RICH-MAR 510 ULTRASOUND
OPERATION HANDBOOK AND MANUAL

Part # MN2440
Rev. E
Batch 000

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 accessories NOT manufactured by Rich-Mar. These include patient lead cords, self-adhesive electrodes, and carbon electrodes.

CAUTION: When using carbon electrodes with any Rich-Mar stimulator, a moistened interface (cloth or sponge) MUST be utilized between these electrodes and the patient to avoid skin irritation and/or electrical burns.

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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 diastheses.
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 unrepairable damage may occur to the transducer in an unloaded state.

Rich-Mar 510 Ultrasound

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 by the largest transducer (30-510). The lower black scale reads the output in total watts produced by the smallest transducer (15). The center blue scale reads the output produced in peak watts per square centimeter and is common to both transducers.
8) **Cradle:** Each 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.

NOTE: The Model 510 ultrasound will not output ultrasound with both transducers removed from the cradles. One transducer must remain in the cradle at all times in order to receive ultrasonic output.

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.

Select either transducer and remove it from the **Cradle** (8). The **Ultrasonic Active Indicator** (2) will then be illuminated. (NOTE: The Rich-Mar 510 ultrasound will not output ultrasound with both transducers removed from the cradles.)

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.

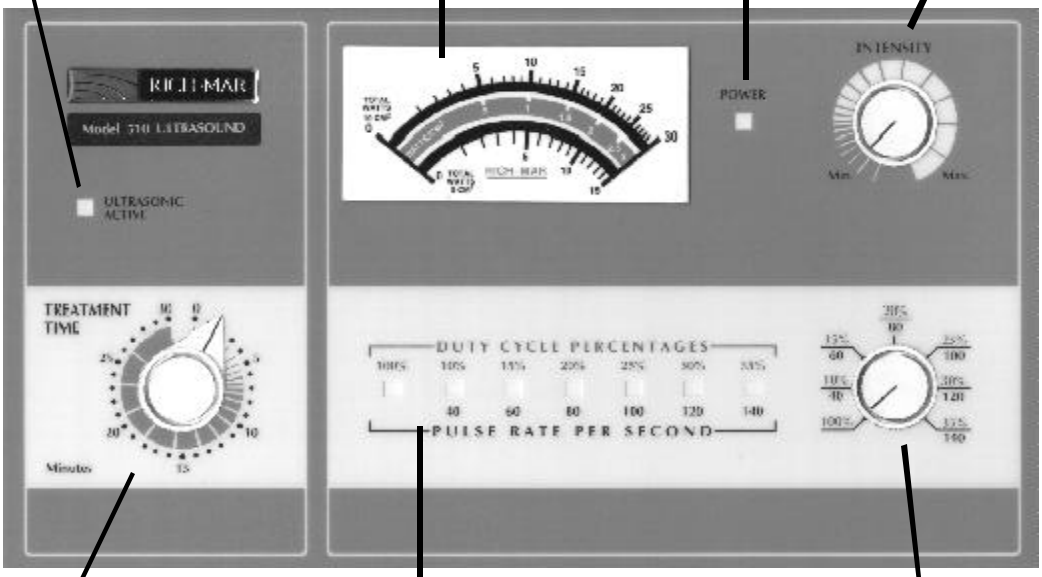
The ultrasound output intensity can now be increased to the required level with the Intensity Control. The intensity level will now be indicated on the **Wattmeter** (7).

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 510 Ultrasound
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

