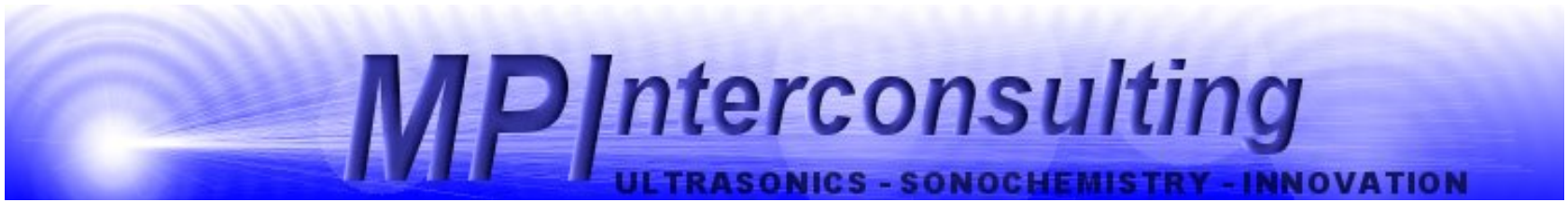
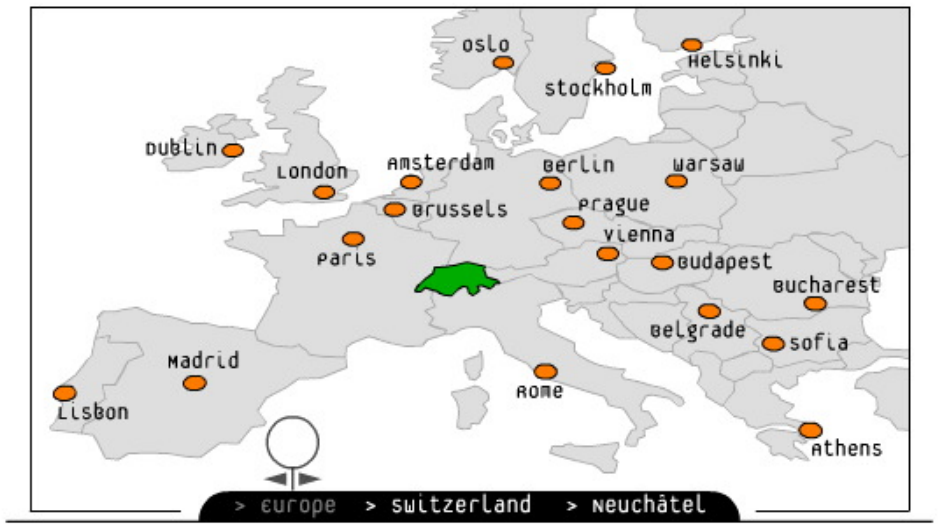
Tubular Clamp-On Multifrequency Liquids & Gasses Processing Reactors

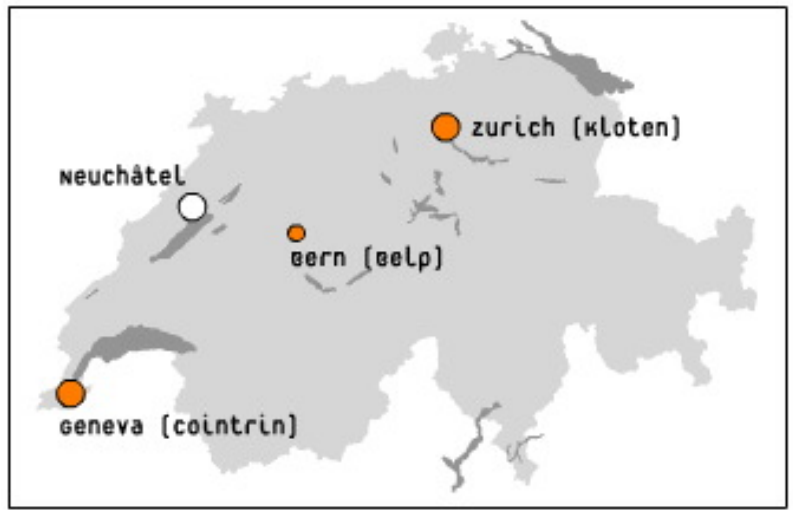
Main Web Site: http://www.mpi-ultrasonics.com
Download Server: http://mastersonic.com
Email: mpi@bluewin.ch



Location:

Neuchatel, Le Locle, Switzerland





MMM Fluids Processing Basics

- Multi-Frequency Multimode, Modulated Sonic & Ultrasonic Technology (MMM Power Supplies).
- A totally new approach in the world of acoustic technologies.
- Unlike Fixed-Frequency systems we adapt through advanced Digital Signal Processing (DSP) of feedback waveform and new modulation techniques producing wide frequency band acoustic field. Any pipe or vessel can be agitated using MMM Power Supplies.

MMM Technology Advantages

- Sonic and ultrasonic parameters in MMM Power Supplies are fully programmable and controllable to offer high operating efficiency and effectiveness for any complex mechanical system, consisting of arbitrary resonating elements.
- MMM creates powerful 3D sonic and ultrasonic activity in liquids and solids with arbitrary shapes and sizes.
- MMM Sonic & Ultrasonic Vibrations are covering and sweeping an extremely wide frequency band to create uniform and homogenous distribution of acoustical activity inside of the vibrating medium.
- Standing waves are eliminated and the whole medium is fully agitated.
- Adapt to any kind of transducer, any number or any power.

MMM Tubular, Clamp-On Reactors Driving

- We offer generator and transducer components for systems integrators and OEMs to make Ultrasonic Fluids Processing systems. We offer our clients the freedom to construct and supply their own pipe resonator systems.

- **Fixed Frequency Systems:**
- When matched with our Fixed-Frequency generators the ring resonators must be tuned to operate at the system resonant frequency.
- **Multi-Frequency Systems:** MPI now offers the industry's most advanced ultrasonic technology for In-Line Liquid Processing applications. When properly adjusted our patented MMM (Multifrequency, Multimode, Modulated) ultrasonic generators can stimulate highly efficient wideband (sonic to megahertz) acoustic energy to nearly any reactor shape. Key benefits to the MMM ultrasonic technology are:
- Wideband (sonic to megahertz) acoustic energy provides greater fluid stimulation to improve any Sonochemistry-related process beyond the limitations of standard fixed frequency systems.
- MMM eliminates the standing waves seen in fixed frequency systems.
- Fully programmable power and modulation technology
  - Power adjust 0% to 100% (standard power modules in 300 watts, 600 watts, 1200 watts, and up to 20 kW on request)
  - Pulse Width Modulation Period (Period 10 ms to 1,000 ms)
  - Pulse Width Modulation Ratio (0% to 100%)
  - MMM special modulation settings (fast sweeping, sweeping, & tracking)
  - Center Frequency settings (large interval)
- Programmable features allows greater processing flexibility with all kinds of fluids.
- MMM technology will drive most any pipe shape (round, oval, square, rectangle), even very large mass systems.
- MMM converters may be connected to most any efficient point on the acoustic load.
- A field adjustable resonant frequency option allows rings to be built without specific tuning. This means ring resonators designs can be simplified and produced at lower cost.
- **The MMM Clamp-On system can adapt to most any other manufacturers installed pipelines systems allowing a simple field upgrade.**

MMM, Clamp-On Applications

- Fluids mixing, Cleaning of internal tube area, Liquid Atomizing, Homogenizing, Tubes Cleaning in Nuclear Industry, Facilitating flow and removing fluid friction, ordinary and precession cleaning, Nano-particles production, Stress Relief, Sonoreactors and applications in Sonochemistry & Electrochemistry, Extractions, Mining Industry, Fuels and oil mixing & blending, Facilitating powders transport in pipe conduits, Large Surfaces Defoaming, Birds and Animals Repealers, Sonar applications, Liquid Metals Processing, Extrusion, Ultra-Filtration, Waste waters treatment, Sterilization, Zebra Shells Repealing, Boilers protection and cleaning, Fuel Injection and Atomizing, Washing Machines, Pulp & Paper Technologies, Ice and snow-making, Dust Removal, Incineration of Liquids, Degassing, Cracking of petrochemicals, Fuel Cells...

