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9. DIGISONIC III SYSTEM

9.1 DESCRIPTION

The Digisonic III system consists of a Digisonic III Controller, transducer, element bar and a 40kHz nozzle. The transducer, element bar and 40kHz nozzle are connected together and then connected to the controller via a cable.

WARNING

The Digisonic III System has been designed with safety in mind. However, no design can completely protect against improper usage, which may result in bodily injury and/or property damage. For your protection and equipment safeguard, observe the following warnings at all times, read the operating instructions carefully before using the equipment, and retain this instruction manual for future reference. If the controller is used in a manner contrary to that specified in this instruction manual, the protection features designed into the unit may be impaired.

- High voltage is present in the controller (power supply), transducer and high frequency cable. There are no user-serviceable parts inside any of these devices. Do NOT attempt to remove the controller cover or transducer case.
- Do NOT touch any open cable connections on the unit while the power is turned ON.
- Do NOT operate controller with transducer disconnected from high voltage cable. High voltage is present in the cable and may pose a shock hazard.
- Do NOT attempt to disconnect the transducer high voltage cable while the unit is running.
- The controller must be properly grounded with a 3-prong plug. Test electrical outlet for proper grounding before plugging in unit.
- Install the Controller in an area free from excessive dust, dirt, explosive or corrosive fumes and protected from extremes in temperature and humidity. Do not place the Controller within a Fume Hood.
- NEVER immerse the transducer in liquids of any kind or let condensed moisture or liquid drip into the transducer.
- NEVER grasp an activated nozzle or touch the tip of a vibrating nozzle. It can cause severe burns and tissue damage.
- NEVER allow a nozzle to vibrate in air.
- NEVER hold or clamp the transducer by the front driver or by the nozzle itself. This can cause permanent damage to the system. Support the transducer by only clamping around the transducer housing (upper portion).
- Do NOT allow the tip of a vibrating nozzle or nozzle to touch the countertop or any other hard surface. It could damage the nozzle, overload the controller, or damage the surface.
- Avoid touching the bottom or sides of a glass or plastic container with an activated nozzle. It could crack or shatter the glass or melt the plastic. Use glassware that is free from cracks or chips.
- Turn OFF the power switch, unplug the controller and disconnect the power cord from the back of the controller before attempting to replace the fuses.
- Inspect high frequency cable for cracks in the protective outer jacket.
- Do not operate unit with a damaged cable. Doing so may cause serious injury.
- In case of AC power loss, wait 3 minutes minimum before reapplying power.
- Do not turn off AC mains power while running a nozzle.

9.1.1 Digisonic III Controller (Figure 9.1)

The controller includes the operating controls, power indicator, On/Off switch, and separable three-wire grounded line cord with integral U.S. or European plug, fuse, and high frequency cable connector. The Controller is 146 mm (5.75") high, 203 mm (7.99") wide and 349 mm (13.74") deep and weighs 3.2 kg (7.0 lbs.).

9.1.1.1 Front Panel Controls and Indicators (Figure 9.1)

The front panel contains the display and pushbuttons for controlling the system.

CLEAR Key (Figure 9.1 Item 1)

The Clear key clears the preceding entry.

AMPL Key (Figure 9.1 Item 2)

Desired amplitude must be set in order for the Ultrasonic Processor to be operational. The other control parameters, Time and Pulse, do not have to be set for continuous operation. AMPL displays the amplitude selected e.g. 40%. To set the amplitude at 40% when the ultrasonics is off, press the AMPL key and the numeric keys for a 40% reading on the screen, and then press the ENTER/REVIEW key.

PULSE Key (Figure 9.1 Item 3)

Ultrasonics generates heat. Pulsing ultrasonics on and off helps to prevent heat buildup in temperature sensitive samples. In addition, pulsing enhances processing by allowing the material to settle back under the nozzle after each burst. The ON and OFF pulse duration can be set independently from 01 second to 59 seconds. During the OFF portion of the cycle, the red indicator on the PULSE key will illuminate. If the OFF portion of the cycle exceeds three seconds, a cautionary message - Sonics in OFF Cycle - will warn the operator against touching the ultrasonic nozzle.

TIMER Key (Figure 9.1 Item 4)

In the pulsed mode the processing time will be different from the elapsed time because the processing time function monitors and controls only the ON portion of the duty cycle. For example, for 1-hour processing time, the elapsed time will be 2 hours if the ON and OFF cycle are set for 1 second.

START/STOP Key (Figure 9.1 Item 5)

The Start/Stop key starts or stops the ultrasonics. In the STOP mode the red indicator goes off.

LCD Screen (Figure 9.1 Item 6)

The LCD screen displays prompts and the following control parameters:

- Amplitude percent selected
- Amount of output power delivered to the nozzle in watts, and as a percentage of maximum wattage.
- Selected duration of processing
- Actual processing time
- Elapsed time
- Accumulated amount of energy in Joules delivered to the nozzle(s).

Figure 9.1 Digisonic III Controller Front Panel

"I" Key (Figure 9.1 Item 7)

The 'I" key switches the main power on.

"O" Key (Figure 9.1 Item 8)

The "O" Key switches the main power off.

▲▼ Keys (Figure 9.1 Items 9 and 10)

Used with the AMPL key when the unit is on standby to set the amplitude of vibration at the nozzle tip. Also used to increase or decrease the amplitude in small increments while the unit is running. To accomplish this task, depress the AMPL key to display Amplitude Setting, then depress the ▲or ▼ key as required.

ENTER REVIEW Key (Figure 9.1 Item 11)

The REVIEW function provides a "window" on the process by displaying various operating parameters without process interruption. Pressing the ENTER/REVIEW key repeatedly during processing will consecutively display the following information.

a) Selected amplitude: e.g. Amplitude 40%
b) Selected processing time and elapsed processing time: e.g. Set 0:30:00 Time 0:22:10
c) Selected pulsing cycle and actual pulsing cycle: e.g. Pulse 01 01 / 01 00
d) Amount of power in watts, and accumulated amount of energy in JOULES delivered to the probe (Note: *The amount of energy displayed will be only for one cycle. Initiating a new cycle will reset the display to zero.)*: e.g. 20 watts 0000000 Joules
e) Elapsed time since processing was initiated: e.g. Elapsed time 0:44:20

9.1.1.2 Rear Panel (Figure 9.2)

The rear panel contains the I/O Port connector, foot switch connector, cooling fan, power entry module with a separate system fuse and the transducer jack.

I/O Port Connector (Figure 9.2 Item 1)

The 9-pin D-sub connector is used for making the electrical connection to an external control. The connector has the pin layout as shown in Table 9.1.

Table 9.1 I/O Port Connector Pin Configuration

PIN#	SIGNAL
1	Not Connected
2	Not Connected
3	Not Connected
4	Enables connection to a frequency counter
5	Enables connection to an external power monitor (5mV is approx. 1 Watt)
6	Ground
7	Energizes the ultrasonics when connected to ground (pin 6)
8&9	Enables the intensity to be remotely adjusted using an external 10K potentiometer*

*Connect the wiper to pin 8 and the other two connections to pins 6 and 9.

NOTE

To vary the intensity remotely using a variable DC power supply (0-5V) instead of a 10K potentiometer, connect positive to pin 8 and negative to pin 6.

