



MPI Interconsulting
ULTRASONICS - SONOCHEMISTRY - INNOVATION

WIDEBAND MMM CLEANING & LIQUIDS PROCESSING

Advanced multifrequency, sonic and ultrasonic cleaning
Wideband White-Noise SONOCHEMISTRY

Main Web Site: <http://www.mpi-ultrasonics.com>

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MMM Technology for Ultrasonic Cleaning ***Generations ahead!***

- **Multifrequency, Multimode, Modulated Sonic & Ultrasonic technology.**
- No other manufacturer has yet achieved and matched **MMM** exciting standards in precision cleaning. **MMM** is not **only** more efficient and effective than any other ultrasonic cleaning technology, it is **UNIQUE**.
- **Seeing is the believing!** Try the aluminum foil test for yourself (next pages)! Place the foil sample into our ultrasonic bath and hold the foil for approx. 5 - 10 seconds and you'll discover why there's simply no comparison with any other conventional ultrasonic cleaning machine!

Aluminum foil perforation test



- *Perfectly, uniformly perforated aluminum foil, after 5 to 10 seconds of exposure to MMM ultrasonic vibrations in a ultrasonic cleaner*
- ***Acoustic Frequency Range: From Hz to MHz; From Infrasonic to Supersonic***

MMM in Action

Activate the movie files: click & play



Perfectly and uniformly perforated foil. No standing waves. Ask any of our competitors if they can show similar results in maximum of 5 seconds.

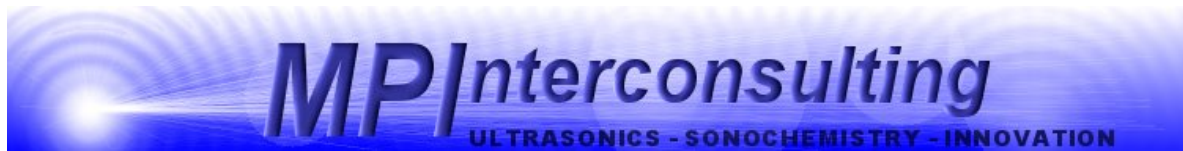
MMM Cleaning Technology Provides:

- Superior and deep penetration, **independent** of water levels.
- Reliability with extra power spread throughout the bath.
- **Even** distribution of ultrasonic energy throughout the liquid gives uniform and thorough cleaning of the surface without the risk of damage to fine parts and sensitive instrument.
- Extremely efficient electronics and transducer coupling to ultrasonic bath (overall approx. 95% efficiency) eliminates or reduces the additional need for heating.
- Spatial distribution of ultrasonic activity inside of a cleaning liquid is homogenous (no dead zones, no standing waves, fast and large frequency sweeping, broadband spectrum, complex modulation).
- Cleaning solvents, detergents and additives can be significantly reduced, or even eliminated because of the very high cleaning activity of the acoustic broadband spectrum.
- Cleaning time can be several times shorter comparing to traditional ultrasonic cleaning technology.
- Fast liquid conditioning and degassing because of very large regulating zone between maximal and average ultrasonic power and because of the ability to switch instantaneously between acoustic spectrums.
- Smooth Ultrasonic, PWM-power regulation from 1% to 100%. Ultrasonic energy can be easily adjusted in order to clean very fine and sensitive parts without damaging them.
- Fast and automatic ultrasonic-power and high-activity recovery after liquid mixing and after introducing ultrasonic load (after introducing parts to be cleaned).
- Cavitation level can be smoothly controlled from very low to very high (by changing signal-processing parameters of MMM generator).
- Ultrasonic erosion and mechanical damages to cleaning baths and vessels, as well as on the parts under cleaning is significantly reduced (compared to traditional technology) because of uniform distribution of ultrasonic activity.
- MMM Ultrasonic Power Supplies can drive any traditional piezoelectric transducer/s, using less energy and producing superior cleaning effects, comparing them to traditional, single frequency, and frequency sweeping Power Supplies.
- Several levels of overload/s protection are implemented.

