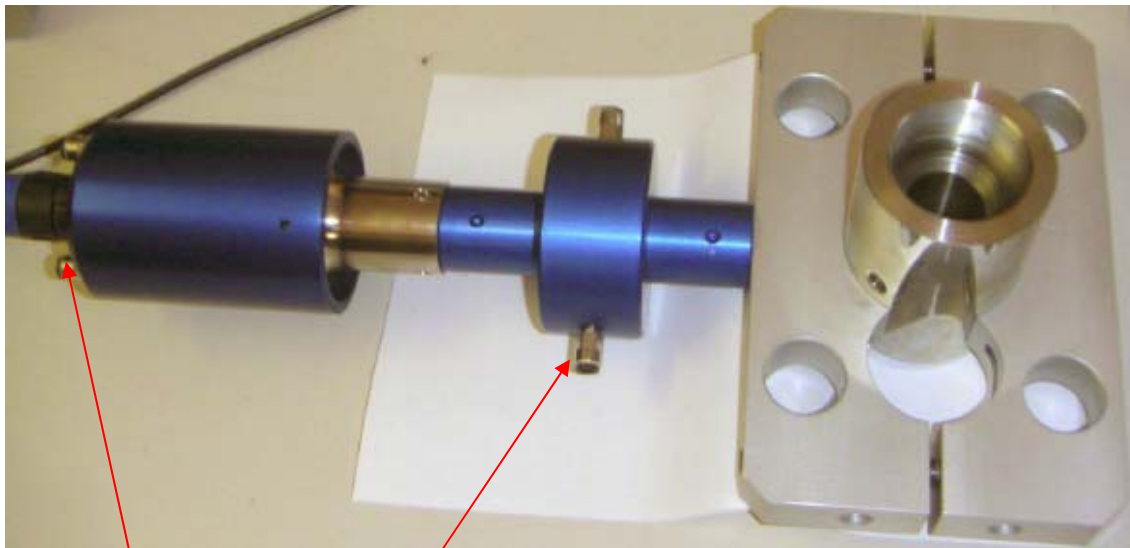


**ULTRASONICALLY ASSISTED PLASTIC MIXING AND EXTRUSION**

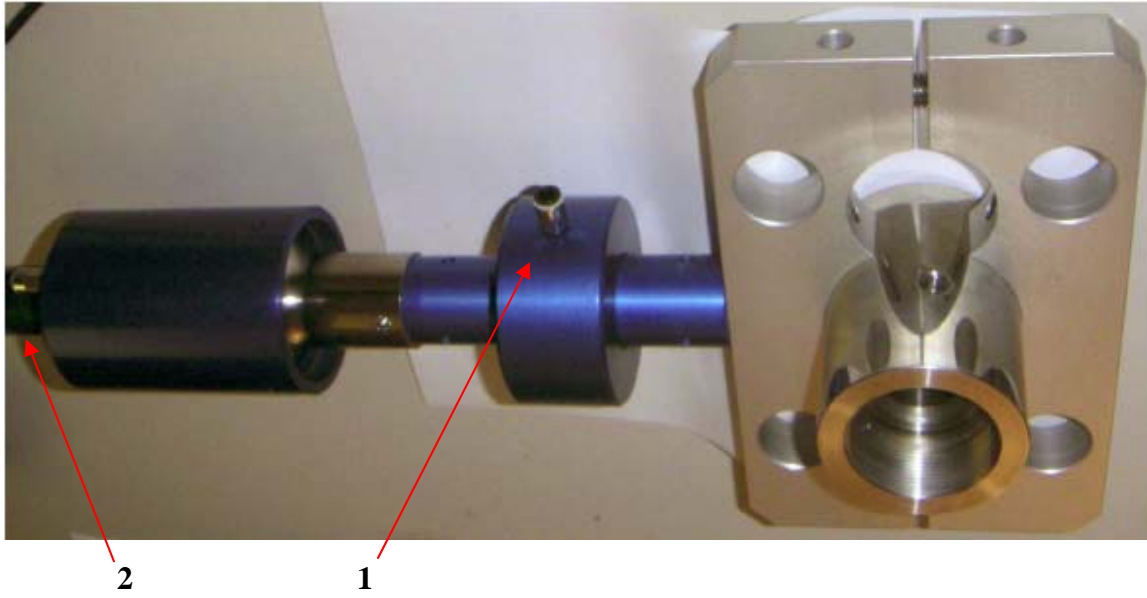


All components of ultrasonic extruder



2

1



**Start testing in no-load conditions using the shortest empty stainless steel cylinder, because it is oscillating well and it is easy for learning process (as presented here).**



