

# ULTRA

# MAX

OPERATORS  
MANUAL

**EXCEL**

ULTRA MAX OPERATOR'S MANUAL

Revision #1.0

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**CAUTION - Use of controls of adjustments or performance of procedures other than those specified herein may result in hazardous exposure to ultrasonic energy.**

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## 1.0 INTRODUCTION

The Excel ULTRA MAX is an ultrasound treatment system supporting both 1 and 3 MHz therapies.

This manual is divided into three sections, each with its own purpose and focus.

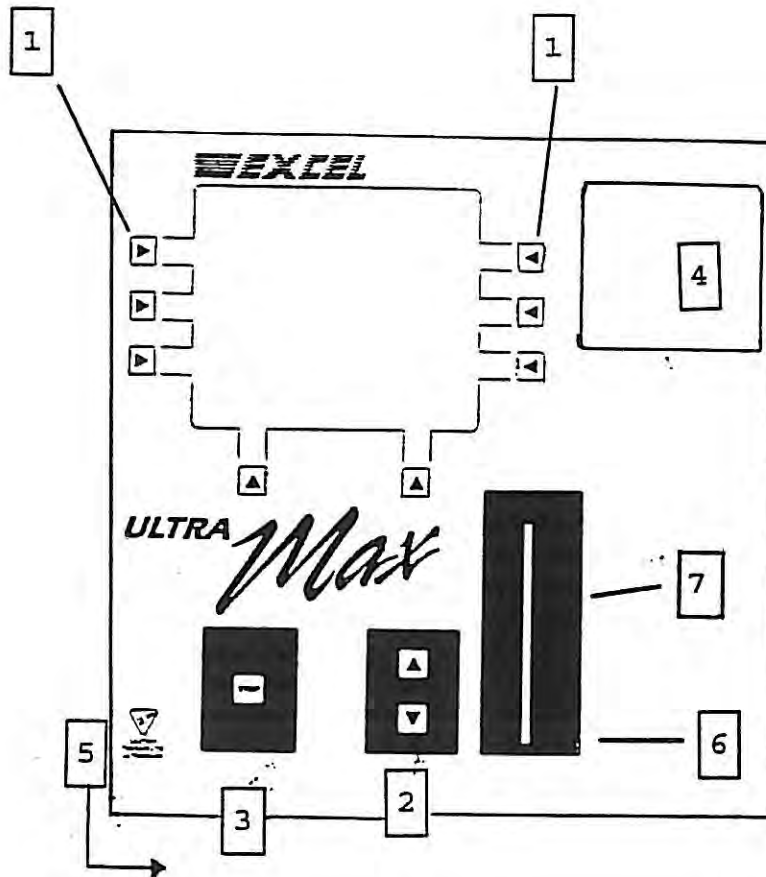
The first section, "Outline of Features and Concepts", describes all of the ultrasound and unit features, their purpose, and how to use them.

The second section is called "Getting Started". It contains step by step instructions on how to set up and run each type of therapy. Screen diagrams are provided for easy cross reference to the ULTRA MAX.

The third section "Contraindications", is a list of patient conditions that are incompatible with ultrasound treatment.

The appendices contain a maintenance schedule, table of icons (small graphic symbols used on the ULTRA MAX), ultrasound power calibration instructions, technical specifications, warranty and ordering information.

## 1.1 Front Panel Controls



1. **MENU SOFT KEYS** allow parameters and options to be selected from menus on the display screen. To make a selection, press the soft key pointing to the desired parameter or option.
2. **UP and DOWN KEYS** adjusts the value in the graphics box with the Up and Down arrows showing.
3. **STOP KEY** stops the current ultrasound treatment, removes the ultrasound energy from the applicator and resets the dose control system.
4. **APPLICATOR HOLDER** holds and protects the applicator during calibration, self warming and between treatments.
5. **ELECTROTHERAPY INPUT** allows electrotherapy current from an external EMS device to pass through the ULTRA applicator head to the patient. One of the two electrotherapy leads is plugged into this jack and the other lead is attached to the patient via a contact pad in the normal way. When the ultrasound applicator is in contact with the patient, the circuit is completed and current will flow. An ultrasound treatment can be underway at the same time, but the electric current is not controlled in any way by the ULTRA unit.
6. **ULTRASOUND OUTPUT INDICATOR** shows when ultrasound energy is being output through the applicator.
7. **COUPLING QUALITY METER** shows the current coupling quality between the applicator and patient. When the meter operates in the green area, there is sufficient coupling to deliver the full set point level.

## 2.0 OUTLINE OF FEATURES & CONCEPTS

This section describes the features of the ULTRA MAX, how they are used and why they are important. The focus is not on how to use a given feature in a particular situation, but a more general look at the feature.

### 2.1 Digital Adjustment Keys

The ULTRA MAX features a digital UP and DOWN Keys for the ultrasound output. Digital Keys are more accurate than traditional "analog" dials, last longer and don't degrade with age. At the beginning of each treatment, the Output is automatically zeroed by the unit, so there is no need to do this manually.

