

**RICH-MAR MODEL V & X ULTRASOUND
OPERATION HANDBOOK AND MANUAL**



*Part # MN2416
Rev. F
Batch 001*

CAUTION

This device is not designed to be connected with any electrical equipment unless manufactured and approved by Rich-Mar.

NOTE: This includes whirlpools and carbon electrodes NOT manufactured by Rich-Mar.

TABLE OF CONTENTS

| | |
|---|----|
| Rich-Mar Model V/X Warranty..... | 4 |
| Ultrasound Indications for Treatment..... | 5 |
| Ultrasound Contraindications & Warnings..... | 5 |
| Functions of Controls..... | 6 |
| Ultrasound Operation..... | 6 |
| Front Panel Illustration..... | 7 |
| Combining Ultrasound with Rich-Mar Stimulation..... | 8 |
| Ultrasound Calibration & Tuning Procedure..... | 10 |
| Troubleshooting Guide..... | 11 |
| Rich-Mar Model V/X Specifications..... | 11 |

Appendix A
Ultrasound Technical Information

Appendix B
Rich-Mar Model V/X Parts List

Appendix C
Rich-Mar Model V/X Schematics

LIMITED WARRANTY

This equipment is sold under an exclusive three-year warranty from date of sale, which warrants it to be free from defects in material and workmanship. We agree to repair or replace at the point of manufacture, without charge, all parts showing such defects, provided the unit is delivered to us, prepaid to our factory, intact for our examination, within three years from date of sale, and provided such examination discloses in our final judgement that it is defective.

This warranty does not apply if the equipment has been subject to misuse, neglect, accidents, incorrect wiring (not our own), improper installation, or put to use in violation of instructions furnished by us, has been damaged by excess voltage or has been repaired or altered outside our factory or if the equipment has had its serial number altered or removed.

Changes: Rich-Mar reserves the right to modify or change the equipment in whole or in part, at any time prior to delivery, in order to include refinements deemed appropriate by the Company but without incurring any liability to modify or change equipment previously delivered, or to supply new equipment in accordance with earlier specifications. This warranty will be honored only if the enclosed card is filled out and returned to the factory. This warranty is valid only to original purchaser.

This warranty is expressly in lieu of all other warranties expressed or implied including the warranties of merchantability and fitness for use and all other obligations on our part, and we neither assume, nor authorize any other person to assume for us, any other liability in connection with the sale or use of this equipment. In no event shall we be liable for consequential or special damages. We make no warranty whatsoever in respect to accessories or parts not supplied by us.

Ultrasound Indications for Treatment

(Therapeutic Ultrasound)

Rich-Mar Ultrasound devices are indicated to produce therapeutic deep heat for the following conditions:

- 1) Relief of pain.
- 2) Muscle spasms.
- 3) Joint contractures.

But not for the treatment of malignancies.

WARNING - Federal law restricts this device to sale by or on the order of a physician or any other practitioner licensed by the law of the state in which said person practices.

Ultrasound Contraindications

Contraindications

Ultrasound should not be used in the following areas:

- 1) Near or over the heart.
- 2) Near or over the eyes.
- 3) On the head.
- 4) Near or over reproductive organs.
- 5) On the lower back during pregnancy or over the pregnant uterus.
- 6) Directly over the spinal column.
- 7) Over growing bone in children.
- 8) Where the skin suffers from any sensory impairment.
- 9) Over areas of malignancies.
- 10) In the area of visceral plexus and large autonomous ganglion.
- 11) Over the thoracic area if the patient is using a cardiac pacemaker.
- 12) Over a healing fracture.
- 13) Over ischemic tissues in individuals with vascular disease where the blood supply would be unable to follow the increase in metabolic demand and tissue necrosis might result.

Precautions

Precautions should be taken when used:

- 1) Over anesthetized areas.
- 2) On patients with hemorrhagic diatheses.
- 3) Ultrasound treatment should not be performed over an area of the spinal cord following laminectomy (i.e.- when major covering tissues have been removed).

Caution

- 1) Excessive doses of ultrasound may cause damage to tissue. Periosteal pain is an indication of excess intensity and if it occurs, the power should be reduced; the transducer should be moved more rapidly over the area being treated; or a lower pulsed duty cycle should be used.
- 2) If the soundhead has been operated unloaded for an extended period of time, the transducer will get hot. If the soundhead is applied to the patient while the transducer is hot, a burn may result.

Warning

Do not operate the soundhead in an unloaded condition. It is possible that unreparable damage may occur to the transducer in an unloaded state.

Rich-Mar Models V & X

Functions of Controls (See Figure 1)

- 1) **Timer:** The timer serves as the main power switch for the unit and allows the operator to set the desired treatment time. Once the timer has been activated, AC power is supplied to the unit. Once the timer reaches zero, AC power is interrupted and the treatment is terminated. The panel indicates the treatment time remaining.
- 2) **Ultrasonic Active Indicator:** This light, when on, informs the user that ultrasound is either ready to be emitted or is currently emitting from the transducer.
- 3) **Power On Indicator:** This light informs the user that the timer has been activated and that AC power is being supplied to the unit.
- 4) **Duty Cycle/ Pulse Rate Switch:** This switch allows the operator to select either a 100% duty cycle or one of six other pulsed duty cycles. The pulsed duty cycles are expressed in either percentage duty cycle or pulses per second.
- 5) **Duty Cycle/ Pulse Rate Indicators:** These lights give the operator a linear, visual indication of the duty cycle in which the unit has been set.
- 6) **Intensity Control:** This allows the operator to increase and decrease the ultrasound output intensity to obtain the desired treatment.
- 7) **Wattmeter:** Indicates the ultrasound output being produced by the unit. The upper black scale reads the output in total watts produced. The lower blue scale reads the output produced in peak watts per square centimeter up to 2.5W/cm².
- 8) **Cradle:** The transducer cradle operates a switch that will shut off the signal to the transducer. When the transducer is set in its cradle the ultrasound output will be shut off until the transducer is removed.