**No.1 is water inlet/outlet for water cooling (placed on the waveguide)  
No.2 is only air inlet/outlet. Do not use any liquid to cool the converter.  
Use 5 micrometers air filter and apply only dry and clean air.**

### GENERAL INSTRUCTIONS:

1. Fix well all mechanical components and parts: Converter, Waveguide Rod, and Vibrating Extruder part. Torque: between 25 Nm and 35 Nm. Be careful not to bend or deform aluminum parts. Strong manual fixation is usually very good method. Use professional fixating tool.
2. **Do not clamp or fix anything to the transducer housing** during assembling. Do not rotate transducer housing. You can destroy internal parts, brake cables...
3. Do not miss reading the following documents which can be downloaded here:  
[http://www.mastersonics.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ixgenerators/latest/](http://www.mastersonics.com/documents/mmm_basics/mmm_power_supplies/msg-ixgenerators/latest/)
4. Connect generator and transducer.
5. Set the generator on low power during initial testing. Initial low power could be between 10% and 20%. Later, after everything is working well, power can be increased until 50%. It is not necessary to have 100% power, because this is very powerful system.
6. During testing and settings use only the frequency range between 17500 Hz and 22500 Hz. **Do not set the generator to operate on any frequency higher than 22500 Hz**, because converter is made to operate on 20000 Hz +/- 2500 Hz. Generator type is MSG.1200.IX-LF.
7. **Good settings are made when vibrations and heating on the transducer housing are minimal (no vibrations). In operation, housing and front mass of the transducer should stay cold (room temperature).** If necessary, apply air cooling on the transducer, and water cooling on water jacket. **Do not apply water cooling on the transducer because transducer will be damaged.**
8. Any increasing overheating on the transducer and anywhere else is the indication that something is not well adjusted, or not well fixed. Check mechanical parts and adjust operating frequency again.
9. **Any unusual, non-uniform acoustical noise, cracking, squeezing, whistling is a warning that something is wrong.** Check everything and start settings again.

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

[http://mastersonic.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ix-generators/latest/instructions-for-first-time-users-ix-generators.pdf](http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/msg-ix-generators/latest/instructions-for-first-time-users-ix-generators.pdf)

[http://mastersonic.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ix-generators/latest/ix-single-converter-settings.pdf](http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/msg-ix-generators/latest/ix-single-converter-settings.pdf)

[http://mastersonic.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ix-generators/latest/ix-single-converter-settings.pdf](http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/msg-ix-generators/latest/ix-single-converter-settings.pdf)

[http://mastersonic.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ix-generators/latest/um\\_msg\\_ix\\_yf\\_2005.pdf](http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/msg-ix-generators/latest/um_msg_ix_yf_2005.pdf)

Read also all documents from here:

[http://mastersonic.com/documents/mmm\\_basics/mmm\\_power\\_supplies/msg-ix-generators/latest/](http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/msg-ix-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.

Above given instructions are generally valid for all MMM and IX 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 setting, but in client's real operating conditions, **the same instructions should be applied creatively and with intellectual flexibility (meaning client should find new set of best operating conditions that are similar, but maybe not identical to here described settings).**

Client should use his own PC. Software **mpi\_ix.exe** for the MSG.1200.IX should be installed (download software here:

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

**Connect the free COM port. Software SR102 has selectable COM ports.**

**EXAMPLE OF GENERATOR SETTINGS IN NO-LOAD CONDITIONS  
APPLICABLE TO PLASTIC EXTRUDER-MIXER**

Inox ultrasonic generator control panel

DDS | Power | FSWM | DMMM | US power

Frequency DDS

min max 18.880 kHz

Sweeping

min max 0.000 kHz

0.22 A DC current

295 V DC voltage

64 W DC power

COM1 Connect

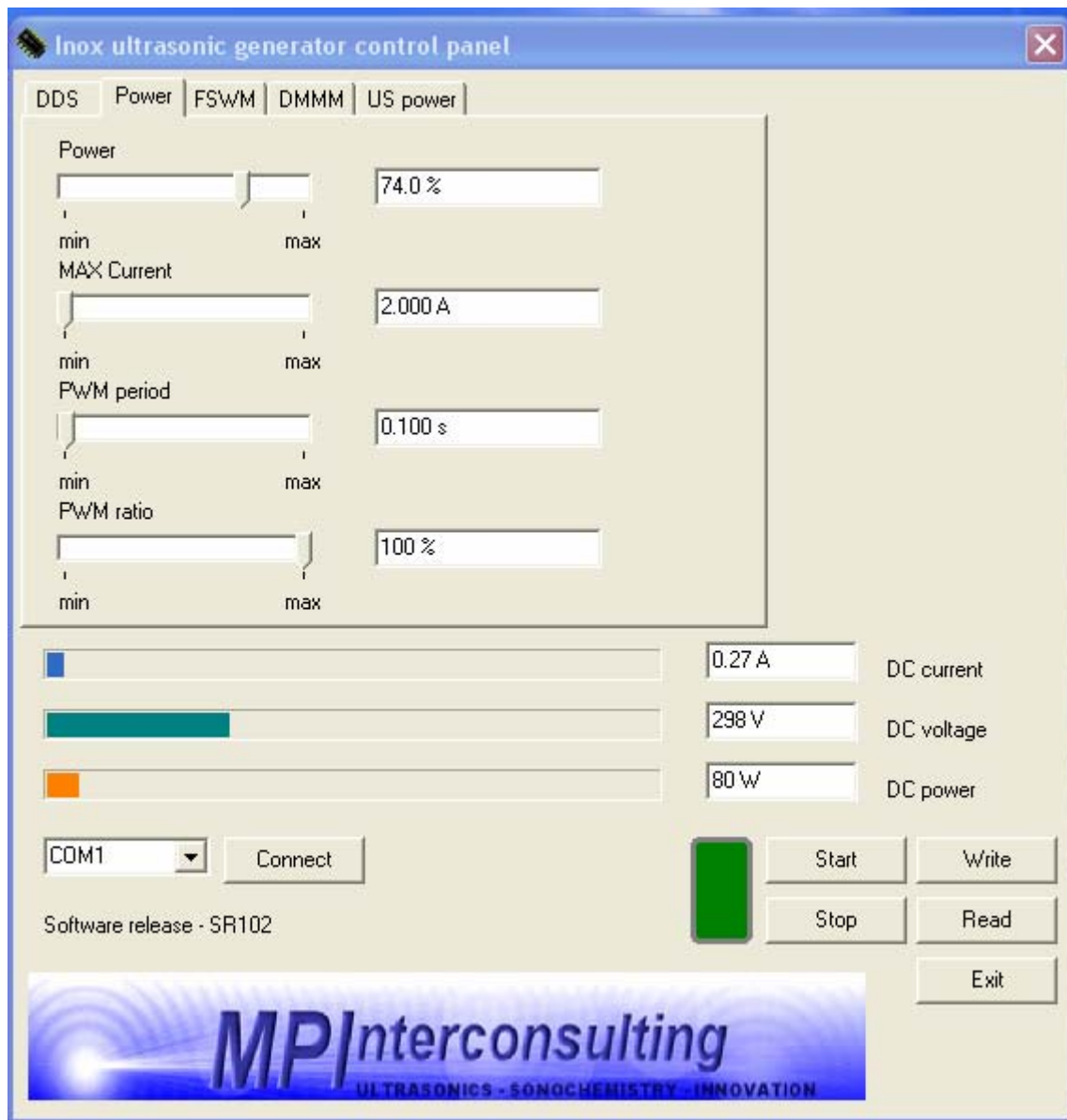