### 2.2 Energy Mode vs. Time Mode

Time (together with power or intensity) has traditionally been the standard method of controlling the amount of ultrasound that a patient receives. For example, "treat patient with 2.5 Watts for 5 minutes" would be a typical treatment. In this example, the ultrasound energy delivered to the patient would be about 0.75 kilojoules (kJ) of energy<sup>1</sup>. Of course this approach assumes that the applicator head is perfectly coupled to the patient for the entire treatment. In real life this is not possible. Patient movement, applicator movement, pausing to re-apply gel, will all mean less than perfect coupling and therefore the patient will receive significantly less energy than under "ideal" conditions.

Energy Mode is the solution to this problem. Instead of prescribing the treatment in time, the actual desired energy is specified. The treatment time is automatically extended to compensate for losses in coupling, thus the patient always receives the full dose of ultrasound energy. This method allows extremely accurate dose control under a variety of conditions and is suitable for both clinical and research environments.

The Excel ULTRA MAX features both Time Mode (traditional) and Energy Mode (improved dose control). Either can be selected and used with any ultrasound treatment. In Energy Mode, coupling and energy calculations are performed 1000 times a second to ensure complete accuracy even under extremely varying conditions. Even in Time Mode, both time and energy are displayed side by side so that practitioners who are familiar with time treating can gradually educate themselves on Energy Mode.

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<sup>1</sup> The calculation is:

$$\text{Energy(kJ)} = \frac{\text{Power(W)} \times \text{Time(s)}}{1000} = \frac{2.5 \times 300}{1000} = \frac{750}{1000} = 0.75 \text{ kJ}$$

### 2.3 Pause Mode

This mode is used to suspend an ultrasound treatment for a period of time, then allow the treatment to be resumed from the same point. While the ultrasound section is in Pause Mode, the time and energy counters freeze at their current values, the PAUSE key is reprogrammed to read RESUME, and the unit stops emitting ultrasound energy. All other treatment parameters, such as frequency, dose, and duty cycle are maintained.

Pause Mode can be entered in two ways. The first is by pressing the PAUSE key while the treatment is running. This can be done at any time and Pause Mode is entered immediately. The second method occurs automatically when the applicator is marginally coupled or uncoupled from the patient for more than five seconds. This greatly reduces the risk of the applicator overheating as a result of extended poor coupling.

To exit Pause Mode and resume the treatment, press the RESUME key while in Pause Mode. All treatment parameters remain unchanged and ultrasound power is returned to the applicator. To exit Pause Mode and cancel the treatment, press the STOP key. This will cancel the treatment in progress, reset the time and energy counters and allow a new treatment to be configured.

### 2.4 Applicator Calibration

All applicators are not exactly the same. Different sizes of applicators will have different operating parameters. There are also subtle differences between applicators of the same size due to variation in the manufacturing process. The ULTRA MAX can be used with any Excel ultrasound applicator because the unit can calibrate or tune itself to the attached applicator. This takes place automatically when the unit is turned on provided the applicator is plugged in and is resting in the applicator holder.

Temperature change will affect the operating point of the applicator. When the unit is turned on in the morning, it will calibrate cold. However, after the self warming cycle, or after a treatment, the applicator will be significantly warmer. To ensure peak operating efficiency, the user should recalibrate the applicator after a large temperature change or periodically throughout the day.

During calibration, the applicator must be dry, free of gel, and remain in the applicator holder. If the applicator is not plugged in or not in the holder when the unit is turned on, the automatic calibration is aborted. Calibration will then take place when the user attempts to configure a treatment.

## 2.5 Applicator Self-Warming

The ULTRA MAX provides an applicator self-warming feature to increase patient comfort. If this option is selected, the unit maintains the selected temperature level between ultrasound treatments. During a treatment, the self-warm feature has no effect.

Self-warming works by applying a small amount of power to the applicator head to warm it up and then removing the power when the desired temperature is reached. The process works much like a household oven, turning the power on and off to control the temperature. The results can be seen on the self-warming temperature monitor on the ULTRA MAX Liquid Crystal Display screen.

The applicator must be in the applicator holder during self-warming.

## 2.6 Ultrasound Coupling Meter

The ultrasound coupling meter is the vertical LED meter on the right side of the unit. It contains 40 bars (10 yellow and 30 green) and indicates the quality of coupling between the applicator head and the patient. The better the coupling, the more LEDs will light.

The ULTRA Max has a sophisticated power control system which allows full power to be delivered to the patient under varying coupling conditions. As long as the coupling meter remains anywhere in the green (coupled) range, then there is sufficient coupling to deliver the set power level. If the coupling meter falls into the yellow (marginally coupled) range, then the patient is not receiving the full set power level due to poor coupling<sup>2</sup>. A single yellow LED at the bottom of the meter indicates an uncoupled state with the ultrasound power on. Activating the Coupling Alarm from the assist screen will provide an audible warning of poor coupling.

If the applicator remains marginally coupled during a treatment for several seconds in a row, then Pause Mode is entered automatically to prevent possible overheating of the applicator. Also, because of the viscosity of ultrasound gel, the unit can be "fooled" into reading marginally coupled or even coupled if there is considerable gel on the applicator, even if it is not coupled to the patient. In order to maintain the accuracy and reliability of the coupling meter and power control system, the applicator should be wiped clean of gel when not coupled to the patient.

