature.

Electronus or electronic potential: are local electrical changes, produced by electrical current, in rest potential of the cell membranes.

At the start of the application, the patient will report a slight pricking sensation. The sensation becomes a more intense pricking, burning and pain with the gradual increase of the intensity.

Polarized current transfers ions from one pole to the other by passing through the tissue. There is an electrolytic dissociation of tissular sodium chloride (NaCl) in sodium cations (Na) and chloride anions (Cl).

The chloride anion will migrate into the positive pole of the electrode, as carrier of the negative charge and losing its negative charge and thus reacting and turning into molecular chloride (Cl2). The same occurs with sodium, which when migrating into the negative pole will lose its electron, reacting and transforming into metal sodium (Na).

Hyperthermia becomes active due to the action of polarized current on the vasomotor nerves, producing through the negative pole in a more significant manner. The vasomotor nerves remain hypersensitive for a considerable amount of time. Hyperemia also reaches deeper structures through a reflex action. Thus, there is an increase of blood irrigation, carrying deeper tessidual nutrition (subcutaneous, fascias and superficial muscles). Hyperemia causes higher oxygenation, increase of metabolism, increase of metabolized substances.

The presence of metabolites produces vasodilation of arterioles and capillaries as a reflex which leads to an increase of the blood flow, higher amount of nutritious substances, more leukocytes and antibodies, increasing the repair capacity of the area.

GUIDELINES FOR THE UTILIZATION OF POLARIZED CURRENT

- Experiments have demonstrated that low intensities are more effective as a directional force, than high intensities of the current;
- The intensity of the current must not exceed 0.1 mA/cm2 of the active electrode area;
- The electrodes are normally the same size, however, the negative electrode can be larger, as it can be more irritating than the positive electrode;
- There is a need for correct coupling between the electrodes and the skin and correct humidification of the pads to reduce resistance and avoid burns;
- Metal electrodes must be used, preferentially aluminum, for polarized currents;
- Solutions of continuity (wounds, ulcers, etc.) may concentrate ionic flow and cause burning;
- After ionization, the pads must be washed in order to remove the used chemical residuals;
- There is no advantage in using a solution with a higher concentration than what is indicated by the manufacturer.

IONTOPHORESE

Within the aesthetic medicine area, ***IONTOPHORESE*** is an extremely used technique ***(Tamarkin, 2004)***. However, within the general rehabilitation area, the same procedure is very typical ***(Leduc, 1988)***. To perform this technique, it is necessary to use a form of electrical current that we call polarized or monophasic, this means, the flow of electrical charge is unidirectional between the positive and negative poles.

It is important to emphasize that the IONTOPHORESE should not be perceived as a different type of electrical current, but as a therapeutic method that combines a physical agent, this means, a determined type of electrical current, a therapeutic active principle with a known polarity. Clinically, this means that we should use the IONTOPHORESE technique in order to provide a determined type of drug or active ion through the skin with therapeutic purpose. The positioning of the solution containing the drug should be directly below the electro-treatment with identical polarity to the drug.

Therefore, at the time in which the flow of the electrical current starts, there will be a reprobation of the drug and this will be repelled inside the patient, appearing in the circulation system after several minutes, after beginning the treatment.

The IONTOPHORESE treatment should be used for hyperhydrose treatment, skin wounds, pain and inflammatory processes in progress.

The drugs used for the main therapeutic purposes are: dexamethasone (anti-inflammation), lidocaine (anesthetic), salicylic acid (inflammatory and analgesic control) and acetic acid (support in calcification loss). Within the area of aesthetics, caffeine is the main active principle used, however, vitamin C, lactic acid, glycolic, salicylic amongst others are also used.

For the use of the IONTOPHORESE technique, two electrical current poles are used, the cathode or negative pole and the anode or positive pole. The two poles can be described as being active and dispersive electrodes.

However, during the application of the current, the active electrode will be the one responsible for receiving the dislocated ions by the dispersive electrode. This will happen regardless of the polarity attributed to the electrodes.

The mechanism by which IONTOPHORESE operates is a simple conduction of therapeutic electrical current. The active principle ions pass through the interface of the skin, primarily through hair follicles as well as sweat glands, which can be used as a path for the passage of the ions. Some factors that lead to higher penetration of the active principles through the skin are: hydration of the skin, vascularisation of the area that receives the active electrode, the patients age and finally, the intensity of the electrical current used ***(Leduc et al. 2003, Oliveita et al. 2005)***.

Generally, the IONTOPHORESE technique is performed using a therapeutic electrical current known as GALVANIC current. Galvanotherapy as it can also be known as, was first described in 1786 by Luigi Galvani. The researcher observed at that time, the contraction of the muscles of frogs legs subject to stimulation through direct therapeutic current. Years later in 1870, Van Bruns observed during experimentation, the presence of iodide ions in the urine after treatment through galvanic current.

Much later in 1900 to 1912, ***LeDuc*** demonstrated the possibility of introducing ions of medicative active principle in the body of animals using galvanic current. ***Stephane LeDuc*** (1853 – 1939) was the pioneer in the study of iontophorese application and thus introduced the term known as “iontotherapy”. She was the creator of the technique at the start of the XX century.