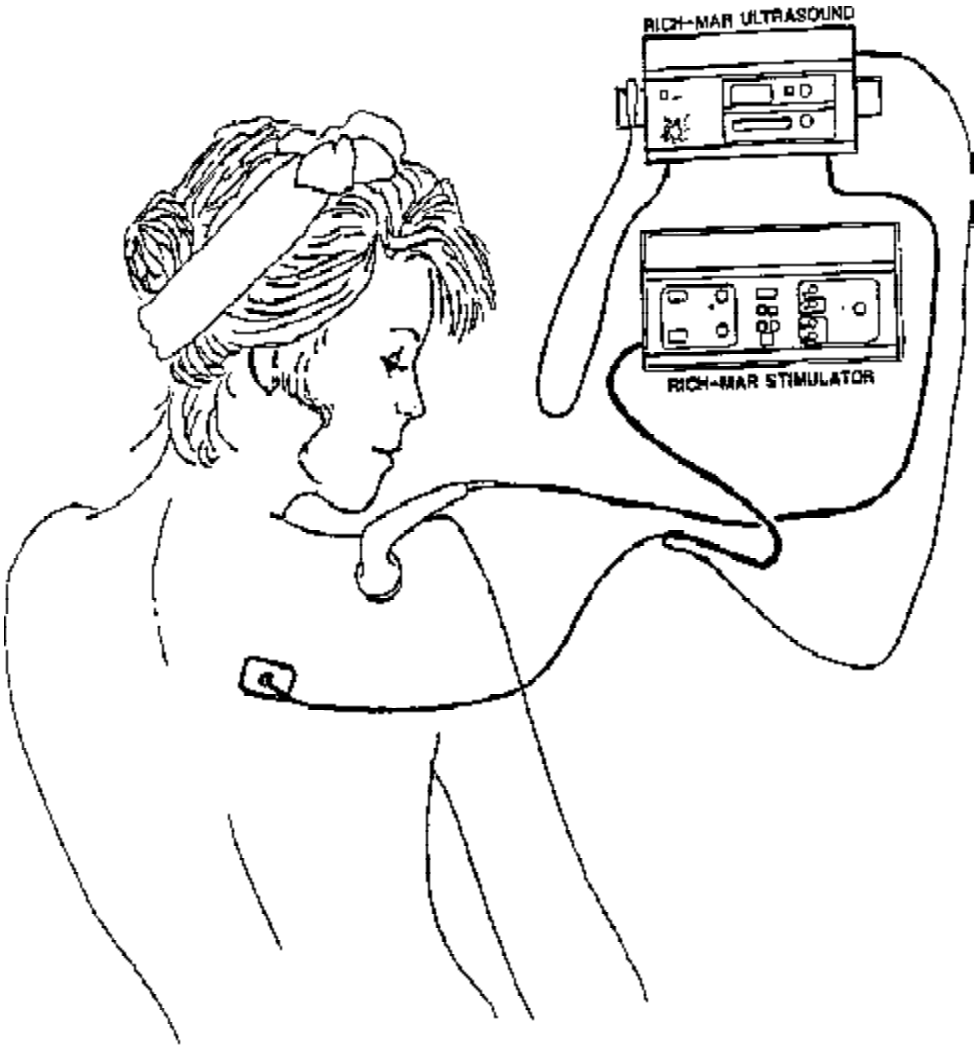
8. Transducer Cradles are located on both sides of the unit.

Combining Ultrasound with Rich-Mar Stimulation
(Figure 2)

The Rich-Mar dual head ultrasounds are designed to be connected to any Rich-Mar muscle stimulator, thus enabling the user to provide combination therapy to patients.

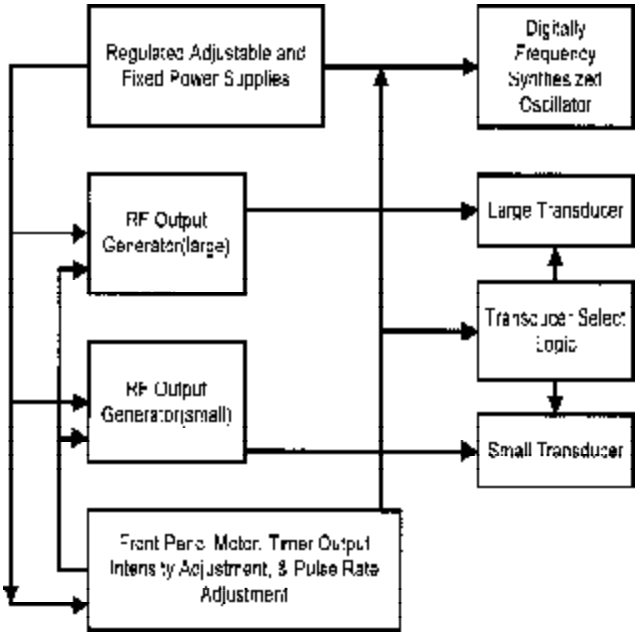
To connect the ultrasound unit to a stimulator, simply plug the connecting cable into the jack located on the lower right rear side panel of the unit.