- Industrial fluids atomizers & gas mixing (air conditioning, semiconductor technologies...)
- Water & fuel atomizers
- Liquid alloys atomizers & solder atomizers
- Incineration of waste and dangerous liquids by atomizing
- Large volume humidifiers & dust removal
- Air and water filtering, purification, decontamination & sterilization (nuclear, included)
- Micro-encapsulation, coating, surface impregnation
- Food and Pharmaceutical applications (surface decontamination)
- Electrochemistry & Sonochemistry process integration (nano technologies)

- Extruders, Wires & Tubes Drawing, Atomizers, Liquid Alloys Treatment, Defoaming, Mixers, homogenizers, Sonochemical Reactors, Waste Waters Processing, Supercritical, Liquid CO-2 Reactors, Extractions, MMM Cutting, Degassing, Fast meat defrosting, Meat preparation before fuming and drying, Relaxation and massage therapies, petrochemicals cracking (diesel etc.), precious metals extractions, perfumes extractions, ...

Pipe Clamp-On Applications

- ***Any Pipe Thickness:***
- ❒ Although the MMM technology will drive most any pipe thickness (e.g. 1mm to 30mm) there are tradeoffs that must be considered.
- ❒ In normal applications with pipe diameters of 25 mm (1”) to 100mm (4”) the MMM technology delivers the most amplitude and best multi-frequency harmonic modes with a thinner wall thickness from 1mm to 2.5mm.
- ❒ Applications requiring a wall thickness greater than 2.5mm may also be driven with good success however more power will be required to drive the system with somewhat less amplitudes and some lesser excitation of multi-frequency harmonic modes.
- ***Any Pipe Diameter:***
- ❒ MMM Pipe-Clamps may be designed for most any size pipe.
- ❒ Active Ultrasonics can redesign the clamp dimensions to adapt to your specific pipe dimension.

- ❒ Larger pipes may require modified designs to allow mounting of multiple converters.
- ***Any Pipe Length:***
- ❒ The unique nature of the MMM generator technology also allows us to create flexible system design that will treat any length of pipe.
- ❒ The length of pipe effectively activated by one clamp is very dependent on many factors and must be tested for each application: Variables are:

Pipe Clamp-On continued

- ♦ Pipe diameter
  ♦ Pipe wall thickness
  ♦ Free standing pipe segment or attached to other pipes
- or equipment.
  ♦ Power limit of the MMM generator
  ♦ The converter / transducer used
  ♦ The viscosity and volume of material under treatment

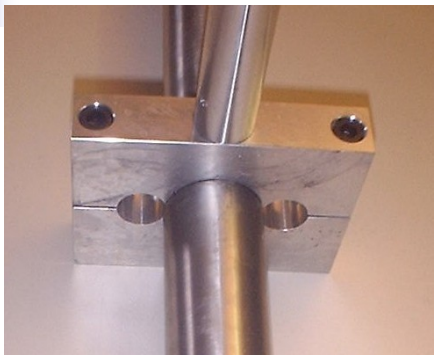
❒ Longer pipe sections may be driven with more ultrasonic energy through the use of multiple clamps driven by one or more MMM generators. Some application examples are:

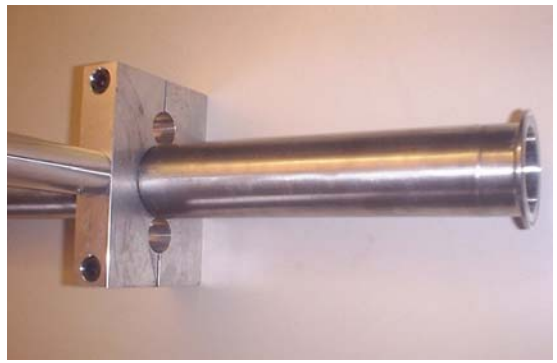
- ♦ Extended atomizing or powder manufacturing through a long pipe section.
- ♦ Extended treatment time for liquids flowing through a pipe section.
- ♦ Long pipe friction and pressure reduction.
- ♦ Continuous cleaning (anti-fouling or anti-film) of long pipe sections (e.g. dairy applications such as milk or yogurt, heat exchangers, etc.)

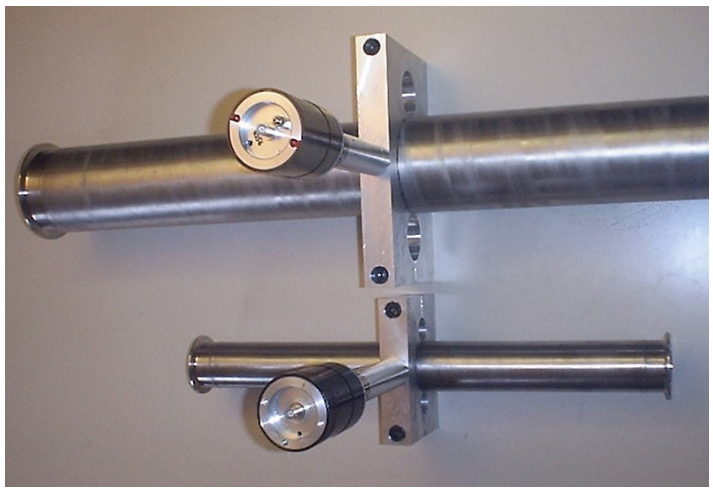
Pipe Clamp-On continued

- ❒ Shorter pipe sections may also be fitted with multiple clamps to improve the ultrasonic power density for the given volume. Applications that may benefit from more intense ultrasonic energy are:
- ♦ Some Sonochemical treatments
- ♦ Ultrasonic Cleaning
- ♦ Very high volume atomizing or powder production.
- ***High Temperature Environments:***
- ❒ Another key advantage to the MMM generator technology is its ability to drive variable length Wave-Guides. Normal Wave-Guides are 100mm to 200mm in length. When driving pipes that contain materials with high temperature the Wave-Guides may be extended from 1 to 3 meters. This allow us to distance the converter from the source of heat, thereby helping to protect the heat sensitive piezo-electric elements.

Simple Clamp-On Design Options







Clamp-On Reactors - Developments

- **Drive New Pipes and Reactor-Vessels Shapes:**
  - **Square, Rectangle, Oval**
  - **Barrels, Half-Barrels**
- **Fluids Filtering, Mixing and Homogenization**
- **Multi-Transducers**
- **Flexible Transducer Placement**
- **Long Wave-guide Driving**
- **Any Power for Any Size Reactors (until 100 kW)**

- **MMM Frequency Agility**: The same DSP technology that allows the MMM generator to be adaptable to any shape reactor vessel is used to provide unprecedented frequency agility. Other fixed-frequency systems are driving the total acoustic system (converter & reactor) at a frequency optimized for the converter without full consideration of how the reactor frame is changing the whole system resonant frequency. Rather than fighting physics our systems are adapting to the new resonant frequency when an un-tuned mass (the reactor vessel) is attached to a converter.

- **MMM Converter Agility**: Additional system flexibility is provided through adaptive inductive compensation that allows attachment and efficient driving of converters from other manufacturers. This allows us to improve existing ultrasonic systems through a simple MMM retrofit.

