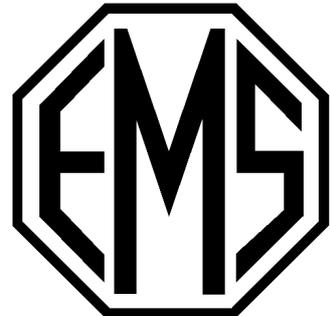


COMBINATION 850

MODEL 90

CE 0120

Electro-Medical Supplies (Greenham) Limited,
Wantage,
Oxfordshire OX12 7AD,
England.
Telephone : (01235) 772272
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General Information

This manual provides the necessary information for the installation and operation of the Combination 850 Unit.

These instructions must be studied before putting the unit into operation.

The information contained in this manual is subject to change without notice.

No part of this manual may be photocopied, reproduced or translated into another language without the prior written consent of Electro-Medical Supplies (Greenham) Ltd.

Record of Amendments

Combination 850 Model 90

ISSUE	COMMENTS	DATE
1	Initial Issue	01-06-99
2	Corrections	19-10-99

EC Declaration of Conformity

Electro-Medical Supplies (Greenham) Ltd
Limborough Road
Wantage
Oxfordshire
OX12 7AD
United Kingdom

Declares that the following medical device is in conformity with the essential requirements and provisions of Council Directive 93/42/EEC and is subject to the procedure set out in Annex 2 of Directive 93/42/EEC under the supervision of Notified Body Number 0120, SGS Yarsley International Certification Services.

Product Name Combination 850

Model Number 90

Signature

A handwritten signature in black ink, appearing to read 'D. Smith', written over a horizontal line.

Position Technical Director

Date 20 August 1999

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Warranty

This Electro-Medical Supplies (Greenham) Ltd., (hereinafter called the company) product is warranted against defects in materials and workmanship for a period of two years from the date of shipment. The Company will at its option, repair or replace components which prove to be defective during the warranty period, provided that the repairs or replacements are carried out by the Company or its approved agents.

The Company will consider itself responsible for the effects on safety, reliability and performance of the product:-

only if assembly operations, re-adjustments, modifications or repairs are carried out by persons authorised by it,

only if the product is used in accordance with the instructions for use,

only if the electrical installation of the relevant room complies with the appropriate national requirements.

Should the product be returned to the Company for repair it must be sent carriage paid.

Consumable items, for example, electrodes, electrode covers and batteries, are excluded from the above warranty.

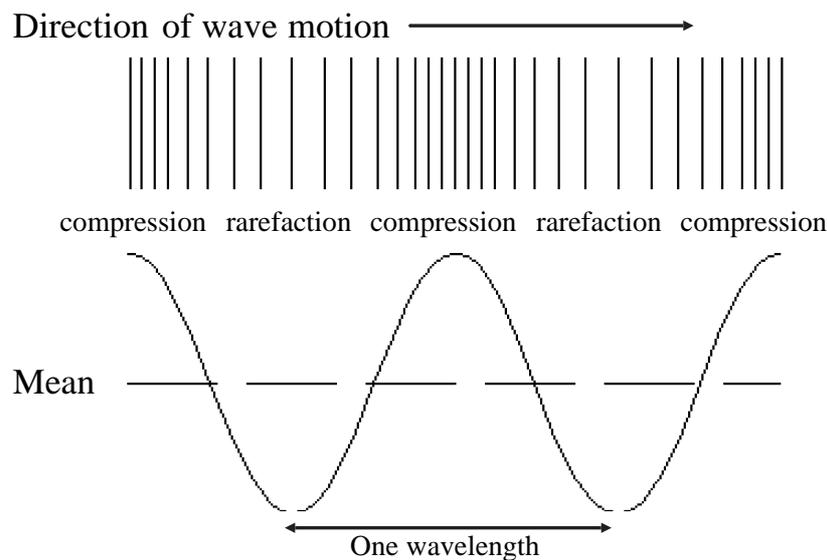
Introduction

Ultrasound

Sound is mechanical vibration. The human ear responds to these vibrations in the range 20 Hz to 20 kHz. Sound above 20 kHz is called ultrasound.

Therapeutic ultrasound is sound in the range 500 kHz to 5 MHz.

Sound waves are produced by some disturbance in a material medium causing the particles or molecules of the medium to vibrate. For this reason sound will not pass through a vacuum. If the vibration is continuous and regular a constant tone or frequency is produced. The vibration or sound wave propagates through the medium as particles in the medium pass on their vibration to neighbouring particles and series of compressions and rarefactions are produced in the direction of travel of the wave. Therefore, sound waves are longitudinal waves.



The diagram shows a sound wave travelling from left to right. The vertical bars represent thin slices of the medium which are displaced to form areas of compression and rarefaction. The sinewave represents their displacement relative to their mean position. The distance over which the vibration repeats itself is called the wavelength. The number of complete vibrations in one second is called the frequency of the sound wave. The velocity of sound in the medium is given by:

$$\text{Velocity} = \text{frequency} \times \text{wavelength}$$

Sound will travel faster through media where the molecules are closer together and so the velocity is higher in solids than in liquids, and higher in liquids than in gasses.

For example, the velocity of sound in stainless steel is approximately 5800 m/s, in water 1500 m/s and in air only 330 m/s.

As the sound wave passes through the medium, causing molecules to vibrate, some of the energy in the wave is converted from kinetic energy to heat. For a collimated sonic beam the intensity, power per unit area, therefore, decreases exponentially with the distance travelled. The attenuation of the beam is also dependent upon the frequency of the sound. In solids the attenuation is proportional to frequency whereas in liquids the attenuation is proportional to the square of the frequency.

The usual method of specifying the degree of attenuation of ultrasound in different media is by the half depth. The half depth is the distance the ultrasound must travel through the medium for its intensity to be reduced to one half of its original value. Many attempts have been made to measure the attenuation in various types of tissue with varying results. It is perhaps more important to remember which types of tissue have the highest absorption and which the lowest. With the lowest absorption first the order is, fat, muscle, skin, tendon, cartilage and bone. For soft tissue the half depth is around 50 mm at 1 MHz and 15 mm at 3 MHz.

It is also important to remember that where there is a change in medium or tissue type there will be both reflection and refraction of the ultrasound beam. In particular, there is almost 100% reflection at the interface of a solid or liquid to air at therapeutic ultrasound frequencies. Any air bubbles in coupling medium will therefore reduce the effective intensity of the ultrasound. Also bone reflects a high percentage of incident ultrasound. It is important, therefore, when applying ultrasound to keep the transducer orthogonal to the surface of the treatment area, to keep the ultrasound transducer moving and to use a good coupling medium to avoid unwanted reflections and locally high intensities.

Interferential Therapy

The Combination 850 Unit generates medium frequency currents used for 2 and 4-pole interferential therapy.

Prior to the introduction of interferential therapy in the mid 1950s, low frequency stimulation was used for pain relief, muscle re-education etc. These currents, however, have the disadvantage that normal human skin has a relatively high impedance at such frequencies. In order to overcome the skin impedance a larger voltage has to be used to achieve the desired current, resulting in a more uncomfortable treatment for the patient.

In addition, the penetration depth of these currents is poor and in part is limited by the discomfort to the patient.

Interferential therapy overcomes the problem of skin impedance. At 50 Hz (faradic current) the impedance for a 100 cm² of skin is approximately 3000 ohms. At 4000 Hz (medium frequency) the skin impedance of the same area is around 50 ohms. This means that a much lower voltage signal can be used to produce the desired current, resulting in less skin sensation and a more comfortable treatment. This medium frequency is, however, well outside of the normal biological frequency range (0.1 to 250 Hz). In order to produce the required stimulation, two medium frequencies are used. A constant frequency of, say, 4000 Hz is applied to one pair of electrodes and a slightly different frequency of say 3900 Hz is applied to the other pair. These two frequencies 'interfere' to produce an amplitude modulated medium frequency (beat frequency) in the tissue. The tissue responds to the cyclic rise and fall in the current intensity. It is the amplitude modulation frequency (AMF) that is within the normal biological frequency range and not the medium frequency (carrier).

