

UPM-DT-100AV MANUAL ULTRASOUND POWER METER



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2014



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SF-SLS-568 (A)

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INTRODUCTION

Measurement of power output levels of diagnostic and therapeutic ultrasound equipment has become increasingly important to determine exact patient exposure levels in case a potential risk exists to the patient. Since the Radiation Control for Health & Safety Act of 1968 and the 1976 Medical Device Amendments to the FDA Act became effective, all manufacturers of diagnostic Doppler ultrasound equipment are required to submit information regarding their maximum peak and average exposure level, beam patterns, and other pertinent information. Hospitals are responsible for regularly scheduled testing (every six months) of output power and safety to maintain their accreditation.

The Ultrasound Power Meter, Model UPM-DT-100AV, is designed to measure the ultrasound power output of diagnostic or therapeutic transducers up to 30 watts. The principle of measurement is the radiant force method. The UPM-DT-100AV uses a positioning clamp to hold the transducer in de-gassed water above a conical target. The ultrasonic energy passes through the water to reflect off the target and is then absorbed by the rubber lining. The

radiant power is directly proportional to the total downward force (weight) on the target. This weight is then transferred through the target support assembly to the electromechanical load cell inside the scale. The cell is in a computer-controlled feedback loop and produces a digital readout in watts of power (custom units) or grams of force. The choice of units (grams or watts) is selected by front panel pushbuttons. The UPM-DT-100AV is supplied with a plug-in 120 VAC to 12VDC 400 mA adapter (using another adapter not rated the same may damage unit). The UPM-DT-100AV has a display resolution of ± 200 milliwatts.

UNPACKING THE UPM-DT-100AV

The power meter comes complete with all accessories in a sturdy carrying case. To make ultrasonic measurements, the water tank requires only one pint of de-gassed distilled water. If de-gassed water is not available, use distilled water, NOT tap water.

The following replacement parts can be ordered if necessary from Ohmic:

REPLACEMENT PARTS

- Test Tank with Rubber
- Positioning Clamp Assembly
- Cone Assembly
- Calibration Weight Standards (ORDER BOTH NUMBERS #49025-12 and # 49045-12.)
- 120 VAC to 12VDC 500 mA power adapter # 12102320
- Instruction Manual [specify "UPM-DT100AVman.PUB"; available in PDF format]
- Carrying Case



Front view of the UPM-DT-100AV. Shown is the electronic balance, base assembly, and test tank.

SELECTING A LOCATION FOR OPERATION

The UPM-DT-100AV should always be used in an environment free from excessive air currents, corrosives, vibration and temperature or humidity extremes. These factors will affect the displayed readings.

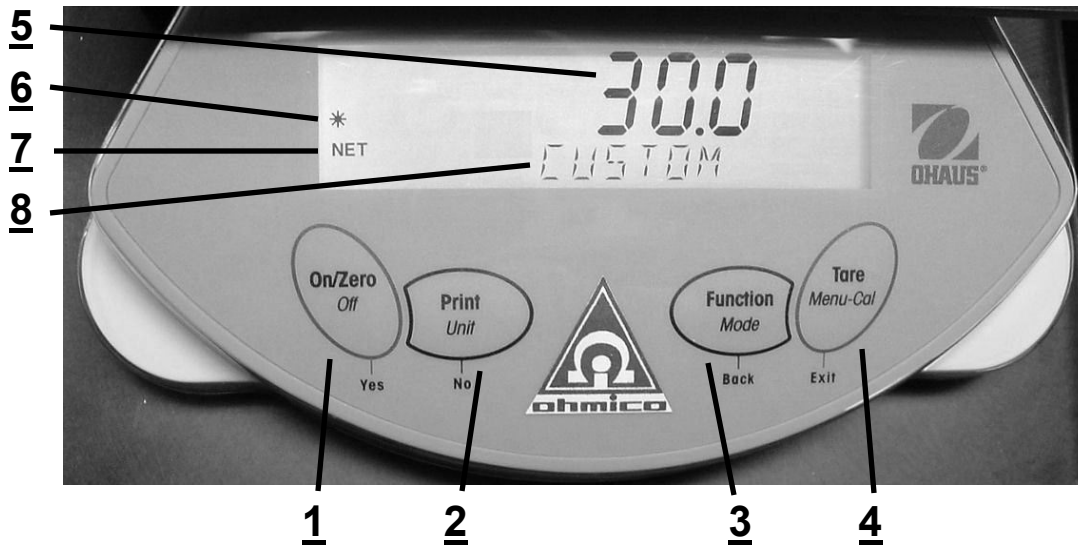
DO NOT operate the UPM-DT-100AV:

- Next to open windows or doors causing drafts or rapid temperature changes

- Near air conditioning or heat ducts
- Near vibrating, rotating or reciprocating equipment
- Near magnetic fields or equipment that generate magnetic fields
- On a non-level work surface

Allow sufficient space around the instrument for ease of operation and keep away from radiant heat sources. Never set any material on the UPM-DT-100AV or place your hands or fingers on it while taking readings.

PANEL CONTROLS & DISPLAY INDICATOR



1. **On/Zero Off** - Yes button; Press to turn unit on or zero, press and hold until OFF is displayed then release to turn off.
 2. **Print Unit** - No button; Press to print, press and hold then release when unit desired is displayed.
 3. **Function Mode** - Back button
 4. **Tare Menu-Cal** - Exit button; press to tare
 5. 7 - segment display; shows readings. A "g" after the reading indicates grams.
 6. Stability Indicator
 7. Net Indicator
 8. 14-segment display; shows units. "Custom" is watts.
- Symbols for weighing units are:
- | <u>Grams Mode</u> | <u>Custom Mode</u> |
|-------------------|--------------------|
| x.xx | x.x |

OPERATING PROCEDURE

1. Remove the top of the carrying case by unlatching the clamps located on two ends. The UPM-DT-100AV is mounted on the base of the carrying case.

7. By means of the positioning clamp, attach the transducer head and place its radiating face 1/8" to 1/4" inch below the water level, parallel to the water surface, and directly above the center of the cone. Check transducer surface for uniform wetting (no air pocket or bubbles should be on its surface).
8. Allow 5 minutes for the scale to stabilize. With no ultrasonic power applied to the transducer, press the **ON/Zero/Off** button to zero the unit.
9. Check response by placing the 1 gram weight on the arm of the cone target (the flat part that is out of the water). The UPM-DT-100AV should read 1.00 grams \pm 0.1. Change the units to the watts mode by pressing and holding the **Print Unit** button until the unit desired is displayed then release. The UPM-DT-100AV should read 14.6 watts \pm 0.2 watts. 1 gram is equal to 14.6 watts.
10. Remove the 1 gram weight. Press the **ON/Zero/Off** button to zero the unit.
11. Apply power to the Transducer Under Test (TUT). Re-zero before each measurement and take your power reading when the display has stabilized. It is a good practice to take three readings and average them. If measurement conditions are not stable, use the grams mode and multiply the readings by 14.65 to obtain watts.
12. Determine the maximum peak power with the maximum duty cycle and pulsed output settings with the equation:

$$PAVE = Pp \div Rtpa$$

PAVE = calculated average power
Pp = Peak Pulsed Power Setting on unit under test
Rtpa = Ratio of Temporal Peak to Average Power (from each manufacturer)
13. To calculate the watts/cm² output, take the total watts reading from the unit and divide by the area. The area is $\pi d^2 \div 4$ (**d** is the diameter of the transducer) if the transducer is smaller than the cone. Otherwise, use (8.2 cm) the cone's diameter as the area.
14. When finished, unplug the UPM-DT-100AV, empty the tank, and place the dry target cone in the tank for protection.

TRANSPORTING THE UPM-DT-100AV

Lift off the target cone assembly from the sleeve, empty water into a storage container, dry the tank and cone, place cone in the tank and clamp the target rod into the storage clips on the side of the target sleeve. Place the power supply in the tank. Rotate the transducer clamp arm over the top of the tank and stretch the large rubber band between the two hooks of the hold-down clip, over the clamp arm and tank. Place the carrying case cover over the base and secure the latches (for shipping instructions see Page 11).