Operation

(See Figure 1)

Before activating the timer be sure that the **Intensity Control** (6) is turned fully counterclockwise. The unit is then activated by setting the desired treatment time into the **Timer** (1). Once the timer is activated the **Power On Indicator** (3) will be illuminated.

Next, select the desired duty cycle with the **Duty Cycle/ Pulse Rate Switch** (4). Once the proper duty cycle has been selected the corresponding **Duty Cycle/ Pulse Rate Indicator** (5) will be illuminated.

The ultrasound output intensity can now be increased to the required level with the Intensity Control. The intensity level will now be indicated on the **Wattmeter** (7).

NOTE: When administering an ultrasound treatment, be sure the treatment area of the patient has an ample quantity of Rich-Mar lotion or gel as a coupling medium. The quality and quantity of the coupling medium has a direct bearing on the amount of ultrasound energy transmitted to the treatment area.

NOTE: Even though this device is equipped with an output failure diagnostic feature, Rich-Mar Corporation recommends that you perform the following on a daily basis:

Before starting treatment, the operator should check the output of the unit by placing some water or coupling agent on the sounded and increasing the intensity. The ultrasonic output of the unit should then show cavitation (bubbling).

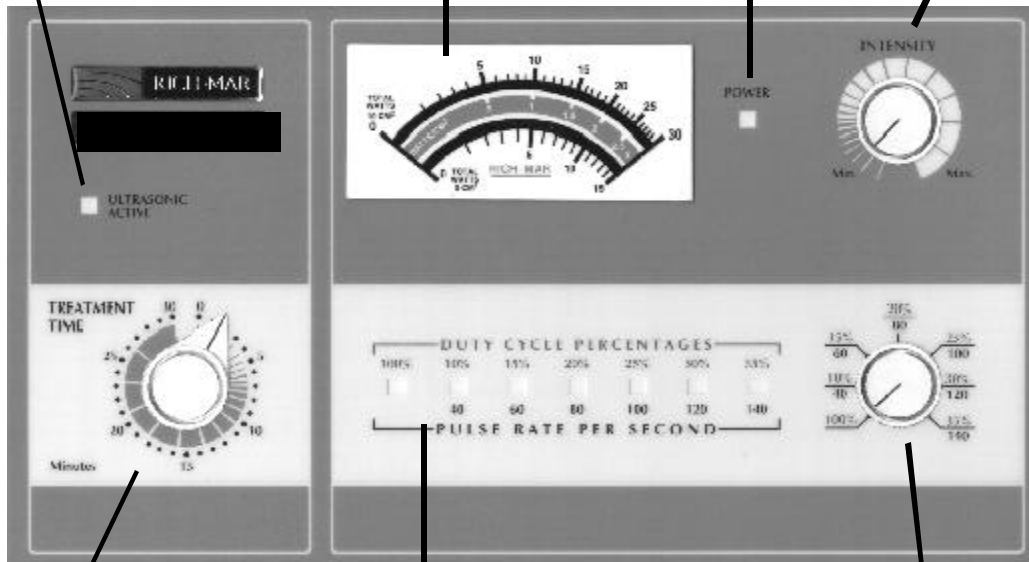
Rich-Mar Models V & X Front Panel Illustration (Figure 1)

2. Ultrasonic Active Indicator

7. Watt Meter

3. Power On Indicator

6. Intensity Control



1. Timer

5. Duty Cycle/
Pulse Rate Indicator

4. Duty Cycle/
Pulse Rate Switch

8. Transducer Cradles are located on both sides of the unit.

Combining Ultrasound with Rich-Mar Stimulation (Figure 2)

The Rich-Mar Model V & X ultrasounds are designed to be connected to any Rich-Mar muscle stimulator, thus enabling the user to provide combination therapy to patients.

To connect the ultrasound unit to a stimulator, simply plug the connecting cable into the jack located on the lower right rear side panel of the unit.

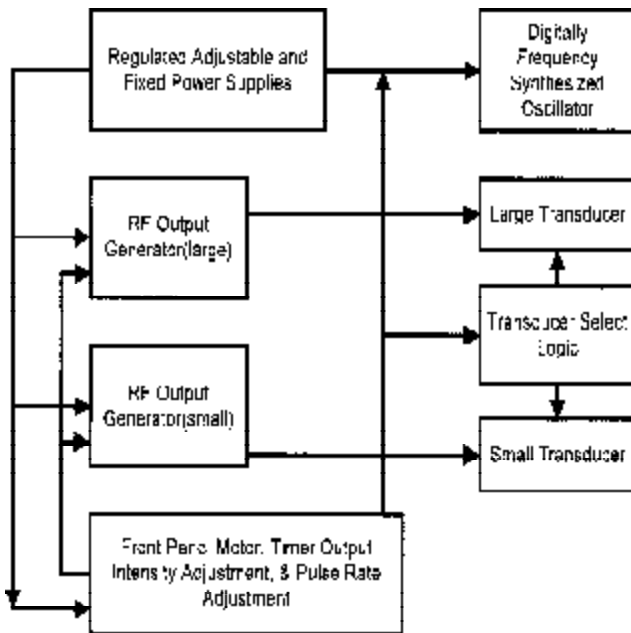
Using the indifferent electrode (dispersive pad) to complete the circuit, the user will now be able to provide electrical stimulation as well as ultrasound through the transducer.



