MAINTENANCE and SERVICE INSTRUCTIONS

1. To fully maintain compliance with Federal Regulation Title 21[21CFR], this unit must be re-calibrated semi-annually.
   It is recommended that all Chattanooga Corporation Ultrasound Products be returned to the factory or an authorized servicing dealer for repairs or re-calibration. Calibration is also recommended after replacement or repair of any major component [See section relating to Calibration Procedures.]

2. The following items should be checked at least monthly to insure proper operation of the unit:
   .1 Power cord plug. Check to make sure that the cord is not frayed, kinked or has torn or cut insulation.

   .2 Transducer(Applicator) Cables. Check to make sure the cables are flexible, free of kinks, not frayed, and that the insulation is intact.

   .3 Transducer(Applicator) Handles. Check to make sure that they are water-tight.

   .4 Transducer(Applicator) Faces. Check to make sure that there is no build-up of gel or foreign material on the transducer faces.

   .5 Stimulator Cables. Check that they are not frayed, kinked or have torn or cut insulation.

   .6 LED's. Check each function to see that it's corresponding LED is illuminated when you are using that function.

   .7 Clean electrodes with antiseptic soap and water, using a small brush, to remove any residual lotion, gels, etc., to prevent a resistance build-up in the electrodes.

INTELECT® 750MP™ CALIBRATION PROCEDURES

CAUTION: An **Electrical Shock Hazard** is present during several portions of the calibration procedure. Calibration should be performed **ONLY BY A QUALIFIED SERVICE TECHNICIAN.**

TEST EQUIPMENT REQUIRED:

1. Power Line Monitor: expanded scale voltmeter for rated line voltage +/- 10%.
2. Autotransformer: adjustable from 90% to 110% of rated line voltage, 150 watts or greater.
3. Oscilloscope: dual trace, 10MHz minimum.
4. Frequency Counter: 1Hz to 10MHz.
5. Digital Voltmeter: Simpson 467 or equivalent,
6. Load Resistor: 200 ohm,1%, 1 watt, (2) required.
7. Ultrasound Power Meter: UPM-30, or equivalent.
8. Oscilloscope probe: 10X
9. Current Probe: Tektronix Model P6021 with optional passive termination (PN 011-0105-00), or equivalent.
10. Adaptor: RCA PHONO PLUG to RCA PHONO JACK with provisions for the attachment of the Current Probe - See Figure 1, below.
11. Stopwatch: Capable of measuring 1 to 29 minutes with more than 1% accuracy and 1 second resolution.
12. Temperature Probe: Thermocouple, to measure between 100 and 150°F (38 to 66°C).
13. Source of approximately 1/2 gallon of distilled, de-oxygenated(5PPM) water at 30°C for use in the UPM power meter - item7.

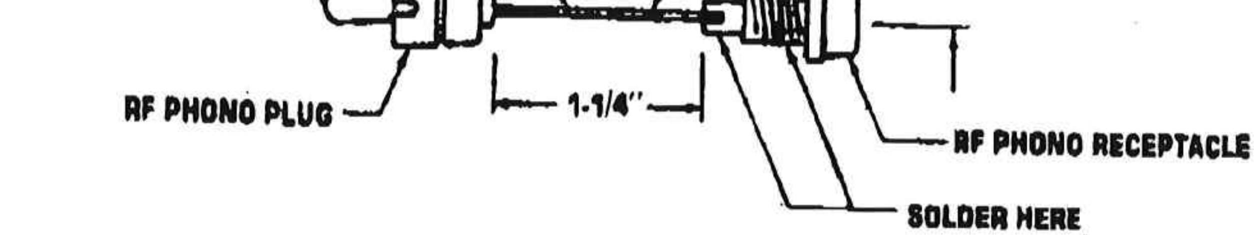


FIGURE 1

INTERFERENTIAL PRE-CALIBRATION CHECK:

1.POWER SUPPLY CHECK:

1.1- Begin by removing the top cover of the unit. With power off, remove the connectors from JP2, JP3 and JP4 on the power supply board. (NOTE: The power supply board is mounted on stand-offs in the bottom of the cabinet, Item 29 on the Cabinet Assembly Drawing.)

1.2-Connect the (-) lead of the DVM to JP3, Pin 3. Set the DVM on the 200VDC Scale. Plug the unit in and turn the power switch to the ON position. JP3 Pin 1 should read +40 VDC, nominal.

1.3-Set the DVM on the 20VDC scale. JP4, Pin 1 should read -15VDC, +/- 5%. JP4, Pin 2 should read +15VDC, +/-5%. JP4, Pin 3 should read +5V, +/- 5% and JP4, Pin 5 should read -5V, +/- 5%.

1.4-Turn the power OFF and re-connect the connectors to JP2, JP3 and JP4.

2.WATCHDOG CHECK:

Turn power to the unit ON and check the RED LED (D1) mounted on both Microcontroller Boards. If the processors are operating properly, the LED's will be illuminated. If the processors are not operating properly, the LED's will be out or blinking.

INTERFERENTIAL CALIBRATION:

NOTE: TPG on the Sine Generator board is the signal ground point for the measurements made on the Sine Generator board.

3. SINE GENERATOR BOARD CLOCK CHECK:

Attach a frequency counter to TP1 (U1 pin 10) on the Sine Generator board. Frequency should be 2.500MHz, +/- .001MHz. (Referring to the Cabinet Assembly drawing, the Sine Generator board-Item 19- is attached to the Interferential Output Amplifier board-item 20- which in turn is attached to the rear panel.)