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
Each 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 10cm^2 transducer.

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

R21- Controls the "Ultrasonic Active LED". This must be adjusted using the 5cm^2 transducer.

R23- This also controls the "Ultrasonic Active LED". This must be adjusted using the 5cm^2 transducer.

R13- Sets the maximum power output for the 5cm^2 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

R3 and R40 on the main board are used to set the right transducer, R13 and R42 are used to set the left transducer.

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 between 25.8-30 watts for the 10cm^2 transducer and 12.9-15 for the 5cm^2 transducer. If this is not the case, perform the Full Calibration procedure listed in the following the section.
4) Adjust R40-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 30, 15, 5 watts for the 10cm^2 side and 15, 10, 5 watts for the 5cm^2 side. 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). Adjust R3 and R40-R13 and R42 fully clockwise.
3) Place transducer under calibration in a UPM-30 wattmeter and set the balance ready to read 30-10cm ^{2} watts and 15-5cm^2 watts.
4) Adjust R3-R13 counter clockwise until the unit is emitting 30 watts -10cm^2 and 15 watts - 5cm^2.
5) Adjust R40-R42 counter clockwise until the front-panel meter reads 30 watts - 10cm^2 scale and 15 watts - 5cm^2 scale.

Calibration of the unit is now complete. Check the accuracy of the unit at 30, 15, and 5 watts for the 10cm^2 side and at 15, 10, and 5 watts for the 5cm^2 side. 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

(NOTE: This procedure must be done using the small transducer.)

1) Set maximum output and meter output reading.
2) Turn intensity pot down until meter reads 2 watts on top scale of meter.
3) Switch selector switch to 10%, adjust R23 fully clockwise, turn R21 counter clockwise until UA light goes out (if light is already out go to next step).
4) Adjust R21 clockwise until UA light comes on.
5) Unplug SH from deck and turn intensity up until meter reads 3.0 watts on top scale of meter.
6) Adjust R23 counter clockwise until UA light comes on, turn intensity to 3.5 watts and UA light should go out. If UA light does not extinguish, repeat step 6.

Trouble-Shooting

Listed below are several options for troubleshooting the Rich-Mar Model 510 Ultrasound. 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 510 Specifications

Input:	120VAC, 60Hz, 1.5 amp 220VAC, 50Hz
Dimensions:	W-14.25"/35.6cm D-9.125" 22.8cm H-5"/12.5cm
Weight:	15 lbs/6.75kg

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.

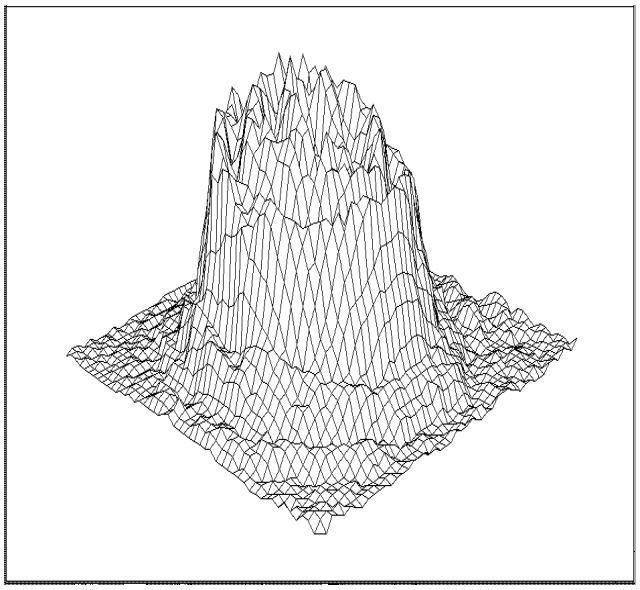
f: The operating frequency in MHz for the applicator.