Disinfecting Recommendations

To disinfect the soundhead between therapy treatments, Rich-Mar recommends using a disinfectant cleaner for ultrasound. OSHA addresses the need for prudent infection control (OSHA Instruction CPL 2-2.44C) to include decontamination of equipment between patients.

Circuit Description



Power Supplies

There are two power supplies. One is a fixed +12 Volt supply for necessary circuitry, and the other is adjustable to +40 Volts. The adjustable power supply is dedicated to the main RF generator. This, in essence, adjusts the output intensity of the device. Digital logic circuits select proper voltage range automatically to match whichever transducer is selected by the operator.

Digitally Synthesized Oscillator

The digitally synthesized oscillator (DSO) provides an ultrastable, adjustable, low-level (+12V) oscillator to match the optimum frequency of the transducer. It consists of a 2048kHz microprocessor crystal, an adjustable digital divider, and a phase-lock-loop circuit. This provides for extremely high stability both long and short term. The output signal is then delivered to the main RF generator.

Main RF Generators

The main RF generator provides the sinusoidal oscillation and adjustable intensity to the transducer. It receives its input signal from the digitally synthesized oscillator, amplifies this signal and then low-pass filters the amplified signal prior to providing the oscillation to the transducer element.

Transducers

The transducer consists of a lead-zirconate-titanate piezo-electric device which converts electrical energy (from the main RF generator) into acoustical energy in the form of mechanical vibrations.

Front Panel Controls and Displays

The front panel of the unit provides a synchronous motor timer for accurate treatment times, a meter for accurate dosage (both in total power and intensity), and a pulse rate control for the selection of seven different pulse rates and duty cycles. Also contained on the front panel control is a indicator showing the ultrasound is active, and that the power is on.

Ultrasound Calibration and Tuning Procedure

Ultrasound Service Information

Rich-Mar Corporation recommends that all Rich-Mar ultrasonic therapy products be returned to the factory or to a servicing Rich-Mar distributor for service or calibration. It is recommended that the device be calibrated annually or when any major component is changed.

Caution

Calibration and peaking adjustments must not be attempted unless the person performing these adjustments has the proper test equipment, which must include an acceptable ultrasonic wattmeter, such as the Ohmic UPM-30 or equivalent. Degassed water must be used to obtain accurate readings.

Warning

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

These controls are as follows:

Main Board

R3 – Sets the maximum power output for the 10cm² transducer.

R40 - Calibrates the upper scale of the front panel meter.

R21 - Controls the “Ultrasonic Active LED”. This must be adjusted using the 5cm² transducer.

R23 - This also controls the “Ultrasonic Active LED”. This must be adjusted using the 5cm² transducer.

R13 - Sets the maximum power output for the 5cm² transducer.

R42 – Calibrates the lower scale of the front panel meter.

RF Deck

SW1- Peaking adjustment – “rough tuning”

SW2 - Peaking adjustment – “fine tuning”

Annual Calibration

Values given are for both models. If different, values in parentheses are given for the Model X.

- 1) Place the transducer under test in an Ohmic UPM-30 watt meter, or equivalent.
- 2) Increase the intensity of the unit to its maximum.
- 3) The unit should be emitting at least 10.0 (21.0) watts, and no more than 12.0 (21.0). If this is not the case, perform the Full Calibration procedure listed in the following the section.
- 4) Adjust R42 such that the correct front panel scale corresponds to the output of the unit.

Calibration of the unit is now complete. Check the accuracy of the unit at 5 and 10 (and 15) watts. The tolerance allowed by the FDA is 20% in either direction.

Full Calibration Procedure

- 1) Remove metal hole plugs from rear of unit.
- 2) Rotate the front-panel intensity knob to its maximum setting (fully clock-wise).
- 3) Place transducer in a UPM-30 wattmeter and set the balance ready to read 11.0 (21.0) watts.
- 4) Adjust R3 clockwise until the unit is emitting 11.0 (21.0) watts.
- 5) Adjust R42 clockwise until the front-panel meter reads 11.0 (21.0).

Calibration of the unit is now complete. Check the accuracy of the unit at 5 and 10 (and 15) watts. Tolerance allowed by the FDA is 20% in either direction.

Tuning (Peaking) Procedure

(NOTE: This will only be required if the transducer or portions of the RF generator have been changed.)

Place the transducer requiring peaking in a wattmeter. Increase the front-panel intensity until the pointer is about one-half of its full intensity (pointer straight up). Turn the unit on, and place in the continuous setting.

- 1) Adjust the switch to the left on the oscillator board until the maximum deflection (maximum output) is achieved on the wattmeter. The crystal is now "roughly" peaked.
- 2) Decrease the switch position by one (i.e.- if the switch was on "6", put in "5" position). Now set the rear switch at "0". Begin to increment the switches in numerical order until the maximum power is reached. (Example: 50, 51, 52,...58, 59, 60, 61, 62 is found to be the maximum because at 63 the power begins to decrease.)
- 3) **Add five to the maximum**, and set the switches accordingly. (Continuing as described above, set the switch position to 67.)
- 4) Continue with the Full Calibration Procedure.

Ultrasonic Active Setting Procedure

- 1) Adjust R21 fully counter clockwise (CCW), and R23 fully clockwise (CW).
- 2) Make certain that the transducer cable is attached to the RF deck.
- 3) Turn the unit on and adjust the front panel intensity until the meter reads one watt total output. Put the machine in the 10% duty cycle position.
- 4) Adjust R21 clockwise until UA light comes on.
- 5) Disconnect the RF cable. Adjust the front panel intensity until the meter reads 3.0 watts. Adjust R23 counter clockwise until the UA light comes on.
- 6) The UA light is now adjusted. Replace the RF deck cable.