Her initial experiments were performed using rabbits. LeDuc applied an electrode of positive polarity or anode to one of the animals, on it she put a drug known as stricine sulphate, which has a positive polarity. On another rabbit, the electrode with negative (cathode) polarity was placed and under this the drug potassium cyanide which was the same polarity. For the closure of the electrical circuit, electrodes were placed connecting the two animals, being the coupling means between these and the skin of the animals to the water.

After several seconds of passage of electrical current between the animals, it was observed that rabbit "A" presented tetanic convulsions with spasms that later led to its death, while animal "B" died from cyanide potassium poisoning. Since then, the procedure of IONTOPHORESE has been used continuously for treatment of patients in different areas of care.

The effects of the use of the IONTOPHORESE technique has been shown as effective for the treatment of diseases such as Parkinson's disease, hiperhidrosis palmar, bone fracturs, Peyronie's disease and pigmentation disorders ***(Riedl et al. 1949, Harris 1982, Henley 1991, Gudeman et al. 1997, Huh et al. 2003, Kavanagh et al.2004, Zhou et al. 2004, Li et al. 2005, Nugroho et al. 2005).***

Some other clinical effects are described in the literature in view of the use of direct current for both iontophorese procedures for direct anodic or cathodic stimulation without the use of specific active principles: analgesia, nervous motor stimulation, local inflammatory control and circulatory stimulation.

Note:

1- As already mentioned in the previous paragraphs, in iontophorese it is necessary to use the polar effect for the introduction of ionizable active principles.
Nowadays, *polarized pulsed currents* are used instead of continuous current (galvanic). To minimize the undesirable effects of the use of polarized current, Neurodyn V2.0 works with pulsed current of medium frequency of 10,000 Hz.

2- The pulsed medium frequency current produces changes in the sensibility threshold, causing an analgesic that prevents the patient from reporting the start of an unpleasant sensation and start of aggressiveness to the skin. Then, the application of this type of polarized current should only be completed by aesthetic medical professionals, qualified and properly authorized.

Electrostimulation - CAUTION AND COUNTER-INDICATIONS

Up to the present date there are no absolute counter-indications regarding the use of electrostimulation, however some precautions must be taken:

Do not Apply on Undiagnosed Pain: It may provoke increased physical activity before a lesion is recovered or it may hide a serious condition.

Implanted Electronic Device: It is recommended that patients with an implanted electronic device (for example, a cardiac pacemaker) should not be subject to stimulation, unless a specialized medical opinion has previously indicated otherwise.
Cardiac Patients: They can present adverse reactions. Be very careful and double the caution during the application of electrical stimulation.
ARRHYTHMIAS: Monitor the patients with ECG during the first sessions.
Pregnancy: Avoid the application during the first three months, mainly on the lumbar and abdominal areas.
Do Not Stimulate the Carotid Sinus: It can exacerbate vagovagal reflexes.
Stimulate With Low Intensities on the Neck and Mouth Areas: In order to avoid spasms of the larynx and pharynx muscles.
Be careful in applications for children, senile and epileptic patients.
Monitoring equipment: Avoid the use of electrostimulation in post-surgical recovery rooms when the patient is being monitored by a cardiac monitor or any other type of electronic monitoring.
Skin conditions: The continuous use of electrical stimulation can cause a dangerous irritation of the skin. If a rash or another strange symptom appears, disconnect the equipment, remove the electrodes and notify their physiotherapist or doctor.
Do not place the electrodes on the mouth or neck: Muscle spasms can occur and cause a blockage of the respiratory conducts.
Aversion to the use of electrical stimulation: Some people think that electrical stimulation is extremely unpleasant. These patients should probably be excluded from treatment.

Placement of the Electrodes

- The key for the success in the use of electrical stimulation lies on the correct placing of the electrodes. Sometimes it is necessary to experiment in several areas before determining the best place and blocking the pain.

- Before placing the electrodes, clean the area with soft soap and water, thus removing oil and possible skin fragments, thus reducing the resistance to the passage of the electrical current. Rinse and dry the area before placing the electrodes.

- Apply the appropriate conductive gel, provided by the manufacturer in a homogenous layer of approximately 1 to 2 mm thickness, on the lower part of each electrode. Some electrodes are self-adhesive and do not need gel.

- The electrodes must be placed with adhesive tape (except self-adhesive ones). Verify that all the sides are firm and fixed to the skin.

- Once the application time is over, remove the electrodes, wash the skin and the electrodes with water and soap, rinse and dry.

Placing of electrodes that are used more frequently in the majority of pain syndromes, severe as well as chronic.

Unilateral: Placing on one of the two sides of a joint, spine, face, head or one limb. It can be performed with one or two electrodes.

Bilateral: the electrodes of one or two channels are placed on both sides of the spine, face, head or joints. With two channels, one pair can be placed on the opposite side or in order to stimulate a determined peripheral nerve on opposite limbs. Note: One channel can be used to stimulate the related area of pain and the other channel, a non-related area.