Combination Therapy

In general terms, combination therapy involves the simultaneous application of ultrasound with an electrical stimulation therapy. In Europe, diadynamic currents are frequently used, but in the UK, ultrasound is most often combined with two-pole interferential therapy.

By combining ultrasound with interferential therapy, the advantages and effects of each treatment modality can be realised - but lower intensities are used to achieve the effect. The accommodation effects that normally accompany interferential therapy are reduced (or even eliminated).

The main advantages of such a combination are said to be:-

- in localising lesions (especially chronic) ie. diagnostic use.
- in ensuring accurate localisation of ultrasound treatment to provide increased accuracy / effectiveness in treating deeper lesions.
- in treating trigger points.

Possible Explanations

It would appear that by applying ultrasound to peripheral nerves, their threshold to stimulation is reduced, thus making them more sensitive or excitable. It is likely that this effect is brought about by the alteration of the ion pump activity, predominantly Na^+ and K^+ , but also Ca^{++} . By altering the transport of these ions across the cell membrane, the resting potential will be altered and in this case, it would seem that it results in a reduced threshold for depolarisation.

It is reasonable to expect this situation to exist in other tissues (apart from nerve) although no direct evidence has been noted to date.

When interferential therapy is applied simultaneously with ultrasound through the same tissues, a reduced intensity is required in order to achieve the same physiological / therapeutic effects when compared with interferential therapy in isolation. This can easily be demonstrated by turning off the ultrasound component whilst continuing with the interferential therapy. The patient very soon becomes aware of a much reduced sensation / effect, which can be restored by restarting the ultrasound.

In addition, the simultaneous application of ultrasound with interferential therapy minimises the accommodation phenomenon normally associated with electrical stimulation of the peripheral nerves.

The combination of ultrasound with interferential therapy appears to give rise to less adverse treatment effects than are associated with the combination of ultrasound with diadynamic currents, or other electrical stimulations. It has also been suggested that a greater effective treatment depth can be achieved with ultrasound - interferential therapy combination.

Unlike routine interferential therapy, the intensity of the electrical stimulation in combination therapy may need to be REDUCED during treatment, probably due to the continued effect of the ultrasound on the nerve membrane threshold.

In summary, by combining the two treatment modalities, none of the individual effects of the treatments are lost, but the benefit is that lower treatment intensities can be used to achieve the same results, and there are additional benefits in terms of diagnosis and treatment times.

Precautions

Interferential Therapy

Interferential therapy is a safe and effective modality. The therapist must, however, be aware of the following precautions and potential hazards.

Simultaneous connection of a patient to high frequency surgical equipment may result in burns at the site of the stimulator electrodes and possible damage to the stimulator itself.

Operation in close proximity (less than 1 metre) to shortwave or microwave therapy equipment may produce instability in the stimulator output.

Consideration must be given to the current densities for any electrode used with the Combination 850 Unit. Current densities greater than 2 mA rms/cm² are not recommended because of the risk of an interferential burn. The small size EMS conductive rubber electrodes (NC3052B 70 x 50 mm) have an area of 35 cm² and should, therefore, only be used with output currents up to 100 mA peak (70 mA rms). All other standard EMS conductive rubber electrodes may be used up to the maximum output of the unit without exceeding this figure. When using other electrodes, the maximum safe output current should be assessed before use. First estimate the effective contact area of the electrode in square cm, and then apply the following formula:-

Maximum peak output current (mA) = Area of electrode (cm²) x 2.8

The factor of 2.8 is the maximum recommended rms output current multiplied by the ratio of the peak current to the rms current for a sinusoidal waveform.

The output display on the Combination 850 control panel shows the peak output current in mA. For sinusoidal currents the rms current is approximately 70% of the peak value.

Patients with implanted electronic devices (eg cardiac pacemaker) should not be subjected to stimulation unless specialist medical opinion has first been obtained.

Contraindications - Ultrasound

Tumours as ultrasound affects tissue repair and could therefore encourage growth

Infections, due the risk of spreading the infection

Pregnancy, treatment over the pregnant uterus as ultrasound could affect rapidly dividing cells

Radiotherapy, sites that have received radiotherapy treatment during the last six months

Thrombosis and impaired circulation.

Areas of impaired sensation

Haemorrhage, due to the risk of increased bleeding, including recently controlled bleeding and haematoma.

Haemophilia

Implanted devices such as cardiac pacemakers should be avoided due to the possibility of affecting their operation. Also some plastics used in replacement surgery may be affected by absorption of ultrasound energy. Metal implants may lead to reflections, and as a precaution low doses of ultrasound should be used near these.

Extreme care should be taken when treating areas near the **eye** because of the danger of damage to the retina.

Similarly, extreme care should be taken near the ears and reproductive organs.

Contraindications - Interferential

There are comparatively few absolute contraindications to interferential therapy.

Acute Sepsis, due to the risk of spreading infection.

Tumours, due to the risk of increased growth or metastatic activity.

Pregnancy, do not treat the lower abdomen, back or pelvis.

Menstruation, do not treat lower back or abdomen due to risk of increased bleeding or pain.

Cardiac conditions, do not treat the chest area or near the cervical ganglion.

Cardiac pacemakers, especially demand type, or any other implanted electronic device.

Febrile conditions

Large open wounds in treatment area

Dermatological conditions in treatment area

Thrombosis

Hypersensitivity or fear of electrical treatments

Any patient who cannot understand the nature of the treatment, for example, young children, very old or senile patients who cannot report back adequately or understand the potential dangers. This may apply equally to persons who do not speak the same language as the therapist.

Severe hypotension/hypertension, do not treat in the region of the lower cervical spine.

If in doubt the patient's physician should be consulted.

Electrodes should never be placed so that the applied current crosses the chest.

Technical Specification

General

Power Input	100-240 Vac 50/60 Hz
Battery	Internal Rechargeable (NiMh)
Classification (EN60601-1)	Class 1, Type BF
Mains Fuses	2 x T630 mA (5 x 20 mm)
Size (height x width x depth)	100 x 240 x 210 mm (including handle)
Weight	2.2 kg
Treatment Programs	16 user-defined set-ups

Ultrasound

Frequency	1.1 MHz \pm 5% and 3.3 MHz \pm 5%
Maximum Intensity	2 W/cm ²
Maximum Output Power	10 W (Mains operation only)
Output Modes	CW and pulsed 1:1, 1:2, 1:4 and 1:9
Pulse Duration	2 ms
Treatment Timer	0 to 20 minutes (treatment linked)
Contact Monitor	Light on transducer

Large Ultrasound Transducer

ERA	5 cm ²
BNR	<6
Beam Type	Collimating

Small Ultrasound Transducer

ERA	0.5 cm ²
BNR	<6
Beam Type	Collimating

Transducers for use with the Combination 850 are fully interchangeable and suitable for underwater treatment (IPx7 rated).

Interferential Therapy

Output (Mains operation only)	0 - 100mA peak Constant Current or 0 - 65 V peak Constant Voltage
Carrier Frequency	4 kHz
AMF	0 - 250 Hz
Swing Pattern	1/1. 6/6 and 6\6
Treatment Timer	0 - 30 minutes
Vector	10 seconds, 20% both channels

Combination Therapy

Ultrasound Output	0 - 1 W/cm ² CW 0 - 2 W/cm ² in pulsed modes
Interferential Output	0 - 40 mA peak Constant Current 0 - 40V peak Contant Voltage

Both the maximum ultrasound intensity and the maximum interferential current are limited for battery operation.