Contact Closure Remote Start / Trigger Input - Connecting Pin 7 (+5 VDC) to Pin 6 (ground) will start or trigger the unit. The open circuit voltage between Pin 7 and Pin 6 is +5 VDC, the short circuit current is approximately 0.75 mA.

Remote Frequency Counter Output - The frequency of the system can be monitored remotely. Pin 4 (frequency output) is referenced to Pin 6 (ground). This signal is one-tenth the operating frequency and is driven by a 4000 series

CMOS logic gate. The 4017-decade counter integrated circuit has a 15 VDC supply. The output frequency will vary between 3.90 to 4.10 KHz. Normal operating frequency will be between 3.98 and 4.02 KHz.

Remote Power Monitor Output - The operating power can be monitored remotely. Pin 5 (power amplitude) is referenced to Pin 6 (ground). This signal has a scaling of approximately 5 mV is equal to 1 watt.

Foot Switch Connector (Figure 9.2 Item 2)

The foot switch connector provides a connection point for an external footswitch which can be used to operate the system.

Cooling Fan (Figure 9.2 Item 3)

The cooling fan keeps the devices in the Controller Module from getting too hot. Make sure the area around the fan is clear of obstructions.

Power Entry Module (Figure 9.2 Item 4)

The power entry module contains a receptacle for a standard IEC power cord, a voltage selector and main fuse holder.

CAUTION

Before plugging in the system, ensure the line voltage setting appearing in the window agrees with the available line voltage. Damage to the equipment could result if the two voltages do not match.

Refer to the Title Page section of this manual to determine the power connection and fuse specifications for this Controller Module.

1. Ensure that the power cord is not connected to the electrical outlet or controller.
2. Open the fuse holder cover using a small screwdriver.
3. Pull out the fuse holder from its housing.
4. To convert from 100/115V to 220/240V replace the two 3 Amp slow blow fuses, with 1.6 Amp fuses.
5. To convert from 220/240V to 100/115V replace the two 1.6 Amp slow blow fuses, with 3.0 Amp fuses.
6. Rotate the fuse holder 180° from its original position and reinsert it into its housing. For 100/ 115V operation the voltage displayed should be 115. For 220/240V operation the voltage display should be 220.
7. Change the electrical power cord as required.

Figure 9.2 Digisonic III Controller Rear Panel

Transducer Jack (Figure 9.2 Item 5)

The transducer jack is used to make the connection between the controller and the transducer.

9.1.2 Transducer (Figure 9.3 Item 1)

The transducer includes the transducer crystals, housing, and front driver (first stage of acoustic amplification). The transducer measures 1.25” (31,8mm) diameter and 4.825” (122.6mm) long. (refer to section 9.5)

9.1.3 Element Bar (Figure 9.3 Item 2)

The element bar is available in a single or five-up version and transfers energy from the transducer to the 40 kHz nozzle(s). The energy delivered to each nozzle is uniform. The element bar is available as a Single-Element or Five - Position Multi-element bar. (refer to section 9.5)

9.1.4 40 kHz Nozzle (Figure 9.3 Item 3)

A resonating nozzle has a central hollow channel and a is available with a variety of spray patterns. Each nozzle measures 7.6mm 0.298”) diameter and between 53.04mm (2.088”) and 61.75mm (2.431”) long depending on the nozzle type, (refer to section 9.5)

9.1.5 40KHz Flow-Thru Half Wave Extender (Figure 9.3 Item 4)

A 40KHz Flow-Thru Half Wave Extender is available for applications where the standard system does not provide sufficient length. The half-wave extender measures 7.62mm (0.30”) diameter and 62.48mm (2.46”) long. (refer to section 9.5)

9.2 OPERATION

The controller (power supply) converts conventional 50/60 Hz AC line power to 40 kHz electrical energy, which is fed to the transducer where it is transformed to mechanical vibration. The heart of the transducer is a lead zirconate titanate electrostrictive (piezoelectric) crystal which, when subjected to an alternating voltage, expands and contracts. The

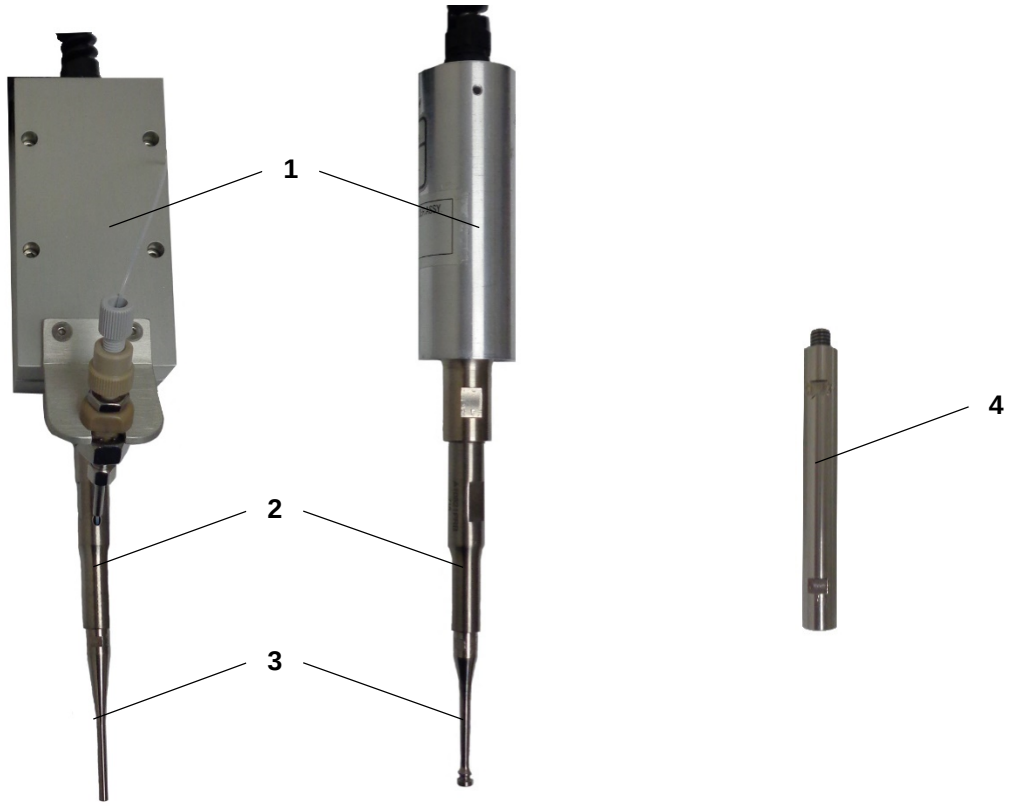


Figure 9.3 Digisonic System Additional Parts

transducer vibrates in the longitudinal direction and transmits this motion to the nozzle(s). The process solution is pumped through the mother horn and delivered to the nozzle tip(s). The rapid ultrasonic vibration of the nozzle's tip causes the liquid solution to be nebulized (or atomized) into micron sized droplets forming an ultrafine mist. This ultrafine mist can be deposited onto any surface as a coating, substrate, etching solution or cleaning agent.