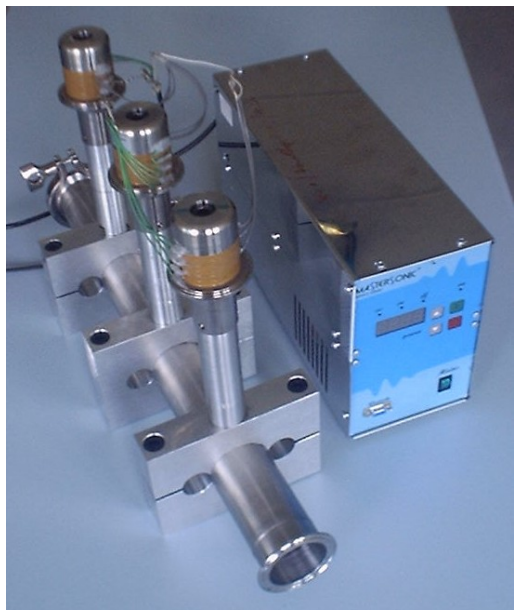
MMM Clamp-On Liquid Treatment in Action

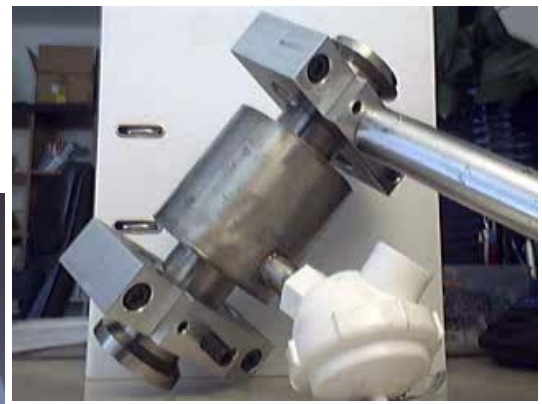
(movie files)

MMM Clamp-On Atomizing in Action

(movie files)

Unlimited Clamp-On Reactors Options





(movie files)

Water Jacket for Heavy Duty, Clamp-On Applications

Operational Heat Protection:

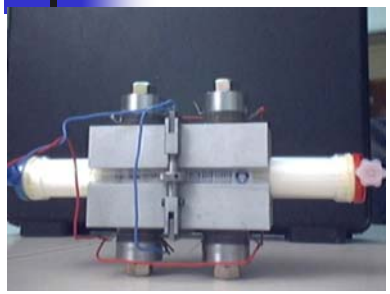
❒ Pipe-Clamp applications that require continuous maximum power delivery should provide cooling to the mechanical system for protection of the ultrasonic converter / transducer.

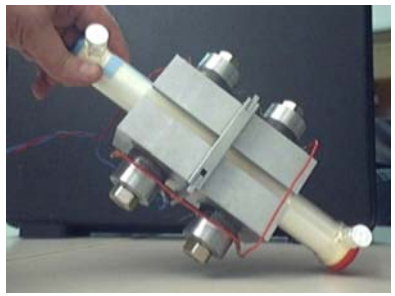
♦ One of the most effective cooling methods are water cooling jackets mounted on the wave-guide. Active Ultrasonics.

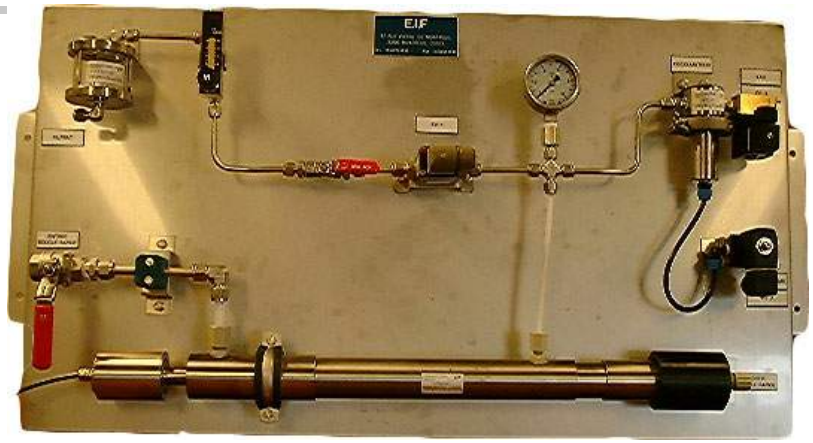
♦ In addition clients may provide additional air cooling when necessary.

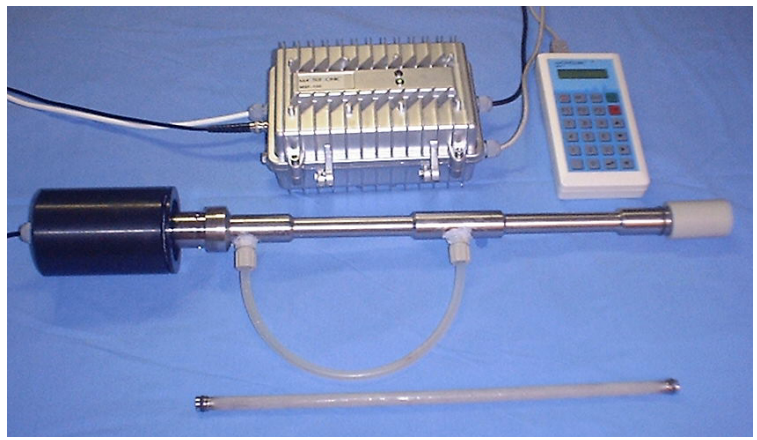
Easy & Simple Connectivity

Ultrasonic & Ultra-Filtration

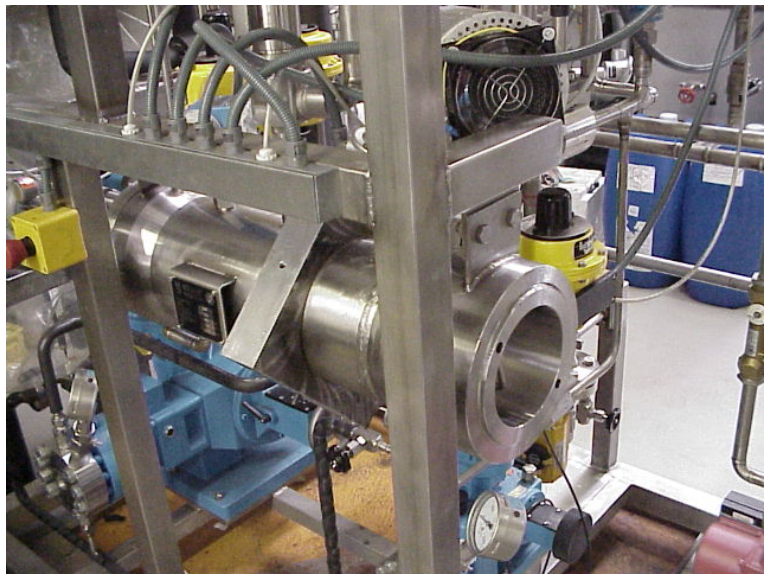


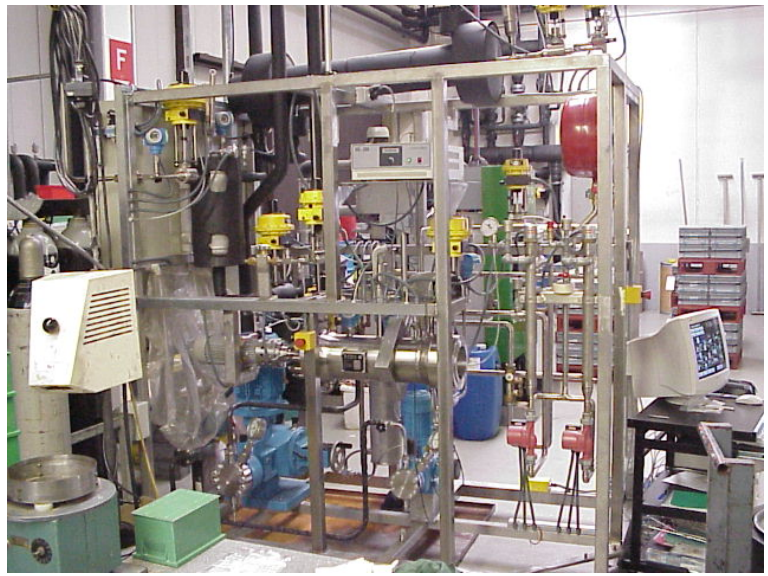






Supercritical CO-2 Clamp-On Reactor





Clamp-On Agitation of the Liquid, Supercritical CO-2 Reactor (300 Bar applications, 25 mm wall thickness)

