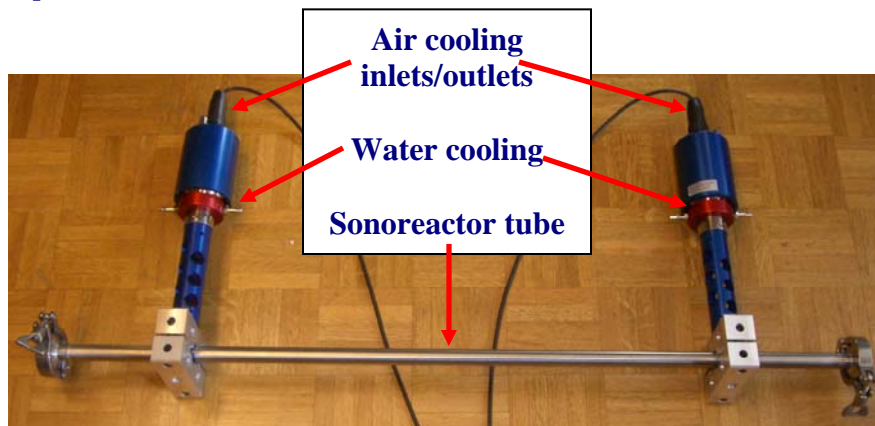


# Clamp-On Tubular Sonochemical Reactor



Only dry air cooling	Ultrasonic converter	Water jacket (only water cooling)	Clamps & waveguide (Torque tested until 30 Nm)	RS 485-USB adapter
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Two photographs are shown below the table. The left photo is a close-up of the reactor tube assembly, with red arrows pointing from the table labels to its components. The right photo shows a laptop with an RS 485-USB adapter connected to its side, with a red arrow pointing from the table label to the adapter.

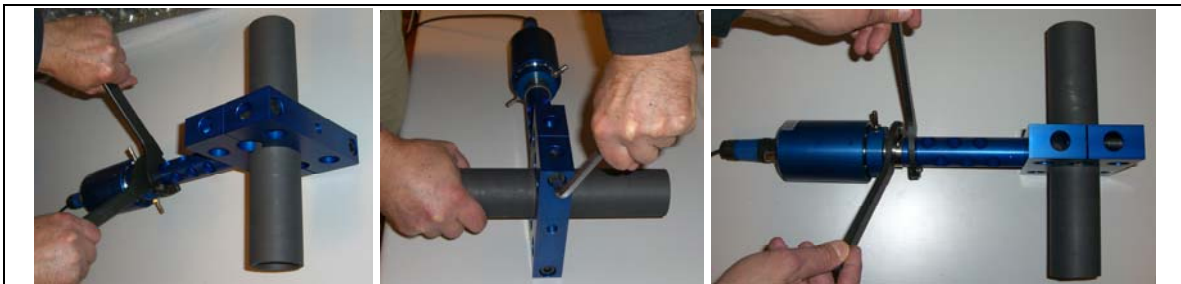
Pictures of the complete ultrasonic system configuration: **MMM-Generator**, Converter-Wave-guide-Water-jacket-reactor tube and PC. PC Interface RS485 to USB (or RS232) is connected between the PC and MMM generator.

For flow-trough, continuous, inline operations please weld your new tube fittings and connections to existing covers of quick flanges.

## Important warnings and comments:

Do not operate/test the reactor high power when reactor tube is empty.  
Liquid inside both-ends closed-tube will gradually heat when reactor is operating.  
Quick flanges should be very well (strongly) closed to avoid heat dissipation there.  
Client should use his own PC.

Converter should be strongly fixed (by screwing) to one side of aluminum clamps (always using the waveguide between the converter and aluminum clamp), this way taking care that vibrations on the reactor tube will be uniformly distributed and maximized. Picture below is showing similar clamp-on reactor example (different tube).



Pictures presenting ultrasonic converter with water jacket (upper part), wave-guide (middle part) and aluminum clamps on the reactor tube (bottom). Apply fastening of clamps, slowly, symmetrically and gradually (on both sides) until reaching **30 Nm torque** value (use proper torque wrench; -not presented on the pictures here). For fixation (screwing, unscrewing) of converter and wave-guide use here presented wrenches.

In operation, the biggest care should be taken to keep constant low temperature on the ultrasonic converter (always below 50 degrees Celsius). Water jacket should be connected to a water flow in order to keep aluminum wave-guide cold and to stop heat penetration from aluminum block towards converter. Certain forced air flow should be realized inside of the housing of the ultrasonic converter in order to keep converter cold (using pressurized, filtered dry air: dust particles smaller than 5 micrometers).