Proximal: All the electrodes are placed above the level of the lesion. Efficient in lesions of peripheral nerves, medullary lesions and in phantom limb pain.

Distal: involves at least the placing of one electrode on the periphery of the pain, in order to ensure the perception of paresthesia throughout the painful area.

Linear: involves the placing of the electrodes in a proximal and distal manner, as well as in areas related to the trigger points or nerve roots related to the pain.

Alternate: involves the alternate placing of the channels when stimulating in a linear manner, in order to ensure a better distribution of the paresthesia on the painful area.

Crossed: occurs when stimulation with two channels crosses the painful area, thus concentrating the perception of the current on the painful area.

Segmentally Related Myotom: when the stimulation is unbearable in the area of the pain, the electrodes must be places on distant muscle groups, however innervated by the same medullary levels of the painful area. It is suggested to use strong stimulation methods and pulse trains.

Remote: the electrodes of one or two channels are places on segmentally related areas or not, related to the painful area. A remote location can be located at in a proximal, distal or counterlateral angle from the pain area. Strong stimulation is generally used in these areas.

Counter Lateral: When the stimulation involving a limb or one of the sides of the body cannot be performed (generally in cases of burns or hypersthesias), the stimulation of the same nerve in a counter lateral manner can be beneficial.

The counter lateral stimulation will not provide the same effectiveness in the relief in comparison to the ipsislateral stimulation and must be used only as a last resort.

Non-related Areas: when the abovementioned techniques are not effective, it maybe possible to obtain good results by stimulating the superficial areas of the median, ulnar and sciatic nerves; the lower and higher extremities of the spine; the high and transcranial cervical regions.

High Cervical Area: it can be performed with one or two channels, placing the electrodes behind the ear and immediately above the mastoid process.

Transcranial: stimulation with one or two channels on the regions of both temporal nasal nostrils. The exact point is situated one inch above and below the ear.

Preference must be given to electrode placing methods that automatically cover the painful regions.

Functional Stimulation (FES): Normally, the muscles are not stimulated directly, but through their nerve. This is because the intensity threshold for the direct stimulation of muscle fibers is much higher than the threshold of motor nerves and only one motor nerve inervates many muscle fibers. A very important aspect is the location of the electrodes on the skin. This determines the location with the highest current density and thus, the mode in which the nerves are stimulated. An option for the position is an "active"electrode on the motor point. This is a point of the surface of the skin where the maximum muscular contraction can be produced. The points are normally located close to the point where the new motor nerve penetrates in the muscle, generally in the

junction of the third proximal with the two distal thirds of the muscular belly. Another option is the placement of electrodes of the same size on each extremity of the muscle so that the motor nerve remains on the path of the stimulating current (bipolar stimulation)

When stimulation on the motor point is used, the electrodes must be of different sizes. This means that the current will be more concentrated in the electrode with the lowest surface area than in the electrode with larger area. The current through each electrode is the same but the current density is inversely proportional to the surface of the electrode. Consequently, for example, if the area of the active electrode is 1 /25 the area of the other electrode, the density of the current in the active electrode will be 25 times higher.

When the bipolar stimulation is applied, the electrodes are normally the same size and positioned on the extremities of the muscular belly and the group to be stimulated. The current density is the same in each electrode. Consequenlty, the motor nerve is on the path of the current.

General factors that interfere with the stimulation:

* Obesity
* Presence of peripheral neuroplastia
* Decrease of sensory capacity
* Acceptance and tolerance of the stimulating current by the patient

In obese patients: the width of the adipose tissue isolated the motor nerve.

In patients with peripheral neuroplasty: there is no response to electrical stimuli of short duration.

In sensory deficiency: There can be skin irritation.
The patient: Must get progressively used to the sensation produced by the stimulation.
THE THERAPIST: Must be proficient in stimulation techniques.
ORTHOTIC USES OF FES:

ELECTRODES - RECOMMENDATIONS

NEURODYN V2.0 allows for transcutaneous neuromuscular stimulation.

To do this, we use special silicon rubber electrodes that are supplied with the equipment.

The size (area in cm^2) of the electrodes used in electrostimulation is very important;

- We recommend to use only electrodes that are provided as accessories of the equipment in the sizes of 30 x 50 or 50 x 50 mm. The application method of these electrodes is very simple. Generally, the used 30 x 50 or 50 x 50 mm are perfectly accommodated on several parts of the body, causing a deep effect on tissues and a comfortable treatment for the patient.
- If the user would like another type of electrode, we always recommend those of a size larger than the ones supplied as accessory.

- Electrodes with a size smaller than those supplied as accessory can cause skin irritations and burns. If the use of these smaller electrodes is necessary, we recommend the current density does not exceed 2 mA effective/cm^2. If these values should be exceeded, the user should be careful as related to possible hazardous effects (NBR IEC 60601-2-10).
- The maximum values of output current to the patient, provided for this equipment do not exceed the current density limit specified by regulation
  NBR IEC 60601-2-10. Thus, with the recommended electrodes, the equipment can be operated with the output at its maximum, if necessary.
- Some chemical products (gel, lotion, etc) can damage electrodes, decreasing their lifetime. Always use the gel provided as accessory.
- After using the electrodes clean them with running water. Always clean the electrodes before storing them.