Applications: Extractions, Precision Cleaning

Examples: MMM CLAMP-ON APPLICATIONS IN PROCESS INDUSTRY

Easier liquids flow and higher flow rate; Friction removal

Clamp-On & Heat Exchangers










Heat Exchanging Applications: Longer operating life before cleaning

Clamp-On & Soft-Mass Treatment

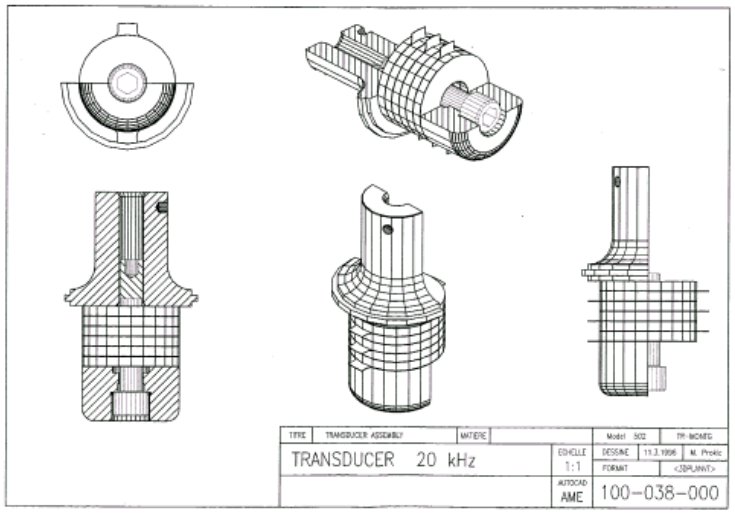





In-Line Filtering, Separation, Mixing, Homogenizing

Extruders & pumps: Higher flow rate, reduced friction

Converters for Clamp-On Applications



<u>Applications</u>: Extruders, Wires & Tubes Drawing, Atomizers, Liquid Alloys Treatment, Defoaming, Mixers, Sonochemical Reactors, Waste Waters Processing, Supercritical, Liquid CO-2 Reactors, Extractions, MMM Cutting, Degassing, Clamp-On Systems…

Tubular 3-Clamp-On Sonoreactor

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MPInterconsulting
ULTRASONICS - SONOCHEMISTRY - INNOVATION

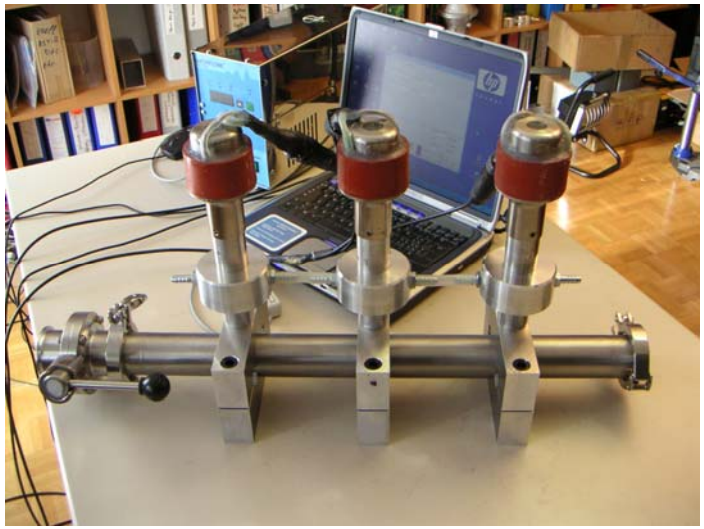
Reactor in operating position

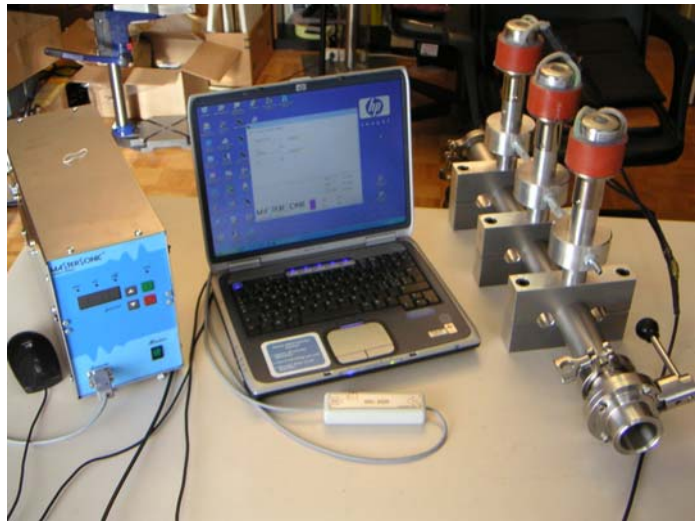
Reactor holder, with the base-plate where reactor should hang.

Reactor holder with foam-type backing in order to avoid direct metal-to-metal contact between the Clamp element and the holder base-plate

Reactor placed on the holder. Different possibilities for mounting are presented.

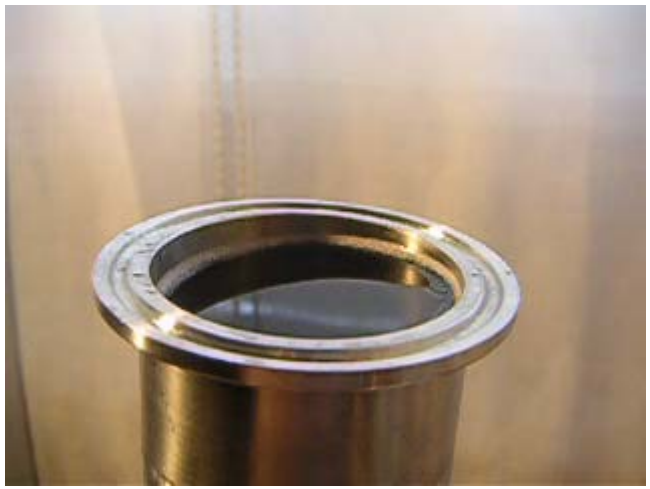
Reactor Configuration

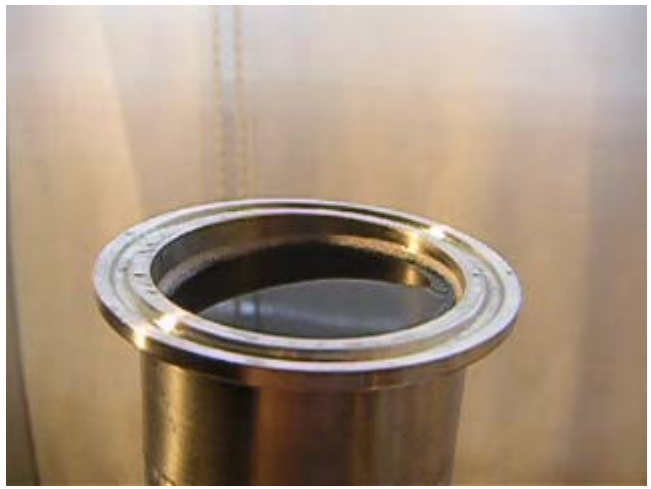




Full configuration of the Reactor in a horizontal position, connected to the IX MMM-generator and to the PC serial port.

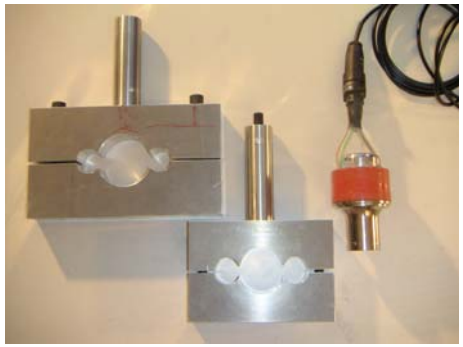
Operating Reactor Movies

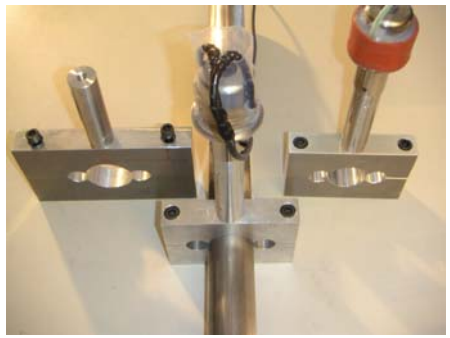




You will recognize that sonoreactor is operating properly if you notice intensive waving and water dancing on the open water surface. Geyser of water droplets would be visible. Activate the movie files on this page.