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<sup>2</sup> Because full set power cannot be delivered while marginally coupled, the Energy Mode feature (if selected) will automatically extend the treatment as necessary to deliver the total energy desired (see section 2.3 Energy Mode vs. Time Mode).



### 3.3.0 GETTING STARTED

This section gives step by step instructions for the configuration and running of each treatment type. The ULTRA MAX screens are shown at each step. It is intended that this section of the manual be used with the unit to provide a "hands-on" tutorial.

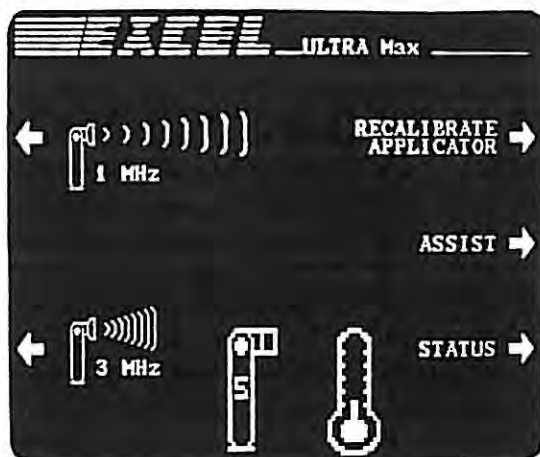
In general, the ULTRA MAX functions much like a banking machine. At each stage in the treatment setup, there will be a number of options on the screen. To select an option, press the button next to the screen that the option points to.

Some options will require entry of a number value. Use the UP and DOWN Keys under the display screen for this purpose. When entering a value, toggle the UP and DOWN keys. To save the number simply choose the next item to modify. The number in the box at the time will be saved by the ULTRA MAX. If the number is noticed to be incorrect after it is entered, simply select that option again and make the necessary corrections. Holding the keys down will cause the values to rapidly change.

### 3.1 General Setup

Since the ULTRA MAX has already been calibrated and tested at the factory, it can be used immediately with a minimum of setup:

- 1) Place the unit on a solid, flat, clean surface. Allow at least 3 inches (7 cm) clear area at the rear and right hand side of the unit to allow sufficient air flow. Blocking either the fan or the air ventilation slots may cause the unit to overheat.
- 2) Plug the unit into an isolated power line if possible. Heavy equipment plugged into the same line may cause power fluctuations. If this is not possible a line voltage regulator can be purchased locally. Use only a Hospital Grade power cord (supplied with the unit).
- 3) Plug the applicator into the unit and place in the applicator holder. Turn the unit ON. The power switch is located in the rear upper left corner. After the power-up sequence (about 3 seconds) the applicator calibration will proceed, then the Main Menu screen should appear.



This is the starting point for setting up and running a treatment. The EXCEL logo appears in the upper left. The "5" inside the applicator icon indicates that a 5 cm<sup>2</sup> applicator is plugged into the unit.

The screen contrast can be adjusted by pressing the ASSIST key, then pressing the screen contrast keys "+" or "-" (see section 3.3.4 Adjusting Screen Contrast, for more information).

### 3.2 Setting up an Ultrasound Treatment

This section provides step by step instruction and screen graphics for the ULTRA MAX unit. Both 1 MHz and 3 MHz frequencies are available through the same applicator. Normally, the applicator is automatically calibrated when the unit is powered on, but may require calibration before running a treatment if the auto-calibration was bypassed (see section 2.6 Applicator Calibration, for more information).

The general procedure for running an ultrasound treatment is as follows:

- 1) Plug the applicator into the unit and placed it in the holder for automatic calibration. Turn the unit ON.
- 2) Select the treatment type and parameters.
- 3) Adjust the output to the desired level, making note of the estimated treatment time and energy delivered.
- 4) Start the treatment, which begins the automatic count down of time or energy (depending on the mode selected).
- 5) Press the PAUSE key at any time during the treatment to remove ultrasound power and stop the dose count down. The treatment can then be resumed by pressing the RESUME key. This is useful for adjusting patient position or applying more coupling gel.
- 6) Press the STOP key at any time during the treatment to terminate the ultrasound power and reset the ultrasound unit. A new treatment can then be configured.

There are two methods for controlling the amount of ultrasound that the patient receives; time and energy. Both are available with all treatment parameters but Energy Mode provides a number of advantages over traditional time based treatments. Section 2.2 Energy Mode vs. Time Mode, provides more information on this topic.

Step 1

This is the Main Menu screen and is the starting point for setting up and running a treatment. The procedure is the same for 1 MHz and 3 MHz and all of the same parameters are available.

