

# INSTRUCTION MANUAL

FOR THE  
EV-503D SD T.E.N.S.  
WITH TIMER



Distributed by:

CE 0197

EVERYWAY

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## **Chapter 1: INTRODUCTION**

### **EXPLANATION OF PAIN**

Pain is a warning system and the body's method of telling us that something is wrong. Pain is important; without it abnormal conditions may go undetected, causing damage or injury to vital parts of our bodies.

Even though pain is a necessary warning signal of trauma or malfunction in the body, nature may have gone too far in its design. Aside from its value in diagnosis, long-lasting persistent pain serves no useful purpose. Pain does not begin until a coded message travels to the brain where it is decoded, analyzed, and then reacted to. The pain message travels from the injured area along the small nerves leading to the spinal cord. Here the message is switched to different nerves that travel up the spinal cord to the brain. The pain message is then interpreted, referred back and the pain is felt.

### **EXPLANATION OF TENS**

Transcutaneous Electrical Nerve Stimulation is a non-invasive, drug-free method of controlling pain. TENS uses tiny electrical impulses sent through the skin to nerves to modify your pain perception. TENS does not cure any physiological problem; it only helps control the pain. TENS does not work for everyone; however, in most patients it is effective in reducing or eliminating the pain, allowing for a return to normal activity.

### **HOW TENS WORKS**

There is nothing "magic" about Transcutaneous Electrical Nerve Stimulation (TENS). TENS is intended to be used to relieve pain. The TENS unit sends comfortable impulses through the skin that stimulate the nerve (or nerves) in the treatment area. In many cases, this stimulation will greatly reduce or eliminate the pain sensation the patient feels. Pain relief varies by individual

patient, mode selected for therapy, and the type of pain. In many patients, the reduction or elimination of pain lasts longer than the actual period of stimulation (sometimes as much as three to four times longer). In others, pain is only modified while stimulation actually occurs. You may discuss this with your physician or therapist.

## **Chapter 2: CAUTIONS**

1. Read operation manual before use of TENS.
2. We emphasize that patient with an implanted electronic device (for example, a pacemaker) should not undergo TENS treatment without first consulting a doctor. The same applies to patients with any metallic implants.
3. If TENS therapy becomes ineffective or unpleasant, stimulation should be discontinued until its use is reevaluated by the physician or therapist.
4. Avoid adjusting controls while operating machinery or vehicles.
5. Turn the T.E.N.S. off before applying or removing electrodes.
6. Everyway T.E.N.S. devices have no AP/APG protection.  
Do not use it in the presence of explosive atmosphere and flammable mixture.

## **Chapter 3 : WARNINGS**

1. Caution should be used in applying TENS to patients suspected of having heart disease. Further clinical data is needed to show there are no adverse results.
2. Electrical stimulation safety has not been established during pregnancy.  
Do not use TENS during pregnancy.

3. Do not place electrodes on the front of the throat as spasm of the Laryngeal and Pharyngeal muscle may occur. Do not stimulate over the carotid nerve, particularly with patients with known sinus reflex sensitivity.
4. Care should be taken so that when operating potentially dangerous machinery the stimulator controls are not changed abruptly.
5. Cases of skin irritation at the electrode site have been reported. Stimulation should be stopped and electrodes removed until the cause of the irritation can be determined.
6. Electrodes should not be placed over the eyes, in the mouth, or internally.
7. Keep this device out of the reach of children.

#### Chapter 4 : GENERAL DESCRIPTION

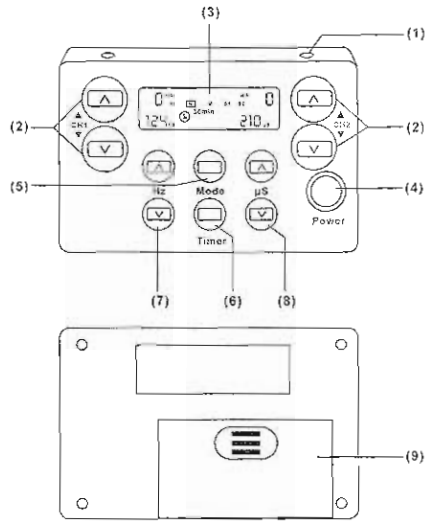
The EV-503D SD TENS is a battery operated pulse generator that sends electrical impulses electrodes to the body and reach the nerves causing pain. The device is provided with two controllable output channels, each independent of each other. An electrode pair can be connected to each output channel. The electronics of the device creates electrical impulses whose Intensity, duration, number per second and modulation may be altered with the controls. Press buttons are very easy to use and the large liquid crystal display showing the exact mode and values of parameters are very convenient for patients.