In case of increased (and fast) heat generation on metal parts, converter and joints, the most probable sources of such problems could be:

- Some bolts and studs are experiencing certain unscrewing
- There is a structural damage somewhere on reactor tube, clamps, waveguides (make proper refastening).
- Generator settings (operating conditions and software settings) are not optimal (make new settings).

Usually, when generator settings are well made, when mechanical fixation is sufficiently strong, and when aluminum clamps are properly fixed, converter will not

generate heat, or better to say that temperature on the converter body would increase very slowly. Significant heating of the converter parts is always indicating that MMM generator settings are not well made, or that there is a problem in mechanical assembling (parts are not strongly fixed or broken). In such situations, stop the generator, reduce the operating power and search for new settings.

When new settings are found, ultrasonic power could be increased. Aluminum clamps and reactor tube will take so much of ultrasonic power as acoustic loading conditions would allow. Generator is able to deliver 600 Watts (and converters can accept 3000W), but in most of situations (like this one you have) aluminum clamps would take significantly less ultrasonic power because of acoustical loading conditions, acoustic impedances, geometry etc.

You should experiment (with low power settings; -around 20%) in no-load open-air conditions in order to find the best generator settings and best loading of aluminum clamps and reactor tube.

All metal-to-metal joints (contact surfaces) realized by screwing should be clean, without any particles and dry (no water between contact surfaces) in order to avoid bad acoustic coupling and destruction of contact surfaces. If you intend to make new aluminum parts, the best aluminum for ultrasonic applications is AL-7075.

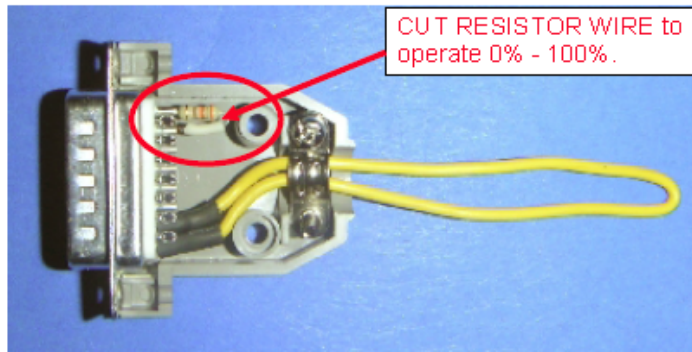
After creating regular operating conditions (vibrating reactor tube with some liquid inside), generator settings should be again readjusted, since initial mechanical oscillating system would change by presence of different loading conditions and different added masses.

Do not apply maximal power settings of the generator, because after certain power level, increasing the power would start producing negative effects, non-linear oscillations, clipping and heat (and reactor tube could be damaged).

# GENERATOR CONTROLS

IMPORTANT NOTE: All new generators have a safety level resistor installed on the provided Remote Control Connector. The provided connector has two functions:

- i. A factory installed resistor inside of this connector is used to keep the initial set-up power level to 30%. After initial set-up this resistor and power limitation should be disabled by opening the connector housing and cutting one or both resistor leads. After removing the resistor load power can be regulated from 0% to 100%. If the resistor is not removed power will always stay limited to 30% (no regulation possible).
- ii. A factory installed wire (yellow) between pins 1 and 2 is acting as a short circuit for the systems external sensor protection option. To operate the generator this short circuit must be in place through the provided wire or through sensors that are normally closed. An open circuit will stop generator operation.



## MMM Generator Installation Note

Installation Power Control for MSG.X00.0W models:

See section 2.2 (Page 12) of the MSG.X00.0W System Operation Manual (See also pages 24 - 28).