Start Write

Stop Read

Exit

Software release - SR102

**MPI Interconsulting**  
ULTRASONICS - SONOCHEMISTRY - INNOVATION



**Inox ultrasonic generator control panel**

DDS | Power | **F5WM** | DMMM | US power

F5WM range: [Slider] 0.512 kHz

F5WM ratio: [Slider] 50 %

F5WM period: [Slider] 0.030 s

[Progress bar] 0.08 A DC current

[Progress bar] 296 V DC voltage

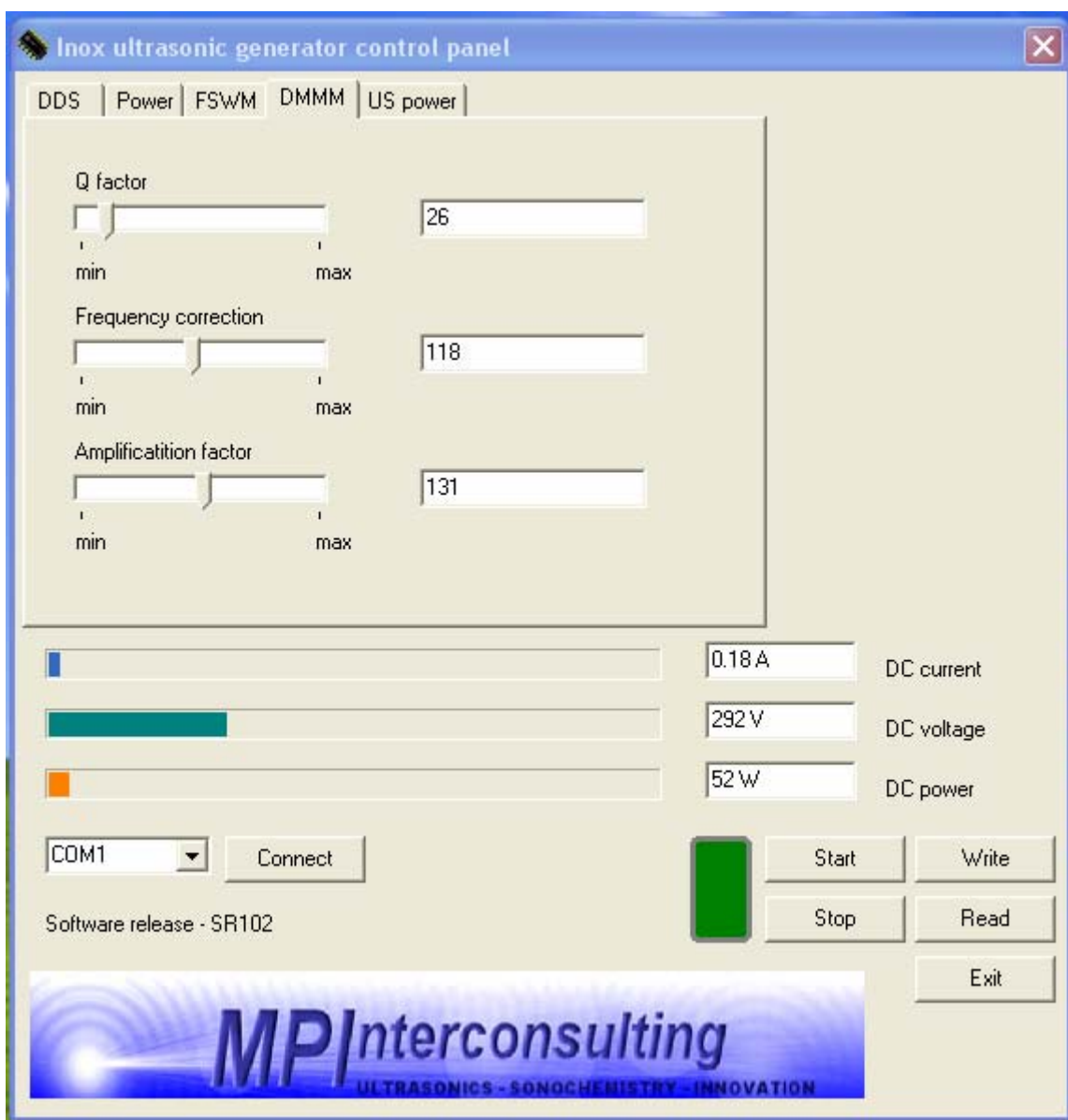
[Progress bar] 23 W DC power

COM1 [Connect]