#### Chapter 5 : TECHNICAL SPECIFICATIONS

The technical specification details of EV-503D SD TENS are as follows

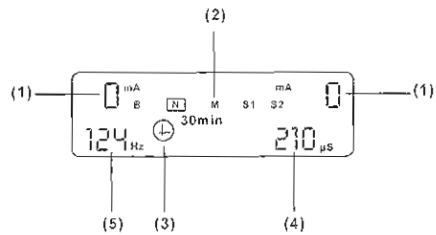
	MECHANISM	TECHICAL DESCRIPTION
01.	Channel	Dual, isolated between channels
02.	Pulse Amplitude	Adjustable, 0-80mA 1mA each step. Max output 80mA(peak to peak) into 500ohm load each channel.
03.	Voltage	Adjustable, 0-40V Max output 40V(peak to peak ) into 500ohm load each channel.
04.	Wave Form	Asymmetrical rectangular biphasic pulse.
05.	Power Supply	One 9 Volt Battery, type 6F22
06.	Size	6.0cm(L) x 9.3cm(W) x 2.5cm(H)
07.	Weight	110grams (battery included)
08.	Pulse Rate	Adjustable, 1~150 Hz , 1Hz / step
09.	Pulse Width	Adjustable, 30~300 $\mu$ S , 10 $\mu$ s / step
10.	Burst Mode	Burst rate adjustable, 0.5~5 Hz Pulse width adjustable, 30~300 $\mu$ S Frequency fixed = 100 Hz *
11.	M (Pulse Rate Modulation)	Pulse rate is automatically varied in a cyclic pattern over an interval of nominally 10 seconds. (in max 150Hz) Pulse rate decreases linearly over a period of 5 seconds from the control setting value to a value which is 40% less. Then increase linearly over a 5 seconds period to its original value. The cycle is then repeated.
12.	S1 (Pulse Width Modulation)	Pulse width is automatically varied in a cyclic pattern over an interval of nominally 10 seconds. (in max 300 $\mu$ S) Pulse width decreases linearly over a period of 5 seconds from the control setting value to a value which is 40% less. Then increase linearly over a 5 seconds period to its original value. The cycle is then repeated.
13.	S2. (Pulse Width Modulation)	Pulse width is automatically varied in a cyclic pattern over an interval of nominally 10 seconds.( in max 300 $\mu$ S) Pulse width decreases linearly over a period of 5 seconds from the control setting value to a value which is 70% less. Then increase linearly over a 5 seconds period to its original value. The cycle is then repeated.
14.	Timer	30, 60 minutes and continue.
15.	Operating Condition	Temperature:0 $^{\circ}$ ~40 $^{\circ}$ C Relative Humidity:30%~75% Atmosphere Pressure : 700Hpa~1060Hpa
16.	Remark	There may be up to a +/-5 tolerance of pulse width and pulse rate and +/- 20% tolerance of amplitude & voltage.

## Chapter 6 : CONSTRUCTION



- (1) LEAD CONNECTOR
- (2) AMPLITUDE CONTROL
- (3) LCD
- (4) POWER (ON/OFF)
- (5) MODE SELECTOR
- (6) TIMER CONTROL
- (7) PULSE RATE CONTROL
- (8) PULSE WIDTH CONTROL
- (9) BATTERY CASE

### LIQUID CRYSTAL DISPLAY

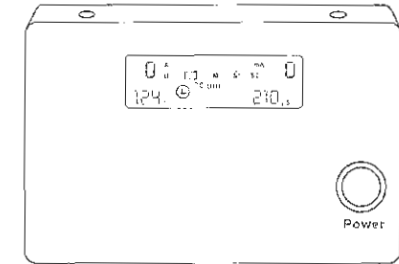


- (1) AMPLITUDE
- (2) MODE
- (3) TIMER
- (4) PULSE WIDTH
- (5) PULSE RATE

## Chapter 7: ADJUSTING THE CONTROLS

### 1. Power ON/OFF

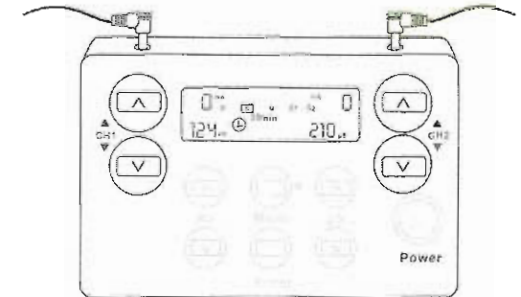
Press "Power Control" to activate the device. The LCD will show the modes, pulse rate, pulse width, amplitude value and the pre-setting time. Press the button again and its power will be shut off. The amplitude value is always at "0mA" when it is turned on.



### 2. Amplitude Control

The amplitude value of output current shows on the side of liquid crystal display.

When it reads "0mA", there is no output. You may start to adjust the amplitude level when the lead wires are connected and electrodes are applied to the skin properly.



a. Increase

By pressing the amplitude increase control, the amplitude level of the appropriate channel is increased by 1mA each step from 0mA up to 80mA.

b. Decrease

To reduce the current strength, press the amplitude decrease control to the required setting respectively. The amplitude is decreased by steps of 1mA.

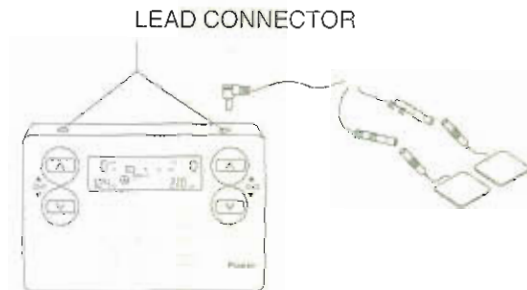
Special Note:

1. The device offers electrodes detection function. The amplitude can not be adjusted when the lead wire & electrodes are not connected.
2. If the electrodes or plug are dropped during the treatment, the output will be terminated immediately and the LCD reads "0mA".