The transducer is matched to the controller and tuned to vibrate at a fixed frequency of 40 kHz. The nebulizing nozzles are resonating bodies, also tuned to vibrate at 40 kHz, any change in mass or geometry can disturb the resonant frequency and cause failure or damage to the nozzle, transducer or controller.

9.2.1 Relationship of Amplitude and Wattage

Sonication power is measured in watts. Amplitude is a measurement of the excursion of the tip of the nozzle (nozzle is also known as a nozzle).

Some ultrasonic processors have a wattage display. During operation, the wattage displayed is the energy required to drive the radiating face of a nozzle, at that specific amplitude setting against a specific load, at that particular moment. For example, the unit experiences a higher load when processing viscous samples then when compared to aqueous samples.

The speed /cruise control on an automobile, can, to a certain extent, be compared to an ultrasonic processor. The speed/cruise control is designed to ensure that the vehicle maintains a constant rate of travel. As the terrain elevations change, so do the power requirements. The cruise control senses these requirements, and automatically adjusts the amount of power delivered by the engine in order to compensate for these ever-changing conditions. The greater the terrain rate of incline and greater the resistance to the movement of the vehicle, the greater the amount of power that will be delivered by the engine to overcome that resistance and maintain a constant speed.

The ultrasonic processor was designed to deliver constant amplitude, to your liquid sample, regardless of these changes in load (much like the vehicle's cruise control described above). As a liquid is processed, the load on the nozzle will vary due to changes in the liquid sample (i.e. viscosity, concentration, temperature, etc.). As the resistance to the movement of the nozzle increases (increased load on the nozzle), additional power will be delivered by the power supply

to ensure that the excursion at the nozzle tip remains constant. The displayed wattage readings will vary as the load changes; however, the amplitude will remain the same.

The resistance to the movement of the nozzle determines how much power will be delivered to maintain amplitude. For example, a ½" nozzle at 100% amplitude will require approximately 5 watts to operate in air. The amplitude of this nozzle is approximately 120um. Insert the nozzle in water and the wattage reading will increase to approximately 90 watts. The wattage required to operate the nozzle will increase as the load increases but the amplitude remains the same.

The AMPLITUDE control allows the ultrasonic vibrations at the nozzle tip to be set to any desired level. Although the degree of cavitation/ultrasonic energy required to process the sample can readily be determined by visual observation, the amount of power required cannot be predetermined. A sensing network continuously monitors the output requirements, and automatically adjusts the power to maintain the amplitude at the preselected level. The greater the resistance to the movement of the nozzle due to higher viscosity, deeper immersion of the nozzle into the sample, larger nozzle diameter or higher pressure, the greater the amount of power that will be delivered to the nozzle. Setting the AMPLITUDE control to its maximum will not cause the maximum power rating of the unit to be delivered to the sample. The maximum power (125 watts) that the Ultrasonic Processor is capable of delivering will only be delivered when the resistance to the movement of the nozzle is high enough to draw maximum wattage.

It is the intensity of cavitation that measures the effectiveness of the sonication, not the total power applied to the system. Intensity is directly related to the amplitude of the radiating face of the tip or nozzle. It is amplitude that must be provided, maintained, and monitored. The unit provides controlled amplitude under varying load conditions in order to give reproducible results.

9.2.2 Safety Precautions

Read All Instructions Before Installing or Using Equipment.

The Digisonic III System has been designed and tested to assure maximum operator safety. However, no design can completely protect against improper usage which may lead to bodily injury and/or property damage. For total safety and equipment protection, read this instruction manual carefully before attempting to operate the equipment. Follow all operating procedures and observe the following safety precautions.

WARNINGS

- *High voltage is present in the Controller (power supply), Transducer and high frequency cable. Do Not attempt to remove the Controller cover or convertor case.*
- ***Do Not** touch any open cable connections on the unit while the power IS turned on.*
- ***Do Not operate Controller with convertor disconnected from high voltage cable.***
- *The Controller must be properly grounded with a 3-prong plug. Test electrical outlet for proper grounding before plugging in unit.*
- *Install the unit in an area free from excessive dust, dirt, explosive or corrosive fumes and protected from extremes in temperature and humidity.*
- *NEVER immerse the convertor in liquids of any kind, or let condensed moisture or liquid drip into the convertor.*
- *NEVER grasp an activated element bar or nozzle or touch the vibrating tip, it can cause severe burns and tissue damage.*
- *Do Not allow the tip of a vibrating nozzle to touch the counter top or any other hard surface. It could damage the nozzle or overload the Controller.*
- *Avoid touching the bottom or sides of a glass or plastic container with a vibrating nozzle. It could crack or shatter the glass and melt the plastic tube.*
- *Turn off the power switch, unplug the Controller, and disconnect the power cord from the back of the Controller before attempting to replace the fuse.*
- *If the Controller has been left in a cold environment fora prolonged period of time, do not operate the unit until it has warmed up to room temperature. Turn the power switch on, with the Amplitude Control Knob on zero, 20 minutes before using to warm-up the electronics faster.*

9.2.3 Safety Inspection Procedures

Safety precautions regarding the operation and handling of high voltage equipment is prominently indicated in this instruction manual. This serves as a safety reminder to the operators to visually and physically inspect the unit to insure optimum and safe performance. This inspection should be scheduled as a routine maintenance procedure, and done with the Controller turned OFF, and the unit unplugged from the AC power source.

As with any product of this kind, some applications are more severe than others, resulting in the equipment being subjected to harsh environments and aggressive handling. Long exposure to acid or caustic fumes will result in corrosion of metal parts or components. Check the rear of the controller, transducer, element bar, nozzle(s) and cables for any signs of rust or discoloration. If discoloration is found, move the component away from the source of the contaminant. Periodically examine the high voltage cable, which attaches the transducer to the controller, for signs of damage. Inspect the cable's insulation for cracks, kinks, wear and burn marks, and check the end connectors for signs of pulling, fraying or breakage due to extended use or rough handling. Replace the cable immediately if damage to the cable is present. Should the cable be subjected to misuse, such as dropping or pulling on the wire itself, the cable must be inspected.

Should the unit not function properly, shut the unit off and inspect the cable as above before any other action is taken.

WARNING

Do not use a cable with broken end connections, exposed wires, cracked or frayed insulation. High voltage is present in the cable and may pose a shock hazard. Do not touch the transducer until the controller power switch is in the OFF position and the unit is unplugged.

If the operator is in doubt as to the condition of the unit, call IVEK Corporation at (01) 802-886-2238 to speak with a customer service representative for prompt attention.

The cable should not be used to carry the transducer or to pull it toward the user. Make certain that the cable always has slack and is never tensioned. Move the controller and transducer closer to one another to accomplish this. If this is not possible, contact IVEK Corporation for a longer cable.