### 2.2. Factory Settings and Initial Generator Start Up.

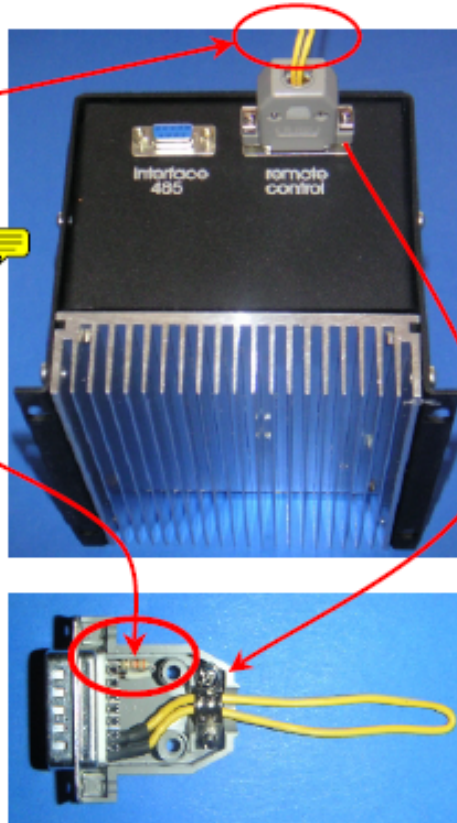
The MasterSonic MSG.X00.0W generator includes an optional external power on safety circuit control that may be implemented through relay control of terminals 1 and 2. These terminals may be connected to a temperature control circuit, door panel switches, operator proximity safety switches, etc. To operate the generator module these terminals must be normally closed. An open circuit will stop all generator operations. If the installation does not require such external control these terminals 1 and 2 should be short circuited with a hard wire connection.

The MSG.X00.0W is delivered from the factory with a short circuit wire between terminals 1 and 2 to allow immediate operation.

For initial start up and testing safety the MSG.X00.0W is also delivered from the factory with a 330 Ohm resistor connected between terminals 7 and 8 to limit the generator power output to 30%. Upon initial connection of the generator to the acoustic load start the generator with this resistor in place to check operation in a low power mode.

If the system operates properly turn the generator off, disconnect the mains power supply, and remove this resistor from terminals 7 and 8. Use diagonal cutters to clip the resistor leads.

After removal of this resistor the MSG.X00.0W power output may be controlled from 0% to 100% via the Remote Control Panel.



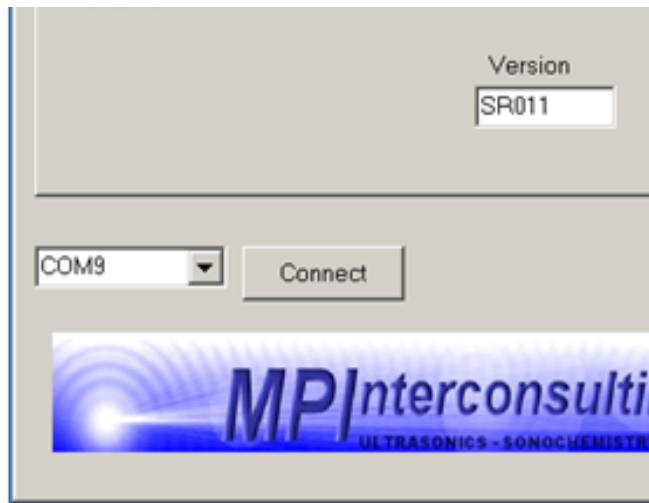
**The first step** is to install the drivers (software) for USB, or Generator-to-PC-interface. Drivers can be downloaded from here:

[http://www.mastersonics.com/documents/mmm\\_basics/mmm\\_power\\_supplies/rs485-USB-adapter-software/](http://www.mastersonics.com/documents/mmm_basics/mmm_power_supplies/rs485-USB-adapter-software/) Ask somebody who is experienced in downloading and installing such software. You need first to download the software from above indicated address, and than to unzip the file, and install the software. **You also need to connect the physically the PC interface between the MSG.600.0W and your PC.**

**The second important step** is to install the software [mpi\\_ow.exe](#) for ultrasonic generator **MSG.600.OW**. You need mentioned software in order to make settings and operate the generator (download the software “[mpi\\_ow.exe](#)” here: [http://www.mastersonics.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ow-generators/latest/](http://www.mastersonics.com/documents/mmm_basics/mmm_power_supplies/msg-ow-generators/latest/), or here [mpi\\_ow.exe](#) ).

The software installation means: Place the software icon on your desktop (on the monitor of your PC... and there is nothing more regarding installation; \_ you just need to activate the software icon).

After activating the software ([mpi\\_ow.exe](#)) the first action is to connect a proper COM port (on the first software tab: Bottom left corner) as shown on the picture below:



#### MMM generators **OW series** Set-Up

- 1.) Set all sweeping parameters to 0 (both fast sweeping and sweeping). This will enable generator to operate on constant frequency.
- 2.) Set the operating power to 30% (safe level for initial parameters setting).