### 3. Lead Connector

Connection of the electrodes is made with two lead connector and lead wires.

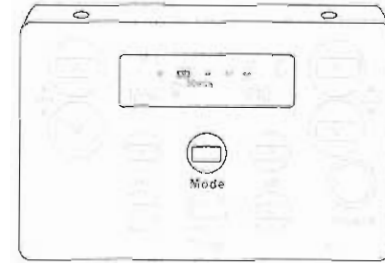
The device must be turned off before connecting the cables. Electrodes must be pressed firmly on the skin. There will be no output before this step is completed.



### 4. Mode Control

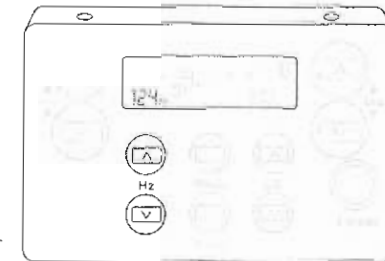
There are 5 modes of options, B for burst stimulation, N for constant stimulation, M for pulse rate modulation(-40%) stimulation, S1 for pulse

width modulation(-40%), S2 for pulse width modulation(-70%). A mode can be selected by pressing the "Mode Control".



### 5. Pulse Rate Control

Pulse rate is adjustable from 2Hz to 150 Hz . Its value is visible on the LCD. This buttons determine how many electrical impulses are applied through the skin each second. By pressing these controls, the number of current impulses per second(Hz) for both channels can be continually adjusted in steps of 1Hz. Unless otherwise instructed, turn the pulse rate control to the 70-120 Hz range.



a. Increase

When pressing this button, the pulse rate will increase linearly.

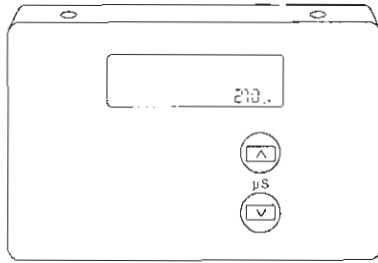
b. Decrease


When pressing this button, the pulse rate will decrease linearly.

### 6. Pulse Width Control


Pulse Width is adjustable from 30 uS to 260 uS. Its value is visible on the LCD.

These buttons adjust the length of time each electrical signal is applied through the skin, which controls the strength and sensation of the stimulation. By pressing the controls, the pulse width can be adjusted in steps of 10 $\mu$ S. If no instructions regarding the pulse width are given in therapy, set the control to the suggested 70-120 $\mu$ S setting.



a. Increase 

When pressing this button, the pulse width will increase gradually.

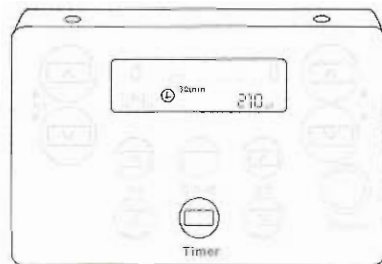
b. Decrease 

When pressing this button, the pulse rate will decrease gradually.

#### 6. Timer

Treatment time of TENS can be preset with Timer Control.

A timer of 30, 60 minutes and Continue is selectable by pressing the "Timer Control".

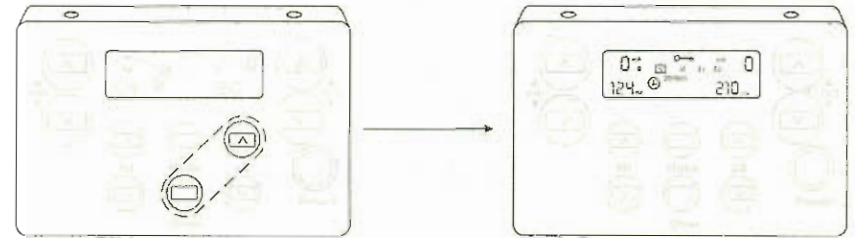


The device will store the mode that is used before it is switched off automatically.

#### 7. Lock a Program

Press pulse width increase button first, then press the timer control (do not release the first button), the program can be locked. Only amplitude is adjustable when a program is locked.

Repeat the same procedure if you want to re-set a program.



#### 8. Check / Replace the Battery:

Over time, in order to ensure the functional safety of TENS, changing the battery is necessary.

1. Make sure that power is turned off.
2. Slide the battery compartment cover and open.
3. Remove the battery from the compartment.
4. Insert the battery into the compartment. Note the polarity indicated on the battery and in the compartment.
5. Replace the battery compartment cover and press to close.

### **Chapter 8: REPLACABLE PARTS**

The replaceable parts and accessories of EV-503D SD T.E.N.S. devices are as given below –

Except leads, electrodes and battery, battery case cover, please do not try to replace the other parts of a device.