GENERAL OPERATING NOTES

Line / Battery Power: The UPM-DT-100AV is supplied with a 120 VAC adapter. Check for correct line voltage before use. For voltages 220/240 VAC, an optional power adapter can be ordered from Ohmic.

1. Slowly fill tank with degassed water. Press the **On/Zero/Off** button to turn unit on. Select Watts(custom) or Grams by pressing and holding the **Print/Unit** button. Release the button when unit needed is displayed. Press the **On/Zero/Off** button to zero unit. Place cone target assembly into test tank and in the small tube inside of the large tube. Press the **On/Zero/Off** button to zero the unit.
2. Place ultrasound transducer 1/8 inch into water above the center of the cone target using the clamp assembly.
3. Place the standard 1 gram test weight on the flat part of the cone target assembly. It should read 1.00 grams or 14.6 watts.
4. Zero the unit and take the power reading. Repeat as required.
5. To turn unit OFF press and hold **On/Zero/Off** until OFF is displayed, then release.

Battery operation optional. To Install Batteries:

1. Remove tank, target, and clamp assembly. Remove table top from base leaving the standoffs connected to the table top.
2. Tilt base of unit over enough to enable removal of rubber feet with a screwdriver. **Be careful not to allow unit to rest on target support sleeve!**
3. Remove balance from the base, and position it to allow access to battery compartment. Again, be careful of the target support sleeve.
4. Remove compartment cover and install 4 AA alkaline batteries in the battery holder, observing orientation marks. Replace the battery holder and compartment cover, and reassemble unit. **Be careful not to damage the target support sleeve.**

Auto Off: By default, the UPM-DT-100AV will shut itself off after 5 minutes when it detects it is running on batteries. To change this setting:

1. Press & hold the **Menu** button; release when MENU is displayed.
2. Press **No** once; "SETUP" will flash. Press **Yes** once.
3. Press **No** twice; "AutoOff" will flash. Press **Yes** once.
4. Press **No** once; display will scroll through 1 min., 2 min., 5 min., or OFF. Set so desired unit is flashing.
5. Press **No**, then press **Exit**.

If you are using the AC adapter your setting will be saved. If using batteries the unit will default to 5 minute Auto Off if unit is turned off and powered up again.

SETUP

If you accidentally get into the **Setup** menu, you can get out by pushing the **Tare/Menu-Cal/Exit** button. The UPM-DT-100AV Ultrasound Power Meter is a custom programmed balance with additional hardware (cone target, tank, etc.) designed to provide ultrasound power readings. Entry into the Setup menu enables the user to modify certain parameters, allowing the unit to perform additional useful functions. These functions are described in the pages that follow. Critical programming such as calibration and Custom mode parameters are locked in and cannot be changed by the user. If reprogramming to the original parameters does become necessary, the unit must be returned to Ohmic's facility in Easton, Maryland. An hourly labor rate will be charged for any necessary repairs and recalibration fees will be assessed. A calibration certificate will be returned with the unit.

CALIBRATION

A 1-gram weight is supplied to check the calibration and programming. With the transducer under test turned off, zero the unit. Place the weight on the arm of the cone target. Within 3 seconds the unit should read 14.6 watts ($\pm .2$ watts) or 1.0 grams ($\pm .01$ grams). If this reading is significantly off, the UPM-DT-100AV needs to be recalibrated. Send it to Ohmic Instruments Co. for calibration. It is recommended that the UPM-DT-100AV be returned to Ohmic on a yearly basis for calibration and certification.