Basic Clamp-On Reactor Elements





Different Clam-on elements and high power MMM converter.

Generator PC-controlled

and handheld controlled via MSH-1

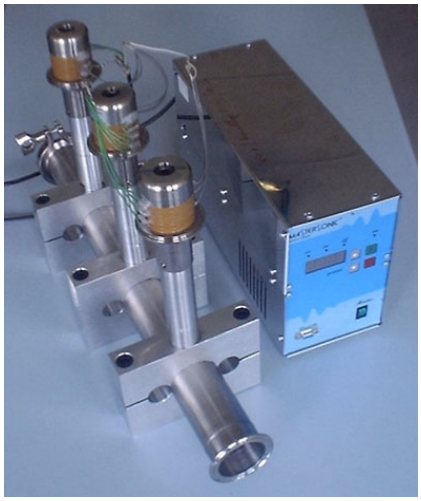
Pipe-Clamp Technology

High Volumetric Power Density (50 – 1000 W/dm^3)

MPI offers custom Pipe-Clamp solutions for liquid processing applications where it is important to deliver uniform and homogenous ultrasonic energy over a large radiating surface. Such system are capable of delivering very high volumetric power (up to 1000 Watts per liter) to the liquid however due to the large radiating surface of the active element the surface power density is usually on the order of 0.5 to 2 Watts per centimeter square. Such power is providing very good cavitation effects and uniform power distribution throughout the reaction chamber.

Below we review our unique Pipe-Clamp systems that offer ultrasonic characteristics similar to submersible transducers. With no internal restrictions and the possibility to use standard pipe interconnect flanges these systems provide convenient flow through systems that are easily integrated into liquid processing applications. Systems are intended for sonochemical reactions where gentle ultrasonic radiation and cavitation effects are required. The Pipe-Clamp systems must be driven by our unique wide band multi-frequency MMM technology.

Applications that benefit from this arrangement are:



. • Mixing/Homogenize is facilitated by uniform ultrasonic energy that generates significant cavitation distributed evenly throughout the reactor volume.

. • Sonochemical Reactions accelerated by strong cavitation within an enclosed reactor.

. • Potable Water Processing

. • Waste Water & Liquid Waste Material Processing

. • Liquid Food Processing

MPI' liquid processing components are designed for heavy-duty industrial applications and can also be adapted to most general laboratory environments. The system components are described below.

MMM Generators (Multifrequency, Multimode, Modulated):

MMM generators deliver wide-band sonic and ultrasonic energy (ranging from infrasonic up to the MHz domain) through arbitrary shaped solid structures and thick or thin wall metal containers to address a variety of liquid processing applications. The secret to MMM Technology is its ability to initiate ringing and relaxing, modulated, multimode mechanical oscillations including harmonics and sub-harmonics. MMM Technology is producing pulse-repetitive, phase, frequency and amplitude-modulated bulk-wave-excitation covering and sweeping an extremely wide

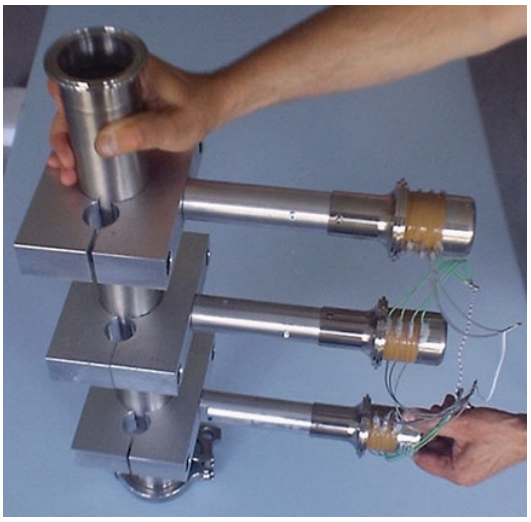
frequency band. Such sonic and ultrasonic driving creates uniform and homogenous distribution of acoustical activity on a surface and inside of the vibrating system, while avoiding the creation of stationary and standing waves, so that the whole vibrating system is fully agitated. The system offers fine control from a programmable interface and produces high efficiency active power (0% -100%).

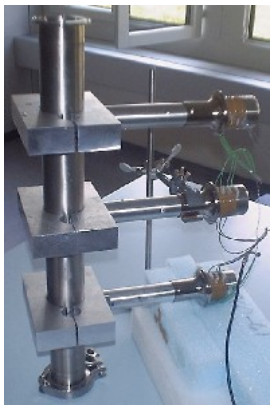
System Control: MMM Wideband Generators may be optioned for Front Panel Control, Removable Handy Panel Control, or Remote Electronic or PC Control.

Converters / Transducers: Our transducers are based on piezo-electric ceramic stacks and are originally designed for demanding ultrasonic welding and cleaning applications.

Pipe-Clamp Acoustic Elements: We offer custom clamp construction to fit nearly any size pipe.

- ***Pipe Clamp-On:*** Custom clamp systems using one or more ultrasonic converters may be externally attached to special stainless steel or titanium pipes segments. The clamped pipe segment becomes the radiator of Ultrasonic energy to material internal or external to the pipe. Due to the large surface area the acoustic surface power density is relatively low, as in a standard ultrasonic bath, but total power input is design to create effective cavitation. These systems simplify treatment of materials in high temperature or pressurized systems. Standard system power may range form 100 W up to 2,000 W using MMM wideband generators. Higher power custom MMM power supplies are available on request.





Any Pipe Thickness:

❒ Although the MMM technology will drive most any pipe thickness (e.g. 1mm to 30mm) there are tradeoffs that must be considered.

❒ In normal applications with pipe diameters of 25 mm (1") to 100mm (4") the MMM technology delivers the most amplitude and best multi-frequency harmonic modes with a thinner wall thickness from 1mm to 2.5mm.

❒ Applications requiring a wall thickness greater than 2.5mm may also be driven with good success however more power will be required to drive the system with somewhat less amplitudes and some lesser excitation of multi-frequency harmonic modes.

Any Pipe Diameter:

❒ MMM Pipe-Clamps may be designed for most any size pipe.

❒ MPI can redesign the clamp dimensions to adapt to your specific pipe dimension.

❒ Larger pipes may require modified designs to allow mounting of multiple converters.

Any Pipe Length:

❒ The unique nature of the MMM generator technology also allows us to create flexible system design that will treat any length of pipe.

❒ The length of pipe effectively activated by one clamp is very dependent on many factors and must be tested for each application: Variables are:

♦ Pipe diameter
♦ Pipe wall thickness
♦ Free standing pipe segment or attached to other pipes or equipment.
♦ Power limit of the MMM generator
♦ The converter / transducer used
♦ The viscosity and volume of material under treatment

❒ Longer pipe sections may be driven with more ultrasonic energy through the use of multiple clamps driven by one or more MMM generators. Some application examples are:

♦ Extended atomizing or powder manufacturing through a long pipe section.

♦ Extended treatment time for liquids flowing through a pipe section.

♦ Long pipe friction and pressure reduction.
♦ Continuous cleaning (anti-fouling or anti-film) of long pipe sections (e.g. dairy applications such as milk or yogurt, heat exchangers, etc.)

❒ Example of power distribution for one 1200 watt MMM generator driving:
♦ 12 clamps = average power of 100 watts per clamp.
♦ 6 clamps = average power of 200 watts per clamp.
♦ 3 clamps = average power of 400 watts per clamp.
♦ To drive longer pipes or more clamps multiple MMM generators may be installed to work in tandem.

❒ Shorter pipe sections may also be fitted with multiple clamps to improve the ultrasonic power density for the given volume. Applications that may benefit from more intense ultrasonic energy are:
♦ Some sonochemical treatments
♦ Ultrasonic Cleaning

♦ Very high volume atomizing and/or powders production.