PARTS	
01	ELECTRODES LEADS
02	ELECTRODES
03	9V BATTERY, TYPE 6F22
04	BELT CLIP
05	BATTERY CASE COVER
06	LEAD CONNECTOR
07	MAIN PCB
08	INTENSITY KNOB

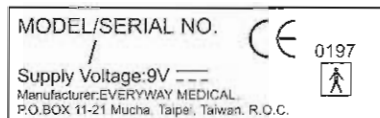
### Chapter 9: ACCESSORIES

Each set EV-503D SD TENS are completed with standard accessories and standard label as given below

#### i. Accessories

REF. NO.	DESCRIPTION	Q'TY
1.KF4040	40 X 40 MM Adhesive Electrodes	4 pieces
2.KE-24	Electrodes Leads	2 pieces
3.GC-02	Alkaline, type 6F22	1 piece
4.	Instruction Manual	1 piece
5.	Carrying Case	1 piece





#### ii. LABEL



The label attached to the back of device contains important message about this device- model, serial number, supply voltage, the name of manufacturer, CE

number and classification. Please do not remove.

### Chapter 10 : GRAPHIC SYMBOLS

-  Note Operating Instructions
-  Degree of Electrical Protection BF
-  Do not insert the plug into AC power supply socket.
-  Direct Current (DC power source)

### Chapter 11 : PARAMETER CONTROLS

#### PULSE DURATION

Wider pulse duration settings will deliver stronger stimulation for any given intensity setting. As mentioned in the Controls section, by using a combination of intensity and pulse duration, it is felt that various pulse widths are capable of stimulating different groups of nerve fibres.

The wider pulse duration is needed to recruit motor fibres, whereas the narrow pulse duration is used on the more sensory fibres.

The choice of which pulse duration to use is partially dependent upon the Treatment Mode and Protocol selected (refer to the appropriate section).

#### PULSE RATE

The Pulse Rate (hertz or pulses per second) chosen depends greatly upon the type of electrode placement given to the patient.

When using contiguous and dermatome electrode placements (i.e. stimulating directly through the area of pain or localized enervation), a quick pulse rate (setting greater than 80Hz on the Pulse Rate Control) is desired. The patient should not perceive individual pulses but rather have the sensation of steady continuous stimulation.

When using point treatments, it has been suggested that slow pulses be utilized (less than 10Hz). With this setting the patient should be able to slightly

perceive individual pulses.

When using multiple electrode placement strategies, such as combinations of point and contiguous electrode placements, the quicker pulse rates are suggested.

Despite above recommendations, these individual patients may require slight variations of the above settings, according to the nature of their condition.

### TREATMENTMODE

Normal or Conventional TENS offers the practitioners complete control over all the various treatment parameters of the instrument.

Burst Mode is analogous to the Low Rate TENS technique except the low frequency individual pulses are replaced by individual "bursts" of 7-10 individual pulses. It is thus a combination of Conventional TENS and Low Rate TENS. In Burst Mode, the treatment frequency is fixed by the instrument and is not adjustable with the Frequency Rate control.

Modulated Mode attempts to prevent nerve accommodation by continuously cycling the treatment intensity. When using Modulated Mode increase the intensity only when the unit is at the maximum intensity of the modulation cycle. If the intensity is increased during a low intensity period of the cycle, the patient may turn up the control very slowly, so that they may feel the intensity any higher.

### INTENSITY

Each patient responds differently to different levels of intensity, due to varying degrees of tissue resistance, enervation, skin thickness, etc. Intensity instructions are therefore limited to the following settings:

Perception – The intensity is increased so that the patient can feel the stimulation, but there is not any muscular contraction.

Slight Contraction – Intensity is increased to a barely visible muscular contraction that is not strong enough to move a joint. When using low pulse rate settings, this will show as individual twitches. At higher pulse rates there will simply be increased muscle tension.

Strong muscular contraction is typically not used in TENS therapy. However,

muscular contraction may be useful if the pain involves a cramped or spastic muscle. The TENS can be used as a traditional muscle stimulator in the circumstances to quickly break the spasm. Use a quick pulse rate, wide pulse duration and set the intensity to visible contraction (still within patient tolerance). Twenty or thirty minutes of such a tetanized muscular contraction will generally break the spasm. In all cases, if the patient complains that the stimulation is uncomfortable, reduce intensity and/or cease stimulation.

### TIME DURATION

The onset of pain relief should occur shortly after the intensity setting has been determined. However, in some cases, pain relief may take as long as 30 minutes to achieve, especially when using point electrode placements and slow pulse rates.

TENS units are typically operated for long periods of time, with a minimum of 20 – 30 minutes and in some post-operation protocols, as long as 36 hours. In general, pain relief will diminish within 30 minutes of the cessation of stimulation. Pain relief obtained through point electrode placements may last longer (perhaps because of the presence of endorphins).

## Chapter 12 : ATTACHMENT OF ELECTRODE LEAD WIRES

The wires provided with the system insert into the jack sockets located on top of the device. Holding the insulated portion of the connector, push the plug end of the wire into one of the jacks (see drawing); one or two sets of wires may be used.

After connecting the wires to the stimulator, attach each wire to an electrode. Use care when you plug and unplug the wires. Jerking the wire instead of holding the insulated connector body may cause wire breakage.

### CAUTION

Do not insert the plug of the patient lead wire into the AC power supply socket.

## Chapter 13: LEAD WIRE MAINTENANCE

Clean the wires by wiping with a damp cloth. Coating them lightly with talcum powder will reduce tangling and prolong life.