SERIAL COMPUTER INTERFACE

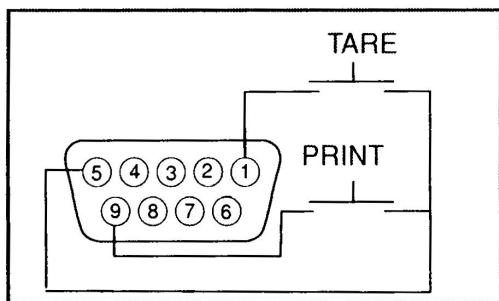
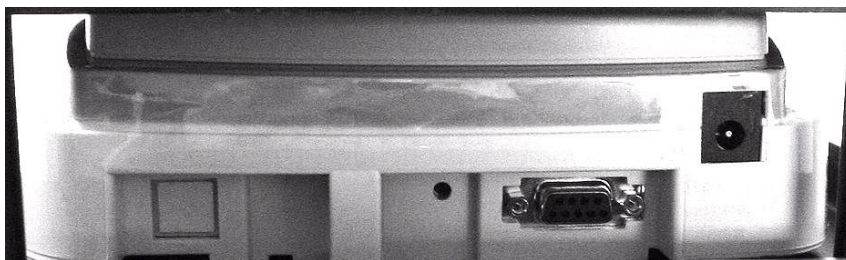
The UPM-DT-100AV is equipped with a bi-directional RS-232 compatible interface for communication with printers and computers. When the balance is connected directly to a printer, displayed data can be output at any time by simply pressing PRINT or by using the Auto Print feature. Connecting the balance to a computer enables you to operate the balance from the computer, as well as receive data. Ohmic UPM's can connect to a PC with a 9-pin PC serial (COM) port using a 9-pin serial cable, available from most computer stores. If your computer has a 25-pin COM port, 25-pin to 9-pin serial adapters are also available from most computer stores and can be used with the cable [Serial data is transmitted using Pin 5 (ground) and Pin 2 (receive)]. Some computer COM ports and serial adapters are not fully implemented (not all pins are used). If the UPM is connected to a partially implemented serial port, functions may be erratic or the unit may fail to communicate.

The UPM serial output requires a terminal emulation program on your computer. Windows XP and older have HyperTerminal already installed. In Windows Vista and later this program is not included. "HyperTerminal Private Edition" can be purchased from Hilgraeve. Other terminal emulation programs can also be used.

Settings for HyperTerminal are on Page 9.

IMPORTANT!

An Ohaus RS-232 cable is required to enable the balance to communicate with a computer or printer. The cable can be ordered from Ohmic. Cable part numbers are as follows:
25-pin: # 80500524; 9-pin: #80500525.



External PRINT and/or TARE switches may be installed as shown in the diagram. Momentary contact switches must be used.

COM1 Pin Connections

- 1 – Remote Tare
- 2 – TxD
- 3 – RxD
- 4 – DSR
- 5 – Ground
- 6 – DTR
- 7 – CTS
- 8 – RTS
- 9 – Remote Print

PROGRAMMING PRINT CONTROL The Print-1 submenu is used to set printing parameters for an external printer or computer. Default settings are in **bold**.

PRINT-1		
Output	When Stable	On/ Off
	GLP Tare	On/ Off
Auto Print	Off , Cont., Interval, When Stable	
	1 - 3600 seconds	
	Stable - Load, Load & Zero	
Content	Num Only - Off , all others	
	On - Header, Gross, Net, Tare, Ref, Result, GLP	
Layout	Line Format - Multi , Single	
	4LF - Yes/ No	
	Form Feed - Yes/ No	
List	Yes/ No	
End Print-1		

Output

Set **When Stable** to **On** to print only stable values. Set **When Stable** to **Off** to print stable or unstable values. Set **GLP Tare** to **On** to print GLP data once after a tare operation. Set **GLP Tare** to **Off** to disable this feature.

Auto Print

When set to **Continuous**, the displayed value is printed continuously. When set to **Interval**, the displayed value is printed at the user specified time interval (1 to 3600 seconds). If set to **When Stable**, the balance will automatically print the display when stability is achieved. An additional setting must be made to determine if only stable non-zero values will be printed (Load & Zero). When set to **Off**, the Auto print feature is disabled.

Content

All of these features can be set On or Off. Numeric data only, Header, Gross, Net, Tare, Reference, Result, GLP.

Layout

Determines the format of data output to a printer or computer. If Line Format is set to **Multi**, a multi-line printout is generated. If it is set to **Single** a single line printout is generated. If **4LF** is set to **yes**, 4 line feeds are appended to the printout. If Form feed is set to **Yes**, a form feed is appended to the printout. This is useful for printing to page printers.