Operational Heat Protection:

❒ Pipe-Clamp applications that require continuous maximum power delivery should provide cooling to the mechanical system for protection of the ultrasonic converter / transducer.

♦ One of the most effective cooling methods are water cooling jackets mounted on the wave-guide.

♦ In addition clients may provide additional air cooling when necessary.

High Temperature Environments:

❒ Another key advantage to the MMM generator technology is its ability to drive variable length Wave-Guides. Normal Wave-Guides are 100mm to 200mm in length. When driving pipes that contain materials with high temperature the Wave-guides may be extended from 1 to 3 meters. This allow us to distance the converter from the source of heat, thereby helping to protect the heat sensitive piezoelectric elements.

Example: 300mm (12”) Wave-Guide

Chamber Designs Services: We provide consulting and custom design services to aid our clients in construction of reaction chambers and systems for special applications.





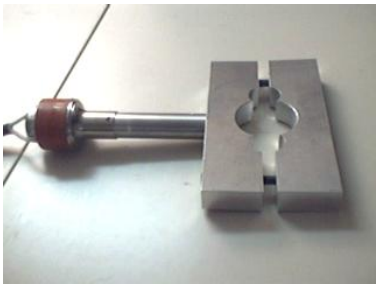

APPLICATIONS

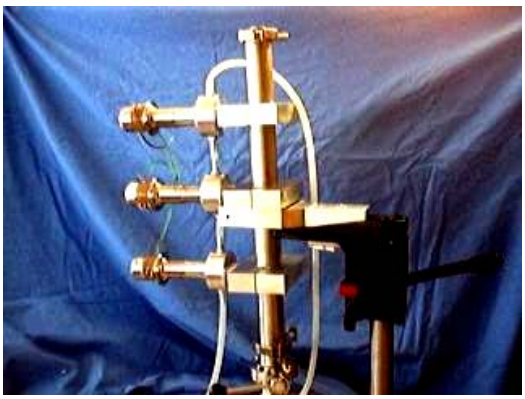
- **Fluids mixing, Cleaning of internal tube area, Liquid Atomizing, Homogenizing, Tubes Cleaning in Nuclear Industry, Facilitating flow and removing fluid friction, ordinary and precession cleaning, Nano-particles production, Stress Relief, Sonoreactors and applications in Sonochemistry & Electrochemistry, Extractions, Mining Industry, Fuels and oil mixing & blending, Facilitating powders transport in pipe conduits, Large Surfaces Defoaming, Birds and Animals Repealers, Sonar applications, Liquid Metals Processing, Extrusion, Ultra-Filtration, Waste waters treatment, Sterilization, Zebra Shells Repealing, Boilers protection and cleaning, Fuel Injection and Atomizing, Washing Machines, Pulp & Paper Technologies, Ice and snow-making, Dust Removal, Incineration of Liquids, Degassing, Cracking of petrochemicals, Fuel Cells…**

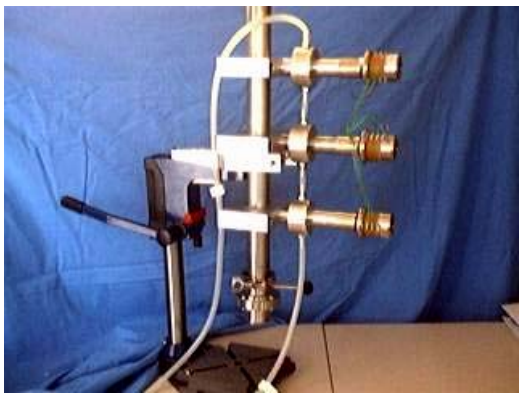
- **Industrial fluids atomizers & gas mixing (air conditioning, semiconductor technologies…)**
- **Water & fuel atomizers**
- **Liquid alloys atomizers & solder atomizers**
- **Incineration of waste and dangerous liquids by atomizing**
- **Large volume humidifiers & dust removal**
- **Air and water filtering, purification, decontamination & sterilization (nuclear, included)**
- **Micro-encapsulation, coating, surface impregnation**
- **Food and Pharmaceutical applications (sterilization & decontamination)**
- **Electrochemistry & Sonochemistry process integration (nano technologies)**

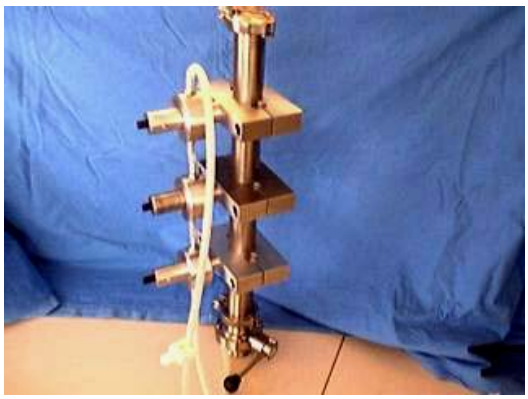
- **Extruders, Wires & Tubes Drawing, Atomizers, Liquid Alloys Treatment, Defoaming, Mixers, homogenizers, Sonochemical Reactors, Waste Waters Processing, Supercritical, Liquid CO-2 Reactors, Extractions, MMM Cutting, Degassing, Fast meat defrosting, Meat preparation before fuming and drying, Relaxation and massage therapies, petrochemicals cracking (diesel etc.), precious metals extractions, perfumes**

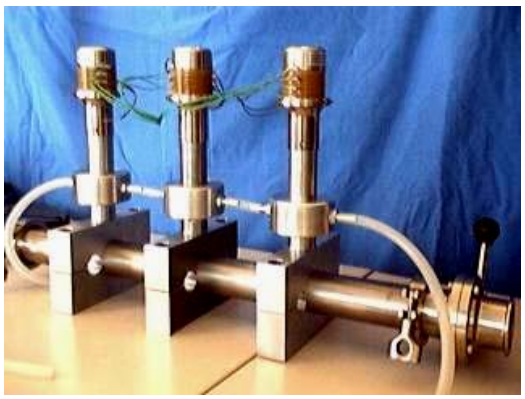
Examples of Clamp-On Tubular Reactors





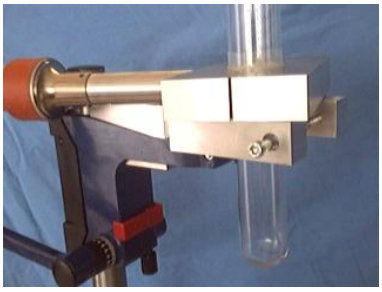




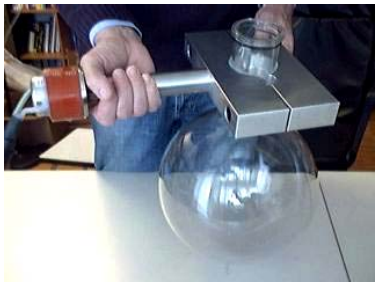


Examples of Clamp-On Glass Reactors



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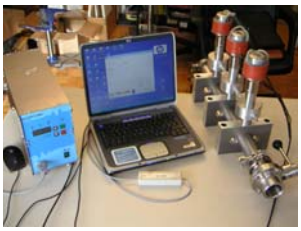
ULTRASONICS - SONOCHEMISTRY - INNOVATION

MMM CLAMP-ON REACTORS



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Generator and System SETUP

Before operating the system be sure to read the Generator Manual, which can be found on the following address:

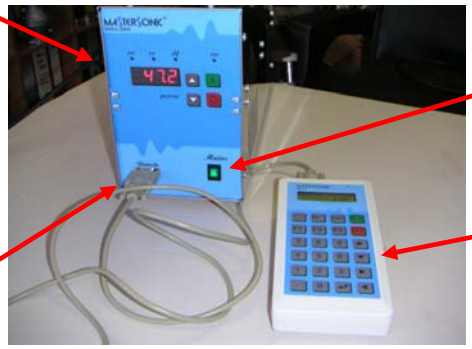
http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/um_msg_ix_v6.pdf

The system can be controlled on two different ways:

A) Using the Handheld Control Unit MSH-1 (Remote Control Panel),
or
B) Connecting the generator to a PC serial port and controlling the system operation from the PC with the provided interface software.