Attention: The application of the silicone electrodes close to the thorax may increase the risk of cardiac fibrillation.

ELECTRODES – BIOCOMPATIBILITY (ISO 10993-1): IBRAMED declares that the silicone rubber electrodes provided with the equipment do not cause allergic reactions. These electrodes should be only put in contact with the intact surface of the skin by respecting a limit of time of 24 hours for such a contact. There are no risks of harmful effects to the cells, nor is there any allergic reaction or of sensitivity. The electrodes in silicone rubber do not cause potential irritation in the skin.
Self-adhesive Electrodes (disposable): The material used in the manufacture of these electrodes eliminates risks and special techniques for their elimination. We suggest following the instructions of the manufacturer selected by the user.

Durability of silicon rubber electrodes:
The wear due to usage time of the silicon electrodes is normal.
A worn electrode will lose the homogeneity of the conduction to electric current giving the feeling that the apparatus is weak. Formation of electric conduction points can occur, where the current density will be very high, which may cause a uncomfortable feeling to the patient. Replace the silicon electrodes at maximum every six months, even if unused or on a monthly basis in case of intense usage. Should any cracks be present, the electrode should be replaced immediately.

Environmental Protection: IBRAMED declares that there are no risks or special techniques associated with the elimination of this equipment and accessories at the end of their useful lives.
CLEANSING OF THE ELECTRODES - After using the electrodes clean them with running water. Always clean the electrodes before storing them.

MAINTENANCE

We suggest that the user inspects the equipment and performs preventive maintenance at IBRAMED or at the sales point ***each 12 months*** the equipment is used. As manufacturers, IBRAMED is deemed responsible for technical or safety characteristics of the product **only in cases** when the unit has been used in accordance with the instructions contained in the user's manual, and where maintenance, repairs or modifications have been made by the manufacturer or by expressly authorized agents, and where the components which can cause safety risks and also where components for the proper functioning of the equipment have been substituted, in case of repairs, with original substitution parts. If required, IBRAMED will be able to make available the technical information necessary for eventual repairs of the equipment (circuit schemes, list of parts and components, etc.). However, this does not imply a repair authorization. We do not assume any responsibility for repairing performed without our express written authorization.

WARRANTY

IBRAMED, Indústria Brasileira de Equipamentos Médicos LTDA, herein identified to the consumer at the address and telephone number: av. Dr. Carlos Burgos, 2800 – Amparo/SP, telephone (19) 38179633, guarantees this product for the period of eighteen (18) months, observed the conditions of the warranty terms attached to the documentation of this equipment.

TECHNICAL ASSISTANCE:

Any doubts or operation problem with your equipment, contact our technical department on (19)- 3817-9633.

TROUBLESHOOTING - What might seem to be a problem at first sight, may not always be a malfunctioning case. Therefore, before contacting the technical assistance, check the items described on the table bellow.

Problems	Solution
The equipment does not turn on 1	• Is the power cable properly connected? If it is not, connect it. Also check the power outlet on the wall.
The equipment does not turn on 2	• Have you checked the protection fuse? Check if they are properly connected. Check also if the value is in accordance with the indicated in the operation's manual.
The equipment is on but does not emit current to the patient 1.	• Have you followed the recommendations and instructions in the operation manual correctly? Check and go through the steps described in the chapter about controls, indicators e operation.
The equipment is on but does not emit current to the patient 2.	• Have you checked the electrodes, gel and the connection cables? Check if the cable plug is properly connected to the equipment. Check if the electrodes are correctly placed to the patient body.
The equipment is working but it seems to be weak.	• Verify the wear of the electrodes and/or the quality of the current conductor gel.

Warrant Term

1) Your IBRAMED product is certified against manufacture defects, if considered the established conditions in this manual for 18 following months.

2) The period of warranty will count from the first purchase date by the consumer, even when the product is transferred to a third party. The replacement of parts and the cost in repairs of malfunctions originated from manufacturing will be comprehended in the warranty.

3) The warranty procedures will be exclusively made by IBRAMED sales points, by IBRAMED itself or by other parties specifically designated by IBRAMED.

4) WARRANTY DOES NOT COMPREHEND DAMAGES WHICH COULD OCCUR TO THE EQUIPMENT IN CASE:

The equipment is not used exclusively for medical purposes.

The specifications and recommendations in the user's manual are not observed in the installation and use of the equipment.

Accidents or natural hazards, connection to electrical system with inappropriate voltage, and/or excessive fluctuation or overcharge/ overvoltage occur.

The equipment is not handled properly, is not taken proper care of, or suffers alterations or repairs made by not certified people or companies not accredited by IBRAMED.

There is removal or adulteration of serial number of the equipment.
Any accident in transportation occurs.