## Chapter 14 : ELECTRODE OPTIONS

Your clinician will decide which type of electrode is best for your condition. Follow application procedures outlined in electrode packing, to maintain stimulation and prevent skin irritation. Use of CE marked Adhesive Electrodes is recommended.

## Chapter 15 : ELECTRODE PLACEMENT

The placement of electrodes can be one of the most important parameters in achieving success with TENS therapy. Of utmost importance is the willingness of the clinician to try the various styles of electrode placement to find which method best fits the needs of the individual patient.

Every patient responds to electrical stimulation differently and their needs may vary from the conventional settings suggested here. If the initial results are not positive, feel free to experiment. Once an acceptable placement has been achieved, mark down the electrodes sites and the settings on the patient's Reference sheet of this manual, so the patient can easily continue treatment at home.

### CONTIGUOUS PLACEMENT

This is the most common placement technique. It involves placing the electrodes alongside the area of localized pain site, in such a way as to direct the flow of current through or around the area of pain.

In a single channel application, this would involve placing each pad on either side of the pain site if the pain is localized on a limb and deep within the tissue. Pad placement on the posterior and anterior aspects of the affected limb will allow the current to flow completely through the limb and thus through the endogenous pain site.

With a two channels application, the clinician may either direct the current flow to cross through the pain site or, in what is called the "bracket" method allowing the current flow on either side of the painful area, generally through the nerve branches that feed into the pain site.

### DERMATOMES, MYOTOMES AND SCLEROTOMES

These are the regions of the body enervated by one spinal nerve. Electrode placement involves both stimulating across the similarly enervated area and/or placing one electrode (or set of electrodes) at the pain site and another electrode (set) at the point where the nerve root joins the spinal cord.

### MOTOR, TRIGGER AND ACUPUNCTURE POINTS

While these points of high tissue conductivity can differ in location and in theory of use, their use as an electrode site is identical. The easiest technique involves placing one pad directly over the point and completing the circuit by placing the second pad on some area on the affected side. This second electrode site can be within a nerve zone, or a master point located between the thumb and the forefinger on the dorsal web area between the two metacarpal bones.

### MULTIPLE PLACEMENT STRATEGIES

Because the TENS has two independently operated channels, the clinician may take advantage of concurrent pad placement strategies.

For example, it is possible to use two different electrode placement strategies at the same time. One channel can be used to directly stimulate the pain site in a contiguous manner; the other channel can be placed along the involved dermatome or utilized for point therapy.

## Chapter 16 : TIPS FOR SKIN CARE

To avoid skin irritation, especially if you have sensitive skin, follow these suggestions:

1. Wash the area of skin where you will be placing the electrodes, using mild soap and water before applying electrodes, and after taking them off. Be sure to rinse soap off thoroughly and dry skin well.

2. Excess hair may be clipped with scissors; do not shave stimulation area.
3. Wipe the area with the skin preparation your clinician has recommended. Let this dry. Apply electrodes as directed.
4. Many skin problems arise from the "pulling stress" from adhesive patches that are excessively stretched across the skin during application. To prevent this, apply electrodes from centre outward; avoid stretching over the skin.
5. To minimize "pulling stress", tape extra lengths of lead wires to the skin in a loop to prevent tugging on electrodes.
6. When removing electrodes, always remove by pulling in the direction of hair growth.
7. It may be helpful to rub skin lotion on electrode placement area when not wearing electrodes.
8. Never apply electrodes over irritated or broken skin.

## **Chapter 17 : APPLICATION OF RE-USABLE SELF ADHESIVE ELECTRODES**

### **Application**

1. Clean and dry the skin at the prescribed area thoroughly with soap and water prior to application of electrodes.
2. Insert the lead wire into the pin connector on the pre-wired electrodes.
3. Remove the electrodes from the protective liner and apply the electrodes firmly to the treatment site.

### **Removal**

1. Lift at the edge of electrodes and peel; do not pull on the lead wires because it may damage the electrodes.
2. Place the electrodes on the liner and remove the lead wire by twisting and pulling at the same time.

### **Care and Storage**

1. Between uses, store the electrodes in the resealed bag in a cool dry place.
2. It may be helpful to improve repeated application by spreading a few drops of cold water over the adhesive and turn the surface up to air dry. Over Saturat

tion with water will reduce the adhesive properties.

### **Important**

1. Do not apply to broken skin.
2. The electrodes should be discarded when they are no longer adhering.
3. The electrodes are intended for single patient use only.
4. If irritation occurs, discontinue use and consult your clinician.
5. Read the instruction for use of self-adhesive electrodes before application.

## **Chapter 18 : BATTERY INFORMATION**

Everyway EV-503D TENS can be used with 6F22 rechargeable battery when necessary.

If you use rechargeable batteries, please follow the instructions.

### **RECHARGEABLE BATTERIES:**

Prior to the use of a new unit, the rechargeable battery should be charged according to the battery manufacturer's instructions. Before using the battery charger, read all instructions and cautionary markings on the battery and in this instruction manual.

After being stored for 60 days or more, the batteries may lose their charge. After long periods of storage, batteries should be charged prior to use.