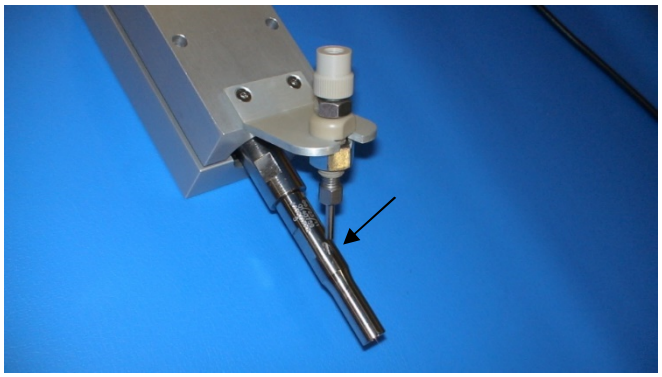
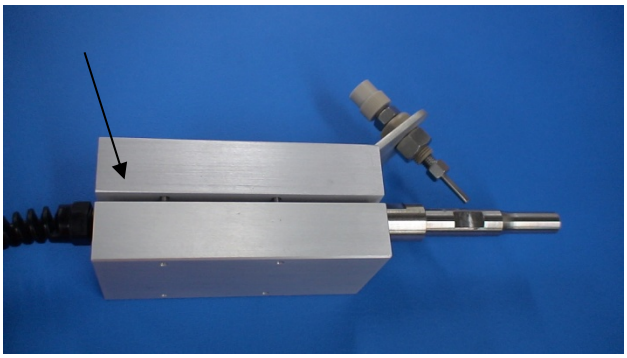
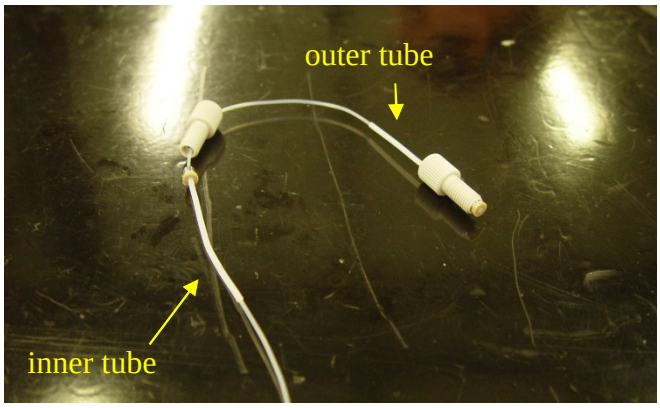
9.2.4 Preparation for Use

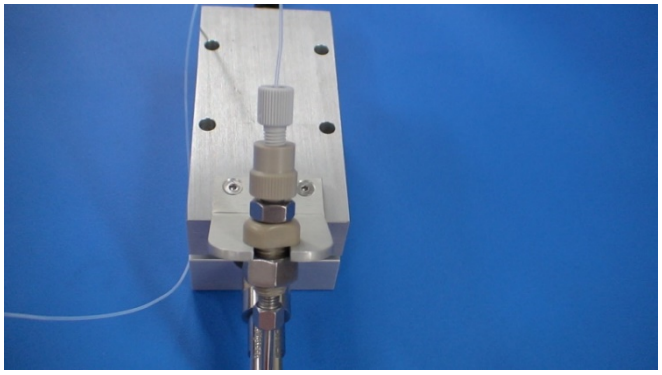
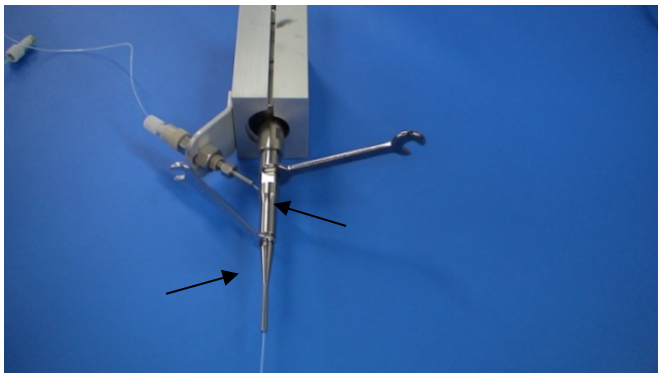
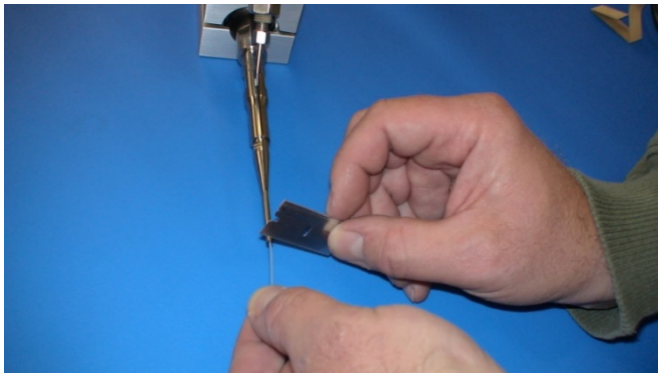
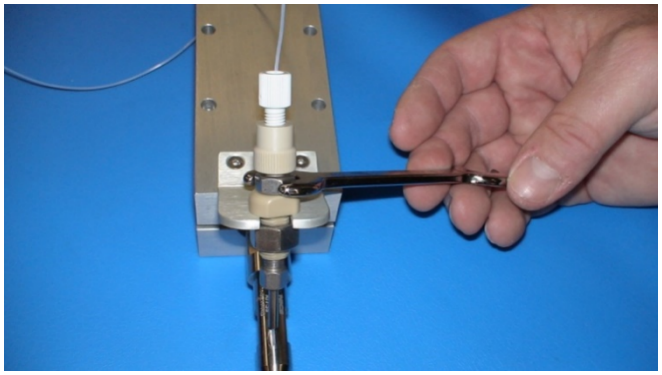
CAUTION

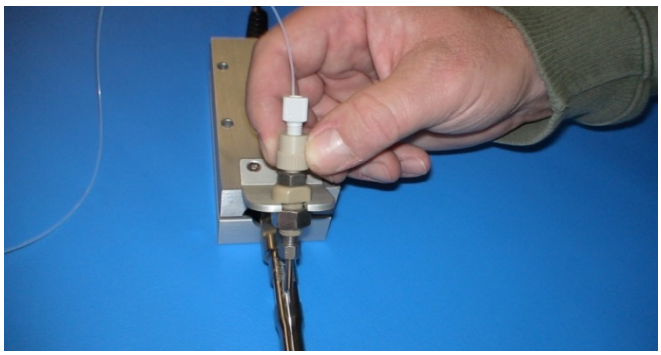
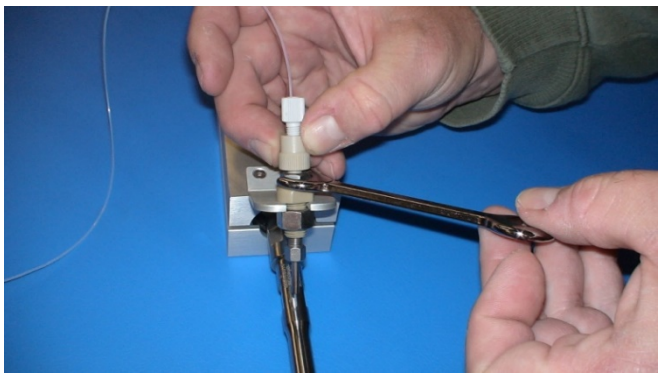
Do not operate the system if it has been in a very cold or hot environment for a prolonged period of time. Wait until all the components reach room temperature.

9.2.4.1 Set-up Instructions for Flat Bottom Ultrasonic Nozzle IVEK Part #'s 122049 and 122065

The following process shows the steps for setting up a system with a single-element bar. The process is the same for a multi-element bar, but would require up to five tubing assemblies.