5) Legal warranty does not cover: expenses with installation of product, installation of software, installation of microcomputer, transport of product to the factory or sales point, labor cost, materials, parts and adaptations necessary to the preparation of the premises where the equipment will be used, such as: electric wiring, computer technician expertise, masonry, hydraulic installations, grounding system, as well as its adaptations. The warranty does not cover either parts subjected to wear and tear such as: command switches, control keys, handles and mobile parts, sucker applicators, application pens for microderm abrasion, power cable, connection cables to the patient, transducer cables, conductive silicon rubber applicators, diathermy applicators, batteries, ultra-sonic transducer (when improper use or its fall is proved), equipment cabinet.

6) No sales point has authorization to alter the conditions here mentioned, or to take any commitment in the name of IBRAMED.

Aparelho:

Número de série:

Registro Anvisa (MS) :

Data de fabricação :

Prazo de validade : 5 anos

Engenheiro responsável : Alexandre Pio Gon

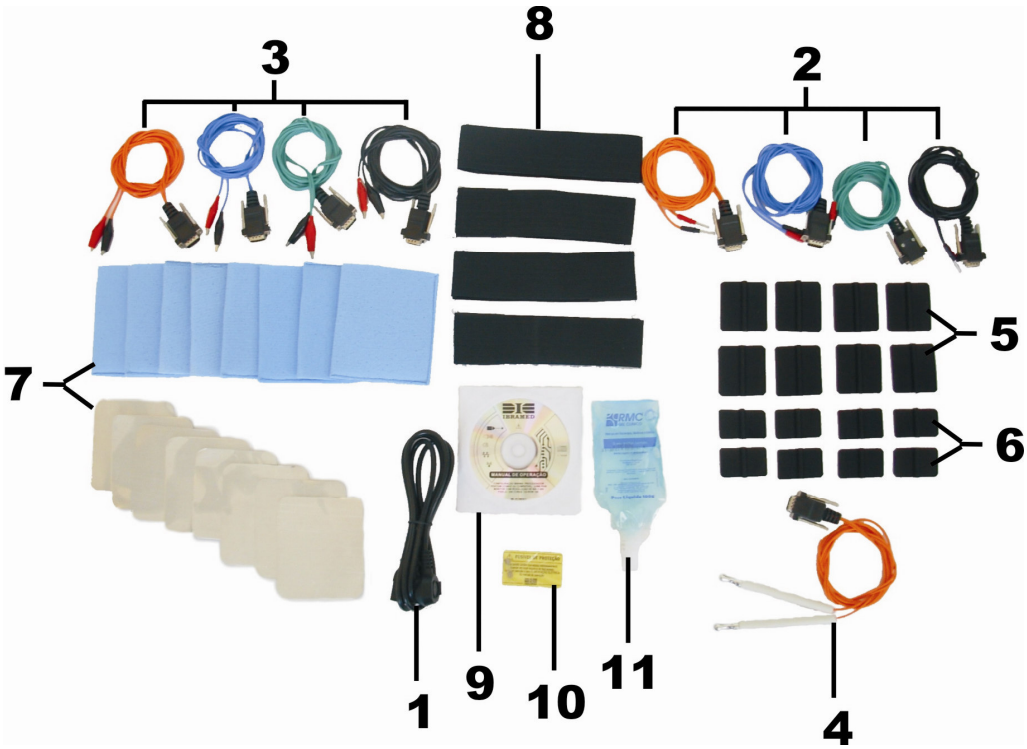
CREA - 0685098583

Accessories included with Neurodyn V2.0 :

The accessories, electrodes or cables used with the equipment are in comformity with the prescription of electromagnetic compatibility for emissions and immunity.

The use of accessories, cables and electrodes different than those for which the equipment was projected may significantly degrade the performance of the emissions and immunity.

List of accessories, electrodes, cables and their accessories, included with the Neurodyn V2.0 for covering the electromagnetic compatibility requirements:



1) 01 dettachable power cable – Code C-008 (Lenght 1.5 meters).
2) 04 cables (each with 2 threads and banana clips on the ends) for connection to the patient (channel 1– orange, channel 2 – black, channel 3 – blue and channel 4 – green) – Codes K-694 and K-694 and K-699 (length 1.5 meters each).
3) 04 cables (each with 2 threads and banana clips on the ends) for connection to the patient (channel 1– orange, channel 2 – black, channel 3 – blue and channel 4 – green) – Codes K-695 and K-697 and K-700 (length 1.5 meters each).
4) 01 cable (with 2 threads and banana clips on the ends) for connection to the patient (channel 1 – orange) - Code 701 (length 1.5 meters each)

List of the remaining accessories which did not affect the requirements of electromagnetic compatibility:

5) 04 50 x 50 mm silicone rubber electrode pairs – Code E-116
6) 04 30 x 50 mm silicone rubber electrode pairs – Code E-115
7) 04 pairs of vegetable sponge aluminum electrodes of 80 x 100 mm - Code E-047 and P-060
8) 04 elastic tape with Velcro – Code C-040
9) 01 CD operation manual – Code M-124
10) 01 5A spare protection fuse – Code F-019
11) 01 Gel tube (100g) Anvisa registry n°80122200001 (manufacturer RCM clinical gel) – Code B-013

The use of accessories, cables and electrodes different than those for which the equipment was projected may significantly degrade the performance of the emissions and immunity. *Thus, DO NOT USE accessories, cables and electrodes from Neurodyn V2.0 equipment in other equipment or medical electro systems.*

The accessories, electrodes and cables described in this manual of operation are provided and manufactured by IBRAMED to be used only with the Neurodyn V2.0.