### **BATTERY CHARGING**

- (1) Plug the charger into any working 110 or 220/240v mains electrical outlet. The use of any attachment not supplied with the charger may result in the risk of fire, electric shock, or injury to persons.
- (2) Follow the battery manufacturer's instructions for charging time.
- (3) After the battery manufacturer's recommended charging time has been completed, unplug the charger and remove the battery.
- (4) Batteries should always be stored in a fully charged state.

To ensure optimum battery performance, follow these guidelines:

- (a) Although overcharging the batteries for up to 24 hours will not damage

## **Chapter 20: SAFETY-TECHNICAL CONTROLS**

For safety reasons, check your Everyway EV-503D TENS each week based on the following checklist.

1. Check the device for external damage.
  - Deformation of the housing.
  - Damaged or defective output sockets.
2. Check the device for defective operating elements.
  - Legibility of inscriptions and labels.
  - Make sure the inscriptions and labels are not distorted.
3. Check the usability of accessories.
  - patient cable undamaged.
  - electrodes undamaged.

Please consult your distributor if there are any problems with device and accessories.

## **Chapter 21 : MALFUNCTIONS**

Should any malfunctions occur while using the Everyway EV-503D TENS, check

- whether the switch/control is set to the appropriate form of therapy. Adjust the control correctly.
- whether the cable is correctly connected to the device. The cables should be inserted completely into the sockets.
- whether the electrodes adhere to the skin firmly.
- whether the LCD is illuminated. If necessary, insert a new battery.
- for possible damage to the cable. Change the cable if any damage is detected.

\* If there is any other problem, please return the device to your distributor. Do not try to repair a defective device.

them, repeated overcharging may decrease useful battery life.

- (b) Always store batteries in their charged condition. After a battery has been discharged, recharge it as soon as possible. If the battery is stored more than 60 days, it may need to be recharged.
- (c) Do not short the terminals of the battery. This will cause the battery to get hot and can cause permanent damage. Avoid storing the batteries in your pocket or purse where the terminals may accidentally come into contact with coins, keys or any metal objects.

(d) WARNINGS:

1. Do not attempt to charge any other types of batteries in your charger, other than the nickel-cadmium rechargeable batteries. Other types of batteries may leak or burst.
2. Do not incinerate the rechargeable battery as it may explode!

## **Chapter 19: MAINTENANCE, TRANSPORTATION AND STORAGE OF TENS DEVICE**

1. Alcohol is suitable for cleaning the device.

Note: Do not smoke or work with open lights (for example, candles, etc.) when working with flammable liquids.

2. Stains and spots can be removed with a cleaning agent.
3. Do not submerge the device in liquids or expose it to large amounts of water.
4. Return the device to the carrying box with sponge foam to ensure that the unit is well-protected before transportation.
5. If the device is not to be used for a long period of time, remove the batteries from the battery compartment (acid may leak from used batteries and damage the device). Put the device and accessories in carrying box and keep it in cool dry place.
6. The packed TENS device should be stored and transported under the temperature range of  $-20^{\circ}\text{C} \sim +60^{\circ}\text{C}$ , relative humidity 20% ~ 95%, atmosphere pressure 500 hPa ~ 1060 hPa.

## Chapter 22 : Conformity to Safety Standards

### CONFORMITY TO MDD REQUIREMENTS

The Everyway EV-503D SD T.E.N.S. devices are in compliance with EN 60601-1:1990+A1:1993+A2:1995 safety standard.

## Chapter 23 : WARRANTY

All Everyway EV-503D TENS devices carry a warranty of one year from the date of delivery. The warranty applies to the stimulator only and covers both parts and labour relating thereto.

The warranty does not apply to damage resulting from failure to follow the operating instructions, accidents, abuse, alteration or disassembly by unauthorized personnel.

Manufacturer: Everyway Medical Instruments Co., Ltd.  
3FL., No. 5, Lane 155, Sec. 3, Peishen Rd.,  
Shen Keng Hsiang, Taipei Hsien,  
Taiwan, R.O.C.

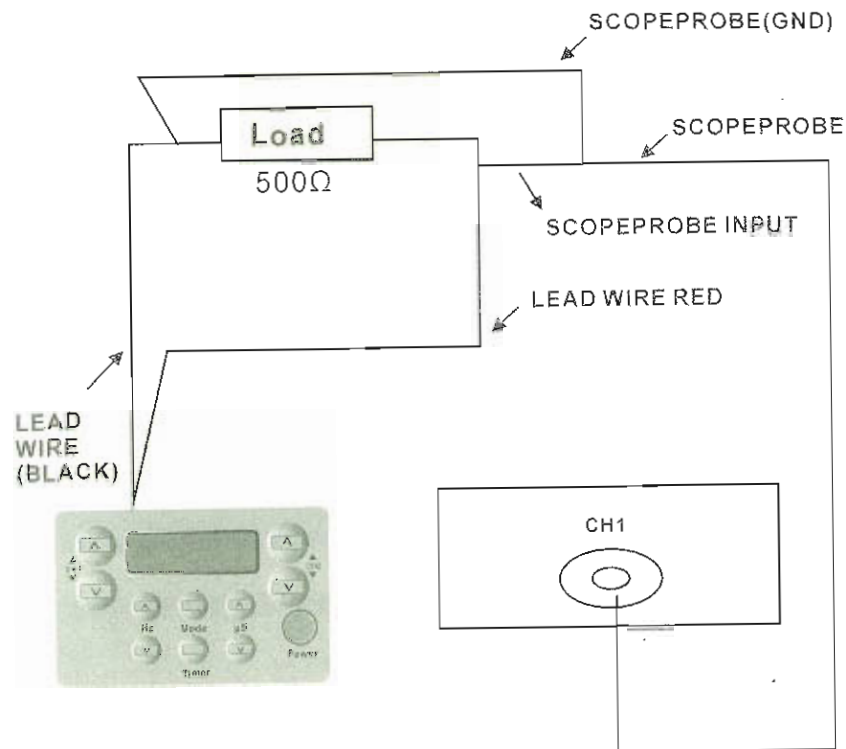
Representative in the EU:  
Physio-Med Services  
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## Appendix I : Test Environment