List

When Yes is selected, a printout of balance settings is printed.

End Print - 1.

Press the Yes button to advance to the next menu. Pressing No returns to output Menu item. When set off, entries may be changed. **OFF** is the default setting.

RS-232-1

The RS-232-1 submenu is used to set communication parameters for an external printer or computer.

RS-232-1	
Power	On/Off
Baud	600... 2400 ...19200
Parity	7 Even, 7 Odd, 7 No Par'
	8 No Parity
Handshake	Off, XONXOFF
	Hardware
End RS1	

Power

This menu item allows setting the Power On or Off for COM1. When the balance is operated from the AC Adapter, this menu is hidden and the setting is On. When the balance is operated from batteries, the menu item is available and the default setting is Off. To enable COM1, Power must be turned On.

Baud

Rates of 60,1200, 2400, 4800, 9600, and 19,200 are available.

Parity

Parity settings of 7 even, 7 odd, 7 No Parity, and 8 No Parity are available.

Handshake

Settings of Off, XONXOFF and Hardware are available.

End RS1

Pressing the **Yes** button will advance to the GLP sub-menu. Pressing **No** returns to the Power (or baud) menu item.

OUTPUT FORMATS

Commands listed in the following table are acknowledged by the balance. The balance will return "ES" for invalid commands sent to the balance.

Command	Function
IP	Immediate Print of displayed weight (stable or unstable).
P	Print displayed weight (stable or unstable).
CP	Continuous Print.
SP	Print displayed stable weight.
SLP	Auto Print stable non-zero displayed weight.
SLZP	Auto Print stable non-zero weight and stable zero reading.
xP	Interval Print x = Print Interval (1-3600 seconds).
H	Enter Print Header Lines
Z	Same as pressing Zero key.
T	Same as pressing Tare key.
xT	Establish a preset Tare value in grams. x = PRESET TARE VALUE IN GRAMS.
PT	Prints Tare weight stored in memory.
PM	Print current mode (weighing mode).
M	Scroll to the next enabled mode.
PU	Print current weighing unit.
U	Scroll to the next enabled unit.
OFF	Turns balance OFF.
PSN	Print Serial Number.
PV	Print Version: name, software revision and LFT ON (if LFT is set ON).

SHIPPING INSTRUCTIONS FOR THE UPM-DT-100AV

To make certain that your Ultrasound Power Meter arrives at our repair department unharmed during shipment, please follow these instructions:

1. Empty water from tank and dry.
2. Wrap the target cone in a protective covering and place in tank; **do not put target support bracket in the tabletop tube nor in the clips** (if tank should move during shipment, the bracket will be damaged).
3. Place the weight under the screw provided. Make sure the transducer clamp assembly is screwed in place tightly over the tank and pull the large rubber band over the tank and clamp.
4. Fasten the case lid onto the base, after making certain there is nothing loose inside.
5. The package used for shipping should be strong and large enough to allow for adequate packing material on all sides of unit.

6. Ship to:

Ohmic Instruments
3081 Elm Point Industrial Drive
St. Charles, MO 63301 USA

7. Enclose paperwork (packing slip, purchase order form, letterhead) which includes your return address, contact name and telephone number. A description of the work that needs to be done would be helpful.

By using the above instructions you will avoid additional charges which can be incurred if the unit is not packaged well enough to withstand rough handling during shipment. **Neither Ohmic nor the shipping company can be held responsible for damage if these instructions are not followed.**

SPECIFICATIONS

Power Range	0 to 30 Watts
Resolution	±200 mW
Minimum Detectable Power	±200 mW
Display Sensitivity	0.2 Watt
Accuracy	±3% + One Count
Stabilization	2.5 Second Integration
Maximum Weight Capacity	410 Grams
Maximum Transducer Size	4½" Diameter
Transducer Operating Frequency	0.5 to 10 MHz
Test Media	Degassed Water
Computer Interface	RS-232, 600-19200 Baud
Default Baud Rate	2400
Power	12 VDC, 500 mA
120 VAC Adapter Supplied (Adapters for 240 VAC available on special order)	120 VAC to 12 VDC w/ 2-Conductor Plug and 6-Ft. Cord
EMI Rating	Conforms to CE & FCC
Battery	4 AA (not included)
Electrical Safety	Conforms to UL, CE & CSA
Size	8.5" x 12" x 8.75" (H x L x W)
Weight	11 Lbs. Net
Carrying Case	Black Anodized Aluminum