\* Press 1 MHz \*

Step 3

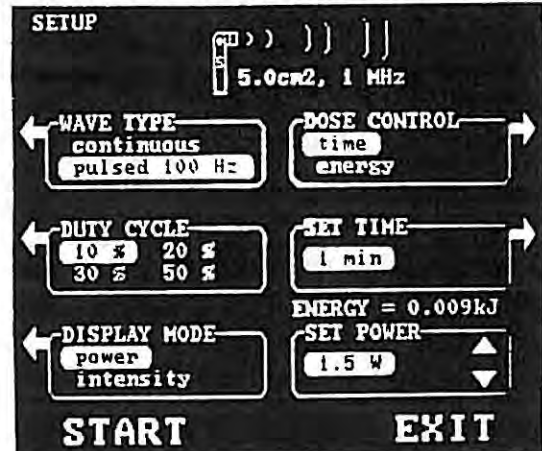
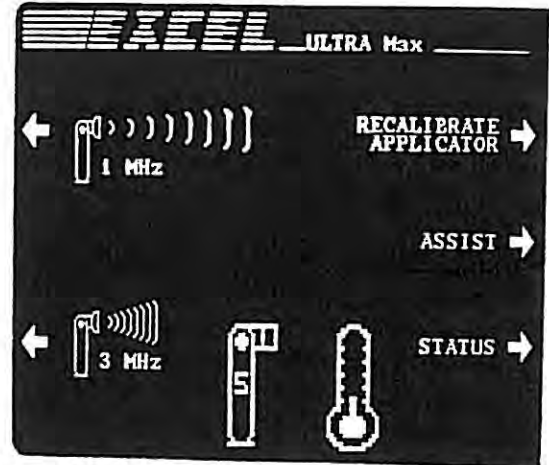
This screen shows all the parameters available for an ultrasound treatment. Each can be customized by selecting the desired parameter. This either moves the menu bar or allows a value to be entered by pressing the UP and DOWN keys. A small applicator graphic in the upper centre of the screen shows the frequency and signal type of the selected ultrasound waveform.

**WAVE TYPE** selects a continuous or pulsed waveform. Continuous Mode provides a constant 1 or 3 MHz signal where as in Pulsed Mode, the 1 or 3 MHz signal is turned on and off at 100 Hz. repetition rate.

**PULSE FREQUENCY** is the rate at which the ultrasound waveform is turned on and off (pulsed) when in Pulsed Mode. The ULTRA MAX pulses at 100 Hz.

**DUTY CYCLE** is the amount of time that the ultrasound waveform is on versus the time that it is off. A 50% duty cycle means that the signal is on for half the time and off for half the time. A higher duty cycle increases the on time of the signal, and also increases the rate of energy transfer to the patient. This parameter is only used in Pulsed Mode.

**DOSE** is the amount of ultrasound energy to be delivered for this treatment. In Time Mode, this is the length of the treatment in minutes multiplied by the output power set point (which corresponds to a desired energy amount). In Energy Mode the actual programmed energy is calculated in kilojoules. As the treatment runs, the total dose entered will count down to zero, at which time the treatment will end. If the coupling is poor and the rate of energy transfer to the patient is compromised the ULTRA MAX will automatically increment the treatment time to ensure the full energy is delivered.



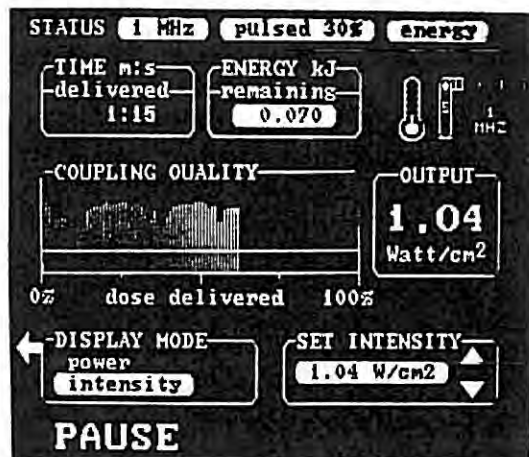
DOSE CONTROL selects Time or Energy Mode. Again, Time Mode controls the treatment in minutes and Energy Mode in kilojoules. A full comparison between the two modes is given in section 2.2 Energy Mode vs. Time Mode.

**\* Press START \***

#### Step 4

This is the Run-time status screen. In addition to adjusting output level during operation this screen provides some other important features as well.

DISPLAY MODE allows both the Set Point (on the screen) and actual delivery point (on the Digital Display) to be displayed in either power or intensity. Power is measured in total Watts and intensity in Watts per centimetre squared. Therefore intensity takes into account the Effective Radiating Area of the applicator while power does not.



The Total Dose in both time and energy are shown. In Time Mode, the time is highlighted and fixed to the value entered on the previous screen. In Energy Mode, the energy is highlighted and fixed to the entered value. The unhighlighted value in either mode is a calculated estimate based on the fixed dose and the current Set Point. This calculation assumes good coupling throughout the treatment and is provided to show the relationship between time and energy.

**\* Set Power \***

The Ultrasound Output Adjust Keys on the front panel allows the set point to be changed up or down. Holding the key down will cause the value to increment rapidly in the desired direction.

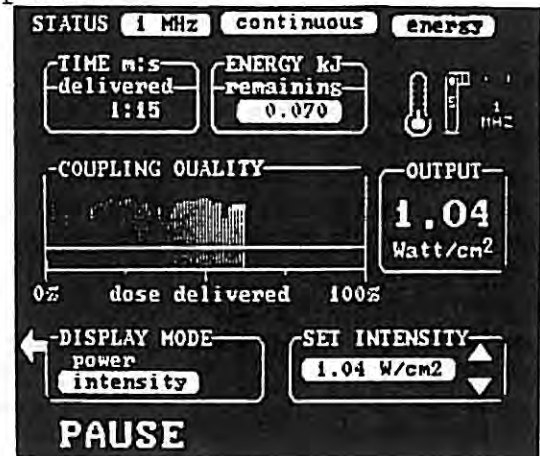
## Step 5

After starting the treatment, the ULTRA MAX goes to the Status Screen and the treatment timer begins counting down the dose from the set value.