Both options will produce the same results, but using the PC and control software is presenting much more flexible and comfortable way with additional visual and real time information about all operating system parameters.

A) Generator Control using the MSH-1



1. **Plug-in the connectors between the Handheld Control Unit MSH-1 and RS485-connector on the front panel of the MSG.1200.IX generator. Handheld Control Unit MSH-1 will operate taking the power directly from the generator (no need for external DC power supply). See instructions regarding how to use MSH-1 on the system manual pages 26 to 29:**

http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/um_msg_ix_v6.pdf

Main Supply Input: 230 VAC/50-60Hz, 30 A

Ultrasonic Reactor Cable: Coax. RG58

For external generator Power ON and OFF switching, cut this yellow wire and install convenient switching device between the open-wire-ends, here.

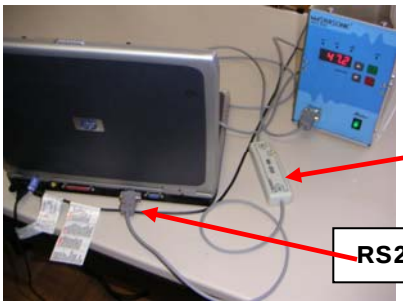
2. **Connect the Ultrasonic Reactor and Main Power Supply cable to the rear panel of the MGG.1200.IX generator. Attention: Apply European 230 VAC, 50/60 Hz, 30 Amp. input power line. When using step-up or step-down transformer, use a 5 kW transformer (to have large safety margin for pulsed-power operations). See instructions on the system manual pages 8, 9 and 10:**

http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/um_msg_ix_v6.pdf

Then Switch ON the Main Switch on the generator front panel: See the picture from the step 1.

Comments: Main Supply voltage variations between 220 VAC and 235 VAC are acceptable. Do not use 208 VAC, 60 Hz, because the system power would be reduced, and internal drivers of the MSG.1200.IX would not operate properly.

B) Generator Control using the PC serial (RS) port



RS485 generator port

MMM-Link-2339, RS485

RS232 PC port

3. **Switch-ON your PC and Download the generator control software file from the following address:**

http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/inox%20control%20panel-17.5-28khz.exe

and then place it on the PC Desktop (the first screen you will see on your monitor, after initiating MS Windows, before using any software). You will see on your PC desktop the following Integrated Circuit Icon: 
Inox.exe
. Later, by clicking on that

icon you will be able to activate the interface software for MSG.1200.IX control. Wait with software activation until you finalize the step 4. (see below).

4. **Take the serial interface MMM-Link-2339 (or MSA2218, RS485 Adapter) and plug its cable-connectors between the PC serial port and RS485-connector on the front panel of the MSG.1200.IX generator (see pictures in step 3.). See instructions regarding how to use MMM-Link-2339 on the system manual (pages 30 and 31):**

http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/um_msg_ix_v6.pdf

As noted in the step 2. The Main power supply and Reactor cable should be connected to the rear panel of the Generator.

Do not open the generator box. The system is factory regulated in the best possible way, so that you will be able to control your system from the MSH-1 or from the PC interface software.

5. **Activate the Generator using the MSH-1 (option A)): See instructions regarding how to use MSH-1 on the system manual pages 26 to 29:**

   http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/um_msg_ix_v6.pdf

Or you can also activate and control the generator by clicking on the interface-software icon: 

(option B)). See instructions regarding how to use software control on the system manual pages 30 and 31:

http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/um_msg_ix_v6.pdf

6. **Apply the following, initial generator settings (before activating the generator START button, or before sending the ultrasonic power to the reactor):**

   a) **Read pages 13 and 14 of the following document:**

   http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/um_msg_ix_v6.pdf

   b) **Set the Generator Power to not more than 30% of the total power,**
   c) **Set the MAX current to minimum,**
   d) **Set PWM period to: 0.010 s,**
   e) **Set PWM ratio to: 100%,**
   f) **Read and apply the specific document with the best settings for your Ultrasonic Reactor that will be sent to you by MPI.**

Examples of Appropriate Parameters Setting for Ultrasonic Reactor Operation

Preliminary steps:

The Reactor should be in its vertical position and filled with liquid. Do not operate reactor without liquid in the tube (start settings and testing with water). See the images on the second page.

Connect the water cooling system and start water flow trough water jackets.

Connect the generator to ultrasonic reactor converters.

Connect the PC Interface Adapter between the PC serial port and the RS485 connector on the generator front panel

Provide mains power to the generator and switch on the generator at the front panel.

Start the MMM PC Interface Control Software. All initial settings will be made using the PC Interface Control Software (before activating the Reactor).

Do not activate the generator to produce an ultrasonic signal. Do not press the Start button provided by the software.

Click on the Power Tab at the top of the PC Interface Control Software and set the input Power (by moving the sliding bar to the left position) to max. 30%.

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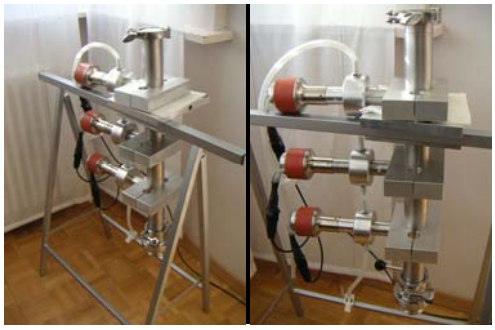
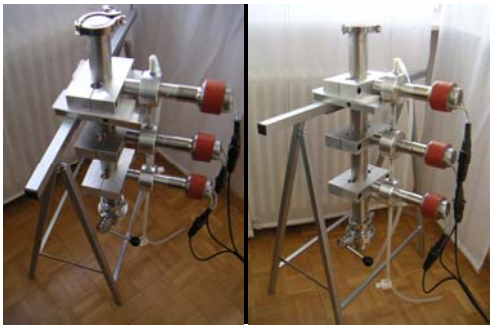
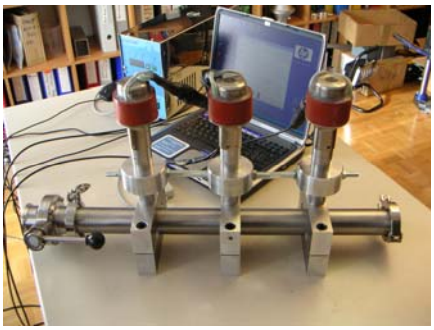
3-clamp-on-tubular-sonoreactor-50mm

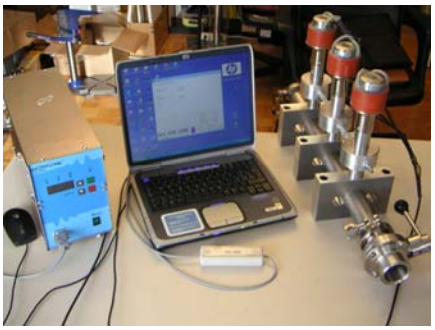
Reactor holder, with the base-plate where the Reactor may hang.

Reactor holder with foam-type backing placed in order to avoid direct metal-to-metal contact between the Clamp parts and the holder base-plate









Reactor in different operating positions, placed horizontally or on the holder. Different possibilities for mounting are presented. Do not place reactor directly to the metal surface, since aluminum clamps are vibrating (use some kind of acoustically isolating, soft and foamy pads).