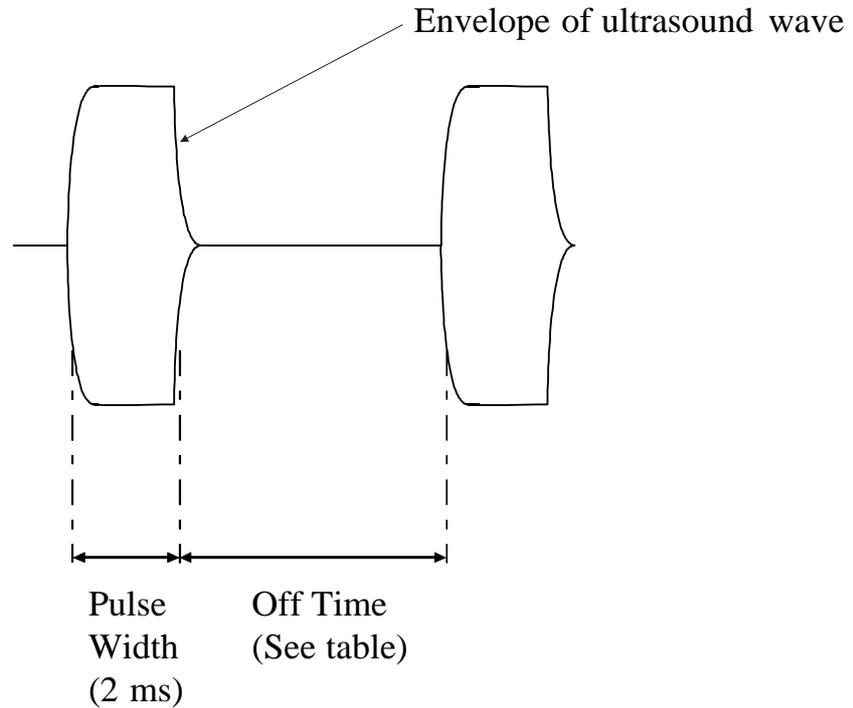
The Combination 850 is designed to operate from any 50/60 Hz single phase supply between 100 and 240 V ac capable of supplying 50 VA. Connection is via an IEC socket at the rear of the unit.

All information on model, serial number, and month/year of manufacture is located on the rear panel.

Each Combination 850 Unit is supplied with a detachable mains cable, carrying handle, spare fuses, a 5 cm² treatment head, 180ml bottle of Therasonic coupling medium, 4 pole patient lead, 2 pole patient lead, 4 medium (100 x 70 mm) rubber pad electrodes, 4 medium sponge covers, electrode connection cables, 2 elasticated stretch bandages and this manual.

The Combination 850 has been designed to meet the requirements of IEC 601-1:1988 (BS5724:Part 1:1989) "Medical Electrical Equipment, Part 1:General requirements for Safety", IEC 601-2-5:1984 (BS5724:Part 2.5:1985) "Medical Electrical Equipment, Section 2.5 Specification for safety of ultrasonic therapy equipment" and IEC601-2-10:1987 (BS5724:Section 2.10:1988) "Specification for nerve and muscle stimulators".

Pulsed Mode Ultrasound Waveform



Mode	Pulse Frequency	Off Time	Duty Cycle	Temporal peak to average ratio
1:1	250 Hz	2 ms	50%	2:1
1:2	166 Hz	4 ms	33%	3:1
1:4	100 Hz	8 ms	20%	5:1
1:9	50 Hz	18 ms	10%	10:1

The pulse width is fixed at 2 ms

Output Display

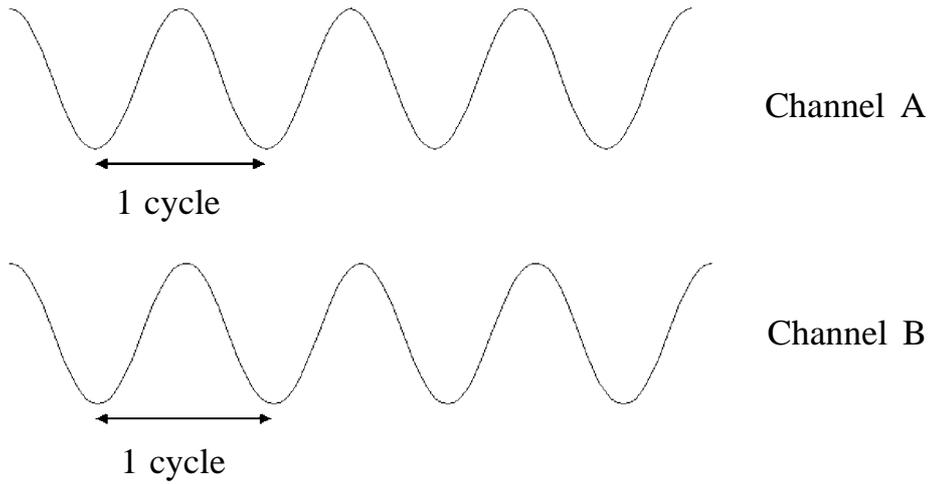
The 850 display shows the temporal-peak spatial-average ultrasound intensity and optionally the temporal-average power or the temporal-peak power as selected.

The maximum output current is 100 mA peak per channel and the maximum output voltage is 65 V peak.

The maximum load impedance in ohms at any given output current is given by:

$$\text{Maximum Impedance} = 65000 / (\text{peak output current in mA})$$

4 Pole Interferential Waveform

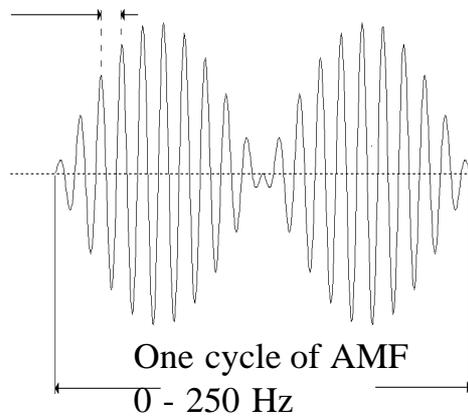


Channel A			Channel B	
Carrier	Frequency	Period	Frequency	Period
4 kHz	4 kHz	250 us	3.75-4 kHz	267-250 us

2 pole Interferential Waveform

One cycle of Carrier
4 kHz

OV reference



Preset AMFs

Base	Peak
100 Hz	100 Hz
0 Hz	10 Hz
0 Hz	25 Hz
0 Hz	100 Hz
10 Hz	150 Hz
50 Hz	200 Hz
100 Hz	150 Hz
80 Hz	130 Hz

Optional Accessories

ML9010S	Rigid carrying case
EMS514	Lightweight durable shoulder carrying bag
NC3052A	Set of 4 sponge electrode covers (small)
NC3053A	Set of 4 sponge electrode covers (medium)
NC3054A	Set of 4 sponge electrode covers (large)
NC3052B	Set of 4 conductive rubber electrodes 70 x 50 mm (small)
NC3053B	Set of 4 conductive rubber electrodes 100 x 70 mm (medium)
NC3054B	Set of 4 conductive rubber electrodes 130 x 100 mm (large)
NC3055A	4 pole patient lead
NC3056A	2 pole patient lead
NC3057	Pair of electrode connection cables (Blue)
NC3058	Pair of electrode connection cables (Yellow)
NC3061	Twin four field electrode