MAINTENANCE

Verification of Proper Scale Functioning: Small variations of water surface motion, air currents or mechanical movements may cause uncertainties in power measurements. To test scale accuracy at low levels, set up the scale as in the Operating Procedure (Page 6). Place the 14.6 watt weight on the flat surface of the target arm. Read meter three times; readings should be within $\pm .2$ counts (for example, 14.4 to 14.8). In case of doubt about lower power resolution, repeat the same procedure using light objects such as thin paper slices to produce readings of 5 to 10 counts; repeat readings. Average uncertainty should be within $\pm .2$ counts on the watts scale. Avoid mechanical and air movement or variations in magnetic fields while making tests.

Out of Measurement Range Warnings: Model UPM-DT-100AV accommodates weight differential of ± 410 grams. When the scale exceeds this range, "Error 8.3" will be displayed. Something may be pressing hard on the target or support. "Error 8.4" indicates underweight condition. If no obvious error has been made by the user the unit should be returned for service when any code is displayed.

No Display: 1) Make sure the AC adapter's plug is fully seated in the jack at the back of the unit. 2) Use a voltmeter to verify the adapter is producing 12 volts DC (approximately). Call our service department for assistance.

WATER, TANK SIZE, TRANSDUCER PLACEMENT & TEMPERATURE CONSIDERATIONS

Water as a Measurement Medium: The measurements are to be performed in de-gassed water because ultrasound propagation in water closely approximates that in tissues (see UL-1-1981, AIUM/NEMA Standard Publication). The ultrasonic attenuation in water can be taken as a lower limit on the attenuation which will be encountered in the body. Large areas in the body can consist of low attenuating material such as urine and amniotic fluid. The use of water prevents measurements in a more highly attenuating material such as liver equivalent gels from representing the highest possible intensities which might be encountered in the body. A measurement temperature of $24^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($75^{\circ}\text{F} \pm 5^{\circ}$) is chosen for convenience.

De-Gassed Water: Ultrasound power measurement accuracy is affected (by lowering the power reading) if the water contains more than five parts per million of air. To de-gas, boil distilled water 20 minutes, then pour into a suitable container, seal tightly and place in refrigerator. This process will give the required quality. The container should be heat resistant glass, or thick plastic may be used after the water has been cooled. Before testing, pour water into tilted test tank to minimize turbulence. The test tank water surface will absorb oxygen and a change of de-gassed water is recommended before each test. An alternative method of de-gassing water is to heat the water to boiling, then pull a vacuum for five minutes.

Water temperature affects accuracy; use a testing temperature of 21 to 27°C ambient. Sonic energy agitates the water surface through heating and scattering. Testing time should be limited to a few minutes; prolonged testing, particularly at higher power levels, will drive out dissolved air and air bubbles will be visible on surfaces in the tank. These bubbles can be gently brushed off.

Transducer Wetting and Placement: After tilting the transducer into the water at a 45° angle, verify that the surface is uniformly wetted. The transducer should be positioned above the cone target. Small variations will occur due to placement. Try various positions above target to obtain a maximum power reading.

ULTRASOUND RADIATION LEVELS

There are no maximum limits in the U.S. for therapy power, only the verification of the displayed setting accuracy to $\pm 20\%$ of actual output is required. Exposure levels for physical therapy applicator heads range from $100\text{mW}/\text{cm}^2$ to $3\text{W}/\text{cm}^2$. Total power requires multiplication by the radiated cross sectional area in cm^2 . The power limits shown in the following table for diagnostic ultrasound have been extracted from FDA Section 510(k) guidance to manufacturers on submissions and clearance as of February 1993. Refer to the AIUM and FDA publications for complete and up to date testing standards and interpretations. Measurements are done in all standard modes of operation. Power intensity is rated as Spatial Peak Temporal Average (I_{SPTA}) and Spatial Peak Pulse Average (I_{SPPA}). The values in mW/cm^2 are derated for tissue and in parenthesis for the water medium (use this chart):