Oscilloscope  
Tektronix TDS 2024

## Appendix II : Waveform of EV-503D

### I. Mode: B (Burst)

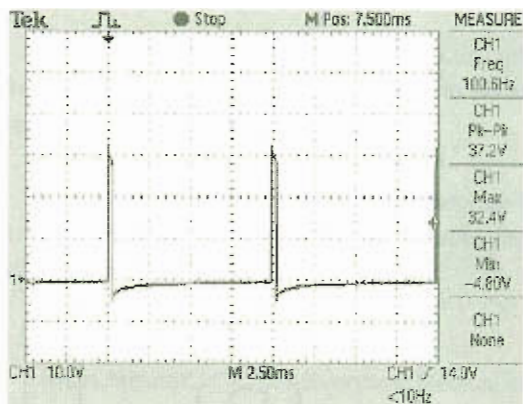
Test Equipment : Tektronic TDS2024 Oscilloscope

Load: 500 ohm

Pulse Rate: 100Hz

Pulse Width: 300 $\mu$ S

Burst Rate: 5Hz



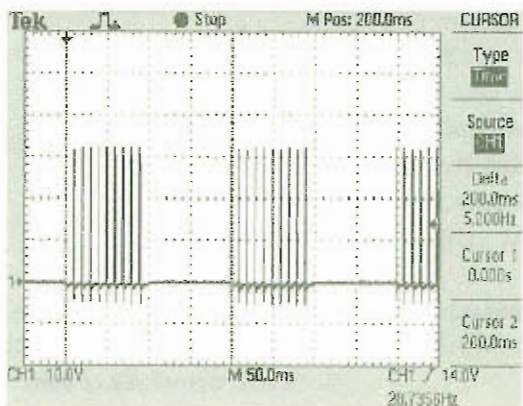
Scope A:

VERT.: 10.0V/DIV

HORIZ.: 2.5ms

OUTPUT: 37.2V pk-pk

Pulse Rate: 100.6Hz



Scope B:

VERT.: 10.0V/DIV

HORIZ.: 50ms

Burst Rate: 5Hz

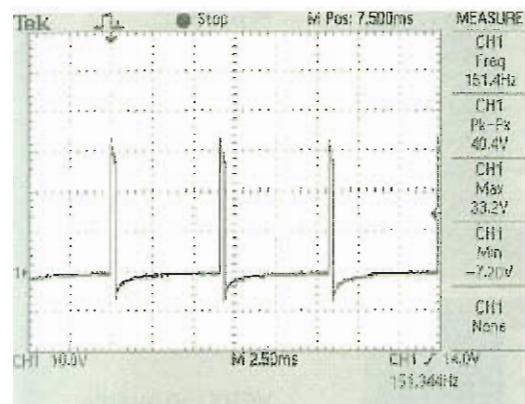
### II. Mode : N (Normal)

Test Equipment : Tektronic TDS2024 Oscilloscope

Load: 500 ohm

Pulse Rate: 150Hz

Pulse Width: 300 $\mu$ S



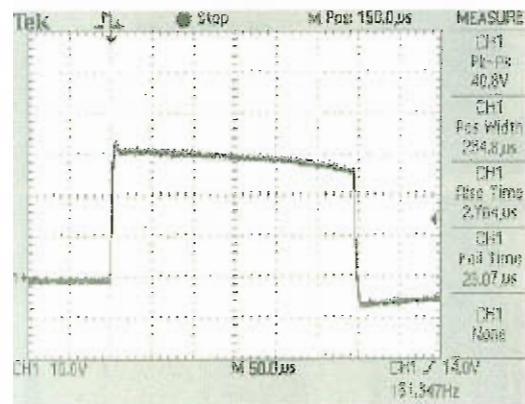
Scope A :

VERT.: 10.0V/DIV

HORIZ.: 2.5ms

OUTPUT: 40.4V pk-pk

Pulse Rate: 151.4Hz



Scope B:

VERT.: 10.0V/DIV

HORIZ.: 50 $\mu$ S

OUTPUT: 40.8V pk-pk

Pulse Width: 294.8 $\mu$ S

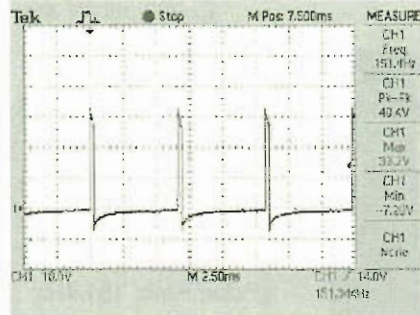
### III. Mode : M (Pulse Rate Modulation)