4. SINE GENERATOR BOARD OUTPUT CALIBRATION:

Rotate the AMPLITUDE BALANCE control from RED to BLACK and verify that the BALANCE BARGRAPH DISPLAY on the front panel moves from RED to BLACK. Set the AMPLITUDE control at maximum in QUAD-POLAR mode and AMPLITUDE BALANCE to the RED postion. Attach the oscilloscope probe to TP2 or U21 pin 1 on the Sine Generator board and adjust R19 for a 3 volt peak +/- .1 volt peak, or 6 volt peak-to-peak, +/- .2 volt peak-to-peak sine wave. Change the AMPLITUDE CONTROL from maximum to minimum and verify that the signal on U21, pin 1/TP2 varies from 3 volts peak down to 0 volts. Set the AMPLITUDE CONTROL at maximum and the AMPLITUDE BALANCE to the BLACK position. Attach the oscilloscope probe to TP3 or U21, pin 7 on the Sine Generator board and adjust R38 for a 3 volt peak, +/- .1 volt peak, or 6 volts, +/- .2 volts, peak-to-peak sine wave. Change the AMPLITUDE CONTROL from maximum to minimum and verify that the signal on U21, pin7/TP3 varies from 3 volts peak down to 0 volts.

CALIBRATION PROCEDURES(cont.)

5. AMPLIFIER BOARD OUTPUT CALIBRATION:
Set the AMPLITUDE CONTROL at maximum in the QUAD-POLAR mode. Attach 200 ohm loads to the RED and BLACK pad outputs, and connect the scope probe across the loads. Set AMPLITUDE BALANCE to the RED position and adjust R23 on the amplifier board for 10 volts RMS +/- .2 volts RMS on the RED output (28.2 volts peak-to-peak, +/-.5 volts peak-to-peak). Set the AMPLITUDE BALANCE to the BLACK position and adjust R11 on the Amplifier board for 10 volts RMS +/-.2 RMS volts on the BLACK output (28.2 volts peak-to-peak, +/- .5 volts peak-to-peak).

6. SINE GENERATOR BOARD DISPLAY CALIBRATION:
Set the AMPLITUDE CONTROL at maximum in the QUAD-POLAR mode. Attach the 200 ohm loads to the RED and BLACK pad outputs. Set AMPLITUDE BALANCE to the RED position and select the RED display, then adjust R47 on the Sine Generator board for a 50ma +/- 1ma reading on the MILLIAMPERE DISPLAY output. Set AMPLITUDE BALANCE to the BLACK position and select the BLACK DISPLAY, then adjust R52 on the Sine Generator board for a 50ma, +/- 1ma reading on the MILLIAMPERE DISPLAY output.

THIS COMPLETES THE CALIBRATION OF THE INTERFERENTIAL PART OF THE UNIT.

ULTRASOUND ASSEMBLY - INITIAL SETUP:
This assembly consists of 2 PC boards mounted inside of an aluminum enclosure, Item 26, page 39, that is attached to the bottom of the unit. The first is the Ultrasound Power Supply Assembly (referred to as the USPS board) and the other is the Ultrasound Amplifier Assembly (referred to as the USAMP board)(Fig. 3, page 25).

NOTE: To perform the following steps, it will be necessary to remove the two Ultrasound PC boards from the aluminum enclosure and to connect the wire harnesses to the boards with extender cables.

7. VOLTAGE CONTROLLED OSCILLATOR (VCO) CALIBRATION:

7.1- Connect frequency counter to the cathode of D6 on the USPS board.
7.2- Place the jumper on TJ1 (USPS board) to jump pins 1 and 2 together.
7.3- Adjust R15 on the USPS board for a frequency counter reading of 1.1096MHz, +/-0.0002 MHz.
7.4- Place the jumper on TJ1 (USPS board) to jump pins 2 and 3 together.
7.5- adjust R13 on the USPS board for a frequency counter reading of 1.0069MHz, +/- 0.0002MHz.
7.6- Repeat Steps 7.2 through 7.6 until the frequency counter readings are within the specified tolerance.
7.7- Place the jumper on TJ1 (USPS board) to jump pins 1 and 2 together.

CALIBRATION PROCEDURES (cont.)

ULTRASOUND CALIBRATION:

NOTES: For the purpose of calibration, the buttons on the front panel of the unit have been re-defined. Pay NO attention to the label names except as points of reference. Refer to this document for the functional definitions of the pushbuttons and displays.

A typical set-up for Ultrasound calibrations is shown in Figure 2, below.

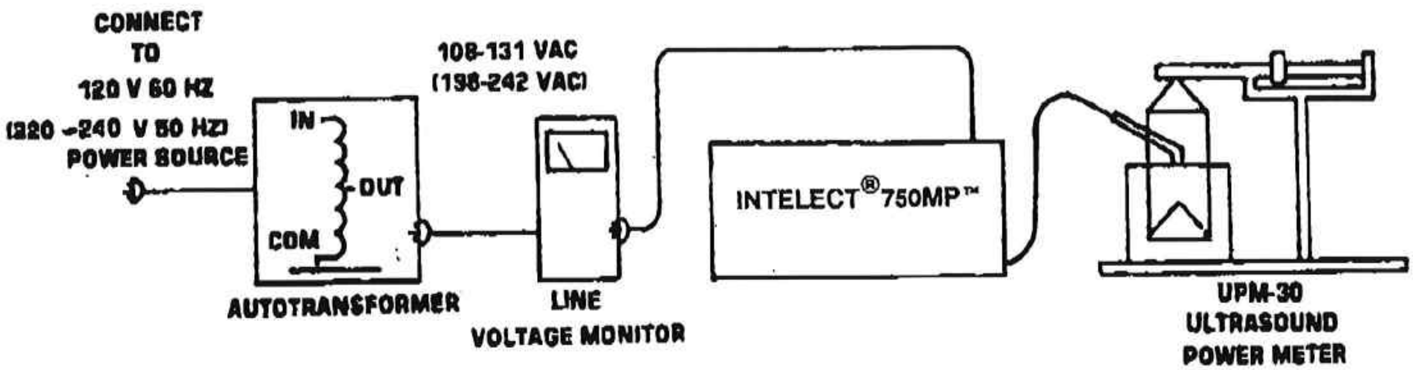


FIGURE 2

PRELIMINARY INFORMATION:

On the Display Controller board (Item 11 on the Cabinet Assembly drawing, which is the second PC board from the front of the unit) there is a switch on the top of the board, toward the right end. The switch (S1) is labeled NORM(al) on one side and CAL(ibrate) on the other. Move the switch to the CAL(ibrate) position.

Turn the unit ON. For the purpose of calibration, the displays and pushbuttons have been redefined. In the Ultrasound output display, the Characters "C1" should be displayed. If these characters are not displayed, check that the switch on the Display Controller board is in the CAL position, then turn the machine OFF and then back ON. The "C1" stands for Calibration Mode 1. This display will show which calibration mode the unit is in. If a mode requires that an Ultrasound applicator be plugged in, but no applicator, or the wrong applicator, is present, "Err" will be displayed.

The WATTS-WATTS/CM^2 button is now defined as the MODE ADVANCE button. Pushing this button will step through the different calibration modes, in order. After C6, the calibration modes start over again at C1.

The START pushbutton is defined as the Memorize or Store button.The Memorize button is pushed when an adjustment is completed in a calibration mode, or to store the calibration values in permanent memory. The START LED will light briefly while memorization is occuring. The Memorize button does not need to be pushed for every calibration mode, only for those modes which establish a calibration value to be stored.

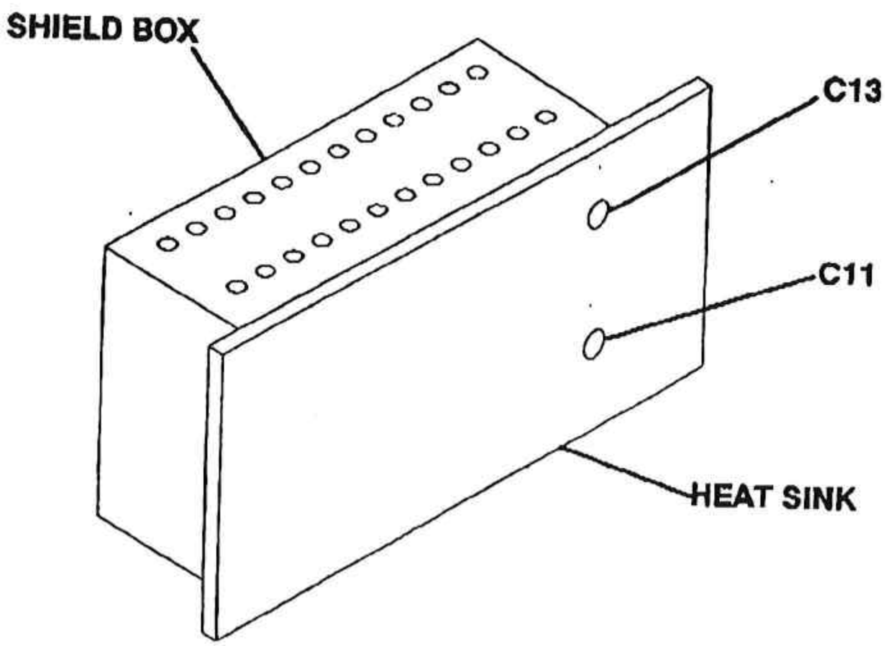
The 100%, 50% and 20% pushbuttons are defined differently, depending on the calibration mode. Refer to the discussion below for the definitions of these buttons.

The Treatment Timer thumbwheel switch is used to set the Power levels P0 - P21 during calibration.

MAKE SURE THAT THE NORM(al)/CAL(ibrate) SWITCH IS IN THE CAL(ibrate) POSTION.

8. Calmode 1: This mode is used for calibration of the mid-point voltage of the digital-to-analog converter which controls the voltage controlled oscillator frequency. In Calmode 1, the microprocessor sends out a command for the digital-to-analog converter to output zero volts. This voltage may be measured with a DVM at test point 3 (TP3) on the Display Controller board with the harness un-plugged from JP2 on the Display Controller board. Adjust potentiometer R1 on the Display Controller board so that a voltage of zero is read at TP3. Re-connect the harness to JP2 that was previously removed. Push the Mode Advance button (the WATTS-WATTS/CM^2 button) to go to Calmode 2.

FIGURE 3



NOTE: In order to access C13, referred to in Section 9.4, and C11, referred to in Section 12.4, it is necessary to detach the Heat Sink/Shield Box from the rear panel. Remove the four(4) screws which hold the Heat Sink to the bottom of the panel. Turn the assembly on its side as shown in Figure 3, above, to access these two adjustments.

9. Calmode 2: In "C2", the optimum frequency for the $10CM^2$ head is determined.

9.1- Plug in the $10CM^2$ applicator and place the applicator in the Ultrasound Power Meter.

9.2- Now, adjust the Intensity control, slowly, until maximum power output is displayed on the Power Meter.

9.3- Leave the control in its present position and push the Fine Adjust (100%) button.