The Coupling Quality Meter on the front panel will show the current coupling status and the OUTPUT Digital Display will display the actual delivered level. The delivered level will be equal to the Set Point, unless the coupling is poor.

The Display Mode and Set Point are shown on the status screen and can be changed at any time during the treatment.

The actual Dose Delivered is shown at the upper centre of the screen. As on the Adjust Output screen, the highlighted counter is the dose control mode selected (time or energy). Both counters reflect the exact dose delivered, taking into account the Set Point, coupling quality, entering pause mode, etc. and are updated in real time.



The Coupling Quality histogram shows the average coupling over the course of the treatment. It is synchronized to either the time counter or the energy counter depending on the dose control mode selected.

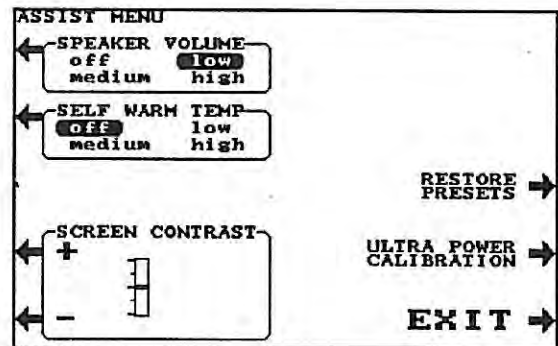
The temperature of the applicator head is constantly monitored throughout the treatment. The applicator icon and real time thermometer graphic are in the upper right of the Coupling Quality histogram. The thermometer is scaled so that the normal operating temperature of the applicator is between the highest and lowest "ticks" marked on the graphic.

Notice that the Status Bar has a 1 MHz, continuous and energy mode indicated for the treatment that is in progress. To run a different ultrasound treatment the current treatment must be stopped, then a new treatment can be configured.

### 3.3 The Assist Menu

The ASSIST key under the INFORMATION section on the front panel gives access to a number of supplementary ULTRA MAX features that are not related to specific treatments. The EXIT function from the Assist Menu reloads the main screen.

All changes made to Assist Menu parameters are automatically stored in memory and will remain intact even when the unit is turned off.



#### 3.3.1 Adjusting Speaker Volume

Move the menu bar to highlight the desired level.

#### 3.3.2 Adjusting Applicator Self-Warm Temperature

Move the menu bar to highlight the desired level. The ULTRA MAX will control the temperature of the applicator head whenever there is no ultrasound treatment running and the applicator is in the applicator holder and calibrated.

#### 3.3.3 Setting The Coupling Alarm

Enabling this feature will engage an audio alarm, much like a "Geiger Counter" type of sound indicating when the ULTRA MAX is inadequately coupled.

#### 3.3.4 Adjusting Screen Contrast

The LCD flat panel display used on the ULTRA MAX allows a wide range of contrast settings to compensate for viewing angle and lighting conditions. Repeatedly pressing the "+" and "-" keys will move the reference bar and change the screen contrast.

#### 3.3.5 Ultrasound Power Calibration

This option is used to fine tune the ultrasound power measurement and display system. Only a qualified biomedical technician should perform this function using a high quality ultrasound power meter. Appendix C contains the power calibration instructions.

#### 4.0 CONTRAINDICATIONS

##### DO NOT USE ULTRASOUND:

- On specialized tissues such as the eyes (cavitation in ocular fluid), ears, ovaries, testes, brain, or spinal cord
- On cancerous cells and precancerous lesions
- Over infection or infectious conditions
- Over viscera (spleen, liver, stomach)
- On pregnant uterus
- On acute sepsis
- On tumours whether malignant or benign
- After or during treatment by deep x-ray, radium or radioactive isotopes (ultrasound only after six months after completion of above treatments)
- On lungs
- On patient with haemophilia
- On deep vein thrombosis, thrombophlebitis or arterial disease
- On areas with lack of sensation (diabetics, nerve root, etc.)
- On patient with a cardiac pacemaker or the cardiac area in advanced heart disease diabetics
- Over ischemic tissue in patients with vascular disease
- Over the stellate ganglion
- After laminectomy (or use with caution because of the lack of soft tissue protection of the spinal cord)
- Over subcutaneous major nerves
- On an acute bursitis on a continuous setting because increased circulation may lead to increased inflammation of the bursa and may increase pain
- Over the epiphyseal areas of immature bones



## APPENDIX A - SCHEDULE OF MAINTENANCE

### Ultrasound Power Calibration

The unit will only hold power calibration data for one applicator of each size. Subsequent calibrations for other applicators of the same size will override the previous calibration for that applicator size.

The power output should be calibrated under the following conditions:

- 1) Whenever a new applicator is used with the unit.
- 2) Once yearly to ensure output accuracy.