Remember:

The use of cables, transducers and other accessories different from those specified on this page, may result in the increase of emissions and in the decrease of the Neurodyn V2.0 immunity.

NEURODYN V2.0 - Technical Characteristics

NEURODYN V2.0 is equipment designed for *continuous operation mode.* It uses a technology which guarantees the precision of the values displayed. This exactitude of the operation data is in accordance with what is prescribed by the particular standard for the safety of neuromuscular stimulation equipment – NBR IEC 60601-2-10, clause 50 / sub-clauses 50.1 and 50.2. The output amplitude control continuously controls the current intensity from the minimum to the maximum and its minimum value does not exceed 2% of the value in the maximum position. The parameters, such as, format of output wave, pulse duration, pulse repetition frequency, out current amplitude range do not differ more than 30% mentioned in the technical description below.

The values covering the *pulse duration and pulse repetition frequencies* herein described were measured at 50% of the output maximum amplitude.

These parameters are valid for charge impedance in the range of 820 ohms to 1200 ohms. The effect of the charge impedance in the described parameters is very important. If the equipment is operated outside the impedance range of the specific charge

the values of the parameters could be innaccurate, as well as the alteration in the wavelengths described here.

Neurodyn V2.0 is a CLASS II monophasic equipment with BF applied part of safety and protection.

AC input.....100 / 240volts 50/60 Hz

Input power - Consumption (max.):…….....85 VA
EQUIPMENT: CLASS II with BF applied part of safety and protection.

Output channels:---------- ----------4 independent channels in amplitude

Intensity of the maximum current per channel with a resistive charge of 1000 ohms):

TENS (R=250Hz e T=500uS):----------1 to 120 mA (end to end)
FES (R=250Hz and T=500uS):----------1 to 120 mA (end to end)
RUSSIAN (Burst Frequency=50Hz and Burst Duration=50%-- 1 to 120mA (end to end)
AUSSIE (Burst Duration=4mS, Burst Frequency=120Hz and Carrier=4KHz)----------
1 to 120mA (end to end)
INTERFERENTIAL (Carrier=4KHz and AMF=100Hz):----------
1 to 120mA (end to end)
POLARIZED ----------1 to 30 mA (end)
MICRO CURRENT (R=500Hz)-----0,01 to 0,99 mA (10 uA to 990 uA end to end)

Pulse Form:

TENS: Symetrical biphasic square wave without CC component
FES: symetrical biphasic square wave without CC component
RUSSIAN: symetrical biphasic sinusoidal wave modulated in bursts without the CC component
AUSSIE: symetrical biphasic sinusoidal wave modulated in bursts without the CC component
INTERFERENTIAL: symetrical biphasic square wave without CC component
POLARIZED: monophasic sinusoidal wave
MICRO CURRENT: Monophasic sinusoidal wave with inversion of positive and negative polarity every 3 seconds.

Pulse Repetition Frequency Range (R) at 50% of maximum amplitude:

TENS: variable from 0.5 Hz to 250 Hz (“steps” of 1Hz”)

Pulse Train Modulation – BURST (only for TENS): 7 pulses corresponding to on cycle of 28 ms and off cycle of 472 ms (2Hz).
FES: variable from 0.5 Hz to 250 Hz (“steps” of 1Hz”)

MICRO CURRENT: Variable from 1 Hz to 500 Hz (1 to 10 Hz “steps”from 1 Hz and 10 Hz to 500 Hz “steps from 10 Hz”)

MAF – Treatment Range Frequency (INTERFERENTIAL):
variable from 1 Hz to 100Hz (“*step*s of 100Hz)

Sweep (MAF) – *Sweep Frequency Range (INTERFERENTIAL)*
variable from 1 to 100 Hz (steps of 1 Hz)

Automatic Vector (INTERFERENTIAL):
Channel 1 and 3: amplitude of the current set at 100% the selected intensity
Channel 2 and 4: amplitude of the current automatically variable from 50% to 100% the selected intensity

Duration of the Pulse (T) at 50% the maximum amplitude:

TENS: variable from 50 useg to 500 useg (“steps" of 25 useg)
FES: variable from 50 useg to 500 useg (“steps" of 25 useg)

Carrier frequency:

RUSSIAN: average carrier frequency set at 2,500 Hz
AUSSIE: average carrier frequency of 1,000 Hz or 4,000 Hz
INTERFERENTIAL: average carrier frequency of 2,000 Hz, 4,000 Hz or 8,000 Hz, where

channel 1 and 3 – set at 2,000 Hz, 4,000 Hz or 8,000 Hz
channel 2 and 4 – variable from 2,001 Hz, 4,001 to 4,100 Hz or 8001 Hz to 8,100 Hz

POLARIZED: medium frequency of 15,000 Hz.
MICROCURRENT: medium frequency of 15,000 Hz.