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

BNR: The Beam Nonuniformity Ratio.

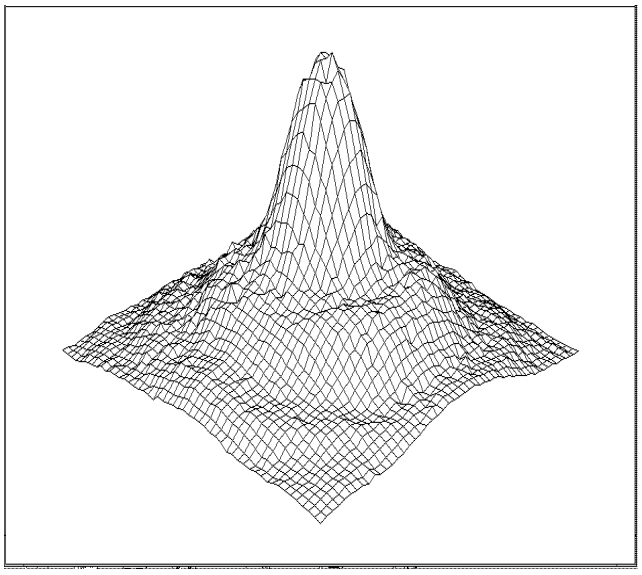
Type: Coll-means collimating applicator.

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 = .95, 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 (Indicated on front panel of device)	Pulses/ Second
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 (Indicated on front panel of device)	Rtpa
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, $5cm^2$ Transducer

Spatial Average = (1.75 Watts)/($5cm^2$) = 0.35 Watts/cm^2

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:

Pulse width (On time) = 2.5mS
Off time=[2.5-2.5(%Duty cycle)]/(%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:
Off tiem=[2.5-2.5(0.10)]/(0.10)=22.5 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 510 Ultrasound Parts List

Main Board (Part name 2652)

Part #	Value	Description	Rich-Mar Part No.
J07		SOCKET, RIBBON CABLE 10 PIN	CN4126
J08		CONNECTOR , AMP 4 PIN .156 M	CN4168
J09		CONNECTOR, AMP 4 PIN .156 M	CN4168
J10		CONNECTOR, RCA (INTERNAL RF)	CN4168
J11		CONNECTOR, AMP 20 PIN .1 M	CN4183
J12		CONNECTOR, RCA (INTERNAL RF)	CN4183
L1		LINE FILTER	FI4901
Q01	LM340T12	REGULATOR, +12V	TS8553
Q02	LM338K	REGULATOR, HIGH VOLT	TS8551
Q03	LM317HVK	REGULATOR, HIGH VOLT	TS8551
Q04	MPSA42	TRANSISTER, NPN	TS8549
Q05	MPSA42	TRANSISTER, NPN	TS8565
Q06	MPSA42	TRANSISTER, NPN	TR8814
R01	5K	POT, 5K TRIMMER 10 TURN	TR8814
R02	220	RESISTOR, 1/2 W 5%	RS7137
R03	100K	POT, 100K TRIMMER 10 TURN	TR8801
R04	220	RESISTOR, 1/2 W 5%	RS7137
R05	100K	RESISTOR, 1/2 W 5%	RS7117
R06	20K	RESISTOR, 1/2 W 5%	RS7129
R07	1 MEG	RESISTOR, 1/2 W 5%	RS7106
R08	1K	RESISTOR, 1/2 W 5%	RS7192
R09	15K	RESISTOR, 1/2 W 5%	RS7115
R10	100K	RESISTOR, 1/2 W 5%	RS7117
R11	20K	RESISTOR, 1/2 W 5%	RS7129
R12	1 MEG	RESISTOR, 1/2 W 5%	RS7106
R13	100K	POT, 100K TRIMMER 10 TURN	TR8807
R14, R15	47K	RESISTOR, 1/2 W 5%	RS7153
R16	470K	RESISTOR, 1/2 W 5%	RS7155
R17	330K	RESISTOR, 1/2 W 5%	RS7148
R18	1 MEG	RESISTOR, 1/2 W 5%	RS7106
R19	2K	RESISTOR, 1/2 W 5%	RS7125
R20	100K	RESISTOR, 1/2 W 5%	RS7117
R21	50K	POT, 50K TRIMMER 10 TURN	TR8811
R22	15K	RESISTOR, 1/2 W 5%	RS7115
R23	100K	POT, 100K TRIMMER 10 TURN	TR8801
R24	47K	RESISTOR, 1/2 W 5%	RS7153
R25	470	RESISTOR, 1/2 W 5%	RS7154

Rich-Mar 510 Ultrasound Parts List, Cont.

