

**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).

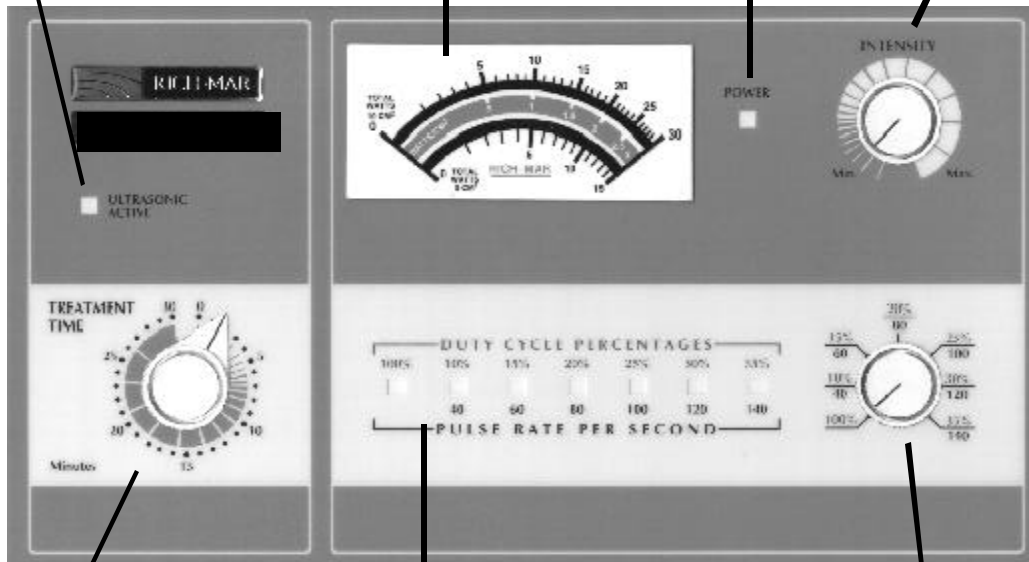
Rich-Mar Models V & X Front Panel Illustration (Figure 1)

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.

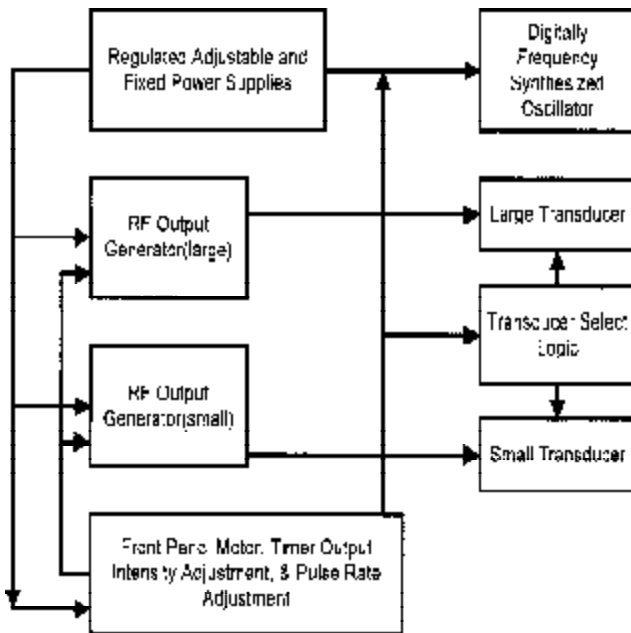
Using the indifferent electrode (dispersive pad) to complete the circuit, the user will now be able to provide electrical stimulation as well as ultrasound through the transducer.



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 an 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.

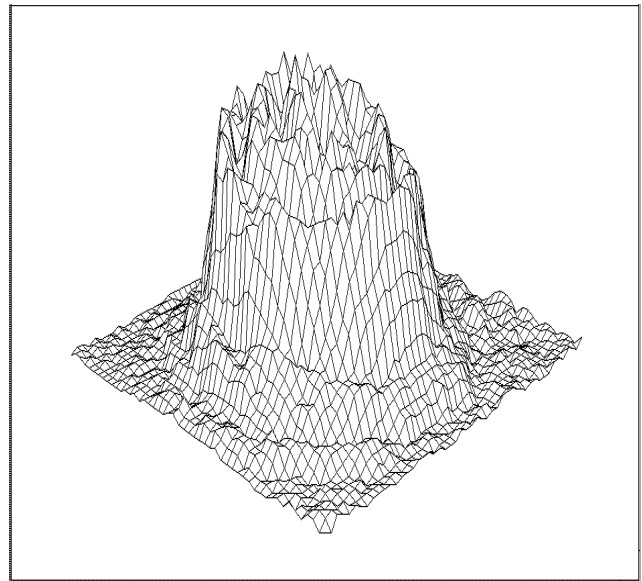
BNR: The Beam Nonuniformity Ratio.

Type: Coll-means collimating applicator.

Near Field/ Far Field

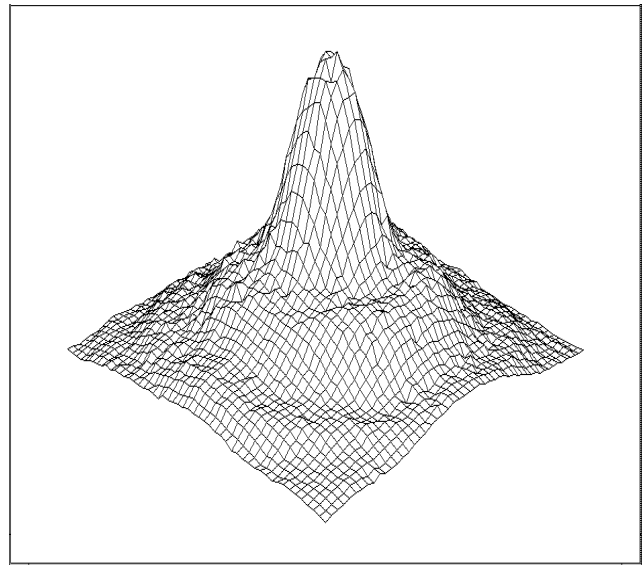
If measurements are made of the sound intensity along the central axis of the beam produced by the applicator, the intensity distribution shows maxima and minima near the applicator and then a gradual decline beyond the last maximum intensity.

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