9.4- Once again, using the Intensity control, adjust the control and C13 (see Figure 3) on the USAMP board, until the highest power output is obtained. These adjustments interact, so it will be necessary to adjust the Intensity control and C13 several times to arrive at the proper calibration. Since the Ultrasound Power Meter responds slowly to changes in output power, wait for the Power Meter to settle after making an adjustment, or make the adjustments slowly enough for the Power Meter to keep up. Note also that, as the water in the Power Meter heats up, the zero reading of the meter will shift. It will be necessary to re-zero the Power Meter during the calibration process. Perform the "re-zero" operation with NO power applied to the applicator.

9.5- Without moving the control, push the Memorize(Start) button. Then, push the 20% button to calculate the new checksum.

10. DRIVE VOLTAGE ADJUSTMENT for $10CM^2$ APPLICATOR:

10.1- Turn the unit OFF. Move NORM(al)/CAL(ibrate) switch to the NORM position. Turn the unit ON and set the Ultrasound Duty Cycle to 100%.

10.2- Connect DVM, set on the 20VDC range, to JP3 on the USPS board, with the (+) lead on JP3, pin 8 and the (-) lead on JP3, pin1.

10.3- Plug the $10CM^2$ applicator into the front panel connector and adjust R1 on the USPS board for a 9 VDC nominal reading.

10.4- Place applicator in the Ultrasound digital power meter.

10.5- Connect the frequency counter, using X10 probe, to JP3, pin 7, (OSCIN) on the USPS board, with the frequency measurement range capable of measuring 1.000MHz, +/-.2MHz. Attach probe ground to JP3, pin 1.

NOTE: Make sure that there is no electrical connection between the oscilloscope ground and the frequency counter ground.

10.6- Remove the RCA PHONO PLUG on the black cable from the connector labeled OUTPUT on the shield box inside the unit. Connect an RCA PLUG to RCA JACK OSCILLOSCOPE CURRENT PROBE ADAPTOR(see Figure 1, page 21) to the connector labeled OUTPUT on the shield box. Attach the black cable, that you removed earlier, to the RCA phono jack on the ADAPTOR. Clamp the current probe on the center conductor of the adaptor. Do not connect the ground lead of the current probe to anything.

CALIBRATION PROCEDURES(cont.)

10.7- Place X10 oscilloscope probe on collector (center lead) of D45C11, which is plugged into connector J2 on the USAMP PC board. Ground probe to C15/R48 side of R48 on the Power Supply Asembly USPS board.

10.8- Monitor the oscilloscope voltage waveform and the Ultrasound Power Meter. Slowly increase the INTENSITY control, alternately adjusting R1 on the USPS board so that the voltage waveform exhibits sharp transitions and squarewave properties; a maximum power reading of 22 Watts is desired.

10.9- Change the Ultrasound Duty Cycle to 20%. Observe the voltage waveform on the oscilloscope to be certain that switching alternately from 100% to 20% Duty Cycle minimally affects the envelope amplitude and squarewave characteristics of the voltage waveform displayed. Adjust R1 as required if the amplitude and squarewave are not correct. Continue to monitor the Ultrasound Power Meter for approximately a 22 Watt reading at 100% Duty Cycle and adjust the INTENSITY control as needed to maintain this power level.

10.10-Turn unit OFF. Move NORM/CAL switch to the CAL position. Turn unit ON and push the Mode Advance (WATTS-WATTS/CM^2) button until the unit is in Calmode 3 (P0 will be displayed).

11. Calmode 3 (P0 - P21) - In "C3", the power is calibrated. A power level will be recorded for each integer power (0,1,2,3,......,21). The Treatment Timer switch is used to set the Power level being adjusted. Setting the numbers on this switch causes the display to go from P0 to P21. The 100% button lowers the power. The 50% button raises the power. The 20% button is the coarse adjust button which causes the power to be adjusted in larger increments. The 20% LED is lighted during large incrementing.

TIP: Start at the high power end - 21 Watts - and work down when calibrating the power levels. This will minimize calibration errors due to heating and cavitation of the water in the Power Meter

11.1- The 10CM^2 applicator should be plugged in and attached to the Power Meter as in Calmode 2.

11.2- Turn the TREATMENT TIMER switch until P21 appears in the display.

11.3- Using the 100% and the 50% buttons, obtain a reading of 21 Watts on the power meter.

11.4- When a stable reading of 21 Watts is obtained, push the Memorize(Start) button.

CALIBRATION PROCEDURES(cont.)

11.5- Turn the TREATMENT TIMER switch until P20 appears in the display and repeat the procedure to obtain a reading of 20 Watts on the Power Meter. When 20 Watts is obtained, push the Memorize button and proceed to the next power level. If more rapid changes in power level are desired, push the 20% button. This increases the amount by which the power is incremented or de-incremented. When the power is close to the desired level, push the 20% button again to return to smaller increments. When large incrementing is in effect, the 20% LED is illuminated.

11.6- Repeat the procedure for each power level, down to 0 Watts (P0). After all power levels are set and memorized, push the Mode Advance(WATTS-WATTS/CM^2) button to go to the next Calmode.

IMPORTANT! Remember to push the Memorize(START) button each time, before proceding to the next power level.

12. Calmode 4 - In "C4", the optimum frequency for the 5CM^2 applicator is determined.

12.1- Plug in the 5CM^2 applicator and place the applicator in the Ultrasound Power Meter.

12.2- Using the Intensity control, adjust the control slowly until maximum power output is displayed on the Power Meter.

12.3- Leave the control in its present position and push the Fine adjust(100%) button.