Main Board (Part name 2652)

Part #	Value	Description	Rich-Mar Part No.
R26	10K	RESISTOR, 1/2 W 5%	RS7109
R27	35.7K	RESISTOR, 1/4 W 1%	RS7208
R28	287K	RESISTOR, 1/4 W 1%	RS7222
R29	169K	RESISTOR, 1/4 W 1%	RS7220
R30	107K	RESISTOR, 1/4 W 1%	RS7217
R31	71.5K	RESISTOR, 1/4 W 1%	RS7217
R32	48.7K	RESISTOR, 1/4 W 1%	RS7212
R33	30.9K	RESISTOR, 1/4 W 1%	RS7209
R34	1 MEG	RESISTOR, 1/2 W 5%	RS7106
R35	330	RESISTOR, 1/2 W 5%	RS7149
R36	20K	RESISTOR, 1/2 W 5%	RS7129
R37	1 MEG	RESISTOR, 1/2 W 5%	RS7106
R38	10K	RESISTOR, 1/2 W 5%	RS7109
R39	47K	RESISTOR, 1/2 W 5%	RS7153
R40, R42	100K	RESISTOR, 1/2 W 5%	RS7117
R43	330K	RESISTOR, 1/2 W 5%	RS7148
R44	10M	RESISTOR, 1/2 W 5%	RS7111
R45	6.8K	RESISTOR, 1/2 W 5%	RS7167
R46	47K	RESISTOR, 1/2 W 5%	RS7153
R47	47K	RESISTOR, 1/2 W 5%	RS7153
R48	20K	RESISTOR, 1/2 W 5%	RS7129
R49	20K	RESISTOR, 1/2 W 5%	RS7129
R50	10K	RESISTOR, 1/2 W 5%	RS7109
RP1	10K	RESISTOR PACK, SIP (5)	RS7185
RP2	100K	RESISTOR PACK, SIP (5)	RS7184
RP3	10K	RESISTOR PACK, SIP (5)	RS7185
TP1		TEST POINT	TP8003
TP2		TEST POINT	TP8003
U01	4049	INTEGRATED CIRCUIT	TS8529
U02	4071	INTEGRATED CIRCUIT	TS8534
U03	LF353	INTEGRATED CIRCUIT	TS2560
U04	LF353	INTEGRATED CIRCUIT	TS2560
U06	4040	INTEGRATED CIRCUIT	TS8527
U07	4081	INTEGRATED CIRCUIT	TS8538
U08	LM339	INTEGRATED CIRCUIT	TS2557
U09	4071	INTEGRATED CIRCUIT	TS8534
U10	4070	INTEGRATED CIRCUIT	TS4533

Rich-Mar 510 Ultrasound Parts List, Cont.

Main Board (Part name 2652)

Part #	Value	Description	Rich-Mar Part No.
U11	4049	INTEGRATED CIRCUIT	TS8529
U12	LF353	INTEGRATED CIRCUIT	TS8560

Osc. Board (Part name 2678)