Controls and Markings

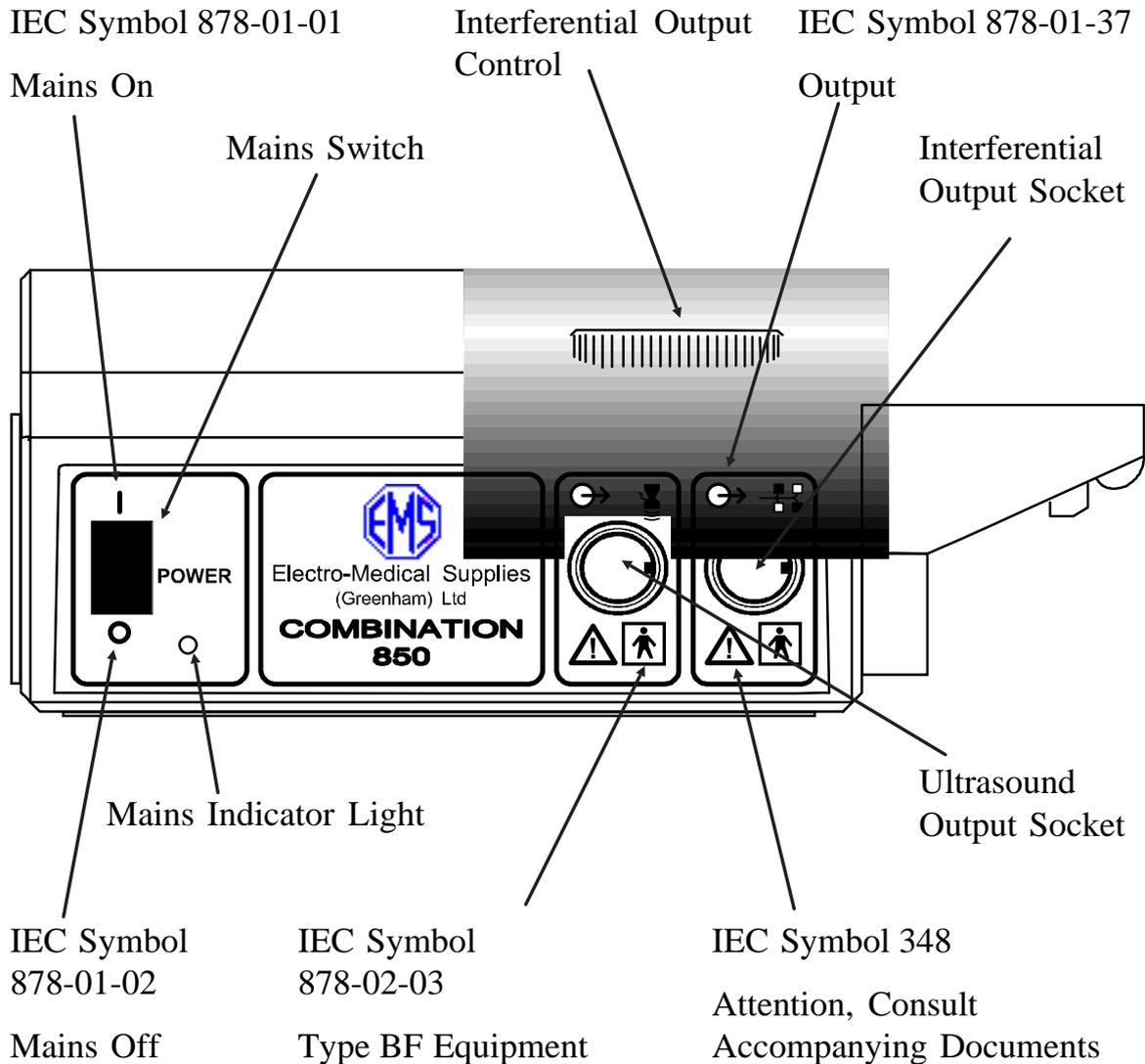


Figure 1 - Combination 850 Front Panel

The **Mains Switch** is a two-position rocker switch: up for on, down for off.

The **Mains Indicator Light** is a green LED which is illuminated when the mains switch is on.

The **Interferential Output Socket** is for connection of the 2 or 4 way patient leads. When used with suction electrodes this socket is connected to the input socket on the suction unit.

The **Ultrasound Output Socket** is for connection of either a 5 cm² or 0.5 cm² transducer.

Name and Address of Manufacturer

IEC Symbol 348

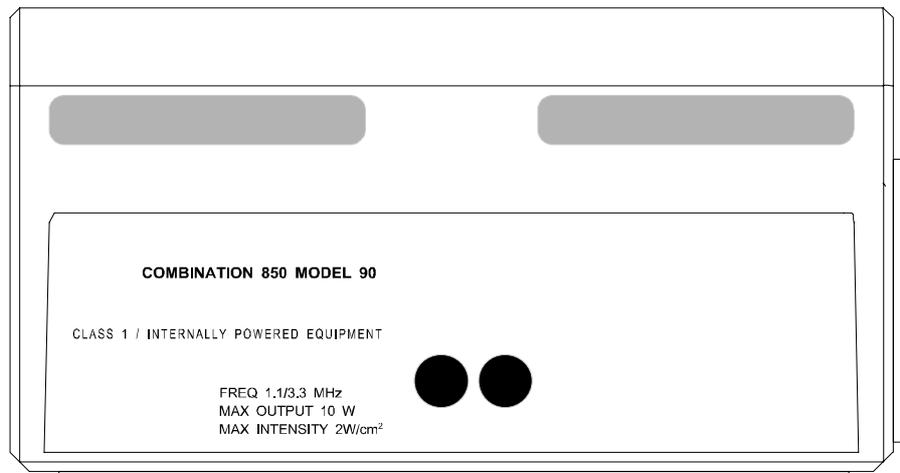
Attention, Consult Accompanying Documents

Serial Number and Date of Manufacture

Details of mains supply

CE Mark showing conformity to 93/42/EEC

Mains inlet



Classification

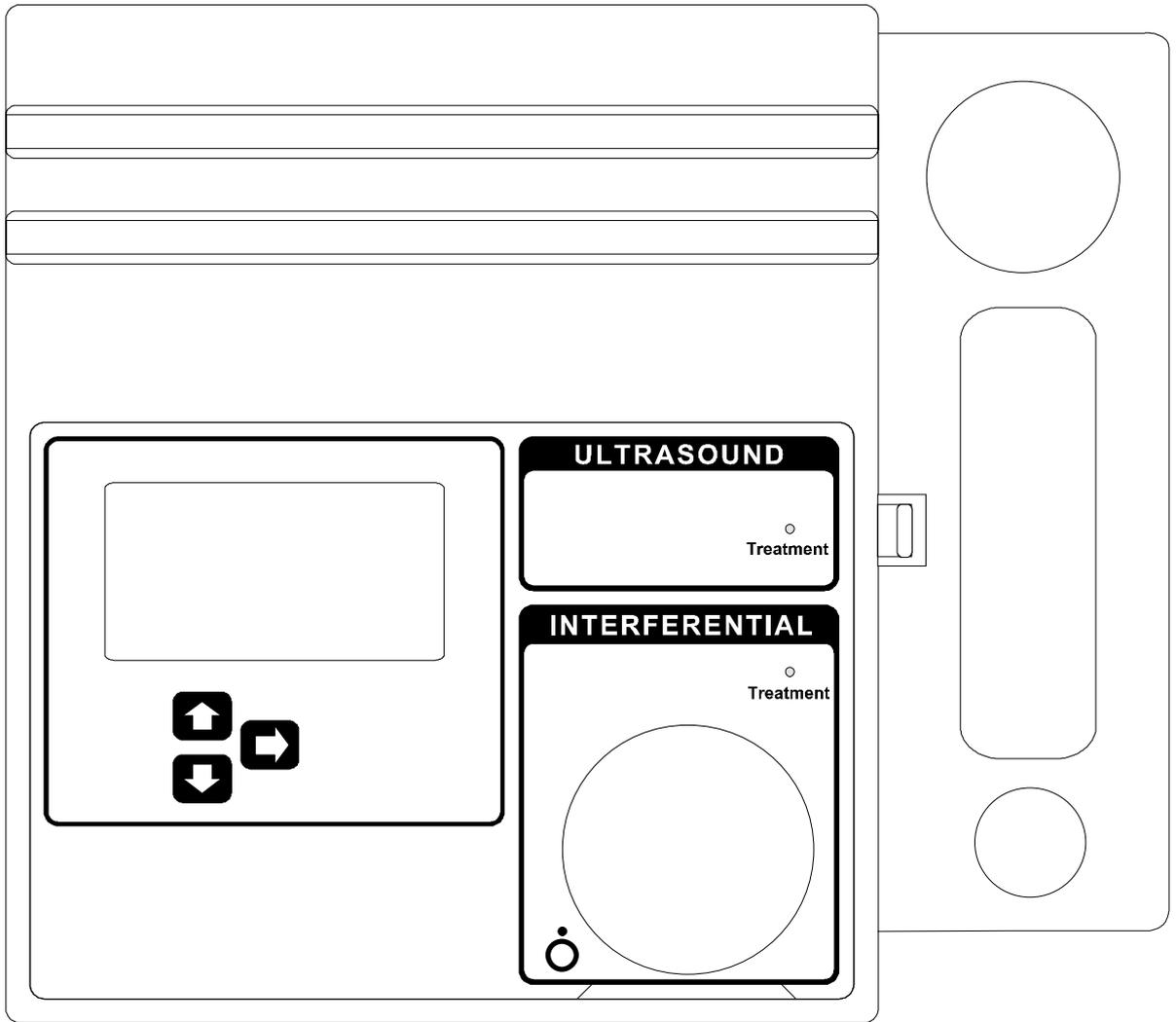
Fuse type and rating

Rated interferential and ultrasound output frequencies and intensities

Model Number

Mains Fuses

Figure 2 - Combination 850 Rear Panel



The **Display** is used with the **cursor keys** to show and modify all the settings and treatment parameters of the Combination 850. See the Operating Instructions section for more information.