12.4- Next, adjust the INTENSITY control and C11 on the USAMP board until the highest power output is obtained. These adjustments interact, so it will be necessary to adjust the Intensity control and C11 several times to arrive at the proper calibration. Since the Ultrasound Power Meter responds to changes slowly, wait for the Power Meter to settle after making an adjustment or make the adjustments slowly enough for the Power Meter to keep up. Note also that, as the water in the Power Meter heats up, the zero reading of the meter will shift, so it will be necessary to re-zero the during the calibration process, **with no power applied to the applicator.**

12.6 Without moving the control, push the Memorize(Start) button Then push the 20% button to calculate the new checksum.

13. DRIVE VOLTAGE ADJUSTMENT for 5CM^2 APPLICATOR:

13.1- Turn the unit OFF. Move the NORM/CAL switch to the NORM position. Turn unit ON and set Ultrasound Duty Cycle to 100%.

13.2- Plug 5CM^2 applicator into the front panel connector.

13.3- Place applicator in the Ultrasound Power Meter.

CALIBRATION PROCEDURES(cont.)

13.4- Connect the frequency counter, using the X10 probe, to JP3, pin7 (OSCIN), on the USPS board, with the frequency measurement range capable of measuring 1.000MHz, +/-.2MHz. Attach the probe ground to JP3, pin 1.

NOTE: Make sure there is no electrical connection betweeen the oscilloscope ground and the counter ground.

13.5- Connect DVM , set on 20VDC range, to JP2 on the USPS board with the (-) lead connected to JP2, pin 6 and the (+) lead connected to JP2, pin 11.

13.6- Remove the RCA PHONO PLUG on the black cable from the connector labeled OUTPUT on the Shield Box inside the unit. Connect an RCA PLUG to RCA JACK OSCILLOSCOPE CURRENT PROBE ADAPTOR to the connector labeled OUTPUT on the Shield Box. Attach the black cable, that you removed earlier, to the RCA phono jack on the ADAPTOR. Clamp the current probe on the center conductor of the adaptor. DO NOT connect the ground lead of the current probe to anything.

13.7- Place X10 oscilloscope probe on collector (center lead) of D45C11 which is plugged into connector J2 on the USAMP PC board. Ground probe to C15/R48 trace side of R48 on the Power Supply Assembly USPS board.

13.8- Monitor the oscilloscope voltage waveform and the Ultrasound Power Meter. Slowly increase the INTENSITY control, alternately adjusting R51 on the USPS board so that the voltage waveform exhibits sharp transitions and squarewave properties; a maximum power reading of 11 Watts is desired.

13.9- Change the Ultrasound Duty Cycle to 20%. Observe the voltage waveform on the oscilloscope to be certain that switching alternately from 100% to 20% Duty Cycle minimally affects the envelope amplitude and squarewave characteristics of the voltage waveform displayed. Adjust R51 as required if the amplitude and square-wave characteristics are not correct. Continue to monitor the Ultrasound Power Meter for an approximately 11 Watt reading at 100% Duty Cycle and adjust the INTENSITY control as needed to maintain this power level.

13.10-Turn unit OFF. Move the NORM/CAL switch to the CAL position. Turn the unit ON and push the Mode Advance (WATTS-WATTS/CM^2) until the unit is in Calmode 5.

14. Calmode 5 (P0 - P11): In "C5", the power is calibrated. A power level will be recorded for each integer power (0, 1,2,3,...,11). The TREATMENT TIMER switch controls which power level is being adjusted. Setting the numbers on the switch causes the display to go from P0 to P11. The 100% button lowers the power. The 50% button raises the power. The 20% button is the fast adjust button which causes the power to be adjusted in larger increments.

14.1- The $5CM^2$ applicator should be plugged in and attached to the Power Meter as in Calmode 4.

14.2 Turn the TREATMENT TIMER switch until P11 appears in the display.

14.3 Using the 100% and the 50% buttons, obtain a reading of 11 Watts on the Power Meter.

14.4 When a stable reading of 11 Watts is obtained, push the Memorize(Start) button.

14.5 Turn the Treatment Timer switch to display P10 and repeat the procedure to obtain a reading of 10 Watts on the Power meter. When 10 Watts is obtained, push the Memorize button again and proceed to the next lower power level. If more rapid changes in power level are desired, push the 20% button. This increases the amount by which the power is incremented or de-incremented. When the power is close to the desired level, push the 20% button again to return to smaller increments. When in the large incrementing mode, the 20% LED will be illuminated.

14.6 Repeat this procedure for each power level, down to 0 Watts(P0). after all of the power levels are set and memorized, push the Mode Advance(WATTS-WATTS/CM^2) button to go to the next Calmode.

IMPORTANT! Remember to push the Memorize(START) button each time, before proceeding to the next power level.

15. CHECKSUM: The Checksum is calculated by the microprocessor in order to insure the integrity of the calibration values when the machine is powered up. The Checksum button must be pushed whenever a change is made to the calibration values or when the machine goes through a complete calibration. To initiate a Checksum calibration, change the Calmode by pushing the WATTS-WATTS/CM^2 button, to any mode **EXCEPT** C3 or C5, and push the 20% button.

NOTE: The following Calmode - Calmode 6 - is for factory use only. This information is provided in the event that you put the unit into this mode.

16. Calmode 6 - "C6" is used to put the machine into Burn-In mode. Push the 50% button to initiate Burn-In. In Burn-In mode, the machine will reset and go into a normal operation mode. The START LED will flash to indicate that the machine is in Burn-In mode. It is important that all calibrations are finished and the Checksum button has been pushed before putting the machine into Burn-In mode. Without the proper values memorized for calibration, the machine will not operate properly.

ADJUSTMENTS COMPLETED: Return switch S1 on the Display Controller board from the CAL position to the NORM position.

CALIBRATION PROCEDURES (cont.)