Duration of Bursts:
RUSSIAN: Variable from 10%, 30% or 50%, namely:
10%= 2 milliseconds On and 18 milliseconds Off.
30%= 6 milliseconds On and 14 milliseconds Off.
50%= 10 milliseconds On and 10 milliseconds Off.
AUSSIE: 2ms or 4 ms

Burst Frequency:

RUSSIAN: low frequency in the range from 1Hz to 100 Hz (“steps” of 1Hz)
AUSSIE: low frequency in the range from 1Hz to 120 Hz (“steps” of 1Hz)

Application Time (Timer): Variable from 1 to 60 minutes (20 minute “default”)

ON time:----------variable from 1 to 60 seconds

OFF time:----------variable from 1 to 60 seconds

RISE – pulse train increase time : variable from 1 to 9 seconds.

DECAY ---------- pulse train increase time : variable from 1 to 9 seconds.

Dimensions .(mm)----------375 x 315 x 125 (W x D x H)

Weight (approx. without accessories):----------2.2 kg

Maximum stacking number:……..... . . . .……..5 boxes

Temperature for transport and stacking:----------5^{0}C a 50^{0}C

Room Temperature for work:----------5^{0} to 45^{0}C

Abbreviations of measurement units used in the cabinet of the equipment and in this instruction manual.

mA = milliamperes

Hz = Hertz

KHz = kiloHertz (Hz x 1,000)

mseg = **mS** = miliseconds

microseg = us = microseconds

min. = minute

s = seconds

VA = volt amperes

Nota: O aparelho e suas características poderão sofrer alterações sem prévio aviso.

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Electromagnetic Compatibility:

Neurodyn V2.0 was designed to comply with the requirements determined by norm IEC 60601-1-2 of electromagnetic compatibility. The objective of this norm is:
- to guarantee that the level of the spurious signals generated by the equipment and irradiated to the environment are below the limits specified in the norm IEC CISPR 11, group 1, class A (radiated emission).

- to guarantee the immunity of the equipment to electrostatic discharges, by either contact or air, stemming from the accumulation of electrical static discharges acquired by the body (Electrostatic Discharge - IEC 61000-4-2).

- to guarantee the immunity of the equipment when submitted to an electromagnetic field inciding from external (Immunity to Irradiated RF - IEC 61000-4-3).

Precautions:

- The operation at a short distance (1 meter, for example) of a short wave or microwave equipment can produce instability in the output of the equipment.

- In order to prevent electromagnetic interference, we suggest that one group of power supply line is used for NEURODYN V2.0 and another separate group for the short wave and microwave equipment. We also suggest that the patient, NEURODYN V2.0 and the connection cables are placed at least at a distance of 3 meters away from the shortwave or microwave therapy equipment

- Radiofrequency communication equipment, mobile phones may cause interference and affect the performance of Neurodyn V2.0. Always install this equipment according to what is described in this instruction manual.

Attention:

- NEURODYN V2.0 complies with all the technical regulations of electromagnetic compatibility if the cables, electrodes and other accessories supplied by IBRAMED and described in this manual are used. (chapter: Accessories and technical characteristics).

- The use of cables, electrodes and other accessories from other manufacturers and/or different from those specified in this manual are used, as well as the substitution of internal components of NEURODYN V2.0 this can result in increase of emissions or decrease in the equipment immunity

- NEURODYN V2.0 must not be used adjacently or stacked on top of other pieces of equipment.

Directions and Manufacturer's Statement – electromagnetic emissions		
Neurodyn V2.0 electro-stimulator is destined for use in the electromagnetic environment specified below. The user of the equipment must ensure that it is used in such an environment.		
Emission Essay	**Compliance**	**Electromagnetic Environment - directions**
RF Emissions NBR IEC CISPR 11 IEC CISPR 11	Group 1	Neurodyn V2.0 electro-stimulator uses RF energy only for its internal functions. However, its RF emissions are very low and unlikely to cause any interference in nearby electronic equipment
RF Emissions NBR IEC CISPR 11 IEC CISPR 11	Class A	Neurodyn V2.0 electro-stimulator is adequate for use in all premises which are not residential and not directly connected to the public low tension electric power distribution line which supplies buildings appropriate for domestic use
Harmonics Emission IEC 61000-3-2	Class A	
Emissions due to tension fluctuation/scintillation IEC 61000-3-3	Class A	

Directions and Manufacturer's Statement - electromagnetic immunity			
Neurodyn V2.0 electro-stimulator is destined for use in the electromagnetic environment specified below. The user of the equipment must ensure that it is used in such an environment.			
Immunity Trial	**Level of the trial IEC 60601**	**Level of Comformity**	**Electromagnetic Environment - directions**
Electrostatic Discharge (ESD) IEC 61000-4-2	± 6 kV per contact ± 8 kV by air	± 6 kV per contact ± 8 kV by air	The flooring must be either wooden, concrete or ceramic. If the flooring is covered with synthetic material, the humidity must be of least 30%.
Rapid electric transitory / train pulse (Burst) IEC 61000-4-4	± 2 kV in the Power lines ± 1 kV in the input /output lines	± 2 kV in the Power lines ± 1 kV in the input /output lines	The quality of the power supply should be equivalent to the one of a hospital or a typically commercial establishment.
Surges IEC 61000-4-5	± 1 kV differential mode ± 2 kV regular mode	± 1 kV differential mode ± 2 kV regular mode	The quality of the power supply should be equivalent to the one of a hospital or a typically commercial establishment.