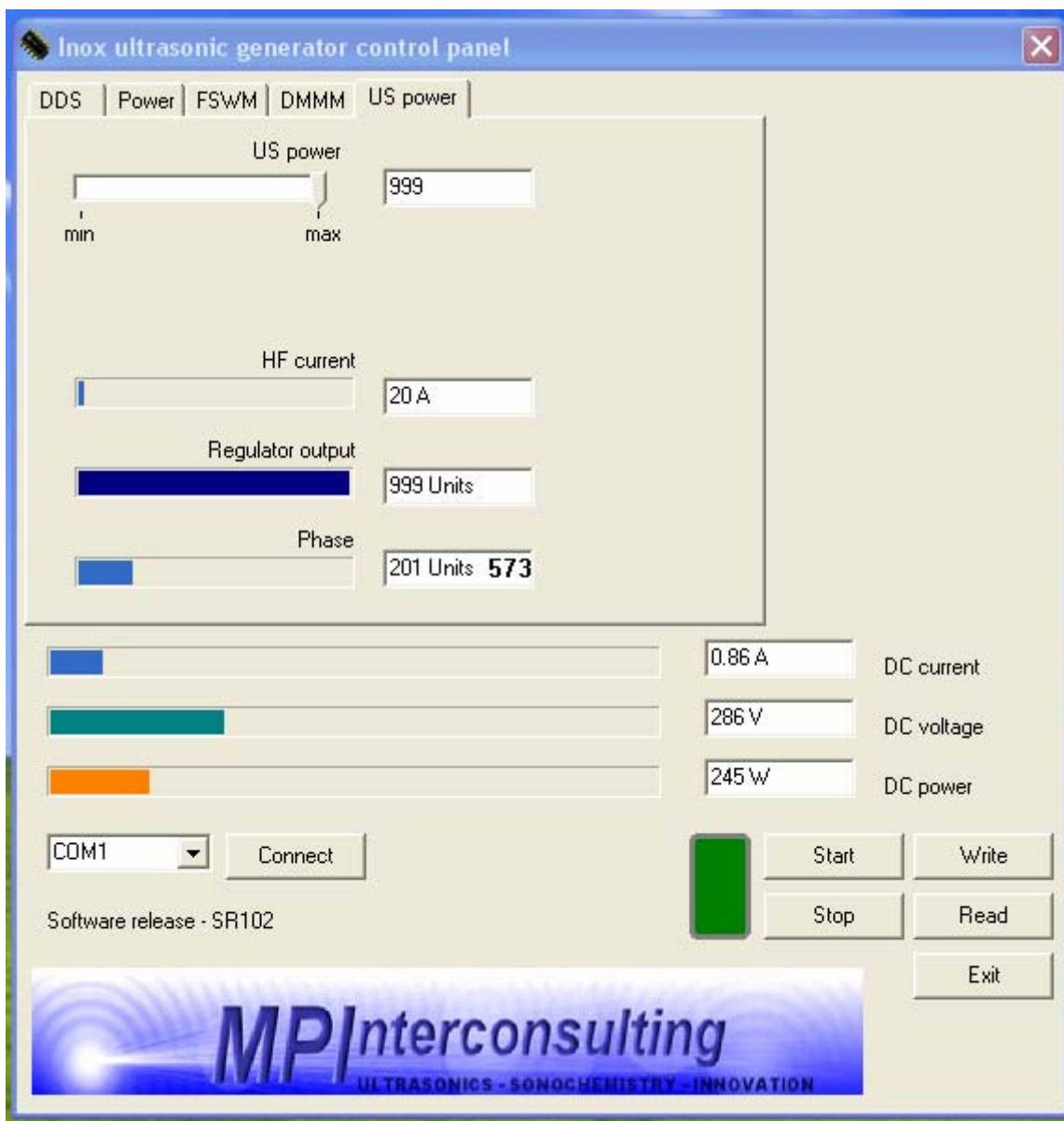
Software release - SR102

[Start] [Write] [Stop] [Read] [Exit]

**MPI**nterconsulting  
ULTRASONICS - SONOCHEMISTRY - INNOVATION

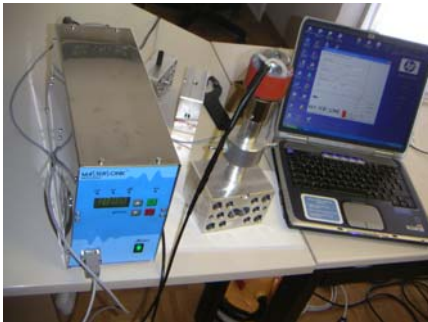






In loading, operating conditions, above-given initial settings should be readjusted to reach maximal ultrasonic activity (start the tuning process again, slowly and step by step).