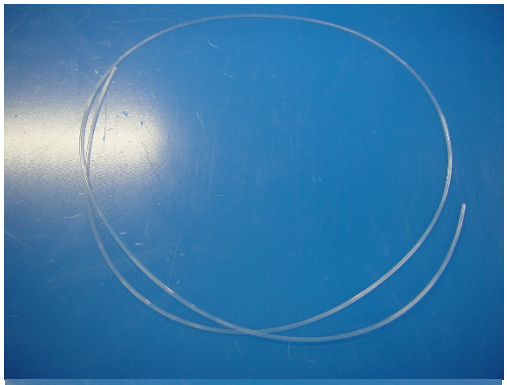
Step Number: 1 Install the Element Bar onto the Transducer and tighten. Place the assembly into the Back-Mounting Clamp as shown. **NOTE:** The element bar end of the Transducer should be flush with bottom end of the Back-Mounting Clamp.	
Step Number: 2 Place the Front Mounting Clamp onto the Back-Mounting Clamp, making sure that the element bar end of the Transducer is still flush with the bottom end of the Back-Mounting Clamp. Align the four holes in Front Mounting Clamp with the corresponding holes in the Back-Mounting Clamp. Ensure that the Tubing Guide is in line with the Element Bar port.	
Step Number: 3 Insert (1) M3 x 20 screw through each of the (4) holes in the Front Mounting Clamp and gently hand tighten in an alternating pattern down into the Back-Mounting Clamp with the 2.5mm hex key wrench. **Do not over tighten;** the edges of the front and back Mounting Clamps will not be flush. **NOTE:** The front and back Mounting Clamps should have an approximate .5mm gap on each side as shown.	
Step Number: 4 Obtain the following: IVEK Part # 142763 Tubing Fabrication, 26 AWG, Ultrasonic Nozzle	

Step Number: 5 Insert the Tubing Fabrication, inner tube side down through the Fitting Sub Assembly, through the Fitting Modification and out through the Tubing Sub Assembly. Continue to feed the Tubing through the Assemblies until the Ferrule is flush against the inside bottom of the Tubing Length Adjuster. Hand Tighten the Super Flangeless Nut to secure the Tubing fabrication in place.	
Step Number: 6 Obtain the following: IVEK Ultrasonic Nozzle, 40kHz, Flat Bottom Spray.	
Step Number: 7 Feed the tubing through the Nozzle. Use the 1/4” and 3/8” open end wrenches to secure the Nozzle to the Element. Place the 3/8” wrench on the flat of the Element to hold it in place and use the 1/4” wrench, placed on the flat of the Nozzle, to rotate the Nozzle in a clockwise direction until it is installed in the Element Bar as shown.	
Step Number: 8 Use a razor blade to trim the end of the tubing flush with end of the Nozzle as shown.	
Step Number: 9 Loosen the Fitting Modification nut with 7/16” wrench as shown.	

Step Number: 10 Turn Fitting Modification union 1/4 turn in counter clockwise direction to pull tubing up into Nozzle (approx. 1/32”).	
Step Number: 11 While holding the union in place, gently retighten the nut with the 7/16” wrench.	

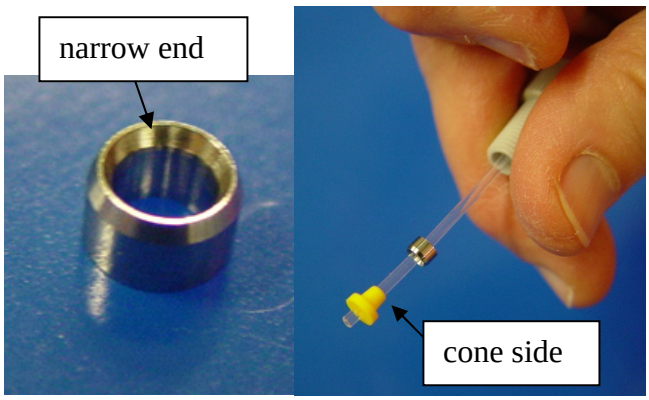
9.2.4.2 Set-up Instructions for Radial and Angled Ultrasonic Nozzles IVEK Part #’s 122045, 122067 and 122068

The following process shows the steps for setting up a system with a Multi-Element Bar. The process is the same for a single element bar, but would require only one tubing assembly.

Step Number: 1 Obtain the following: 3 ½ feet of 142323-008 Tubing, FEP Teflon; .030” I.D., 1/16” O.D. 142275 Nut, Super Flangeless, ¼-28, Gray Delrin, 1/16” Tubing 142518 Ferrule, Super Flangeless, Yellow ETFE, 1/16” Tubing	
Step Number: 2 Slide (1) Nut over the one end of (1) piece of Tubing as shown.	

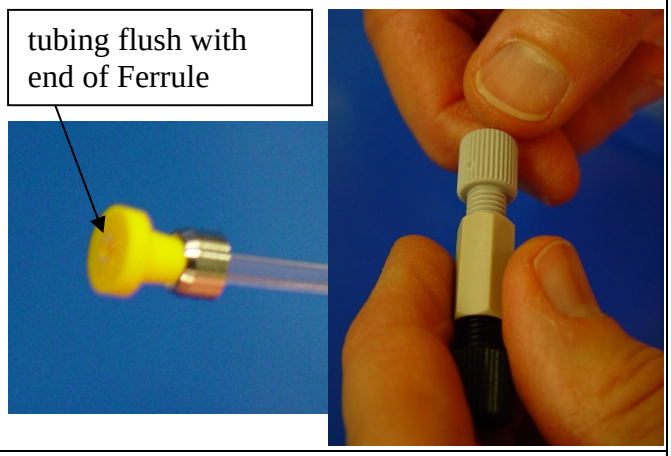
Step Number: 3

Slide (1) lock ring, narrow side out and away from the Nut, and (1) Ferrule, cone side in and towards the lock ring, over the end of the Tubing as shown.



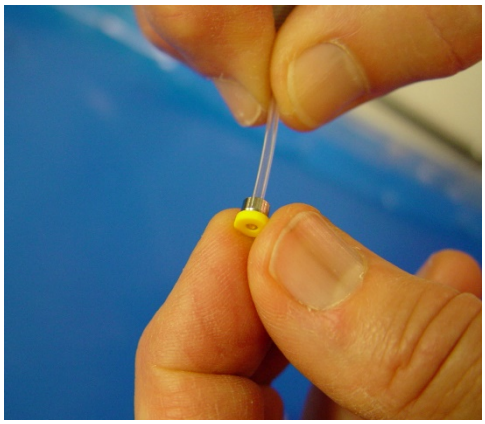
Step Number: 4

Slide the Ferrule and lock ring towards end of Tubing, until the cut edge of the Tubing sits flush with the bottom of the Ferrule. Insert the Ferrule with the Tubing in place into the open end of the Nut and Union Set Tool, slide the Nut down the Tubing and hand screw into the Set Tool until it bottoms out.