APPENDIX B - TABLE OF ICONS



Applicator not in holder.



Applicator not plugged into unit, or bad applicator.



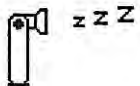
2 cm<sup>2</sup> applicator installed.



5 cm<sup>2</sup> applicator installed.



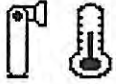
10 cm<sup>2</sup> applicator installed.



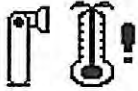
Pause mode.



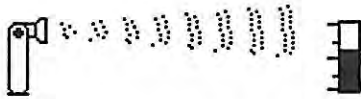
The unit is not calibrated to this applicator.



Applicator temperature monitoring (normal range).



Applicator over heating, automatic shutdown.



Calibration in progress.

## APPENDIX C - ULTRASOUND POWER CALIBRATION

The ultrasound power calibration is **For Service Adjustment Only**. The power calibration procedures enable the technician to calibrate the ultrasound output power of the device for each size applicator. The power accuracy will be within +/- 5% of the power meter measurement after power calibration. The absolute accuracy of the system is dependant upon the accuracy of the power meter used.

Note that there are two independent calibrations. The first calibration is the frequency calibration. The frequency calibration calibrates the generator frequency to drive the applicator at the frequency of optimum efficiency. The frequency calibration occurs every time the unit is powered on or the applicator is changed.

The second calibration is the power calibration. This calibration calibrates the delivered power. The power calibration is performed by the service technician only. One set of power calibrations can be stored for each size of applicator. When a second applicator of the same size is power calibrated with the device it overwrites any previous power calibration for that size applicator.

The ULTRA MAX should not be power calibrated when the unit is cold. If the unit or applicator has been exposed to cold temperatures, the unit should be placed in self warming mode until the applicator has warmed and the unit returns to room temperature. Self warming can be initiated through the following steps.

1. Press the assist key and turn self warming to LOW. Press EXIT to return to the main menu.
2. Clean and dry the applicator head and place the applicator in the holder.
3. Frequency calibrate the applicator by pressing the RECAL APPLICATOR Key. Once the applicator has been frequency calibrated, the unit will return to the main menu.
4. The unit will then start self warming.

The thermometer icon on the main screen will appear as the applicator is warming and will display the relative temperature of the applicator. If the applicator is removed from the holder, self warming will be suspended and the self warming icon will turn off. To continue self warming replace the applicator in the holder. Self warming will continue automatically. The warming procedure should take less than 5 minutes to complete.

### Restrictions

The ULTRA MAX power calibration applies only to the applicator which is being power calibrated. Only one applicator of each size can be power calibrated with the unit at any time. If a second applicator of the same size is used for power calibration, the power calibration for the second applicator overwrites the power calibration for the first applicator.

### Equipment

The following equipment is required to power calibrate the ultrasound portion of the ULTRA MAX.

1. Ultrasound Power Meter

### Procedure

1. Set up the ultrasound power meter according to the instructions in your power meter manual.
2. If the ultrasound applicator is cold, initiate self warming at the low level and wait until the applicator has warmed (see Section 3.0 for details on self warming).
3. Initiate power calibration by pressing ASSIST and then POWER CALIBRATION. Enter the password and press ENTER to begin power calibration. The password is "632".
4. Select an applicator to be calibrated. Place the CLEAN and DRY applicator in the holder and press CONTINUE. If the applicator is removed from the holder or unplugged from the unit during frequency or power calibration, the Power calibration will be terminated and the unit will return to the main menu.

- 5 Place the applicator in the power meter and zero the power meter. For proper power meter operation refer to your power meter manual. If at any time during the power calibration procedure, the meter needs to be adjusted, the ultrasound power can be turned off by pressing PAUSE. The PAUSE Key will be relabeled RESUME. The power can then be re-started by pressing RESUME.
6. The ultrasound power will be turned on at either 1 or 3 MHz.

Four power points must be entered for each of the frequency ranges in order to complete the power calibration. To enter power calibration data press POWER and adjust the power in the "Measured Power" box to match that measured by the power meter. Enter the new figure by pressing the key beside the "Measured Power" box. "ok." will appear in the calibration box at the upper right of the screen corresponding to the point that has just been entered. The program will advance to the next point. Corrections are limited to a 30% deviation from the factory power calibration. If the actual power delivered is outside of the allowable correction range, please call EXCEL for factory service.

The procedure begins at 1 MHz. Once all 4 points for a frequency range have been entered, the calibration for that frequency will be saved. Pressing EXIT will terminate the power calibration and return to the applicator selection screen. If EXIT is pressed before all points for a frequency range have been entered, the power calibration for that frequency will be aborted.

To change frequencies press the FREQUENCY key. This will change the frequency and reset the procedure to the first point in the next frequency selected. If the previous frequency had not been completed, the data to that point will be ignored. Thus, if you make a mistake, the easiest way to recover is to change the frequency twice. This will return you to the beginning of the frequency you were calibrating.

To restore the default power calibration for the current applicator size, press RESTORE APPLICATOR POWER DEFAULTS. This will restore the factory defaults for that applicator size only. All of the "ok's" will disappear from the status box indicating that none of the power calibration has been completed. It may be advantageous to press restore defaults before beginning the calibration for each applicator size. This will help you keep track of where you are in the power calibration process.