Trouble-Shooting

Listed below are several options for troubleshooting the Rich-Mar Models V & X Ultrasounds. If these solutions fail to remedy the problem, please call the Rich-Mar Service Department at 1-800-762-4665.

1.) Unit fails to turn on.

Check power cord for full installation.

Check fuse.

Check timer connections.

2.) Ultrasonic active indicator fails to illuminate.

Check to see that the cradle is in the upright position.

Check internal cable connection.

Check "Ultrasonic Active" setting.

Check LED.

3.) Meter won't advance.

Check to see that the cradle is in the upright position.

Check meter connection.

Check voltage supply.

4.) Meter reads very low level and there is no "Ultrasonic Active" light on.

Check to see that the opposite cradle is in the down position and that opposite transducer is hung up properly.

Check to see that the cradle is in the upright position.

Model V & X Specifications

Input: 120VAC, 60Hz, 1.5 amp
220VAC, 50Hz

Dimensions: W-14"
D-9"
H-5"

Weight: 11 lbs

APPENDIX A
ULTRASOUND TECHNICAL INFORMATION

Ultrasound Technical Information

Applicator Type:

The ultrasonic radiation fields produced by Rich-Mar therapeutic ultrasound transducers are of the plane wave type and are essentially cylindrical in shape. This type of applicator is referred to as a collimating applicator.

Applicator Label:

Each Rich-Mar applicator is labeled to provide the user with information on its applicable parameters. The following abbreviations are used on the label.

Gen: The Rich-Mar ultrasonic generator for which the applicator is intended.

f: The operating frequency in MHz for the applicator.

Area: The effective radiating area of the applicator in square centimeters.

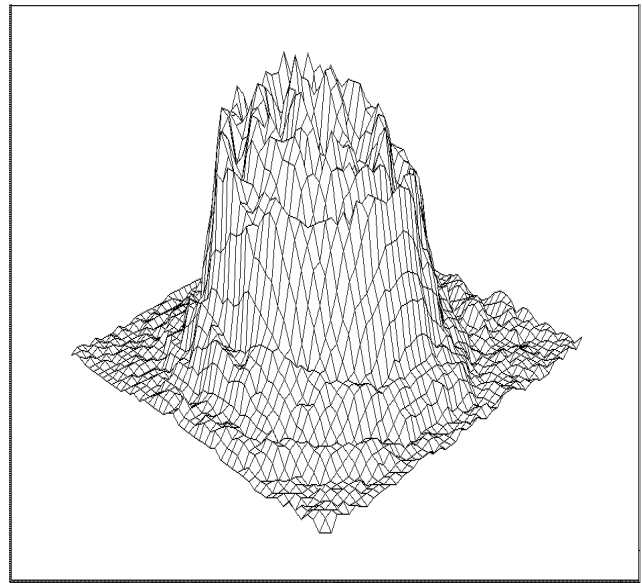
BNR: The Beam Nonuniformity Ratio.

Type: Coll-means collimating applicator.

Near Field/ Far Field

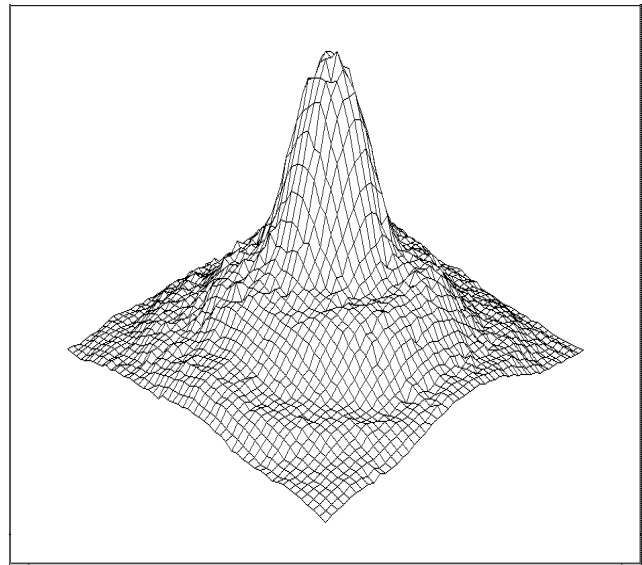
If measurements are made of the sound intensity along the central axis of the beam produced by the applicator, the intensity distribution shows maxima and minima near the applicator and then a gradual decline beyond the last maximum intensity.

The “interference” or “near field” is the area in the ultrasound beam extending from the applicator surface to the location of the most distant intensity maximum. In this area, maxima and minima of intensity are located close to each other. This is the area in which most therapeutic application occurs. This is shown in the following figure measured 0.5cm from the transducer face.



Near Field Distribution

Beyond this point, the beam has a more uniform intensity and is called the “far field”. Below is shown the far field distribution at 16cm from the transducer face.



Far Field Distribution

The preceding descriptions apply for radiation emitted into the equivalent of an infinite medium of distilled, degassed water at 30°C.

Transducer Parameters and Tolerances:

The Rich-Mar ultrasound units operate at frequencies of either 1MHz or 3MHz +/- 10%. The effective radiating areas (ERA) of the transducers are ten, five, or two square centimeters, depending upon the size of the transducer being used. The tolerance for the ERA

is +/- 25% on the 2 and 5 square centimeter transducers. The tolerance for the 10 square centimeter transducers is +0, -25%. The Beam-Nonuniformity-Ratio (BNR) for any Rich-Mar transducer is 5.5:1 or less.