The **Interferential Output Control** sets the interferential output current or voltage dependent on whether constant current or constant voltage mode is selected. When the treatment time is not zero advancing the output control from its off position will cause the **treatment indicator** to light and the interferential treatment time to count down.

The **Ultrasound Intensity Up** and **Down keys** set the ultrasound output intensity. When ultrasound is selected, the treatment time is not zero and a suitable transducer is connected to the ultrasound output socket, pressing the up key will increase the intensity by 0.1 W/cm². The **ultrasound treatment indicator** will light whenever ultrasound is being generated by the transducer.

The Combination 850 will start to charge the internal battery whenever the mains supply is connected and the mains switch on the front panel is in the on position (mains indicator on). The **battery charging indicator** on the Control Panel shows that the battery is being charged. When the battery is fully charged the charging circuit is disabled and the battery charging indicator will turn off. The Combination 850 uses rapid battery charging to minimise the charge time.

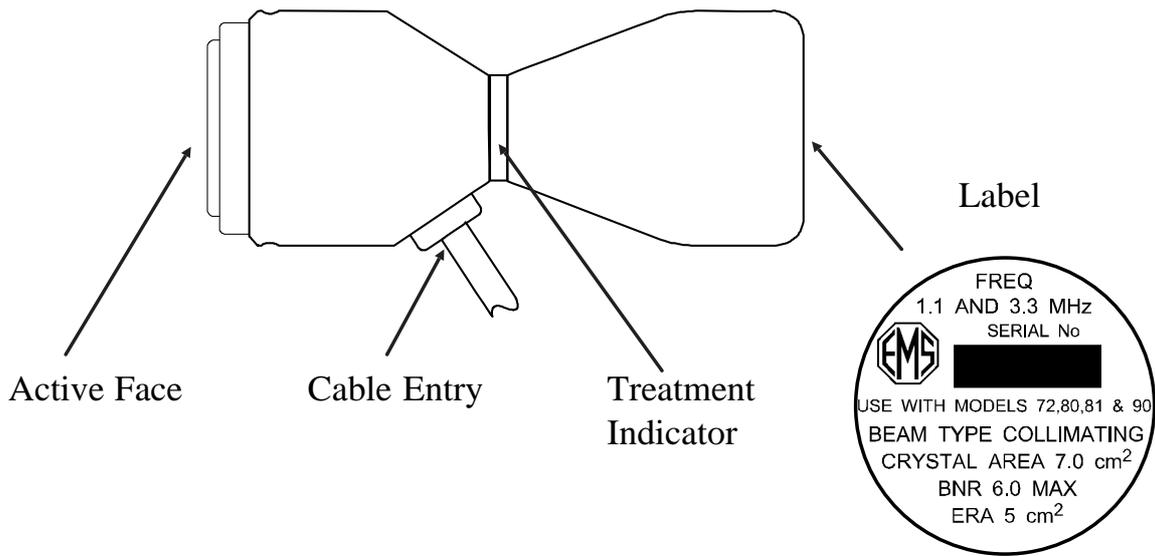


Figure 6 - Combination 850 5 cm² Transducer

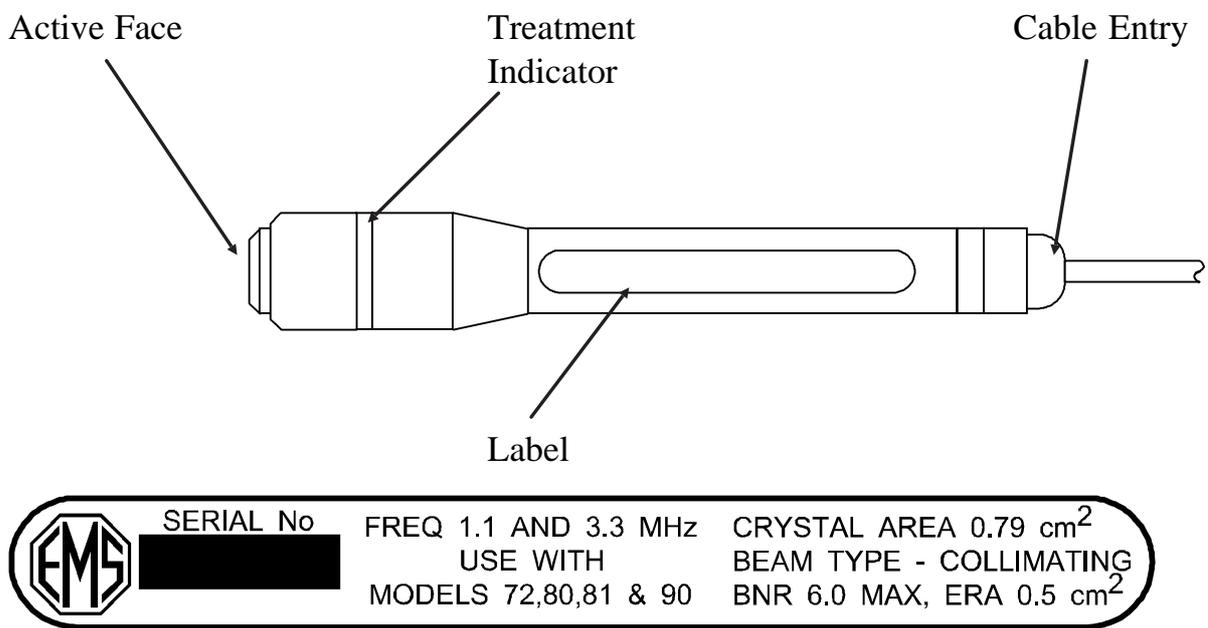


Figure 7 - Combination 850 0.5 cm² Transducer

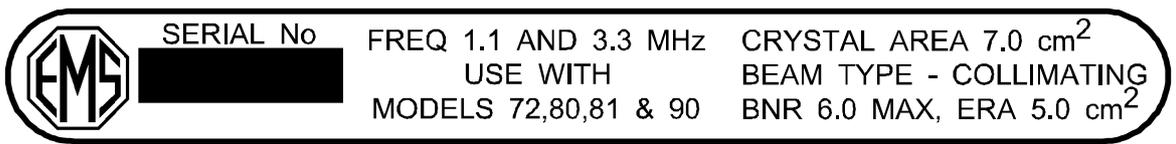
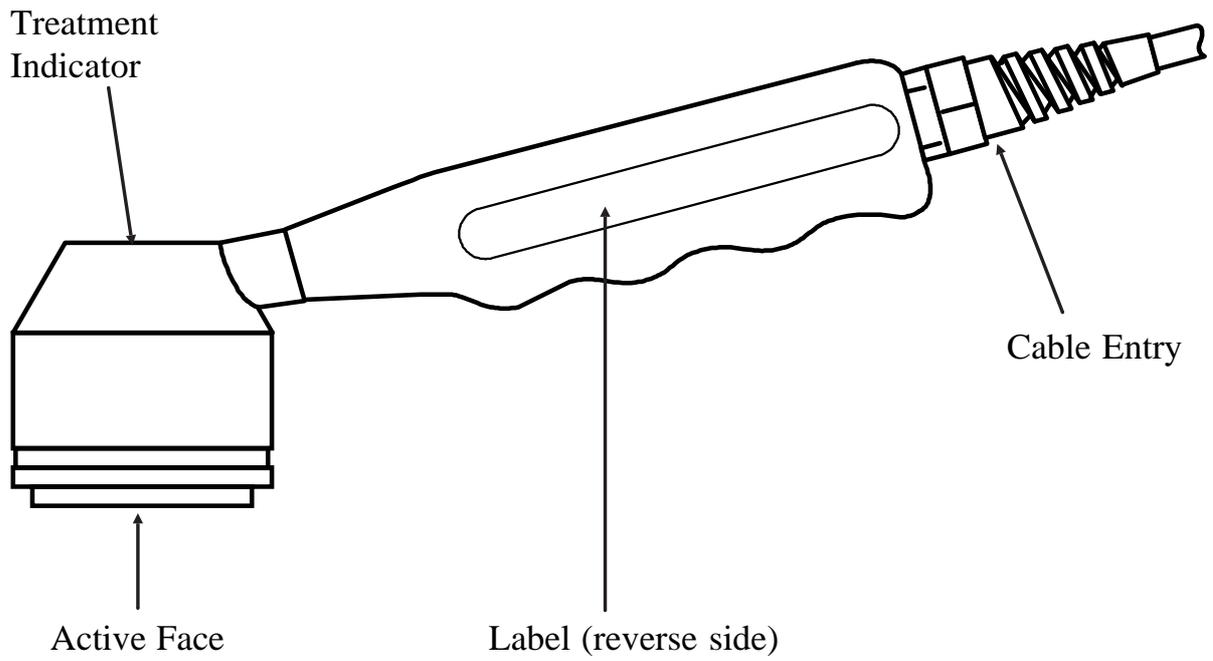