Part #	Value	Description	Rich-Mar Part No.
C1	.1 UFD 50V	CAPCITOR, CERAMIC BLOCK	C104010501
C10	47 PFD 150V	CAPACITOR, DIPPED MICA	C470015008
C11	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C12	.1 UFD 50V	CAPACITOR, CERAMIC DISK	C104010509
C13	.068 UFD 50V	CAPACITOR, CERAMIC DISK	C682010501
C2	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C3	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C4	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C5	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C6	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C7	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C8	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
C9	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	C104010501
CR1		DIODE, 1N914	D150914
P1		PLUG, RIBBON CABLE 10P RT ANGL	J50201-RT
R1	10K	RESISTOR, 1/2 W 5%	R103035
R2	10K	RESISTOR, 1/2 W 5%	R103035
R3	100K	RESISTOR, 1/2 W 5%	R103035
R4	4.7K	RESISTOR, 1/2 W 5%	R472035
R5	10 MEG	RESISTOR, 1/2 W 5%	R106035
R6	4.7K	RESISTOR, 1/2 W 5%	R472035
R7	10K	RESISTOR, 1/2 W 5%	R103035
R8	10K	RESISTOR, 1/2 W 5%	R103035
RP1	10K	RESISTOR PAK, 10 PIN SIP	RP550103
S1		SWITCH, BCK RIGHT ANGLE	S4510RA
S2		SWITCH, BCD RIGHT ANGLE	S4510RA
TP1		TEST POINT	H754572
TP2		TEST POINT	H754572
TP3		TEST POINT	H754572
TP4		TEST POINT	H754572
TP5		NO TEST POINT IN THIS HOLE	
TP6		TEST POINT	H754572

Rich-Mar 510 Ultrasound Parts List, Cont.

Osc. Board (Part name 2678)

Part #	Value	Description	Rich-Mar Part No.
U1	4538	INTEGRATED CIRCUIT	U214538
U2	4049	INTEGRATED CIRCUIT	U214049
U3	4040	INTEGRATED CIRCUIT	U214040
U4	4046	INTEGRATED CIRCUIT	U214046
U5	4059	INTEGRATED CIRCUIT	U214059
U6	4001	INTEGRATED CIRCUIT	U214001
U7	4013	INTEGRATED CIRCUIT	U214013
U8	4050	INTEGRATED CIRCUIT	U214050
Y1		CRYSTAL, 2048KC	Y8520485

1 MHz RF Deck Board (Part name 2657) - two per device

Part #	Value	Description	Rich-Mar Part No.
C1	.018 UFD 400V	CAPACITOR, POLYPROPELENE 5%	CA2802
C2	.020 UFD 400V	CAPACITOR, POLYPROPELENE 5%	CA2803
C3	.018 UFD 400V	CAPACITOR, POLYPROPELENE 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, 1N914	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	

Chassis (Part name 0127)

Rich-Mar Part No.	Description
FA4802	FAN
TI8101	TIMER 30 MINUTE
BD2648	OPTO SWITCH BOARD
TF8302	TRANSFORMER, EE 994 (RMV)
TF8302	TRANSFORMER, EE 994 (RMX)
KN5701	KNOB POINTER

Rich-Mar 510 Ultrasound Parts List, Cont.

Chassis (Part name 0127)

Rich-Mar Part No.	Description
KN5702	KNOBS 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 1AMP SLOW
FU5001	FUSE HOLDER (SAME AS HV2000)
LI5905	GREEN LED
LC1733	LINE CORD
JK5509	RCA MALE CONNECTOR - SOLDER TYPE
MS9114	STRAIN RELIEF (LINE CORD)
SH7415	TRANSDUCER, C4 COMPLETE (RMV)
SH7464	TRANSDUCER, C5 COMPLETE (RMX)
LI5902	GREEN LED COVERS
CN4168	CONNECTOR, AMP 4 PIN .156 FEMALE
CH3734	BLACK FEET
LI 5903	AMBER LED COVERS

Panel Board (Part name 2645)

Component #	Value	Description	Rich-Mar Part No.
CR1		LED, GREEN	LI5905
CR2		LED, AMBER	LI5903
CR3		LED, AMBER	LI5903
CR4		LED, AMBER	LI5903
CR5		LED, AMBER	LI5903
CR6		LED, AMBER	LI5903
CR7		LED, AMBER	LI5903
CR8		CONNECTOR, AMP 20 PIN .1 M	CN4182
J1		CONNECTOR, AMP 2 PIN .1 M	CN4164
J2		CONNECTOR, AMP 2 PIN .1 M	CN4164
J3		METER, 25	ME6103
L1		TRANSISTOR, MPSA42	TS8565
Q1		POT	PO6517
R1	25K	RESISTOR, 1/2 W 5%	RS7109
R2	470	RESISTOR, 1/2 W 5%	RS7109
R3	470	RESISTOR, 1/2 W 5%	RS7130
R4	20K	RESISTOR, 1/2 W 5%	RS7109
R5	10K	RESISTOR, 1/2 W 5%	RS7192

Rich-Mar 510 Ultrasound Parts List, Cont.