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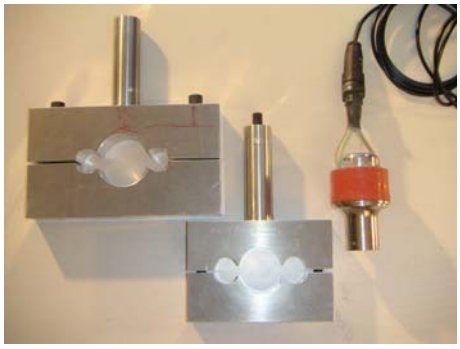
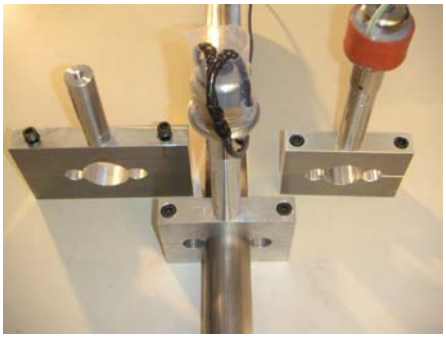
Clamp-On Tubular Reactor Elements





Different Clam-on elements and high power MMM converters.

Handheld controlled generator with MSH-1 controller unit

Generator PC-controlled

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First Example:

This example is only applicable to the water-filled reactor type delivered with these instructions. This procedure will allow you find the best operating conditions quickly without wasted efforts and without making improper settings that could harm the system. You may make slight parameter variations within the given range. When making new settings and reactor testing (with new liquid content), please reduce the power to 30% and first search for the best operating conditions under low power.

After introducing all initial settings as detailed below you may press the software Start button. The Generator will start producing ultrasonic power and the Reactor will start oscillating. You may continue adjusting generator settings when the Reactor is operating.

Monitor the Input DC Power reading (lower right section of the software screen), which is indicating the input power level.

Systematically repeat the fine tuning process for all parameters (slightly varying them within the specified ranges) until reaching the highest input DC Power level.

When you reach the maximal input power, memorize the parameters clicking the Write button on the control software window. All parameters will be stored in an active memory. Now you can start active liquid processing tests. After switching-OFF the system (pressing the software Stop button), and after re-activating the generator for subsequent tests, you can recall all previous stored parameters by clicking on the Read software button. These parameter settings will be read from the generator memory and displayed on the PC control software window.

Click on the DDS page tab at the top of the PC Control Panel Window:

Make settings:

Frequency:

Preliminary testing shows an efficient central frequency range for the water filled reactor between 18.280 kHz and 18.750 kHz. Click on the Frequency DDS slide bar and set to 18.280 kHz to start.

Using your keyboard Left/Right Arrows or your mouse scroll wheel slowly change the frequency in 10 Hz steps up to 18.750 kHz to find the best central frequency point for every new test environment. Experiment until reaching the highest input power by noting the DC Power indicator in the lower right section of the PC control window. As you pass through the best central operating frequency the higher system efficiency is exhibited by improved DC Power delivery.

Sweeping:
Set from 0.100 kHz to 0.400 kHz (as above find the best interval by slowly sweeping across this defined range. The Best setting is when the input system DC Power is maximized, providing that reactor is producing uniform and continuous acoustic sound, without whistling, impulsive, non-periodical and cracking noise).

Click on the Power page tab:

Make settings:

Power:
Set 30% as the starting point. After experimenting in a real operating regime you may increase the power to 70%. Note that system input power as shown by the DC Power reading on the lower right section of the software screen does not reach more than 600 W. 600 W is the power limit for this reactor. Increasing power over this limit would mechanically over-stress the reactor tube and could cause damage.

MAX current:
Set to 3 A. If testing with some other liquid (not water), initially set this current limit to 2 A. After a period of safe operation you may gradually increase the setting to 3 A. This is the safe operating margin for your system.

PWM period:
Set at its minimum 0.010 s setting to start. When the PWM ratio is set to less than 100%, you may experiment by increasing it until 0.100 s).

PWM ratio:
Keep at 100% until more experience is gained in using this system. When you are fully aware of all parameters and safe operation conditions you may reduce the PWM ration to 20% to realize low frequency pulsing (ON – OFF) liquid processing regimes.

Click on the FSWM page tab:

Make settings:

FSWM range:
Set between 0.000 kHz and 0.200 kHz (start with 0.000 kHz, and later experiment by going higher until reaching maximal input DC Power).

FSMW ratio:
Set between 50% and 90% (start with 50%). Experiment with different values, until getting the highest input DC Power.

FSWM period:
Set between 0.020 s and 0.100 s. Start testing with 0.020 s and higher to reach the highest input DC Power.

Click on the DMMM page tab:

Make settings:

Q factor:
Set between 30 and 150 (start with 30, and later go higher). For low viscosity and low density liquids, Q-values should be higher. For high density and high viscosity liquids, Q-values should be lower. Experiment with different values, until getting the highest input DC Power.

Frequency correction:
Set between 100 and 255 (start with 150). Experiment with different values, until getting the highest input DC Power.

Amplification factor:
Set between 20 and 150. Start testing with 50 and later adjust until getting highest input DC Power.

Second Example:

This example is only applicable to the water-filled reactor type delivered with these instructions. This procedure will allow you find the best operating conditions quickly without wasted efforts and without making improper settings that could harm the system. You may make slight parameter variations within the given range. When making new settings and reactor testing (with new liquid content), please reduce the power to 30% and first search for the best operating conditions under low power.

After introducing all initial settings as detailed below you may press the software Start button. The Generator will start producing ultrasonic power and the Reactor will start oscillating. You may continue adjusting generator settings when the Reactor is operating.

Monitor the Input DC Power reading (lower right section of the software screen), which is indicating the input power level.

Systematically repeat the fine tuning process for all parameters (slightly varying them within the specified ranges) until reaching the highest input DC Power level.

When you reach the maximal input power, memorize the parameters clicking the Write button on the control software window. All parameters will be stored in an active memory. Now you can start active liquid processing tests. After switching-OFF the system (pressing the software Stop button), and after re-activating the generator for subsequent tests, you can recall all previous stored parameters by clicking on the Read software button. These parameter settings will be read from the generator memory and displayed on the PC control software window.

Click on the interface software DDS page tab:

Make settings:

Frequency:
Preliminary testing shows an efficient central frequency range for the water filled reactor between 21.100 kHz and 21.400 kHz. Set to 21.100 kHz to start. Slowly sweep the frequency up to 21.400 kHz to find the best central frequency point for every new test

environment. Experiment until reaching the highest input DC Power.

Sweeping:
Set from 0.450 kHz to 0.580 kHz. The Best setting is when the input system DC Power is maximized, providing that reactor is producing uniform and continuous acoustic sound, without whistling, impulsive, non-periodical and cracking noise).

Click on the Power page tab:

Make settings:

Power:
Set between 40% and 70%. Set 30% as the starting point. After experimenting in a real operating regime you may increase the power to 70%. Note that system input power as shown by the DC Power reading on the lower right section of the software screen does not reach more than 600 W. 600 W is the power limit for this reactor. Increasing power over this limit would mechanically over-stress the reactor tube and could cause damage.

MAX current:
Set to 3 A. If testing with some other liquid (not water), initially set this current limit to 2 A. After a period of safe operation you may gradually increase the setting to 3 A. This is the safe operating margin for your system.

PWM period:
Set at its minimum 0.010 s setting to start. When the PWM ratio is set to less than 100%, you may experiment by increasing it until 0.100 s).

PWM ratio:
Keep at 100% until more experience is gained in using this system. When you are fully aware of all parameters and safe operation conditions you may reduce the PWM ration to 20% to realize low frequency pulsing (ON – OFF) liquid processing regimes.

Click on the FSWM page tab:

Make settings:

FSWM range:
Set it to 0.000 kHz.

FSMW ratio:
Set it to 50 %.

FSWM period:
Set between 0.020 s and 0.100 s. Start testing with 0.020 s and hitherto reach the highest input DC Power.

Click on the DMMM page tab:

Make settings:

Q factor:
Set to 50. (Start with 30 and later go higher). For low viscosity and low density liquids, Q-values should be higher. For high density and high viscosity liquids, Q-values should be lower. Experiment with different values, until getting the highest input DC Power.

Frequency correction:
Set between 150 and 255 (start with 150). Experiment with different values, until getting the highest input DC Power.

Amplification factor:
Set between 35 and 55. Start testing with 40, and later adjust until getting highest input DC Power.