PRE-AMENDMENT ACOUSTIC OUTPUT LIMITS

Use	I_{SPTA} Tissue	(mW/cm^2) Water	I_{SPPA} Tissue	(mW/cm^2) Water
Peripheral Vessel	720	1500	190	350
Cardiac	430	730	190	350
Fetal Imaging & Other *	94	180	190	350
Ophthalmic	17	68	28	110

* Abdominal, intra-operative, pediatric, small organ (breast, thyroid, testes, etc.), neonatal cephalic, adult cephalic.

THEORY OF MEASURING ULTRASOUND POWER WITH THE RADIATION FORCE METHOD

Sound is a form of energy that sets the particles in the isonated medium into vibrational motion. The particles then possess a kinetic energy. If dP_m is the rate of the flow of this energy about an area dA , then the mean acoustic energy is:

Eq. 1 $I = dP_m/dA$

I = Acoustic intensity at a point in that area,
Watts/cm²

When a plane sound wave propagates through a uniform non-absorbent medium, the intensity must be the same for all points in the wave. Let E represent the energy density, i.e., the energy per unit volume. When the sound energy passes through a unit cross-sectional area with a speed c , the intensity is:

Eq. 2 $I = cE$

E = Energy density per unit volume, ergs/cm³
 c = Ultrasound wave velocity, cm/sec

The radiation pressure effect can be explained by analogy to the application of an alternating electric voltage to a non-linear load. With the non-linear load it appears that both AC and DC components are present. In ultrasonics the non-linear element is the density of the fluid and hence acoustic impedance (load) varies in the same periodical manner as the density. Therefore in ultrasound the two components of pressure, one alternating and the other direct are present. The average AC pressure per cycle is zero, but the DC pressure of radiation is:

Eq. 3 $P_r = I/C$

P_r = Pressure of Radiation, ergs/cm³

Therefore, from the above two equations, the pressure of radiation (P_r) is equal to the energy density (E).

Eq. 4 $P_r = E$

It is this DC pressure of radiation that can be measured. At low frequencies, below 100 KHz, a standard high frequency hydrophone can be used. For higher frequencies, generally used in medical applications, 1-15 MHz, hydrophones are not available. At these frequencies the force can be measured using a precision balance and a radiation force target that is perfectly absorptive. The conversion from force to power can be accomplished using the equation:

Eq. 5 $p = Wgc$

W = measured force, grams
 g = acceleration, dynes
 c = velocity of ultrasound, cm/sec
 p = power, ergs/sec

By combining all constants together and converting from ergs/sec to watts, we obtain a simplified equation that is used to calculate the ultrasonic power once the force is measured:

$$P = w(14.65)$$

P = Ultrasonic power in watts
 w = Ultrasonic force in grams

To determine the ultrasonic watt density (watts/cm² or watts/in²) of a given transducer the P is divided by the cross sectional area of the transducer.

WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive.

Ohmic Instruments warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses or any product or parts which have been subjected to misuse, neglect, accident, or abnormal conditions of operation.

In the event of failure of a product covered by this warranty, Ohmic Instruments will repair and recalibrate an instrument returned within 1 year of the original purchase, provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. OHMIC INSTRUMENTS COMPANY SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1. Notify Ohmic Instruments, giving full details of the difficulty, and include the model, type, and serial numbers (where applicable). On receipt of this information, service data, or shipping instructions will be forwarded to you.
2. On receipt of shipping instructions, forward the instrument, transportation prepaid. Repairs will be made and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of Ohmic Instruments products should be made via United Parcel Service or "Best Way" prepaid. The instru-

ment should be shipped in the original packing carton, or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in packing material and surrounded with at least four inches of excelsior or similar shock absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon delivery to purchaser. All material in the shipping container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact Ohmic Instruments.) Final claim and negotiations with the carrier must be completed by the customer.

Ohmic Instruments will be pleased to answer all application or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to:

Ohmic Instruments
3081 Elm Point Industrial Drive
St. Charles, MO 63301
ATTN: Technical Support.
Or call Ohmic Technical Support at 410-820-5111.