100% Mode

When operated in the 100% mode, the generator produces a non-interrupted sinusoidal waveform of one or three MHz. The peak power and average power are therefore the same.

The error in indication of radiated power in intensity for the continuous mode does not exceed +/- 14% allowing for a 6% error in the wattmeter, which equals +/- 20%.

Pulsed Mode

When operated in the pulsed mode, the generator produces a square-wave burst of sinusoidal waveform of 1MHz or 3MHz of 2.5 milliseconds in duration. Depending upon the Rich-Mar model of therapeutic ultrasound in use, the duty cycle can be chosen between 5% and 95% duty. This then implies the repetition rate is selectable between 20 and 380 pulses per second. (This is computed by taking the inverse of the duty cycle $1/380 = .0026$, $1/20 = .05$). The tolerance for the pulsed mode is +/- 20%.

See the following chart for second comparison on %Duty cycle to pulses.

| % Duty Cycle | Pulses/Second |
|---|---------------|
| <small>(Indicated on front panel of device)</small> | |
| 5 | 20 |
| 10 | 40 |
| 15 | 60 |
| 20 | 80 |
| 25 | 100 |
| 30 | 120 |
| 35 | 140 |
| 40 | 160 |
| 45 | 180 |
| 50 | 200 |
| 55 | 220 |
| 60 | 240 |
| 65 | 260 |
| 70 | 280 |
| 75 | 300 |
| 80 | 320 |
| 85 | 340 |
| 90 | 360 |
| 95 | 380 |

The error in indication of radiated power in intensity for the pulsed mode does not exceed +/-14% allowing for an allowable 6% error in the wattmeter, which equals +/-20%.

Timer Accuracy

The Food and Drug Administration requires that the treatment timer accuracy is to within 0.5 minutes for the preset duration of emission for settings less than five minutes, to within 10% of the preset duration of emission for settings from five to ten minutes, and to within one minute of the preset duration of emission for settings greater than ten minutes.

Ratio of Temporal Peak to Temporal Average (Rtpa):

The ratios of temporal peak to temporal average intensities (Rtpa) will vary with the pulse rate of the device. Depending upon the Rich-Mar model of therapeutic ultrasound in use, the duty cycle can be chosen between 5% and 95% duty.

The Rtpa is calculated in the following manner:

$Rtpa = (1/Duty):1$

Example 5% duty = .05 (min. duty, max. Rtpa)

$Rtpa = (1/.05):1$

$Rtpa = 20:1$

Example 95% duty = .95 (max. pulsed duty, min. Rtpa)

$Rtpa = (1/.95):1$

$Rtpa = 1.05:1$

See the following chart for %Duty cycle to Rtpa comparison.

| % Duty Cycle | Rtpa |
|---|--------|
| <small>(Indicated on front panel of device)</small> | |
| 5 | 20:1 |
| 10 | 10:1 |
| 15 | 8.33:1 |
| 20 | 5:1 |
| 25 | 4:1 |
| 30 | 3.33:1 |
| 35 | 2.86:1 |
| 40 | 2.5:1 |
| 45 | 2.22:1 |
| 50 | 2:1 |
| 55 | 1.82:1 |
| 60 | 1.66:1 |
| 65 | 1.54:1 |
| 70 | 1.43:1 |
| 75 | 1.33:1 |
| 80 | 1.25:1 |
| 85 | 1.18:1 |
| 90 | 1.11:1 |
| 95 | 1.05:1 |

The Rtpa tolerance does not exceed +/- 20%.
The temporal maximum intensity for each duty cycle as well as the 100% modulation is whatever is indicated on the meter.

The temporal average intensity for each duty cycle will be the meter indication multiplied by the percentage duty cycle.

Temporal Average = (Duty) x (Meter Indication)
Example, 5 Watts, 35% Duty
Temporal Average = .35 x 5 Watts = 1.75 Watts

The Spatial Average Intensities for each of these setting will be divided by the transducer's Effective Radiating Area (ERA)

Spatial Average = (Temporal Average)/(ERA)
Example, 5 Watts, 35% Duty, 5cm² Transducer

Spatial Average = (1.75 Watts)/(5cm²) = 0.35 Watts/cm²

The pulse width (On time) of all Rich-Mar therapeutic ultrasound devices is 2.5 milliseconds (mS). The time between pulses (Off time) in milliseconds is calculated as follows:

$$\text{Pulse width (On time)} = 2.5\text{mS}$$

$$\text{Off time} = [2.5 - 2.5(\% \text{Duty cycle})] / (\% \text{Duty cycle})$$

Where %Duty cycle is represented as a decimal.

Please see the following example for computing the Off time for a 10% Duty cycle:

$$\text{Off time} = [2.5 - 2.5(0.10)] / (0.10) = 22.5 \text{ milliseconds}$$

Additional Technical Notes:

The peak power is the same in the pulsed modes as in the 100% modulated mode.

Unless otherwise stated, all technical parameters are accurate within +/- 20%.

When in the pulse modes the unit is still generating therapeutic heat, although it is an amount reduced by a factor directly related to the duty cycle. The pulse rates are used to allow the practitioner to treat areas of bony prominences without creating periosteal pain. The line leakage is tested in both the forward and reverse polarities to be less than 50 microamperes exceeding all standards for medical devices in this class.

The device is designed to meet or exceed UL Standards 544 for medical devices and the Canadian Standards Association (CSA), No. 125.