Figure 8 - Combination 850 5 cm² Angled Transducer

Installation

Upon receipt, check for any visible damage which may have occurred in transit. If any signs of damage are found then retain all packing material and inform the carrier and the Company or its agent from whom the system was purchased.

If not already fitted, connect a suitable plug to the mains cable. The plug must have provision for an EARTH (GROUND) connection. The mains cable has the following colour code, BROWN is LIVE (LINE), BLUE is NEUTRAL and GREEN/YELLOW is EARTH.

Attach the carrying handle to the right hand side of the unit. This is done by locating the key-hole slots in the handle on the three fixings at the right hand side of the unit and pushing the handle down until it "clicks" into position. The handle release button prevents the handle being removed inadvertently. To remove the handle, press the release button away from the unit and pull the handle upwards.

Connect the mains cable to the IEC socket on the rear of the unit and to a suitable power outlet.

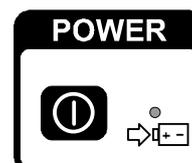
Connect the 5 cm² or 0.5 cm² ultrasound transducer to the ultrasound output socket. When inserting the plug make sure that it is correctly aligned with the socket. The plug has a locking ring to make sure that the transducer is not disconnected inadvertently. The transducer may be stored in the holder in the carrying handle: 5 cm² transducer at the rear, 0.5 cm² transducer at the front. The active face of each transducer is fitted with a protective label prior to shipment and this must be removed before the ultrasound transducer is used.

Connect either the 4-way or 2-way patient lead to the interferential output socket. When inserting the plug make sure that it is correctly aligned with the socket. The plug has a locking ring to make sure that it is not disconnected inadvertently.

Operating Instructions

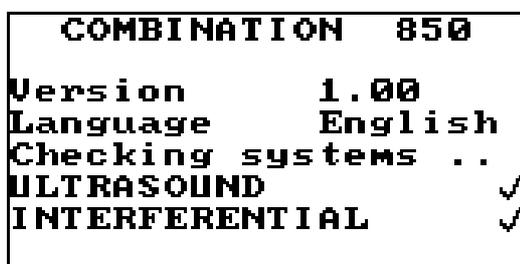
1. For mains operation, connect the Combination 850 to a suitable mains supply as described in the installation section of this manual. Switch the Combination 850 on using the mains switch on the front panel. The green mains indicator adjacent to the mains switch will light. The battery charging indicator on the control panel will also light. When the internal battery is fully charged the light will turn off and the battery charging will cease automatically.

2. Switch on the Combination 850 by pressing the on / off button on the control panel until the company logo is displayed on the LCD and then release it.

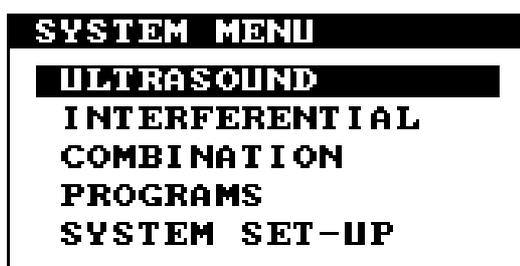


After 1 second the company name is displayed below the logo.

Approximately 1 second later the Combination 850 will give a short beep and display the software version and current language selection.



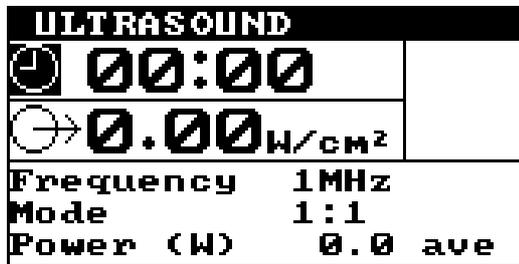
A brief check is made on the function of the ultrasound and interferential systems before the Combination 850 System Menu is displayed.



To select an item from the System Menu, use the up and down cursor keys to move the highlight bar up and down the options in the menu and press the ENTER key to select the item.

3. ULTRASOUND

Highlight ULTRASOUND in the System Menu and press the ENTER key. The ultrasound set-up screen will be displayed.

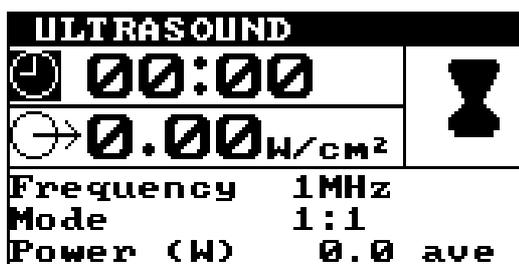


On entry to the Ultrasound screen The 'Time' symbol is highlighted. To set the treatment time use the right cursor key to increase the time and the left cursor key to decrease the time. Each keypress changes the time by 30 seconds.

Press the down cursor key and the highlight bar will move to 'Frequency'. Pressing either left or right cursor key will change the ultrasound frequency (1 or 3 MHz). If a 1 MHz only ultrasound transducer (as used with the Therasonic 350) is connected to the output socket, pressing the left and right cursor keys will have no effect and the frequency will be fixed at 1 MHz.

Pressing the down cursor key again will move the highlight bar to 'Mode'. Pressing the left or right cursor key will change the mode to CW (Continuous wave) or one of the pulsed options.

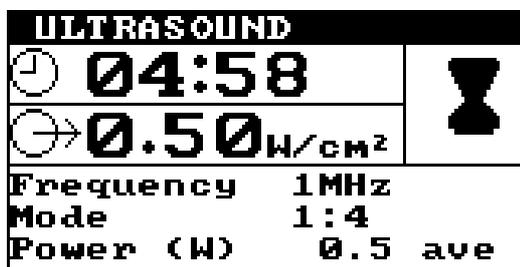
Pressing the down cursor key again will move the highlight bar to 'Power'. The Combination 850 always displays the temporal-peak spatial-average intensity in watts per square centimetre in the the output section of the display. The display can also show the temporal-peak or the temporal-average power in watts at the bottom of the display. To change the power display use the left or right cursor keys. Remember that the ERA of the transducer will affect both the peak and average power ($\text{Power (W)} = \text{Intensity (W/cm}^2) * \text{ERA (cm}^2)$) and the mode will affect the average but not the peak power.



If not already connected, plug the transducer into the output socket. The display will show a silhouette of the transducer in the top right of the screen.

Apply sufficient coupling medium to the area to be treated. EMS Therasonic coupling medium is recommended. Apply the active face of the transducer to the treatment site via the coupling medium, and press the ultrasound intensity up key. The treatment indicators on the control panel and on the transducer will light, the timer will start to count down and the output display will show 0.1 W/cm². If the treatment time is zero or a suitable transducer is not connected to the ultrasound output socket then the Combination 850 will give a short beep.

Move the transducer over the treatment site in small circular paths whilst increasing the output to the desired intensity using the ultrasound intensity up key. Each press will increase the intensity by 0.1 W/cm².