### Another example of optimal installation and settings



Picture of a complete ultrasonic system configuration: MMM-Generator, Converter-Wave-guide-Water-jacket-Aluminum-Clamps and PC. PC Interface RS485 to RS232 is connected between the PC and MMM generator. Client should use his own PC. Software **mpi\_ix.exe** for the MSG.1200.IX should be installed (download software here:

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



Above presented are pictures of aluminum blocks modified by drilling additional holes inside of the not-used aluminum mass in order to facilitate multi-frequency vibrations. Holes in aluminum blocks can be drilled on many different ways from any side of the block. The client needs to experiment making different holes distribution (with different diameters, creating new aluminum blocks). The idea behind making holes in the vibrating aluminum body is to make such aluminum block more flexible, more elastic and to reduce its rigidity in order to facilitate vibrations and increase amplitude in the internal area of plastic flow. Converter can be strongly fixed (by screwing) from any side of the aluminum block (always using the waveguide between the converter and aluminum block), taking care that vibrations in the plastic-flow central zone will be maximized. Here given solution regarding holes is probably not the best one and client should experiment with many different configurations of holes geometry and distribution in order to get optimal results. Every hole is reacting as a kind of mass-spring oscillator (with relatively high mechanical quality factor), this way facilitating complex vibration of the aluminum block.



Picture presenting ultrasonic converter (upper part, red color), wave-guide with water jacket (middle part) and aluminum block (bottom). In operation, the biggest care should be taken to keep constant low temperature of the ultrasonic converter (always below 50 centigrade). 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 around the ultrasonic converter in order to keep converter cold (using a fan or pressurized air, or also placing certain solid envelope around the converter and making air flow inside). Usually, when generator settings are well made, when mechanical fixation is strong, and when aluminum block is well designed, 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). In such situations, stop the generator, reduce the operating power and search for new settings (later we will give good settings). When new settings are found, power could be increased. Aluminum block will take so much of ultrasonic power as acoustical loading conditions would allow. Generator is able to deliver 1200 Watts (and converter can deliver 3000W), but in most of situations (like this one) aluminum block would take significantly less ultrasonic power because of acoustical loading conditions, acoustical impedances, geometry etc. Ultrasonic converter and wave-guide can be fixed from any side of the aluminum block, providing that vibrations in the plastic-flow channels are maximized. Client should experiment in no-load open-air conditions in order to find the best generator settings and best design of aluminum blocks. 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 client intends to make new aluminum parts, the best aluminum for ultrasonic applications is AL-7075. After placing aluminum block/s in the extruder-mixer line and filling it with plastic mass (creating regular operating conditions), generator settings should be again readjusted, since initial mechanical oscillating system would change by presence of different loading conditions and different added masses. In any case, in any application, there should be applied the waveguide with water jacket between the

converter and oscillating aluminum block (because this is also a kind of mechanical interface which is separating converter from reflected vibrations. Do not apply maximal power settings on the generator, because after certain power level, increasing the power would start producing negative effects, non-linear oscillations and heat.



For fixation (screwing, unscrewing) of converter and wave-guide use here presented wrenches.

Good initial generator settings for oscillating aluminium blocks (for extruder-mixer) in no-load conditions are (see below):

**DDS,**

**Frequency:** 20.770 kHz. Also any of here listed frequencies would produce good operating results: 18.190 kHz, 18.200 kHz, 19.730 kHz, 20.360 kHz, 20.370 kHz, 20.770 kHz, 21.400 kHz, 21.790 kHz. (Best operating frequencies in this case are between 20 and 21 kHz, when operating in no-load conditions: the best operation in air found on 20.770 kHz).

**Sweeping:** Keep at maximum of 1 kHz. Later experiment from 0.5 until 1 kHz (1 kHz looks the best).

**POWER:** 10% to 100%. Start with low power (around 50% or less). Work at minimum power that is producing good results, linear, smooth and stable oscillations, and minimal heating on the converter parts.

**Current:** 3 A,

**PWM-period** 0.050s, **PWM-ratio** 100%

**FSWM:** best 0.000 kHz. (Later set sweeping on 0 and experiment with FSWM range from 0 to 0.1 kHz), **FSWM-ratio** 50%, **FSWM-period** 0.050 s.

**DMMM,**

**Q-factor:** 38 (also good from 50 to 100),

**Frequency correction:** 0 (also good from 0 to 10),

**Amplification factor: 126 (also good from 50 to 200).**

**Ultrasonic power: 472 (also good from 500 to 999). Work at minimum power that is producing good results, linear, smooth and stable oscillations, and minimal heating on the converter parts.**

**In loading, operating conditions, above-given initial settings should be readjusted to rich maximal ultrasonic activity (start the tuning process again, slowly and step by step).**