NOTE: When the unit is energized in either BURN-IN mode or NORMAL mode, if the CHECKSUM does not check correctly, "Err" appears in the display. When this message appears, the CHECKSUM must be re-checked per Step 15. If the "P" values do not check, either "E10" or "E5" will appear. "E10" means a value is missing for the 10 CM^2 head. "E5" indicates the same for the 5CM^2 head.
When this message appears, the Power calibration for the head indicated must be repeated

CHECK OPERATION of UNIT

CIRCUIT OPERATION CHECKS:

17. START DELAY: With POWER SWITCH OFF, set some time on the TREATMENT TIME switches. Turn POWER SWITCH to ON and listen to assure that the output relay on the amplifier board does not click. This checks that the output is not enabled until the START SWITCH is pressed. Press the START SWITCH. The START SWITCH should not load the Treatment Time into the display or light the START SWITCH until approximately 1 second has elapsed since the POWER was turned ON.

18. AMPLIFIER OUTPUT RELAY DELAY: With POWER SWITCH OFF, attach oscilloscope probe to pin 6 of U1 on the amplifier board and turn power ON. At Power ON, the voltge on the oscilloscope will go instantly to (-) 5 volts, and stay at that level for approximately 1/2 second, after which time it will switch to high. Turn POWER SWITCH to OFF and observe that the output goes to (-) 5 volts in 8 milliseconds or less.

GENERAL FUNCTIONAL TESTS - INTERFERENTIAL:

TREATMENT MODES: To perform the following tests, attach 200 ohm loads(resistors) to the RED and BLACK pad outputs and connect oscilloscope probes across the loads, using both vertical channels of the scope. Set the TREATMENT TIME switch greater than 00 minutes, press the START SWITCH, rotate the AMPLITUDE BALANCE control to the middle, rotate the the AMPLITUDE control to minimum to turn OFF the RESET INDICATOR (yellow LED below AMPLITUDE control) and then rotate the AMPLITUDE control to maximum.

19. QUAD-POLAR: When the unit is turned ON, the initial TREATMENT MODE will be QUAD-POLAR and the initial SWEEP MODE will be CONSTANT. The output of the unit will be a 5000Hz sine wave in the RED channel and a 5000Hz, minus the BEAT FREQUENCY, sine wave, in the BLACK channel. The output voltage of both channels will be equal when the AMPLITUDE BALANCE is in the middle position. Rotating the AMPLITUDE BALANCE control toward the RED CHANNEL will reduce the voltage of the BLACK CHANNEL while the voltage in the RED CHANNEL remains un-changed. Rotating the AMPLITUDE BALANCE control toward the BLACK CHANNEL will reduce the voltage of the RED CHANNEL while the voltage in the BLACK CHANNEL remains un-changed The amount of reduction in both cases will be about 40% of set AMPLITUDE.

CALIBRATION PROCEDURES(cont.)

20. QUAD-POLAR with SCAN MODE: Press the QUAD-POLAR W/SCAN button and leave the SWEEP MODE in CONSTANT. The green LED in the QUAD-POLAR W/SCAN button will illuminate. Switching between the QUAD-POLAR W/SCAN and the QUAD-POLAR modes will not cause the AMPLITUDE RESET LED to illuminate. In this mode, the AMPLITUDE BALANCE is automatically swept from BLACK to RED and then back to BLACK over a 12 second period. The AMPLITUDE BALANCE DISPLAY will be indicating this sweep.

21. CONT(inuous) 5000HZ MODE: Press the CONT. 5000Hz button. The green LED in that button will light. The BEAT FREQUENCY DISPLAY will be blanked and all the green LED's in the SWEEP MODE switches will be out. Reset the AMPLITUDE CONTROL and then increase it to maximum. The output waveforms are 5000Hz sine waves in both channels. The AMPLITUDE BALANCE CONTROL functions in this mode.

22. PRE-MOD(ulated) MODE: Press the PRE-MOD button. The green LED in that button will illuminate. Make sure that the CONSTANT SWEEP MODE has been selected. Both outputs will be 5000Hz sine waves that are amplitude modulated at the BEAT FREQUENCY. Change the BEAT FREQUENCY control from minimum to maximum and verify that the frequency of modulation changes over the range.

BEAT FREQUENCY SWEEP MODES: All of these SWEEP MODES will be checked with the PRE-MOD(ulated) TREATMENT MODE selected.

23. CONSTANT SWEEP MODE: In this mode, the BEAT FREQUENCY is adjusted over a 1 to 200 Hz range by the BEAT FREQUENCY CONTROL and displayed on the three digit BEAT FREQUENCY display.

24. 1-SET SWEEP MODE: In this mode, the BEAT FREQUENCY is swept from 1 Hz to the frequency set by the BEAT FREQUENCY CONTROL and back to 1 Hz during a 12 second period. The swept frequency is displayed on the three digit BEAT FREQUENCY display.

25. 80-150HZ SWEEP MODE: In this mode, the BEAT FREQUENCY is swept from 80 Hz to 150 Hz and back to 80 Hz during a 12 second period. The swept frequency is displayed on the three digit BEAT FREQUENCY display.

26. 1-10HZ SWEEP MODE: In this mode, the BEAT FREQUENCY is swept from 1 Hz to 10 Hz and back to 1 Hz during a 12 second period. The swept frequency is displayed on the three digit BEAT FREQUENCY display.

GENERAL FUNCTIONAL TESTS - ULTRASOUND:

27. TREATMENT TIMER:

27.1 Check operation of the TREATMENT TIME SWITCHES. Set the TREATMENT TIME SWITCH to 01 minutes and press the START button. The TREATMENT TIME display should indicate 01. Press the reset switch (S1) on the Micro-controller board to reset the TREATMENT TIME to 00. Repeat the above test for switch settings of 02, 04, 08, 10, 20, 40 and 59 minutes.