Once all of the power calibration points have been entered for both ranges, press EXIT to return to the applicator selection menu.

7. Repeat for each applicator size by inserting the new applicator and following steps 2 through 6.
8. Verify the power calibration by running a treatment into the power meter. Set the DISPLAY MODE to POWER. The value displayed on the POWER/INTENSITY DIGITAL DISPLAY should correspond to the value on the power meter.

APPENDIX D - TECHNICAL SPECIFICATIONS

ULTRA MAX General Unit

Line Voltage:  
120 VAC

Line Current:  
2 A (max)

Fuse:  
2 A, 250 V

Dimensions:  
12" x 13" x 5"

Material:  
type 5052 aluminium  
0.050" thickness

Weight:  
13 lbs



## Ultrasound Output

Waveform: 1 or 3 MHz acoustic sine wave, continuous or pulsed

Parameter	Minimum	Maximum	Steps	Units
Dose: Energy Mode	0.01	9.99	0.01	kJ
Dose: Time Mode	1	99	1	min
Pulse Frequency	100	100		Hz
Duty Cycle	10	50	4	%

Uncertainties in the Ultrasound Parameters:

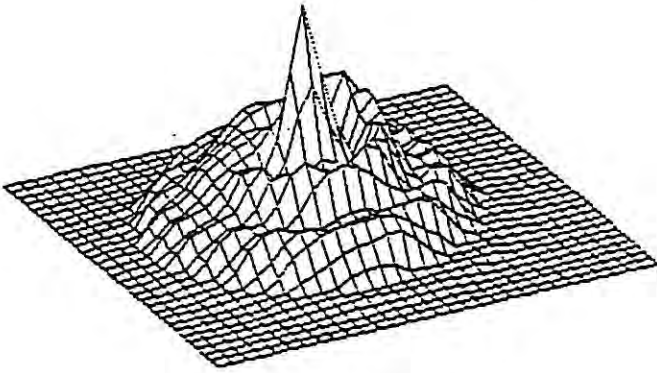
Parameter	Error
Ultrasonic Frequency <sup>3</sup>	+/- 0.01 %
Effective Radiating Area	+/- 15 %
Ratio of Temporal-max : Temporal-avg	+/- 0.1 %
Pulse Duration	+/- 0.1 %
Pulse Frequency	+/- 0.1 %
Treatment Time	+/- 0.2 %
Radiated Power	+/- 5 %
Radiated Intensity	+/- 20 %

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<sup>3</sup> The unit calibrates itself to the natural resonating frequency of the crystal and matching plate that is attached to the unit. The resonating frequency is tested to be within +/- 15 % of 1 and 3 MHz. The calibration steps are 0.01 % of 1 and 3 MHz as indicated.

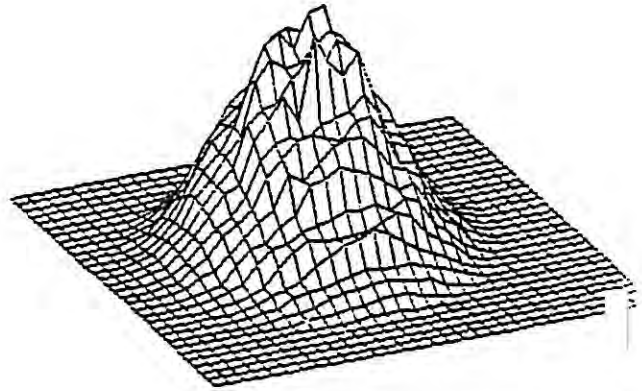
APPENDIX E - SPATIAL DISTRIBUTION OF RADIATED FIELD

1 MHz, 2 cm<sup>2</sup>



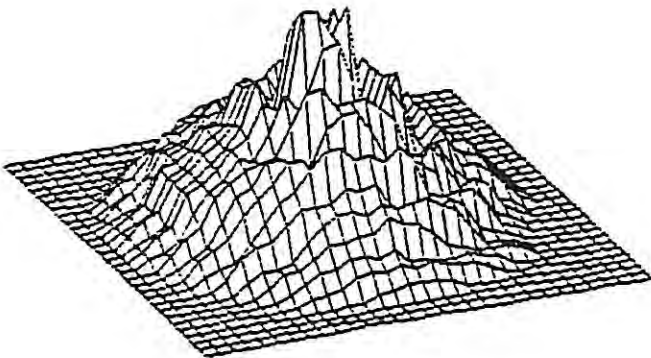
Scanned Area: 0.81 in<sup>2</sup>  
Excitation Level: 1 W  
ERA: 1.956770 cm<sup>2</sup>  
BNR: 4.070109