APPENDIX B
PARTS LIST

Rich-Mar Model V/X Ultrasound Parts List

* DENOTES PARTS FOR THE MODEL X ONLY

Main Board (Part name 2644 and 2649*)

| Part # | Value | Description | Rich-Mar Part No. |
|-------------------------|-------------------|-------------------------|-------------------|
| C01 | 2200 UF 35V | CAPACITOR, ELECTROLYTIC | CA2845 |
| C02 | .1UF 50V | CAPACITOR, CERAMIC MONO | CA2809 |
| C03 | 10UF 100V | CAPACITOR, ELECTROLYTIC | CA2832 |
| C04 | 1000UF 80V | CAPACITOR, ELECTROLYTIC | CA2894 |
| C05* | .1UF 500V | CAPACITOR, CERAMIC | CA2819 |
| C06* | 25UF 150V | CAPACITOR, ELECTROLYTIC | CA2840 |
| C07 | .1 500V | CAPACITOR, CERAMIC | CA2819 |
| C08 | 10UF 100V | CAPACITOR, ELECTROLYTIC | CA2832 |
| C09 | 25 UF 150V | CAPACITOR, ELECTROLYTIC | CA2840 |
| C10 | 1UF 35V | CAPACITOR, TANTALUM | CA2813 |
| C11, C12, C13, C14, | .1UF 50V | CAPACITOR, CERAMIC MONO | CA2809 |
| C15, C16, C17, C18, | | | |
| C19, C20, C22, C25, C26 | | | |
| C21 | 1UF 50V | CAPACITOR, CERAMIC MONO | CA2801 |
| C23, C24 | .1UF 500V | CAPACITOR, CERAMIC | CA2819 |
| C27 | .001UF 1KV | CAPACITOR, CERAMIC | CA2823 |
| C28 | 1UF 35V | CAPACITOR, TANTALUM | CA2813 |
| CR1, CR2, CR3, CR4 | 1N914 | DIODE | DI4602 |
| CR5*, CR6, CR7, CR8 | 1N4005 (1N5404*) | DIODE | DI4605 (4601*) |
| CR9, CR10 | 1N4005 | DIODE | DI4605 |
| CR11, CR12, CR13 | 1N914 | DIODE | DI4602 |
| CR15 | 1N4005 | DIODE | DI4605 |
| H01 | | HEATSINK (THM 7020) | HS5203 |
| H02, H03, H04* | | HEATSINK (THM 6354) | HS5210 |
| J01 | 2PIN MALE | CONNECTOR, AMP | CN4162 |
| J02 (FAN AC) | 2PIN MALE .1" | CONNECTOR, AMP | CN4164 |
| J04, 05, J06 | 4PIN MALE .156" | CONNECTOR, AMP | CN4168 |
| J07 | 10PIN RIBBON | CONNECTOR | CN4124 |
| | CABLE SKT | | |
| J08 | 4PIN MALE .1" | CONNECTOR, AMP | CN4170 |
| J10 | INTERNAL RF CABLE | CONNECTOR, RCA | JK5503 |
| J11 | 20PIN MALE .1" | CONNECTOR, AMP | CN4182 |
| LF | | FILTER, LINE | FI4901 |
| L2* | WOUND @ FACTORY | INDUCTOR | CL4417 |

Rich-Mar Model V/X Ultrasound Parts List, Cont.

* DENOTES PARTS FOR THE MODEL X ONLY

Main Board (Part name 2644 and 2649*)

| Part # | Value | Description | Rich-Mar Part No. |
|----------|---------------------|--------------------|-------------------|
| Q01 | LM340T12 (+12V REG) | INTEGRATED CIRCUIT | TS8552 |
| Q02 | LM 338K (REG) | INTEGRATED CIRCUIT | TS8551 |
| Q03 | LM 317HVK (HV REG) | INTEGRATED CIRCUIT | TS8549 |
| Q04 | 2N3904 | TRANSISTOR, NPN | TS8570 |
| R01* | 5K 1/2W 10% | TRIMMER POT | TR8812 |
| R02* | 220 1/2W 5% | RESISTOR | RS7137 |
| R03 | 100K 1/2W 5% | TRIMMER POT | TR8801 |
| R04 | 220 1/2W 5% | RESISTOR | RS7137 |
| R05 | 100K 1/2W 5% | RESISTOR | RS7117 |
| R06 | 20K 1/2W 5% | RESISTOR | RS7129 |
| R07 | 470K 1/2W 5% | RESISTOR | RS7155 |
| R08 | 1K 1/2W 5% | RESISTOR | RS7192 |
| R09 | 15K 1/2W 5% | RESISTOR | RS7115 |
| R10 | 100K 1/2W 5% | RESISTOR | RS7117 |
| R11 | 20K 1/2W 5% | RESISTOR | RS7129 |
| R12 | 1 MEG 1/2W 5% | RESISTOR | RS7106 |
| R13 | 10K 1/2W 5% | RESISTOR | RS7109 |
| R14, R15 | 47K 1/2W 5% | RESISTOR | RS7153 |
| R16 | 470K 1/2W 5% | RESISTOR | RS7155 |
| R17 | 330K 1/2W 5% | RESISTOR | RS7148 |
| R18 | 1 MEG 1/2W 5% | RESISTOR | RS7106 |
| R19 | 10K 1/2W 5% | RESISTOR | RS7109 |
| R20 | 100K 1/2W 5% | RESISTOR | RS7117 |
| R21 | 50K 1/2W 10% | TRIMMER POT | TR8801 |
| R22 | 100K 1/2W 5% | RESISTOR | RS7117 |
| R23 | 100K 1/2W 10% | TRIMMER POT | TR8801 |
| R24 | 10K 1/2W 5% | RESISTOR | RS7109 |
| R25 | 470K 1/2W 5% | RESISTOR | RS7154 |
| R27 | 35.7K 1/8W 1% | RESISTOR | RS7208 |
| R28 | 287K 1/8W 1% | RESISTOR | RS7222 |
| R29 | 169K 1/8W 1% | RESISTOR | RS7220 |
| R30 | 107K 1/8W 1% | RESISTOR | RS7217 |
| R31 | 71.5K 1/8W 1% | RESISTOR | RS7214 |
| R32 | 48.7K 1/8W 1% | RESISTOR | RS7212 |

Rich-Mar Model V/X Ultrasound Parts List, Cont.