Step Number: 5

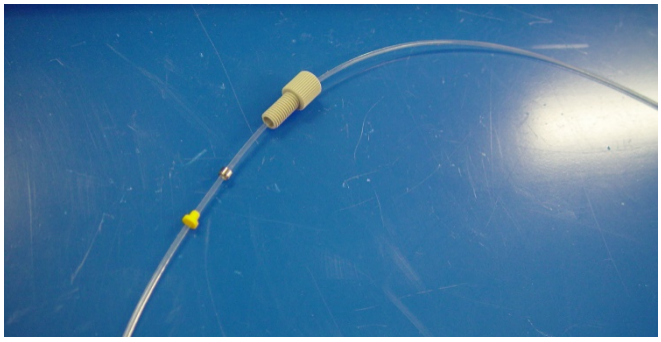
Unscrew the Nut from the Set Tool and gently tug on the Ferrule to make sure it is secure on the end of the Tubing.



Step Number: 6

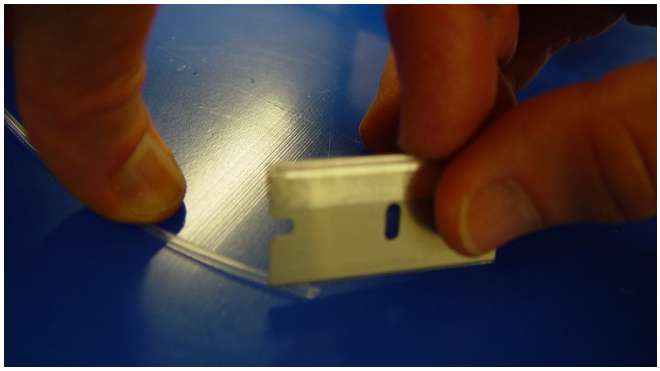
Slide (1) Nut and (1) lock ring and Ferrule (in the same direction/orientation as steps 3 & 4) over the open end of the Tubing.

NOTE: Do not secure 2nd Nut and Ferrule at this time leave in place on the tubing as shown.



Step Number: 7

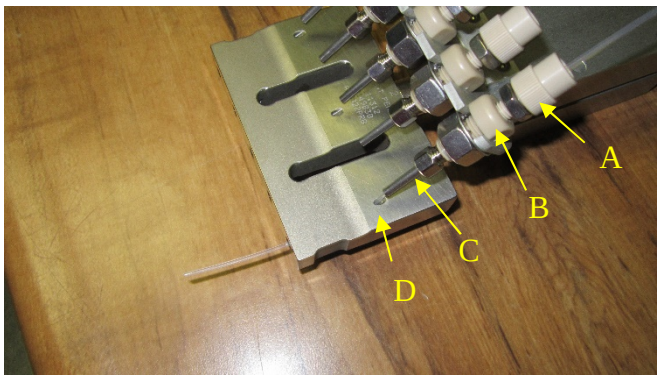
Using the razor blade cut the open end of the Tubing at an angle as shown.



Step Number: 8

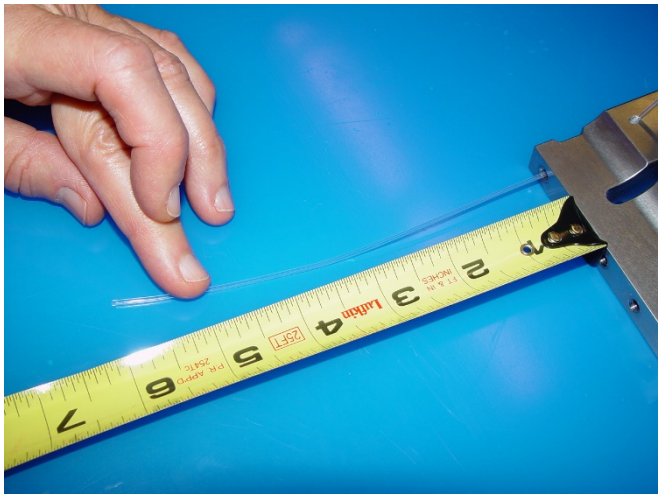
Insert the angled cut end of the Tubing down through the (A) Fitting Sub Assembly, through the (B) Fitting Modification, through the (C) Tubing Sub Assembly, through the corresponding hole in the middle of the (D) Multi-Elem Bar, and out through the bottom.

NOTE: Two of the Multi-Elem Bar corresponding holes are not visible in the picture. The locations and number of corresponding holes are related to the part number used on the job order. Part# 122101-01 Ultrasonic Nozzle, 40 KHZ, Multi-Elem Bar, 5 Position, Style B; Char 01 is depicted in this work instruction.



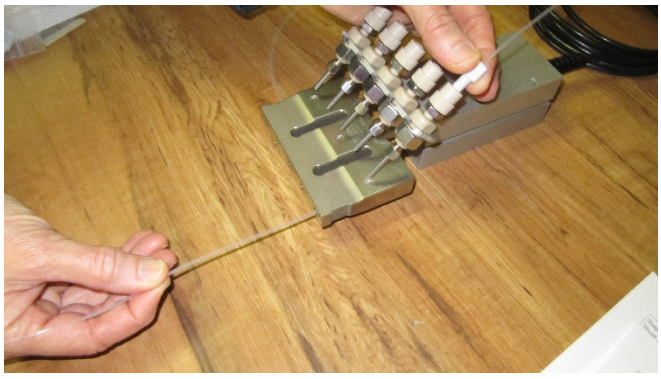
Step Number: 9

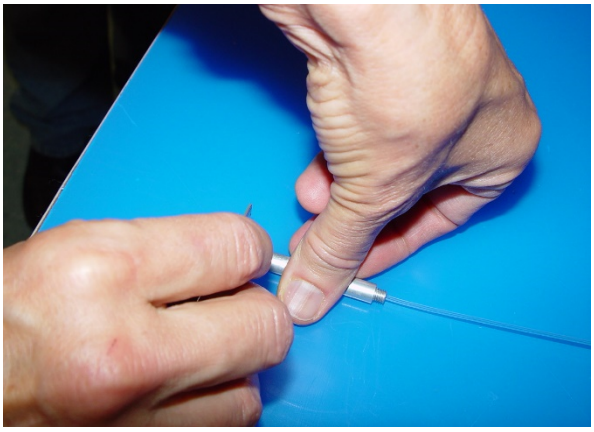
Pull the Tubing through the Assembly until 6 inches are exposed from the bottom of the Multi-Elem Bar.



Step Number: 10

While holding the 6 inches of Tubing in place, slide the ring and Ferrule and Nut from Step 6 down until the ring and Ferrule are against the inside edge of the Bulkhead Union. Hand tighten the Nut into the Union as shown. Gently tug the Tubing to make sure it is secure.



Step Number: 11 Slide the Tube Length Cut Off Fixture, threaded side in, over the Tubing. Using the flat edge of the Fixture as a guide cut the tubing straight across with the razor taking note to remove as little tubing as possible to create the straight edge. **NOTE:** Repeat Steps 2-11 as necessary.	

9.2.4.3 Additional Set-up Instructions for All Configurations

The following process shows the steps for completing the set-up of your system.

1. Attach the transducer cable to the Transducer Jack on the back of the controller.

2. If applicable, connect the I/O port cable to the I/O Port Connector on the back of the controller. The IVEK Digispense 3000's and 4000 BT can be used to connect to the Digisonic III Controller Module.