- 3.) Adjust the Operating Frequency to the point where the load (transducer) current is maximal and where at the same time the phase is minimal. At this point the ultrasonic activity in the tank should be maximized.
- 4.) Adjust the inductive compensation in order to get higher load current and maximal acoustic activity in the tank. (After final adjustment the internal inductive compensating ferrite gap may be fixed with a silicone spacer.)
- 5.) Set the Fast Sweeping adjustment to the maximum setting of 255.
- 6.) Set the Sweeping adjustment from 100 to 125.
- 7.) Increase the power until smooth and continuous oscillations are present. If the ultrasonic tank starts producing cracking and sharp noise, stop increasing the power. Always set power to stay within a relatively smooth and quiet operating regime. Increasing the power over the suggested limits will only produce heating and may damage transducers. Entering into a regime of non-linear and clipping oscillations is not producing better cleaning effects (it is producing only very high noise level, high thermal losses and possibly damaging tank and transducers).
- 8.) Adjust the operating frequency again to find the maximum load current and minimum phase pint.
- 9.) Repeat all setting steps 1 through 8 above to find better operating conditions. Do not forget to remove power limiting resistor from the Remote Control Connector.
- 10.) Additional fine tuning, to get better ultrasonic activity, may be made by adjusting all sweeping intervals while keeping the same, previously found, operating frequency. For example set Fast Sweeping to 0 and Sweeping to 7 (this is sometimes producing very good results in case of ultrasonic cleaning). Parameter settings and cavitation effectiveness may be verified by comparison of treated aluminum foil samples. Submerge strips of 3 micrometer thick and soft aluminum foil (kitchen foil) into the bath for fixed periods (e.g. 20 seconds) under various parameter settings. Compare the aluminum foil perforations, holes, and indentations. Uniform pin holes and indentations show good distribution of cavitation.
- 11.) Newly assembled cleaning tanks should be put in operation for several hours at 50% power to mechanically stabilize the transducers. This will improve long-term transducer operation.
- 12.) To optimize the system operation be sure to fill the tank with water to about two thirds of its volume (or a little bit more) and keep this level. MMM wideband ultrasonic activity and homogenous 3-D power distribution will not be optimized if the water level is low.

**Good settings of your ultrasonic generator are already made and memorized inside the generator before delivery. You do not need to make significant changes and new settings. Also proper (very good) mechanical fixation of all parts of your reactor is already made before delivery and you do not need to make it again. In case of minor problems you could very slightly modify settings of the generator and double check critical fastening elements (bolts).**

**For putting the generator in operation and making proper generator settings (learning process), please download the instructions here (very important, read carefully, go step by step, do not neglect something):**

[http://www.mastersonics.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ow-generators/latest/](http://www.mastersonics.com/documents/mmm_basics/mmm_power_supplies/msg-ow-generators/latest/)

If under certain settings generator starts going into overloading state (stopping operation), reduce the power and slowly and systematically change some of setting

conditions. Do not force repeatedly the generator to go often in overloading conditions, because this way you would damage the generator, converter and/or mechanical parts.

Above given instructions are generally valid for all MMM and OW generators (like your generator). Details regarding settings and optimal conditions would always be different, depending on operating conditions, geometry of oscillating objects, loading conditions etc. Here given general instructions are good to get basic knowledge and experience regarding how to operate MMM generator and how to make settings, but in client's real operating conditions, **the same, here given instructions should be applied creatively and with intellectual flexibility (meaning that, if necessary, the client should find new set of best operating conditions that are similar, but maybe not identical to here described settings).**

## GOOD SETTINGS IN YOUR CASE ARE:

Good initial generator settings of your generator found (and memorized) in MPI laboratory during initial testing are (see below):

Frequency: Best operating frequency is 17.735 kHz. In case if you would for some reason change operating frequency, **never go higher than 20.5 kHz.**

ULTRASONIC POWER: 2060 (Somewhere in the middle of the full range). This is not the real ultrasonic power control (only pulse width control on the transistors gates), but it is increasing security during modulated sweeping frequency operations.

ULTRASONIC POWER: From 10% to 100%. During settings procedure (searching for new operating conditions) start with low power (for instance 20%). Operate the reactor at minimum power that is producing good results, linear, smooth and stable oscillations, and minimal heating on the converter parts. In loaded situation power may need to be readjusted.

Fast Sweeping: From 0 until 10. Whatever gives better vibrating results.

Sweeping: Keep at 130. Later experiment using other values (between 10 and 200).

Tracking range: Keep on 15