* DENOTES PARTS FOR THE MODEL X ONLY

Main Board (Part name 2644 AND 2649*)

| Part # | Value | Description | Rich-Mar Part No. |
|--------|----------------|-----------------------------|-------------------|
| R33 | 30.9K 1/8W 1% | RESISTOR | RS7207 |
| R34 | 1 MEG 1/2W 5% | RESISTOR | RS7106 |
| R35 | 100K 1/2W 5% | RESISTOR | RS7117 |
| R36 | 20K 1/2W 5% | RESISTOR | RS7129 |
| R37 | 1 MEG 1/2W 5% | RESISTOR | RS7106 |
| R38 | 10K 1/2W 5% | RESISTOR | RS7109 |
| R39 | 47K 1/2W 5% | RESISTOR | RS7153 |
| R40 | 10K 1/2W 5% | RESISTOR | RS7109 |
| R41 | 20K 1/2 W 5% | RESISTOR | RS7129 |
| R42 | 100K 1/2W 10% | TRIMMER POT | TR8801 |
| R43 | 330K 1/2W 5% | RESISTOR | RS7148 |
| R44 | 10 MEG 1/2W 5% | RESISTOR | RS7111 |
| R45* | 6.8K 1/2W 5% | RESISTOR | RS7167 |
| U01 | 4049 | INTEGRATED CIRCUIT | TS8529 |
| U02 | 4071 | INTEGRATED CIRCUIT | TS8534 |
| U03 | LM353 | INTEGRATED CIRCUIT | TS8560 |
| U04 | LM 353 | INTEGRATED CIRCUIT | TS8560 |
| U05 | 555 | INTEGRATED CIRCUIT | TS8573 |
| U06 | 4040 | INTEGRATED CIRCUIT | TS8527 |
| U07 | 4081 | INTEGRATED CIRCUIT | TS8538 |
| U08 | LM339 | INTEGRATED CIRCUIT | TS8557 |
| C01 | .018UFD 400V | CAPACITOR, POLYPROPELENE 5% | CA2803 |
| C02 | .020UFD 400V | CAPACITOR, POLYPROPELENE 5% | CA 2802 |
| C03 | .018UFD 400V | CAPACITOR, POLYPROPELENE 5% | CA 2803 |
| C04 | .1UFD 500V | CAPACITOR, POLYPROPELENE 5% | CA2819 |
| C05 | .001UFD 500V | CAPACITOR, CERAMIC DISK | CA2823 |
| C06 | 69=80 PF 500V | CAPACITOR, CERAMIC DISK | CA2889 |
| C07 | .001UFD 1KV | CAPACITOR, DIPPED MICA (2) | CA2823 |
| C08 | .1UFD 50V | DIODE, 1N914 | CA2819 |
| CR1 | | CONNECTOR, AMP 2PIN .1M | D150914 |
| P01 | | CONNECTOR, AMP 2PIN .1M | CN4164 |
| P03 | | | CN4164 |
| P04 | | | CN4164 |

Rich-Mar Model V/X Ultrasound Parts List, Cont.

* DENOTES PARTS FOR THE MODEL X ONLY

1 MHz RF Deck Board (Part name 2657)

| Part # | Value | Description | Rich-Mar Part No. |
|--------------------|---------------|--|-------------------|
| C1 | .018 UFD 400V | CAPACITOR, POLYPROPYLENE 5% | CA2802 |
| C2 | .020 UFD 400V | CAPACITOR, POLYPROPYLENE 5% | CA2803 |
| C3 | .018 UFD 400V | CAPACITOR, POLYPROPYLENE 5% | CA2802 |
| C4 | .1 UFD 500V | CAPACITOR, CERAMIC DISK | CA2819 |
| C5 | .001 UFD 1 KV | CAPACITOR, CERAMIC DISK | CA2823 |
| C6 (2) | 680 PF 500V | CAPACITOR, DIPPED MICA (2) | CA2888 |
| C7 | .001 UFD 1 KV | CAPACITOR, CERAMIC DISK | CA2823 |
| C8 | .1 UFD 50V | CAPACITOR, CERAMIC BLOCK | CA2809 |
| CR1 | | DIODE, IN914 | DI4602 |
| Q1 | | 15N40 (preferred) or 10N40 TRANSISTOR | 8698 or 8502 |
| P1 | | CONNECTOR, AMP 2 PIN .1M | CN4164 |
| P2 | | WIRE, COAXIAL CUSTOM | CN4164 |
| P2A | | CONNECTOR, AMP 2 PIN .1M | CN4164 |
| P3 | | CONNECTOR, AMP 2 PIN .1M | CN4164 |
| P4 | | CONNECTOR, AMP 2 PIN .1M | CN4164 |
| T1, T2, T3, T4, T5 | | ALL TORROIDS ARE CUSTOM WOUND ONTO THE CIRCUIT BOARD AND MUST BE REPLACED AT THE FACTORY | |