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ULTRASONIC THERAPY UNIT INSPECTION RECORD				ACTION			WORK ORDER NO.	
				NOT NEEDED	NEEDED	TAKEN		
LOCATION	MANUFACTURER		DATE OF INSPECTION		CARD COLUMNS	WORK ORDER TRANSACTION		
UNIT MODEL	TRANSDUCER MODEL		NEXT INSPECTION DUE		1-15	STOCK NO.		
UNIT SERIAL NO.	TRANSDUCER SERIAL NO.		TECHNICIAN		18	DETACHMENT		
1. PREVENTIVE MAINTENANCE INSPECTION			SAT.	UNSAT.	20-24	INDEX NO.		
REMARKS					26-29	PM MANHOURS		
					30	PM MINUTES		
2. FUNCTIONAL/OPERATIONAL CHECKOUT			SAT.	UNSAT.	32-35	REPAIR HOURS		
REMARKS					36	REPAIR MINUTES		
3. LEAKAGE CURRENT - CHASSIS - 100µA TRANSDUCER - 50µA			SAT.	UNSAT.	38-43	CONTRACT COSTS		
TEST CONDITION	POWER	CHASSIS	TRANSDUCER		45	REPAIRMAN'S CODE		
GROUNDED NORMAL POLARITY	ON				47-50	DATE COMPLETED		
	OFF				51-52	ACTION CODE		
GROUND LIFTED NORMAL POLARITY	ON				53-60	WORK ORDER NO.		
	OFF				61-66	RC/CC		
GROUND LIFTED REVERSE POLARITY	ON				67-69	DOWN DAYS		
	OFF				70-75	QUANTITY INSPECTED		
4. GROUND WIRE RESISTANCE (150 milliohms max.)				_____m ohms		78-80	TRANSACTION CODE	
5. TIMER	TOL.	SELECTED	TIMED					
< 8 MIN.	± 0.8 MIN.			6. ANNUAL INSPECTION REQUIREMENTS COMPLETED				DATE
8 M. - 10 MIN.	± 10%			7. IS UNIT SUBJECT TO 21CFR1050 REQUIREMENTS?				YES NO
> 10 MIN.	± 1.0 MIN.			8. COMBINED MUSCLE STIMULATOR INSPECTED?				YES NO
REMARKS								
WORK PERFORMED BY					LABEL AFFIXED:			
					USER MAINTENANCE:			

9. CONTINUOUS WAVE MODE CERTIFICATION (Average Power)

WATTS SELECT	POWER		DIFF.	WATTS OUT	ALLOWABLE RANGE		WATTS SELECT	POWER		DIFF.	WATTS OUT	ALLOWABLE RANGE	
	ON	OFF			SAT.	UNSAT.		ON	OFF			SAT.	UNSAT.
5	1				3.7 - 6.3		10	1				7.4 - 12.6	
	2							2					
	3				SAT.	UNSAT.		3				SAT.	UNSAT.
Average of 3 Readings							Average of 3 Readings						
15	1				11.1 - 18.9		20	1				14.8 - 25.2	
	2							2					
	3				SAT.	UNSAT.		3				SAT.	UNSAT.
Average of 3 Readings							Average of 3 Readings						
	1							1					
	2							2					
	3				SAT.	UNSAT.		3				SAT.	UNSAT.
Average of 3 Readings							Average of 3 Readings						

10. PULSED MODE CERTIFICATION (Amplitude Modulated Waveform)

MAX. PULSE MODE SETTING	POWER		DIFF.	WATTS OUT	CALCULATIONS	
	ON	OFF				
(Pp)						
Average of 3 Readings				= Measured Average Power (Av)		
Pp	R _{TPA}	CALC. AVERAGE POWER (Pp / R _{TPA})	Difference Between Measured AV And Calculated AV		Is Difference < ± 0.6% Of (Pp / R _{TPA})	REMARKS
					YES NO	

11. SHORT TERM LIFE TEST COMPLETE? YES NO

12. ADDITIONAL TEST (Describe in Detail):