27.2 Using a stopwatch, check the TREATMENT TIMER at the following time settings to assure the accuracy listed:

1 minute, +/- 0.5 minute
5 minutes, +/- 10%
10 minutes, +/- 10%
20 minutes, +/- 1 minute
30 minutes, +/- 1 minute

NOTE: Pressing the START switch a second time places the unit in the "PAUSE" mode in which there is no output from the unit and is identified when the digits in the TREATMENT TIME display are flashing. To exit from the "PAUSE" mode, press the START switch again and reset the AMPLITUDE and INTENSITY controls.

28. DUTY CYCLE and PULSE FREQUENCY CHECK:

28.1 Select 20% DUTY CYCLE and connect the oscilloscope X10 probe to TP1 on the Display Controller PC board. Connect the ground lead of the scope probe to JP2, pin 10 on the Display Controller PC board.

28.2 Adjust the time base of the oscilloscope to 1 msec/div and measure the period of the 100Hz signal. It should be between 8.0 and 12.0 msec.

28.3 Adjust the oscilloscope time base for 10 divisions of one(1) cycle of the signal. Verify that the pulse width of the signal is 8 divisions.

28.4 Select 50% DUTY CYCLE and verify that the pulse width of the signal is 5 divisions.

28.5 Select 100% DUTY CYCLE and observe that the signal is at a DC level less than 0.5 volts.

29. MODULATED RF DUTY CYCLE CHECK:

29.1 Remove the RCA PHONO PLUG on the black cable from the connector labeled OUTPUT on the Shield Box inside the unit. Connect an RCA PLUG to RCA JACK OSCILLOSCOPE CURRENT PROBE ADAPTOR to the connector labeled output on the Shield Box. Attach the black cable, removed earlier, to the RCA PHONO JACK on the ADAPTOR. Clamp the current probe on the center conductor of the adaptor. DO NOT connect the ground lead of the current probe to any thing.

29.2 Plug in the $10CM^2$ applicator.

29.3 Select 20% DUTY CYCLE and observe the DUTY CYCLE of the 100Hz modulated RF waveform.

29.4 Select 50% DUTY CYCLE and observe the DUTY CYCLE of the 100Hz modulated RF waveform.

29.5 Plug in the $5CM^2$ applicator.

29.6 Select 20% DUTY CYCLE and observe the DUTY CYCLE of the 100Hz modulated RF waveform.

29.7 Select 50% DUTY CYCLE and observe the DUTY CYCLE of the 100Hz modulated RF waveform.

30. OUTPUT METER CALIBRATION VERIFICATION:

30.1 Attach each applicator in turn and adjust the INTENSITY control to the following power levels indicated on the unit power indicator and check the actual Ultrasound output with the Ultrasound Power Meter. (See following page)

I-750MP Meter	Ultrasound Power Meter Indication	
	Minimum	Maximum
$5CM^2$ Applicator		
1.0 W	.86 W	1.14 W
2.0 W	1.72 W	2.28 W
5.0 W	4.30 W	5.70 W
7.0 W	6.00 W	8.00 W
10.0 W	8.60 W	11.40 W
$10CM^2$ Applicator		
2.0 W	1.72 W	2.28 W
5.0 W	4.30 W	5.70 W
10.0 W	8.60 W	11.40 W
15.0 W	12.90 W	17.10 W
20.0 W	17.20 W	22.80 W

30.2 Vary the line voltage from 108 to 132 VAC, for 120 V units - 198 to 242 VAC for 220/240 volt units - and check that the output remains within the limits listed above.

30.3 Select 50% DUTY CYCLE and check the peak output meter accuracy by comparing its indication to the average power indication on the Ultrasound Power meter.

AVERAGE POWER = (% DUTY CYCLE) x (Peak Power)

$5CM^2$ Applicator		
1.0 W	.43 W	.57 W
2.0 W	.86 W	1.14 W
5.0 W	2.15 W	2.85 W
7.0 W	3.00 W	4.00 W
10.0 W	4.30 W	5.70 W
$10CM^2$ Applicator		
2.0 W	.86 W	1.14 W
5.0 W	2.15 W	2.85 W
10.0 W	4.30 W	5.70 W
15.0 W	6.50 W	8.50 W
20.0 W	8.60 W	11.40 W

30.4 Select 20% DUTY CYCLE and verify the Output Meter accuracy as in 30.3, above.

$5CM^2$ Applicator		
1.0 W	.18 W	.23 W
2.0 W	.34 W	.46 W
5.0 W	.86 W	1.14 W
7.0 W	1.20 W	1.60 W
10.0 W	1.72 W	2.28 W
$10CM^2$ Applicator		
2.0 W	.34 W	.46 W
5.0 W	.86 W	1.14 W
10.0 W	1.72 W	2.28 W
15.0 W	2.58 W	3.42 W
20.0 W	3.44 W	4.56 W

CALIBRATION PROCEDURES(cont.)

31. HEAD MAXIMUM TEMPERATURE - TRIP CHECK:

31.1 Attach the $10CM^2$ applicator to the unit, set the unit for maximum power at 100% DUTY CYCLE and leave the applicator in air.

31.2 Allow the applicator to heat until the HEAD MAX TEMP LED illuminates, the beeper sounds three double beeps and the Ultrasound energy is removed from the applicator. This will be indicated when the output meter goes to 0.

31.3 After the head cools, the HEAD MAX TEMP LED will turn off. Rotate the INTENSITY control to its minimum position until the reset LED turns off. Then, turn the INTENSITY control to the maximum position to re-apply power to the applicator.