3 MHz, 2 cm<sup>2</sup>



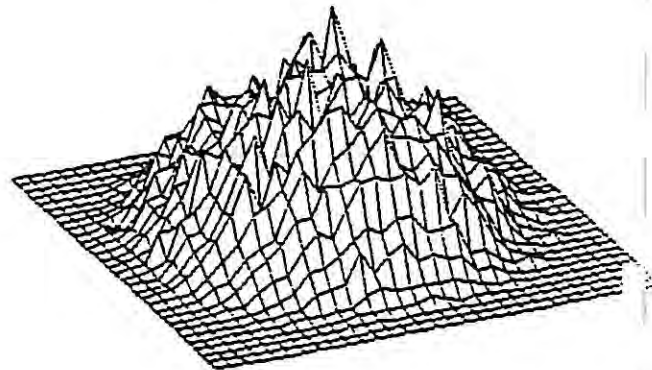
Scanned Area: 0.81 in<sup>2</sup>  
Excitation Level: 1 W  
ERA: 1.817416 cm<sup>2</sup>  
BNR: 2.891477

1 MHz, 5 cm<sup>2</sup>



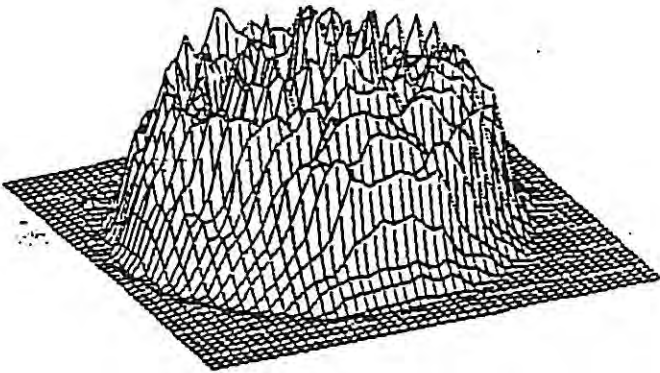
Scanned Area: 1.44 in<sup>2</sup>  
Excitation Level: 2 W  
ERA: 5.192253 cm<sup>2</sup>  
BNR: 3.970596

3 MHz, 5 cm<sup>2</sup>



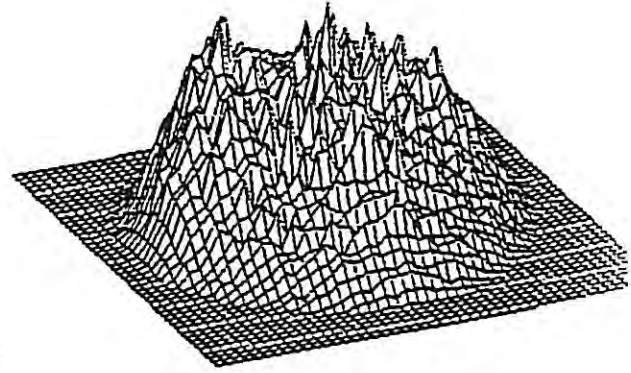
Scanned Area: 1.44 in<sup>2</sup>  
Excitation Level: 2 W  
ERA: 5.027092 cm<sup>2</sup>  
BNR: 3.919519

1 MHz, 10 cm<sup>2</sup>



Scanned Area: 2.56 in<sup>2</sup>  
Excitation Level: 2 W  
ERA: 9.469228 cm<sup>2</sup>  
BNR: 2.167490

3 MHz, 10 cm<sup>2</sup>



Scanned Area: 2.56 in<sup>2</sup>  
Excitation Level: 2 W  
ERA: 8.629150 cm<sup>2</sup>  
BNR: 2.677282

All plots are taken on a plane parallel to the transducer face at a distance of 0.2 inches. The radiation is emitted into the equivalent of an infinite medium of distilled, degassed water at 30 degrees C and with a line voltage in the range of +/- 10 percent of 115 VAC.

APPENDIX F - EXCEL TECH LIMITED WARRANTY

The Excel Tech Ltd. ULTRA is warranted to be free of defects in workmanship and material for a period of 1 year from the date of original purchase. Excel Tech Ltd. shall repair or replace the unit, at their option, and at no charge to the purchaser, provided Excel Tech Ltd. is satisfied that same is defective as foresaid, and the purchaser gives prompt notice of any such defect. The purchaser must receive from Excel Tech Ltd. an RMA (Return Merchandise Authorization) number before any returned goods will be accepted. All returns without an RMA number will be promptly returned at purchaser's expense.

Excel Tech Ltd. warrants user handled parts such as knobs, switches, buttons, lead assemblies and transducer head assembly for a period of 60 days from the original purchase date.

This warranty shall not apply to repairs or replacements necessitated by neglect, abuse, loss or damage caused by fire, flood, acts of God or other casualties or if the product's serial numbers have been in anyway altered, defaced, or removed. Excel Tech Ltd. shall not under any circumstances be liable for any special, indirect, or incidental losses or damages of any kind whatsoever.

The warranty period shall not be extended by the inability of the purchaser to use the product or parts during the time of examination or the time of repair or replacement of the product.

The purchaser's sole remedy and Excel Tech Ltd.'s sole liability from any cause whatsoever and regardless of the form of action, shall be limited to the warranty as set forth herein.

The ULTRA and accessories are subject solely to the foregoing written warranties and representations. If the original purchaser so decides to resell the ULTRA and accessories to a third party, the equipment shall no longer be warranted by Excel Tech Ltd.

All returned units should only be shipped upon the direction of an Excel Tech Ltd. employee, to a specified location with the RMA number clearly shown on the box.

Serial Number: \_\_\_\_\_