More about MMM

- Until now, conventional ultrasonic cleaning baths have been very power hungry and power inefficient, only about 5-25%. Larger industrial units could become power hungry monsters, making the unit not only inefficient but also ineffective. Often as a last resort, heaters are used to "assist" cleaning.
- There have been conventional "sweep frequency" ultrasonic cleaners but still based on "fixed frequency" and **narrow** frequency interval sweeping, with a slightly faster response time. "Fixed frequency" is more suitable to work in pre-determined conditions e.g. in ultrasonic welding of plastic parts.
- Conventional fixed/single frequency operation results in "standing waves" being set up in the cleaning bath. A direct consequence of these standing waves is that cleaning is patchy across the surface being cleaned. Thus, some areas are excessively cleaned while other left unaffected. It also makes the effectiveness of conventional ultrasonic cleaner very variable and subjective to fluid level, fluid temperature and load conditions.
- Using our state-of-the-art MMM technology, these "standing waves" do not exist and the efficiency goes well up!

Ultrasonic Cleaning: How to select the best option



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MPI offers solutions for liquid bath cleaning applications where it is important to deliver uniform and homogenous ultrasonic energy over a large radiating surface. Due to the large radiating surface of the active elements the surface power density is usually on the order of 0.5 to 2 Watts per square centimeter. Such power is providing very good cavitation effects and uniform power distribution throughout the bath or special cleaning chamber.

Through the use of standard plate mount transducers, submersible transducers, tubular arrays, or a single-transducer with an integrated resonating bar or tube, we can provide either standard bath systems or custom baths that adapt to existing wash processes. For special cleaning applications that require strong spot washing or cleaning the interior of very small holes or cavities, as found in small machined parts for the watch or telecommunications industry, we can offer a high power probe cleaning SONICATOR.

For standard cleaning applications we offer both fixed frequency systems and wideband frequency systems using our unique MMM technology. Advantages of our wideband MMM technology include:

- Complex MMM modulation techniques eliminate standing waves and dead zones to improve parts cleaning and reduced hot cavitation zones that can damage small and sensitive parts.
- New modulation techniques offer uniform distribution of ultrasonic energy and generate significant cavitation throughout the bath volume independent of water level.
- Wideband frequency modulations create a wide range of cavitation bubble sizes offering faster and more thorough cleaning of parts.
- Reduction of standing waves reduces transducer or tank pitting to extend operational life.
- Faster liquid conditioning and degassing of fresh cleaning solutions.
- More efficient cleaning method allows reduction or elimination of cleaning solvents and heating.
- Smooth power regulation 0% to 100% plus fully programmable Pulse Width Modulation options allow cleaning of fine and delicate or heavy parts with the same system.
- Adjustable inductive compensation, available on OEM modules, allows simple adaptability to 3rd party transducers and the possibility for field upgrades to existing systems.

MPI' liquid cleaning components are designed for heavy-duty industrial applications and can also be scaled to accommodate most any environment.

Fixed Frequency Generators: Standard power supply generators are available for up to 3,000 watt power output (adjustable 50% to 100%) and higher power systems are available on special request. Standard fixed frequency systems are available in 25 kHz, 30 kHz, and 40 kHz (custom frequencies may be discussed). Delivered power to the material under treatment is a function of the radiating surface connected to the transducer, generator power/amplitude adjustment setting, and the treated material density.



MMM Generators (Multi-frequency, 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 cleaning 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%) available in a range from 100 W up to many kW.



System Control: Our Fixed Frequency and 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 designed for demanding ultrasonic cleaning applications.

Acoustic Elements: We offer a large variety of radiating elements that may be customized for a wide range of applications.