Always keep the face of the transducer in contact with the treatment area, and always keep the transducer moving to avoid any standing waves.

If the transducer face is lifted off the treatment area or if for any other reason there is insufficient contact

between the transducer and the treatment area for more than two seconds, then the timer will cease to count down, the light on the transducer and the treatment indicator on the control panel will turn off and the intensity on the LCD will flash indicating poor contact. The power applied to the transducer will also be reduced to a low level. When good contact is restored, the light on the transducer and the treatment indicator on the control panel will light, and output display will cease to flash and the timer will continue to count down.

If the output intensity is returned to zero, using the ultrasound intensity down key, before the treatment time has elapsed, the timer will display the remaining treatment time. When the output is turned on again the treatment will continue.

At the end of the treatment the timer will display 00:00, the ultrasonic power from the transducer will be terminated, the light on the transducer and the treatment indicator light on the control panel will turn off, the LCD will show zero intensity and power and a long (approximately 2 seconds) alarm will sound. The display will return to the ultrasound set-up screen.

Remove the transducer from the treatment area, wipe any coupling medium from the transducer face and return it to the holder at the rear of the handle.

Remove the remaining coupling medium from the treatment site.

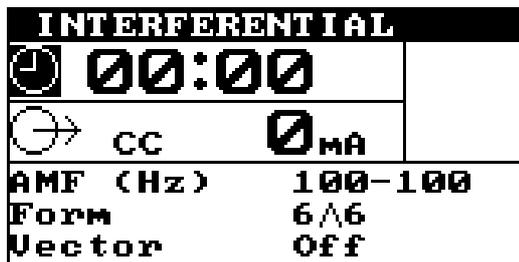
The Combination 850 transducers are suitable for treatment using a water bath. This is especially useful when treating areas which are not uniform such as feet or hands. When using a water bath it is advisable to use degassed water (water that has been boiled to remove any air and then allowed to cool). After the part of the body has been immersed in the water, remove any air bubbles that may have accumulated on the skin. Set up the unit as described and then immerse the transducer in the water before turning the output on. Hold the transducer with its face approximately 1cm away from the treatment site and increase the output, using the ultrasound intensity up key, to the required level remembering to keep the transducer moving in small circular paths to prevent standing waves. At the end of the treatment when the output has been automatically turned off, remove the transducer from the water and dry both it and the area treated.

The Combination 850 ultrasound contact monitor is normally treatment-linked. This means that the treatment time only counts down when there is adequate contact between the transducer active face and the treatment area. Some users may prefer to have this link disabled or enabled with an audible warning when there is poor contact. To change the contact monitor behaviour see the System Set-Up options on page 34.

To return to the System Menu press the EXIT key.

4. INTERFERENTIAL

Highlight INTERFERENTIAL in the System Menu and press the ENTER key. The interferential set-up screen will be displayed.

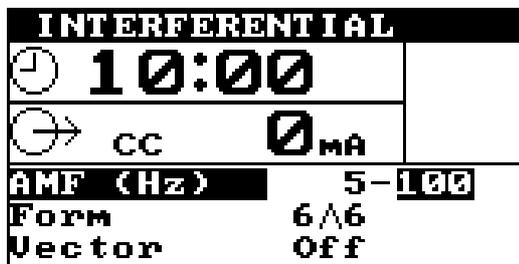


On entry to the interferential screen The 'Time' symbol is highlighted. To set the treatment time us the right cursor key to increase the time and the left cursor key to decrease the time. Each keypress changes the time by 1 minute.

Press the down cursor key and the highlight bar will move to the 'output' symbol. Pressing either left or right cursor key will switch the output mode between constant current and constant voltage.

In constant current mode the electrode impedance is monitored during treatment and if a high impedance is detected on either channel, the output is terminated and an alarm sounded. In constant voltage mode the electrode impedance monitor is disabled as the output current is automatically reduced if the electrode impedance increases. Constant voltage mode is useful for combination therapy and with internal (vaginal or anal) electrodes.

Pressing the down cursor key again will move the highlight bar to 'AMF' (Amplitude Modulation Frequency). Pressing the right cursor key will change the AMF to the next preset value and pressing the left cursor key will change the AMF to the previous preset value. A list of the preset AMFs is given on page 17 of this manual.



To set an AMF which is not in the preset list, first choose the preset AMF nearest to that required (not essential) and then press the ENTER key. The base frequency will be highlighted. Use the up and down cursor keys to increment and decrement the frequency. If the up or down key is held down, the key will repeat. When the base frequency is correct, press ENTER. The highlight bar will move to the peak frequency. Set the peak frequency in the same way using the up and down keys and confirming the

value with ENTER. If a peak frequency is set below the base frequency, then the base and peak frequencies are swapped automatically.

Press the down cursor key again and the highlight bar will move to 'Form'. The Form determines the way in which the AMF sweeps between the base and peak frequencies. Three standard forms are available with the Combination 850. The 1|1 form gives 1 second at the base frequency followed by 1 second at the peak frequency. The 6|6 form gives 5 seconds at the base frequency, sweeps linearly to the peak frequency in 1 second, followed by 5 seconds at the peak frequency and finally sweeps back to the base frequency in 1 second.

The 6\6 form sweeps from the base to the peak frequency in 6 seconds and then back to the base frequency in 6 seconds. Use the left or right cursor keys to select the required form.

Press the down cursor key again and the highlight bar will move to 'Vector'. When the vector option is off, the A and B outputs produce equal intensities (current or voltage dependent on the output mode). When the vector option is on, the relative amplitude of the outputs is slowly varied. Over a ten second period channel A output rises smoothly from 80% of its normal amplitude to 100% while channel B falls from 100% to 80%. During the next 10 seconds A falls while B rises and so on. The effect is to move the physical location of the point of maximum stimulation in the tissue and therefore, increase the treatment area. The vector option is turned on and off using the left or right cursor keys when 'Vector' is highlighted.

When all the settings are as required, select either the 2-way output lead for 2-pole interferential therapy or 4-way output lead and connect it to the interferential output socket on the front of the unit (see figure 1).

Attach suitable electrodes to the patient and connect to the output lead using the blue and yellow cables provided. See section on Electrodes for further advice on applying these.

Slowly advance the interferential output control (see figures 1 and 3). It will be felt to click on. If the treatment time is zero, then the treatment time on the LCD will flash and the unit will give an intermittent alarm until the control is returned to its OFF position.

If all settings are valid then the interferential treatment indicator on the control panel will light and the treatment time will begin to count down from its set value.

Always advance the control slowly. If the control is advanced too quickly initially then the Combination 850 will not energise its interferential output and the output display on the LCD will flash. Turn off the interferential output control and try again.

Slowly advance the interferential output control until the patient feels the effect of the applied current. The output display will show the average of the peak currents or voltages of the two channels.

When the output mode is constant current, if the unit detects a high electrode impedance at any time during treatment then the interferential output is immediately terminated, the output current display will flash and an intermittent alarm will sound. Turn the interferential output control off and check that the electrodes are secure, and the sponges are damp.

Also, check all interconnecting leads before re-applying the output to the patient. Note that in soft water areas it may be necessary to add a small amount of bicarbonate of soda to the water used to wet the sponges to achieve adequate contact.

During the last 5 seconds of treatment the interferential output is smoothly reduced to zero.

When the treatment time reaches zero, then the time display will flash and the unit will give an intermittent alarm until the interferential output control is returned to its OFF position.

To return to the System Menu press the EXIT key.

5. COMBINATION THERAPY

US	IT
00:00	00:00
0.0 W/cm ²	↔ CC 0 mA
Freq 1MHz	100-100Hz
Mode 1:1	Form 6/6
0.0 Wave	Vector X

Highlight COMBINATION in the System Menu and press the ENTER key. The combination set-up screen will be displayed.

On entry to the Combination screen The 'Time' symbol in the ultrasound section is highlighted. All the parameters in both the

ultrasound and interferential sections are set in the same way as for the individual modalities by moving the highlight bar to the treatment parameter to be changed and using the left and right keys to modify the setting. When the highlight bar reaches the bottom of the ultrasound section (average / peak power setting) the next down cursor press moves to the 'Time' symbol in the interferential section.