31.4 Repeat steps 31.2 and 31.3 until the power has cycled on and off five(5) times. As soon as the HEAD MAX TEMP LED lights for the fifth time, measure the temperature of the metal face of the applicator. The temperature must read between 133 and 147°F (56 to 64°C). If this is not the case, adjust R8 on the Display Controller PC board, repeating the foregoing procedure until the correct range is attained.

31.5 Replace the $10CM^2$ applicator with the $5CM^2$ applicator, set the unit for maximum power at 100% DUTY CYCLE, leaving the applicator exposed to air, and repeat steps 31.2 through 31.4. If R8 must be adjusted for the $5CM^2$, applicator, re-install the $10CM^2$ and repeat steps 31.2 through 31.4. This procedure <u>MUST</u> be repeated until the HEAD MAX TEMP LED illuminates in the <u>same range</u> for both applicators.

32. GENERAL FUNCTIONAL TESTS - COMBINATION OPERATION:

32.1 Attach a 200 ohm load(resistor) between the Ultrasound applicator face and the Lead on the RED channel marked "COMBO:.

32.2 Connect oscilloscope probe to the Ultrasound side of the 200 ohm resistor and probe ground to the other side of the 200 ohm resistor.

32.3 Turn unit ON, start the Treatment Timer and push the COMBO button. PRE-MOD will be selected. Turn up AMPLITUDE and verify that a pre-modulated interference waveform is being generated across the 200 ohm load resistor.

32.4 Push the QUADPOLAR button and turn AMPLITUDE down to reset. Turn AMPLITUDE up and verify that a sine wave is being generated across the 200 ohm load resistor.

32.5 It is not possible to select the QUADPOLAR W/SCAN mode or the CONTINUOUS 5000Hz mode while the COMBO indicator is on. Pressing the COMBO button again will extinguish the COMBO LED and again send the stimulation to both RED electrodes instead of the Ultrasound applicator.

TROUBLESHOOTING

The following problems and solutions are presented to assist you in solving some of the problems that could possibly happen to your Intelect® 750MP™.

PROBLEM	CAUSE	ACTION TO TAKE
No power to unit.	1) Unit not plugged in. 2) No power to receptacle. 3) Input fuse blown.	1) Plug in unit. 2) Check for tripped circuit breaker or blown fuse on the facility circuit. 3) Change 1-1/4 amp. Slo-Blo fuse in the power entry receptacle on the back of the unit. (800ma fuses for 220/240 Volt units). **Remove the power cord before changing fuses.**
Power to unit but no displays are illuninated.	4) Internal fuse blown. 5) Internal cables dis-connected.	4) Check the 5 amp fuses(two) on the power supply board. **THIS SHOULD BE DONE ONLY BY A QUALIFIED SERVICE TECHNICIAN.** 5) Check internal cables and re-connect any that are loose.
"Err" displayed by the Ultrasound meter.	6) Unit's Ultrasound section is out of calibration.	6) Re-calibrate the unit per the instructions in the Calibration Procedure.
Displays are illuminated but no Ultrasound output.	7) INTENSITY control needs to be reset. 8) Ultrasound fuse blown. 9) Circuit failure.	7) Rotate the control to the MIN. position until the RESET indicator turns OFF. Then increase slowly to the desired level 8) Check the 1-1/2 amp Slo-Blo fuse on the power supply board. **THIS SHOULD BE DONE ONLY BY A QUALIFIED SERVICE TECHNICIAN.** 9) Have the unit serviced or return it to the factory for service.

TROUBLESHOOTING(cont.)

PROBLEM	CAUSE	ACTION TO TAKE
Displays are illuminated but no Interferential output.	10) AMPLITUDE control needs to be reset. 11) Broken lead wires. 12) Poor patient contact. 13) Circuit failure	10) Rotate the control to its MIN. position until the RESET indicator turns OFF. Then increase slowly to the desired level. 11) Replace lead wires. 12) Clean with isopropyl alcohol and re-apply the pads. 13) Have the unit serviced or return it to the factory for service.
HEAD MAX. TEMP. indicator illuminates and beeper sounds.	14) Transducer head too hot. 15) Shorted applicator cable. 16) Water in the transducer head.	14) Place the transducer in water until the HEAD MAX. TEMP. circuit resets. 15) Check the cable with an ohmmeter. If the cable is shorted, replace the cable with the same type. 16) Remove the transducer head and dry out the applicator. If the O-ring is defective, replace it. Consult factory.
Ultrasound output meter only indicates less than half of maximum output when INTENSITY is set at maximum.	17) Applicator cable loose. 18) Applicator cable broken. 19) Oscillator/Amplifier detuned. 20) Crystal damaged.	17) Re-seat the cable and tighten the ring on the cable plug, in the output connector 18) Replace cable with the same type. 19) Recalibrate the Ultrasound section. 20) Replace the transducer head in the applicator and recalibrate the Ultrasound section.
"E5" or "E10" appears in the Ultrasound Power Meter Display.	21) Missing or wrong calibration values for the indicated head(5CM^2) or (10CM^2) in memory.	21) Re-calibrate the power settings for the head indicated. "E5" for the 5CM^2 head or "E10" for the 10CM^2 head.

TROUBLESHOOTING (cont.)

PROBLEM	CAUSE	ACTION TO TAKE
"Cbl" displayed in the Treatment Time display.	22) No ultrasound applicator cable connected.	22) connect the selected applicator to the output connector on the control panel. Make certain that the connector is screwed in tight.
	23) broken wire in the applicator cable.	23) replace the cable.