Test Equipment : Tektronic TDS2024 Oscilloscope

Load: 500 ohm

Pulse Rate: 150Hz

Pulse Width: 300µS



Scope A:

VERT.: 10.0V/DIV

HORIZ.: 2.5ms

OUTPUT: 40.4V pk-pk

Pulse Rate: 151.4Hz



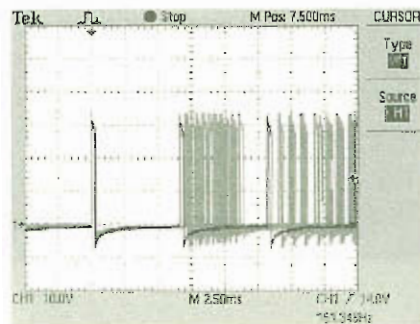
Scope B:

VERT.: 10.0V/DIV

HORIZ.: 2.5ms

OUTPUT: 38.4V pk-pk

Pulse Rate: 190.42Hz



Scope C:

Modulation : -40%

26

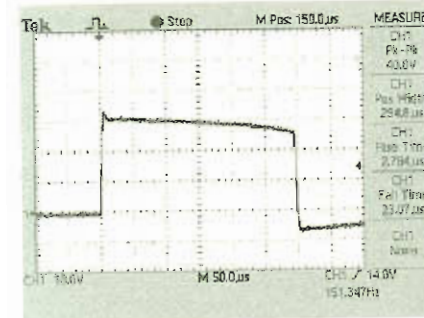
### IV. Mode: S1 (Pulse Width Modulation)

Test Equipment: Tektronic TDS2024 Oscilloscope

Load: 500 ohm

Pulse Rate: 150Hz

Pulse Width: 300µS



Scope A:

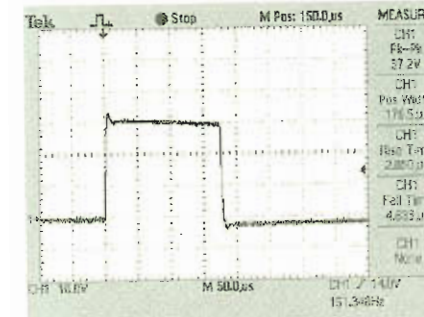
VERT.: 10.0V/DIV

HORIZ.: 50µs

OUTPUT: 40.8V pk-pk

Pulse Width: 294.8µS

Pulse Rate: 190.42Hz



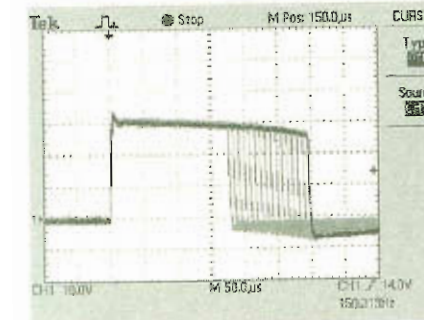
Scope B:

VERT.: 10.0V/DIV

HORIZ.: 50µs

OUTPUT: 37.2V pk-pk

Pulse Width: 176.5µS



Scope C:

Modulation: -40%

27

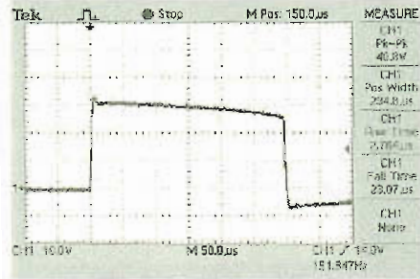
V. Mode : S2 (Pulse Width Modulation)

Test Equipment : Tektronic TDS2024 Oscilloscope

Load: 500 ohm

Pulse Rate: 150Hz

Pulse Width: 300µS



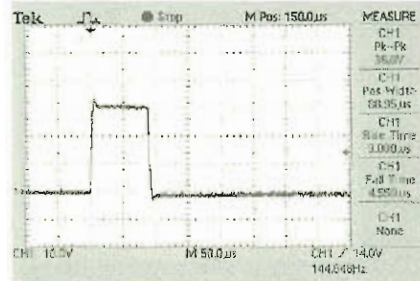
Scope A:

VERT.: 10.0V/DIV

HORIZ.: 50µs

OUTPUT: 40.8V pk-pk

Pulse Width: 294.8µs



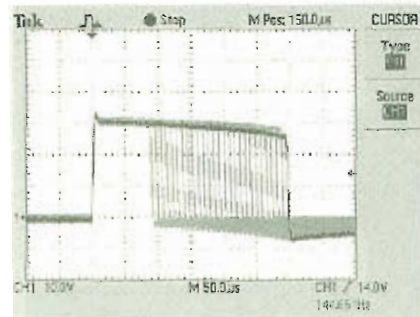
Scope B:

VERT.: 10.0V/DIV

HORIZ.: 50µs

OUTPUT: 36V pk-pk

Pulse Width: 88.95µs



Scope C:

Modulation: -70%