Panel Board (Part name 2645)

Component #	Value	Description	Rich-Mar Part No.
R6	1K	SWITCH, ROTARY	SW7807
S1		METER, 510	ME6143
L1		SPACERS, NYLON	SP0717

Main Board (Part name 2652)

Component #	Value	Description	Rich-Mar Part No.
C01	2200 UFD 35V	CAPACITOR, ELECTROLYTIC RADIAL	CA2852
C02	.1 UFD 50V	CERAMIC BLOCK	CA2809
C03	10 UFD 100V	ELECTROLYTIC AXIAL	CA2832
C04	1000 UFD 80V	ELECTROLYTIC AXIAL	CA2894
C05	.1 UFD 500V	CERAMIC DISK	CA2819
C06	25 UFD 150V	ELECTROLYTIC AXIAL	CA2840
C07	.1UFD 500V	CERAMIC DISK	CA2819
C08	10 UFD 100V	ELECTROLYTIC AXIAL	CA2832
C09	25 UFD 150V	ELECTROLYTIC AXIAL	CA2840
C10	1 UFD 35V	CAPACITOR, TANTALUM	CA2813
C11	.1 UFD 50V	CERAMIC BLOCK	CA2809
C12	.1 UFD 50V	CERAMIC BLOCK	CA2809
C13	.1 UFD 50V	CERAMIC BLOCK	CA2809
C14	.1 UFD 50V	CERAMIC BLOCK	CA2809
C15	.1 UFD 50V	CERAMIC BLOCK	CA2809
C16	.1 UFD 50V	CERAMIC BLOCK	CA2809
C17	.1 UFD 50V	CERAMIC BLOCK	CA2809
C18	.1 UFD 50V	CERAMIC BLOCK	CA2809
C19	.1 UFD 50V	CERAMIC BLOCK	CA2809
C20	.1 UFD 50V	CERAMIC BLOCK	CA2809
C21	1 UFD 100V	CAPACITOR, TANTALUM	CA2810
C22	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	CA2809
C23	.1 UFD 500V	CAPACITOR, CERAMIC DISK	CA2819
C24	.1 UFD 500V	CAPACITOR, CERAMIC DISK	CA2819
C25	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	CA2809
C26	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	CA2809
C27	.001 UFD 1KV	CAPACITOR, CERAMIC	CA2823
C28	1 UFD 100V	CAPACITOR, ELECTROLYTIC	CA2810
C29, C30, C31, C32	.1 UFD 50V	CAPACITOR, CERAMIC BLOCK	CA2809
CR01, CR02, CR03, CR04		DIODE, 1N4005	CA2809
CR05, CR06, CR07, CR08		DIODE, 1N4005 - (5404-510)	CA2809

Rich-Mar 510 Ultrasound Parts List, Cont.

Main Board (Part name 2652)

Component #	Value	Description	Rich-Mar Part No.
CR09, CR10		DIODE, 1N4005	CA2809
CR11, CR12, CR13		DIODE, 1N914	DI4602
CR14		DIODE, 1N4005	DI4605
HS1		HEAT SINK, T0220	HS5208
HS2		HEAT SINK, TO3 (2/25, 3/510)	HS5210
J01		CONNECTOR, AMP 2 PIN .156 M	CN4161
J02		CONNECTOR, AMP 2 PIN .1 M	CN4165
J03		CONNECTOR, AMP 4 PIN .156 M	CN4168
J04		CONNECTOR, AMP 4 PIN .145 M	CN4168
J05		CONNECTOR, AMP 4 PIN .156 M	CN4168
J06		SOCKET, RIBBON CABLE 10 PIN	CN4126

APPENDIX C
SCHEMATICS