3. Check to make sure that the element bar is securely attached to the transducer and the nozzles are securely attached to the element bar.

4. Plug the electrical line cord into the electrical outlet, if the unit is already on; press the "O" key.

5. If the optional remote switch is used make sure the cable is connected to the rear of the controller.

CAUTIONS

- *Never place a washer between the element bar and the nozzles.*
- *Never apply grease to the mating surfaces or threads of the transducer, element bar, or nozzles.*

6. Mount the assembly in a laboratory stand, secure the clamp to the upper section of the transducer housing only. Do not secure the clamp to the element bar or nozzle(s).

9.2.5 Operating

The Digisonic III System does not require manual tuning. It has an automatic tuning feature and is fully self-tuning across a wide band of load conditions.

1. To operate, follow these instructions:

   a. Support (clamp) the assembly by the transducer or transducer housing only.
   b. Turn the pump on to prime the pump and output hose to the nozzle (Refer to Chapter 7).
   c. Adjust flow rate then turn the pump off.
   d. Then, turn controller power on.
   e. Press the amplitude button and lower the amplitude to 35%.
   f. Press the Enter/REVIEW switch until the LCD displays "AMPLITUDE CONTROL 35%"
   g. Turn pump back on and adjust amplitude to obtain desired spray pattern.

CAUTION

The sides and end of the nozzle should never be allowed to come in direct contact with the container or hard surface. The stresses resulting at the point of contact could cause fracture of the nozzle or the glass container.

2. With the pump running and the nozzle vibrating a very fine mist or spray pattern can be seen. The spray pattern can be optimized by adjusting the flow rate and amplitude settings.

3. If sputtering occurs or an uneven spray pattern develops with varying droplets sizes, then,
   a. Reduce the flow rate of the process liquid, or
   b. Increase the amplitude setting, or
   c. Do both a & b to obtain an even, consistent spray pattern and uniform droplet size.
   d. Use the amplitude adjustment to make fine adjustments to the spray pattern.

4. The front panel LCD will cycle through a number of screens. With the controller off "STOP", the "ENTER/ REVIEW' switch will cycle through two screens;

   a. Energy: XXXXXXX Joules
      Time: 0:00:00 H:M:S
   b. Time: -:--:-- H:M:S
      Pulse -- -- -- -- Ampl XX%

5. With the controller on "START", the "ENTER/REVIEW' switch will cycle through five screens;
   a. XXX Watts XXXXXXX Joules
   b. Elapsed Time 0:00:00 (H:M:S)
   c. Amplitude Control XX%
   d. Set -:--:-- Time 0:00:00
   e. Pulse -- -- / -- --

The bottom line of the LCD acts as a bar graphic (watt meter) indicating Watts (0 -100%) while the controller is on.

NOTES

- *If the START key is pressed, processing will remain uninterrupted until the STOP key is pressed.*
- *If the rear panel trigger is used, processing will remain uninterrupted while the switch is closed.*
- *The START key and rear panel trigger are mutually exclusive. If the process is initiated by the START key, the switch becomes inoperative. If the process is initiated by the switch, the STOP key becomes inoperative.*

If you are having persistent spray application problems technical assistance is readily available by contacting IVEK Corporation at (01) 802-886-2238. Ask to speak with an application or technical specialist.

9.2.5.1 Local vs. Remote Operation

Energizing the system and changing the intensity can be operated using the front panel (Local) or via the D-Sub connector on the rear of the module (Remote). Connecting a switch to pins 6 and 7 (see section 9.1.1.2) allows for timed or pulsed activation of the nozzle. Connecting a potentiometer to pins 6,8 and 9 (see section 9.1.1.2) allows controlling the intensity of the nozzle.

9.2.6 40KHz Nozzle Attachment and Replacement

9.2.6.1 To Tighten Nozzle

Turn power off and lay transducer, element bar and nozzle(s) down onto a soft towel or mat placed on the counter top. Position the open-end wrenches on the wrench flats of the 40kHz nozzle and while pressing down on the element bar tighten the nozzle securely in a clockwise direction.

9.2.6.2 To Remove Nozzle

Turn power off and lay transducer, element bar and nozzle(s) down onto a soft towel or mat placed on the counter top. Position the open-end wrenches provided on the wrench flats of the 40KHz nozzle and while pressing down on the element bar loosen the nozzle securely in a counterclockwise direction.

CAUTIONS

- *Always use firm padding under the assembly when tightening or loosening the nozzle. Also avoid pressing nozzle(s) or sides of transducer into counter top when using the wrenches in order to prevent damage.*
- *Never touch the tip of a live nozzle to your hand or skin.*
- *Always allow the unit to reach room temperature before operating.*

- ***Do not operate the controller without the transducer attached.***
- *Avoid touching the activated nozzle to the sides or bottom of the sample container, and do not place it down on the work surface*
- *Do not use the On/Off switch for pulsing, only use the rear panel trigger signal to pulse the nozzle(s).*

9.3 INSTALLATION

9.3.1 Power Requirements

The controller requires a single phase, grounded, three-wire, 115 VAC or 220 VAC, 50/60 Hz source, unless otherwise fitted, and has a 3.0 ampere slow blow fuse for 115 VAC service or a 1.6 ampere slow blow fuse for 220 VAC service. There is a selector switch on the rear panel of the controller to set voltage for 115 VAC (92 -140 VAC RMS) or 220 VAC (185 – 280 VAC RMS) service.

CAUTION

Do *not operate a unit set for 115 VAC service on a 220 VAC line or operate* a *unit set for 220 VAC service on a 115 VAC line.*

9.3.2 Placement of Equipment

A built-in fan positioned at the back of the controller draws in cool air from the room to provide radiant and convectional cooling of the internal components. Therefore, **do not block the fan inlet.** Position the controller so that air flows freely around the entire case.

WARNING

The electrical line cord is equipped with a 3-prong grounding plug. Do not, under any circumstances, remove the grounding prong. The plug must be plugged into a mating 3-prong grounding type outlet.

9.4 MAINTENANCE

Proper care of the nozzle(s) is essential for good performance and long service life. Tightness of the nozzle, cleanliness of the mating surfaces, and condition of the tip are all very important to overall performance. The tip is continuously subjected to intense shock waves which cause cavitational erosion. Keeping the tip face smooth and polished will significantly improve nebulizing efficiency and increase the useful life of the nozzle. The following maintenance procedures should be performed weekly.

- Check the tightness of the nozzle periodically with the open-end wrenches provided.
- Keep the stud threads and the mating surfaces between the nozzle and the mother horn clean and dry.
- Check the nozzle tip for signs of cavitational erosion and pitting.
- Do not file or grind the nozzle tips.
- Replace nozzle(s) periodically, especially if they no longer spray properly, are badly pitted or eroded, or if they are bent or cracked.