All information and instructions in the preceding sections on ultrasound and interferential treatment still apply for combination treatment.

Set the interferential treatment time to be greater than the required ultrasound treatment time. It is also recommended that the interefereential output mode is set to constant voltage (CV).

When all the treatment parameters are set, connect the 2-way interferential lead to the interferential output socket. Attach one electrode near to the injury site and connect it to the 'yellow' socket of the junction box of the 2-way lead. Connect the ultrasound transducer to the ultrasound output socket. The face of the ultrasound transducer is internally connected to the 'blue' output of the 2-way interferential lead.

Apply coupling medium to the treatment site and position the ultrasound treatment head on the patient so that the lesion point is between the interferential electrode and the ultrasound transducer.

Turn on interferential output and slowly increase the intensity until the patient just feels the normal 'tingling' sensation associated with the modality.

Turn on ultrasound output. The patient may feel a slight increase to the sensation. Set the intensity to the required level.

Slide ultrasound head up to the lesion area making sure that there is always coupling medium between the face of the transducer and the skin.

When directly over the lesion, the patient will feel increased sensation - this is the centre of the lesion.

Always keep the face of the ultrasound transducer in contact with the treatment area, and always keep the transducer moving to avoid any standing waves.

Treat with ultrasound and interferential for the remaining time set

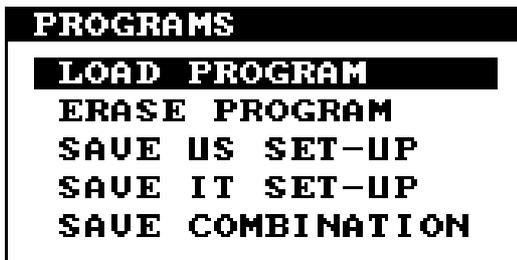
At the end of treatment, remove the transducer from the treatment area, wipe any coupling medium from the transducer face and return it to the holder at the rear of the handle.

Remove the remaining coupling medium from the treatment site and remove the interferential electrode.

To return to the System Menu press the EXIT key.

6. PROGRAMS

The Combination 850 can store up to 16 user defined set-ups. Highlight PROGRAMS in the System Menu and press the ENTER key. The programs menu is displayed. The options are to load a previously saved program, erase a



previously saved program, save the ultrasound set-up only as a program, save the interferential set-up only as a program or save a combination set-up.

To load a program, highlight the LOAD PROGRAM option and press ENTER.

The LCD shows the 16 user programs as file cards with the first program at the front. To move through the programs use the left and right cursor keys to step by one program and the up or down cursor keys to bring the back row to the front.



Pressing EXIT will return to the PROGRAMS menu without loading a set-up.

When the required program is displayed, press the ENTER key to load the set-up. All the displayed set-up parameters are

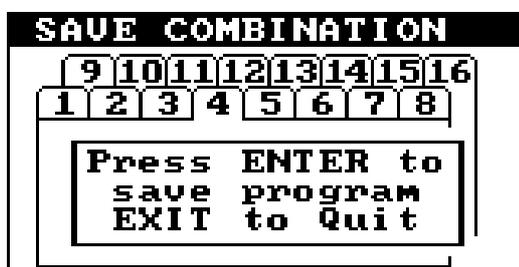
loaded and the corresponding modality is selected so that the treatment is ready to begin.

To erase a previously saved set-up, select the ERASE PROGRAM option from the programs menu. Display the program to be deleted



using the cursor keys. When the program to be deleted is displayed, press ENTER. A message will be displayed asking the user to confirm the deletion. Press ENTER to erase the program or EXIT to abort.

To save a set-up, select one of the last three options in the programs menu. The options save only the ultrasound settings, only the interferential settings or the combination settings. The display will show the 16 programs as above. Bring the program position where the set-up is to be stored to the front and press ENTER.



A message will be displayed asking the user to confirm the set-up is to be saved. Press ENTER to save the set-up and EXIT to abort.

7. SYSTEM SET-UP

Highlight SYSTEM SET-UP in the System Menu and press the ENTER key. The system set-up screen will be displayed. The first item in the list is the

software version and cannot be modified by the user.

SYSTEM SET-UP	
Version	1.00
Language	English
Volume	High
Contrast	50 %
Key-Click	Off
Contact	On

The highlight bar is on 'Language'. To change the system language use the left and right cursor keys.

The sounder has three volume levels: Low, Medium and High. To change the volume of the

sounder, first highlight 'Volume' using the up and down cursor keys and then use the left and right cursor keys to select the required level.

The LCD contrast may be set from 0 to 100%.

The Key-Click option, may be set to 'On' when the unit will give a sort beep to confirm each key press.

The contact option sets the ultrasound contact monitor to be on, off or audio. When set to on, the ultrasound treatment time is linked to the contact alarm. When set to off, the link is broken but the light on the transducer still indicates poor contact. When set to audio, an alarm will sound when the contact is poor.

To save power, the Combination 850 will automatically switch itself off, if the ultrasound and interferential outputs are off and there has been no key pressed for five minutes.

Interferential Electrodes

It is recommended that only electrodes supplied by Electro-Medical Supplies are used with the Combination 850. Three sizes of conductive rubber electrodes are available, or alternatively the unit may be used with a Suction Unit.

The three sizes available are small (70 x 50 mm), medium (100 x 70 mm) or large (130 x 100 mm). Replacement sponge covers are available for each electrode.

Since the aim of interferential therapy is to excite as many sensory receptors and peripheral nerves as possible, it is sensible to use as large an electrode as is practical for the area of the body being treated. This will also reduce the possibility of any adverse effects at the site of the electrode due to high current density.

Inspect the area to be treated to ensure there are no open wounds, areas of infection, abrasions etc. Wash the skin in warm soapy water to minimise skin impedance and remove any creams or gels that may have been used.

Explain to the patient what is being done and what is going to happen.

Soak the sponge electrode covers in warm water. In a soft water area it may be necessary to add a small amount of bicarbonate of soda to the water to ensure low contact impedance for the electrodes. Fit the rubber electrodes into the sponge covers.

Apply the electrodes to the patient using the elasticated bandages supplied. The bandages must cover the whole of the electrode and maintain an even pressure in order to achieve a uniform current flow. A piece of polythene may be used between the top surface of the sponge cover and the elasticated bandage to prevent the bandage becoming wet.

It is important to ensure that the patient feels the expected sensation in the required area during treatment, otherwise the electrodes should be relocated.

The electrodes must never be placed so that the stimulating current crosses the chest or passes near the heart.

Electrodes should be cleaned and disinfected between patients.

See the current EMS catalogue / price list for the full range of accessories and electrodes.

Maintenance

The ultrasound transducers may be disinfected with a suitable disinfectant. Dettol* endoscope disinfectant or a solution of 2% glutaraldehyde are suitable. It is NOT suitable for steam sterilisation or by disinfectants containing sodium hypochlorite.

The conductive rubber electrodes and sponge covers may be disinfected using any suitable disinfectant - a solution of 2% glutaraldehyde may be used. They are NOT suitable for steam sterilization. Disinfectants containing sodium hypochlorite should not be used.

The unit may be cleaned by wiping over with a damp cloth. The use of abrasive materials and cleaning solvents should be avoided.

Regularly inspect all treatment leads, cables and connectors for signs of damage.

The ultrasonic output power should be checked at least annually.

The mains fuses are mounted on the rear panel to the left of the mains inlet. The unit must be disconnected from the the mains before any attempt is made to replace these fuses. The fuse holders are of a bayonet type. A suitable screwdriver should be used to lightly press in the fuse holder cap and give it a quarter turn anti-clockwise to release it (reverse for the insertion of replacement fuses). Information on fuse type and rating is given on the rear panel of the unit and in the Technical Specification of this manual.

If the mains fuses continue to blow then EMS qualified Service personnel must be called in.

The Combination 850 has an internal NiMh rechargeable battery. This battery must only be replaced by authorised service personnel.

There are no user serviceable parts inside the unit and it should not be opened.

Full servicing instructions are available on request.