Osc. Board (Part name 2678)

| Component No. | Value | Description | Rich-Mar Part No. |
|--------------------------------|-------------|---------------------------------|-------------------|
| C1, C2, C3, C4, C6, C7, C8, C9 | .1UFD 50V | CAPACITOR, CERAMIC BLOCK | CA2809 |
| C5 | .1UFD 50V | CAPACITOR, CERAMIC BLOCK | CA2887 |
| C10 | 47PF 150V | CAPACITOR, DIPPED MICA | CA2864 |
| C11 | .1UFD 50V | CAPACITOR, CERAMIC BLOCK | CA2809 |
| C12 | .1UFD 50V | CAPACITOR, CERAMIC DISK | CA2887 |
| C13 | .068UFD 50V | CAPACITOR, CERAMIC DISK | CA2809 |
| CR1 | | DIODE, IN914 | DI4602 |
| P1 | | PLUG, RIBBON CABLE 10P RT ANGLE | CN4122 |
| R1, R2 | 10K | RESISTOR, 1/2W 5% | RS7109 |
| R3 | 100K | RESISTOR, 1/2W 5% | RS7117 |
| R4 | 4.7K | RESISTOR, 1/2W 5% | RS7150 |
| R5 | 10 MEG | RESISTOR, 1/2W 5% | RS7111 |
| R6 | 4.7K | RESISTOR, 1/2W 5% | RS7150 |
| R7, R8 | 10K | RESISTOR, 1/2W 5% | RS7109 |

Rich-Mar Model V/X Ultrasound Parts List, Cont.

* DENOTES PARTS FOR THE MODEL X ONLY

Osc. Board (Part name 2678, Cont.)

| Component No. | Value | Description | Rich-Mar Part No. |
|---------------|-------|--------------------------|-------------------|
| RP1 | 10K | RESISTOR PAK, 10 PIN SIP | RS7185 |
| S1 | | SWITCH, BCK RIGHT ANGLE | SW7805 |
| S2 | | SWITCH, BCD RIGHT ANGLE | SW7805 |
| U1 | 4538 | INTEGRATED CIRCUIT | TS8581 |
| U2 | 4049 | INTEGRATED CIRCUIT | TS8529 |
| U3 | 4040 | INTEGRATED CIRCUIT | TS8527 |
| U4 | 4046 | INTEGRATED CIRCUIT | TS8528 |
| U5 | 4059 | INTEGRATED CIRCUIT | TS8531 |
| U6 | 4001 | INTEGRATED CIRCUIT | TS8520 |
| U7 | 4013 | INTEGRATED CIRCUIT | TS8525 |
| U8 | 4050 | INTEGRATED CIRCUIT | TS8530 |
| Y1 | | CRYSTAL, 2048KC | MS9110 |

Panel Board (Part name 2645)

| Component No. | Value | Description | Rich-Mar Part No. |
|--------------------------------------|-------|---------------------------|-------------------|
| CR1 | | LED, GREEN | LI5905 |
| CR2, CR3, CR4, CR5, CR6, CR7, CR8 | | LED, AMBER | LI5903 |
| J1 | | CONNECTOR, AMP 20 PIN .1M | CN4182 |
| J2, J3 | | CONNECTOR, AMP 2 PIN .1M | CN4164 |
| L1 | | METER, MODEL V | ME6101 |
| Q1 | | TRANSISTOR, MPSA42 | TS8565 |
| R1 | 25K | POT | PO6517 |
| R2, R3, R5 | 10K | RESISTOR, 1/2W 5% | RS7109 |
| R4 | 20K | RESISTOR, 1/2W 5% | RS7103 |
| R6 | 1K | RESISTOR, 1/2W 5% | RS7192 |
| S1 | | SWITCH, ROTARY | S27807 |
| L1 | | METER X | ME6102 |
| | | SPACER, NYLON | SP0717 |

Rich-Mar Model V/X Ultrasound Parts List, Cont.

* DENOTES PARTS FOR THE MODEL X ONLY

Chassis (Part name 0123 and 0124*)

Rich-Mar Part No.

Description

| | |
|-----------|-----------------------------------|
| FA4802 | FAN |
| TI8101 | TIMER 30 MINUTE |
| BD2648 | OPTO SWITCH BOARD |
| TF8302 | TRANSFORMER, EE 994* (RMV) |
| TF8302 | TRANSFORMER, EE 994* (RMV) |
| KN5701 | KNOB POINTER |
| KN5702 | KNOB ROUND |
| CN4182 | CONNECTOR, AMP 20 PIN (2) |
| CN4162 | CONNECTOR, AMP 2 PIN .156" FEMALE |
| CN4167 | CONNECTOR, AMP 4 PIN .1" FEMALE |
| JK5509 | COMBO JACK |
| FU5008 | FUSE 1 AMP SLOW |
| FU5001 | FUSE HOLDER (SAME AS HV2000) |
| LI5902 | GREEN LED COVERS |
| LI5905 | GREEN LED |
| LC1733 | LINE CORD |
| J 5030448 | RCA MALE CONNECTOR-SOLDER TYPE |
| MS9114 | STRAIN RELIEF (LINE CORD) |
| SH7415 | TRANSUDUCER, C4 COMPLETE* (RMV) |
| TRND O214 | TRANSUDUCER, C5 COMPLETE* (RMX) |
| CN4168 | CONNECTOR, AMP 4 PIN .156" FEMALE |
| CH3734 | BLACK FEET |
| LI5903 | AMBER LED COVERS |

APPENDIX C
SCHEMATICS