<ul style="list-style-type: none"> • Ultrasonic Bath: Standard and custom ultrasonic baths constructed of stainless steel with integrated bottom or side wall plate converters. System power may range from 100 W up to many kW using Fixed Frequency or MMM wideband generators. 	
<ul style="list-style-type: none"> • Ultrasonic Plate Arrays: Standard and custom ultrasonic plate arrays for custom stainless steel bath construction. System power may range from 100 W up to many kW using Fixed Frequency or MMM wideband generators. 	
<ul style="list-style-type: none"> • Submersible Ultrasonic Box Arrays: Standard and custom size submersible ultrasonic box arrays constructed of stainless steel. System power may range from 100 W up to many kW using Fixed Frequency or MMM wideband generators. 	
<ul style="list-style-type: none"> • Submersible Ultrasonic Tube Arrays: Standard and custom size submersible ultrasonic tube arrays constructed of stainless steel. These tubular systems radiate acoustic energy 360° around the total length of the tube and generate a high degree of effective cavitation. System power may range from 100 W up to many kW using Fixed Frequency or MMM wideband generators. 	
<ul style="list-style-type: none"> • Submersible Ultrasonic Bar Sonotrodes (Single Ended or Push-Pull Versions): Standard and custom size submersible ultrasonic bar sonotrodes constructed of solid titanium. These bar systems radiate acoustic energy 360° around the total length of the bar and generate a high degree of effective cavitation. System power may range from 100 W up to 3 kW using Fixed Frequency or MMM wideband generators. 	

• **Submersible Ultrasonic Sonotrodes as Single Ended SONICATORS:**

For special cleaning applications that require strong spot washing or cleaning the interior of very small holes or cavities, as found in small machined parts for the watch or telecommunications industry, we can offer a high power SONICATOR.

In combination with our fixed frequency generators we offer a wide range of acoustic elements to meet all of your high power Sonicator / Homogenization needs. Using advanced digital generator technology we have set a new standard in high power liquid processing.

The new generator design offers new capabilities in tracking shifts in the center operating frequency. Normal generators are unable to manage even minor shifts (30 Hz to 100 Hz) when probes become de-tuned due to cavitation wear. Our systems can track simple probes over a very large frequency range of ± 500 Hz, a 1,000 Hz window in some cases. That means extended probe life, more reliable operation, and less maintenance.

Our converters feature a sealed front mass interface with upper air cooling ports for continuous operations. Boosters are available in titanium or aluminum, with or without mounting rings. Probes may be constructed to your specifications. Standard probes are made of high grade titanium in diameters up to 60 mm

Applications include:

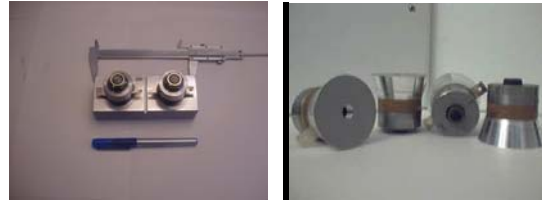
- Ultrasonic Cleaning
- Sonoreactors
- Homogenization
- Emulsification
- Dispersion of solids in liquid
- Disruption of bacterial cells, viruses and spores
- Acceleration of chemical and enzymatic reactions
- Liquids degassing
- Liquid Processing in static or flow cell chambers.
- Laboratory or industrial applications.



- **Pipe Clamp-On:** Custom clamp systems using one or more ultrasonic converters may be externally attached to stainless steel or titanium pipe or tube segments. The clamped segment becomes the radiator of Ultrasonic energy to material internal or external to the pipe. These systems simplify treatment of materials in flow through, high temperature or pressurized systems. System power may range from 100 W up to 1,200 W using MMM wideband generators.



- **3rd Party Transducers:** Our MMM generators offer great flexibility in adapting to other supplier's transducers or ultrasonic baths. We can make inductive and frequency adjustments in the field to turn ordinary ultrasonic baths into super cleaning systems.



Cleaning System Design Services: We provide consulting and custom design services to aid our clients in construction of cleaning systems for special applications.