9.5 SPECIFICATIONS

FLOW RATE:	0.1 to 30 cc/min.
DROPLET SIZE:	20um average
SPRAY PATTERNS:	Conical, Radial or Custom
VISCOSITY RANGE:	1 to 70 Centipoise

Controller:

Features:
Programmable Operation
Pulse Mode
Digital Amplitude / Intensity Control
Elapsed Time Indicator
Display of Wattage and Joules
Overload Protection

Electrical:

Power Rating:	120 Watts
Input Voltage:	100-120 VAC - Or - 220-240 VAC @ 50/60 Hz
Rated Current:	2.4 A @ 110-120 VAC - Or – 1.2 A @ 220-240 VAC
Output Voltage:	1000 Vrms Max
Output Frequency:	40 kHz

Mechanical:

Size:	203 X 349 X 146 mm
Weight:	3.2 Kg

Environmental:

Pollution Degree:	2
Installation Category:	II
Operating limits:	
Temperature Range:	+5°C To +40°C
Humidity:	10 - 95% RH (Non-Condensing)
Altitude:	2,000 Meters
Shipping/Storage Limits:	
Temperature Range:	+2°C To +49°C
Humidity:	10 - 95% RH (Non-Condensing)
Altitude:	12,192 Meters

Agency: CE

Transducer:

Part Number:	122088-01
Dimensions Dia. x L:	31.75 x 123.83 mm (1.25”x4.825”)
Cable Length:	3.05 meters (10’)

Single-Element Bar:

Part Number:	122100
Dimensions Dia. x L*:	11.82 x 59.84 mm (0.46” x 2.35”)

Multi-Element Bar, 5-Position:

Part Number:	122101
Dimensions WxHxL*:	15.88 x 71.12 x 93.73 mm (0.625” x 2.80” x 3.69”)

Nozzle, Radial 6 Holes:

Part Number:	122045
Dimensions Dia. x L*:	7.6 x 48.3 mm (0.298” x 1.9”)
Tip Diameter:	5.08 mm (.200")
Atomization Ports:	0.51mm (0.020”)
Tip Amplitude:	70 microns (max.)

Nozzle, Flat Bottom Spray:

Part Number:	122049
Dimensions Dia. x L*:	7.6 x 56.97mm (0.298” x 2.243”)
Tip Diameter:	2.84 mm (0.112")
Atomization Port:	1.02mm (0.040”)
Tip Amplitude:	70 microns (max.)

Nozzle, Flat Bottom Spray, Extended:

Part Number:	122065
Dimensions Dia. x L*:	7.6 x 118.92mm (0.298” x 4.682”)
Tip Diameter:	3.58 mm (0.141")
Atomization Port:	1.59mm (0.0625”)
Tip Amplitude:	70 microns (max.)

Nozzle, Angled 0.025” ID:

Part Number:	122067
Dimensions Dia. x L*:	7.6 x 54.28 mm (0.298” x 2.137”)
Tip Diameter:	3.57mm (0.140")

Atomization Ports: 0.64mm (0.025")
Tip Amplitude: 70 microns (max.)

40 kHz Flow-Thru Half Wave Extender:
Part Number: 122043
Dimensions Dia. x L*: 7.62mm x 62.48mm (0.30" x 2.46")
Thru Hole Dia.: 1.78mm (0.07")

* Tuned length not including threaded section.

9.6 PROBLEM GUIDE

Table 9.2 contains a list of possible problems, causes and solutions for the controller. In addition, the following procedures can be used based on the failure.

WARNING

Hazardous voltages exist inside the controller. Under no circumstances should the controller be opened. There are no user serviceable parts inside the controller. Any unauthorized access to the inside will void the warranty.

Perform the following procedure to determine if the controller and/or the transducer failed or if the nozzle(s) need to be replaced. This procedure should be performed only if the system has malfunction or has blown a number of line fuses.

1) Assembly the complete system; including controller, transducer, element bar, and nozzle(s).
2) Disable the pumps and move the transducer with element bar and nozzle(s) into air (nothing contacting the nozzle(s), inside or out). The nozzle(s) should be dry and clean.
3) Turn the controller On and set the amplitude to 100%. Start the ultrasonics and observe the front panel wattmeter. The wattmeter should read below 10 watts and the system should be fully operational. Do not leave active for more than 30 seconds or if the system starts to make a noise.
4) If the wattmeter reads greater than 10 watts, turn the controller Off. Remove the nozzle(s) from the element bar.
5) Turn the controller On and set the amplitude to 100%. Start the ultrasonics and observe the front panel wattmeter. Do not leave active for more than 30 seconds or if the system starts to make a noise,
   a. If the front panel wattmeter reads below 10 watts, then it is possible a nozzle or nozzle(s) need to be replaced. This could be caused by a nozzle failure or a nozzle being out of tune.
   b. If the front panel wattmeter reads above 10 watts, either the controller or transducer has failed and the complete system should be returned for repair.

9.7 MODEL NUMBER

The model number provides important information about the specifics of your controller. Refer to this number when calling IVEK Technical support. The model number for your controller is located in the Title Page section of this manual.

520278 - # # # #

Transducer Connector
A – Lemo

Interface Connector & Cable
A – 9-Pin D-Sub W/Spade Terminal
B – 9-Pin D-Sub W/Terminal Block DS3000
C – 9-Pin D-Sub W/Terminal Block DS4000
D – 9-Pin D-Sub Kit for I/O Port

Front Panel
A – LCD W/Amplitude Adjust, Params Monitoring

Power Cord
A – US Cord 115/230 VAC, CE
B – International Cord 115/230 VAC, CE

Table 9.2 Common Operational Problems And Solutions

PROBLEM	PROBABLE CAUSE	POSSIBLESOLUTION
No power, nothing works.	AC power may be absent or inadequate. Unit not plugged in.	Ensure AC power cord is plugged into a properly grounded three-prong outlet capable of supplying 115VAC (92- 140V RMS) or 220VAC (185 - 280V RMS), 50/60Hz, rated at 3.0 amps.
	Fuse is blown.	Unplug main power cord from outlet. Remove fuse from rear panel fuse holder. Test fuse conductivity. Install good fuse in rear panel fuse holder.
	Supply Breaker is tripped.	Check or reset breaker at panel.
Stops working all together	The unit was plugged into an electrical outlet that provides a different voltage from that required. See Power Requirements section.	Change power entry module configuration. See Power Entry Module section.
OVERLOAD indication is displayed on the screen.	The element bar is not secured properly.	Tighten the element bar.
Poor atomizing performance.	Transducer was energized for more than 10 seconds without liquid flowing through it causing it to overheat.	Energize the transducer only when there is liquid flowing through it, and for no more than 10 seconds after dispensing liquid.
Uneven atomization and/or nozzle cavitation.	Amplitude set too high.	Decrease Amplitude setting.
	Tubing too soft.	Use more rigid tubing.
	Incorrect tubing sizes.	For optimum performance, the diameter of the tubing connecting the inlet side of the delivery system should be larger than the diameter of the tubing used to connect the delivery system to the transducer.
	Too much liquid pulsation.	If a valveless metering pump, such as a rotary pump, is used, and the dispense requires more than one revolution of the pump, try a pulse dampening device.
	Pressure too high	Pressure reducing regulators should be used when working with high pressure delivery systems.
With amplitude set to 100 and the transducer in air (out of the sample), the indication on the wattmeter exceeds 10 watts.	Either the transducer or controller module has failed.	The complete Digisonic III system should be returned for repair.
With the transducer disconnected from the element bar, the indication on the wattmeter is less than 10 watts.	Transducer has failed or is out of tune due to excessive erosion.	Replace transducer.
		If none of the above solves the problem, contact IVEK technical support for assistance.