Immunity Trial	Level of the trial IEC 60601	Level of Comformity	Electromagnetic Environment - directions
Voltage falls, short interruptions and voltage variations in the input power lines IEC 61000-4-11	< 5% U_T (> 95% of tension fall in U_T) per 0.5 cycle 40% U_T (60% of tension fall in U_T) per 5 cycles 70% U_T (30% of tension fall in U_T) per 25 cycles < 5% U_T (> 95% of tension fall in U_T) per 5 seconds	< 5% U_T (> 95% of tension fall in U_T) per 0.5 cycle 40% U_T (60% of tension fall in U_T) per 5 cycles 70% U_T (30% of tension fall in U_T) per 25 cycles < 5% U_T (> 95% of tension fall in U_T) per 5 seconds	The quality of the power supply should be equivalent to the one of a hospital or a typically commercial establishment. If the user of the equipment requires continuous operation during energy interruption, it is recommended that the equipment should be fed by a source of uninterrupted power supply or a battery.
Magnetic Field in the frequency of Power feed (50/60 Hz) IEC 61000-4-8	3 A/m	3 A/m	Magnetic fields in th frequency of powe supply must be on th same level characteristic of hospital environment o a typically commercia establishment.
NOTE: U_T is the power AC voltage before the application of the trial level.			

Directions and Manufacturer's Statement - electromagnetic immunity			
Neurodyn V2.0 electro-stimulator is destined for use in the electromagnetic environment specified below. The user of the equipment must ensure that it is used in such an environment.			
Immunity Trial	**Level of the trial IEC 60601**	**Level of Comformity**	**Electromagnetic Environment - directions**
RF Conducted IEC 61000-4-6 RF Radiated IEC 61000-4-3	3 Vrms 150 kHz to 80 MHz 10 V/m 80 MHz to 2.5 GHz	3 V 10 V/m	RF Communication equipment, portable or mobile, must not be used next to any part of Neurodyn V2.0 , including cables, with a separation distance of less than the recommended, calculated from the equation applicable to the frequency of the transmitter. Separation distance recommended $d = 1.2\sqrt{P}$ $d = 0.35\sqrt{P}$ 80 MHz up to 800 MHz $d = 0.7\sqrt{P}$ 800 MHz up to 2.5 GHz Where P is the maximum output nominal potency of the transmitter in watts (W) according to the manufacturer of the equipment, and d is the separation distance recommended in meters (m). It is also recommended that the Field intensity established by the RF transmitter, as determined by an electromagnetic inspection at the site[a] should be lower than the conformity in each frequency band[b]. Interference around the equipment marked with the following symbol might occur: 
NOTE 1: In 80 MHz and 800 MHz highest frequency band is applied. NOTE 2: These directions may not be applicable in all situations. The electromagnetic propagation is affected by the absorption and reflection of structures, objects and people.			
[a] The Field intensities established by the fixed transmitters, such as base radio stations, telephone (cellular/wireless) and mobile terrestrial radios, radio amateur, transmission radio AM and FM and TV transmission cannot be theoretically predicted with accuracy. To evaluate the electromagnetic environment due to fixed RF, an electromagnetic, it is recommended to check the local. If the field intensity measurement at the local where Neurodyn V2.0 is used, exceeds the level of conformity used above, the equipment must be observed in order to verify whether the operation is normal. IF an abnormal performance is observed, additional procedures may be necessary, such as reorientation or the reinstalling of the equipment. [b] Above 150 KHz to 80 MHz frequency band, the field intensity should be lower than 10 V/m.			

Recommended Separation Distances between portable and mobile RF and Neurodyn V2.0

The Neurodyn V2.0 electro-stimulator is conceived to be used in electromagnetic environments in which RF disturbances are controlled. The user may help to prevent electromagnetic interferences by keeping a minimum distance between the portable and mobile RF communication equipment (transmitters) and Neurodyn V2.0, as recommended below, according to the maximum potency of the communication equipment.

Maximum Nominal Output potency of the transmitter W	**Distance of Separation in accordance with the frequency of the transmitter M**		
	150 KHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 0.35\sqrt{P}$	800 MHz to 2.5 GHz $d = 0.7\sqrt{P}$
0.01	0.12	0.035	0.07
0.1	0.38	0.11	0.22
1	1.2	0.35	0.7
10	3.8	1.1	2.2
100	12	3,5	7

For transmitters with a maximum nominal output potency not listed above, the separation distance recommended in meters (m) may be determined by an equation applicable to the frequency of the transmitter, where P is the maximum nominal output potency in watts (W) according to the manufacturer of the transmitter.
NOTE 1: From 80 MHz to 800 MHz, the distance of separation relative to the highest frequency band is applied.
NOTE 2: These directions may not be applicable in all situations. The electromagnetic propagation is affected by the absorption and reflection of structures, objects and people.