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<https://www.mpi-ultrasonics.com>

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Index

1. Ultrasonic World Message	3
2. MPI Ultrasonic Systems Based on MMM Technology	4
3. Important Safety and Operating Instructions	5
4. Assembly Electrical Cables	6
4. Assembly Cables & Generator & Transducer	8
5. MMM Generators Software	9
6. Assembly Sialon Tube	15
7. Water Test	16
8. Remote Controlle.....	17



1. Ultrasonic World Message

MPI Ultrasonic Power Supplies are engineered for unmatched compatibility and performance and are capable of driving virtually any piezoelectric ultrasonic transducer currently used in the high-power ultrasonics industry. Operating seamlessly across a wide frequency range of 15 kHz to 100 kHz (or even broader), our systems provide the flexibility and precision that modern industrial applications demand. MPI offers expert modifications in our specialized labs to ensure optimal performance in highly specific or demanding cases.

A standout feature of MPI Ultrasonic Generators is their universal frequency adaptability. Thanks to advanced digital software settings, the same generator can effortlessly operate at any frequency within the 15 to 100 kHz range. This allows for easy frequency selection and fine-tuning within any desired range. For applications requiring narrower bands, our Sonorod generators are optimized to operate between 19 and 25 kHz, delivering precise control where it matters most.

What sets MPI Ultrasonics apart from the competition is our market-leading frequency-window automatic controls. While typical competitors offer limited intervals of 1 to 2 kHz, MPI provides vastly larger and fully customizable frequency windows, giving you unparalleled flexibility and control across nearly any frequency interval. This feature opens the door to applications and efficiencies that other systems simply cannot match.

Our power supplies also utilize dynamic load power regulation between series and parallel resonance, enabling them to capture even broader frequency intervals. This means MPI Ultrasonic Generators can operate any piezoelectric transducer in resonant, fixed-frequency modes, within precisely selected frequency intervals, or under forced, frequency-modulated wideband regimes. Whether you need a stable, fixed-frequency operation or dynamic, wideband modulation, MPI delivers. Compared to other well-known ultrasonic generators on the market, MPI offers superior performance, reliability, and versatility.

MPI Ultrasonic Power Supplies can be operated in all the conventional ways you're familiar with—and in many innovative ways that competitors simply don't offer. All current industrial and manual control options are available, including manual controls, LCD front panel settings, analogue interfaces, and PLC integrations. Whatever your specific operational requirements, MPI can customize our systems to align with your processes, providing a seamless user experience.

For added assurance, MPI incorporates an internal scanning procedure to automatically identify the optimal operating regime and settings for each specific ultrasonic transducer. This ensures maximum efficiency, performance, and equipment longevity.

Our power supplies feature smooth, precise power and amplitude regulation, with built-in protections to safeguard your equipment. We apply strict limits on maximum load power, transducer amplitude, and output voltage to protect piezoceramics. Additionally, MPI Ultrasonic Power Supplies include comprehensive protections against overheating, short-circuiting, over-current, and over-voltage situations, ensuring long-term reliability and safety in even the most demanding environments.

Designed for global compatibility, our standard line of MPI Ultrasonic Power Supplies operates on European mains voltage from 200 Vac to 240 Vac at 50/60 Hz. Need something different? No problem. MPI can easily customize power supplies for other voltage standards, such as 115 Vac at 50/60 Hz. Internally, all standard models feature stabilized, universal voltage SMPS for control and logic modules, capable of operating from 95 to 265 Vac. For clients seeking advanced power



solutions, we also offer optional high-power PFC (Power Factor Correction) inputs to boost energy efficiency and performance.

By choosing MPI Ultrasonics, you're not just getting a product—you're investing in a cutting-edge solution that combines innovation, flexibility, and unmatched reliability. Whether you're upgrading your current systems or seeking new capabilities, MPI delivers the power, precision, and performance to drive your business forward.

2. MPI Ultrasonic Systems Based on MMM Technology

MPI Ultrasonic Power Supplies are built on advanced MMM (Multimode, Spatially Uniform, Overall) technology, enabling unparalleled performance in ultrasonic applications involving arbitrarily shaped, solid objects of any size. This technology allows for the precise and efficient ultrasonic agitation of complex geometric structures, making our systems ideal for industries where high-power ultrasonics and complex material processing are required.

In objects with complex geometries, multiple resonant modes are typically present. Each resonant mode can be described as a dualistic, electromechanically coupled resonator, where two resonators - each with distinct resonant frequencies - are mutually coupled. One of these resonators exhibits series resonance, while the other operates under parallel resonance. These resonances can be represented as dual electric circuits, which together define the typical piezoelectric impedance of the resonant structure.

For objects with intricate shapes, this results in multiple resonant modes, each with its own pair of series and parallel resonances at different frequencies. MPI Ultrasonic Generators are capable of selectively exciting any of these resonant frequencies, whether series or parallel. Moreover, our systems can operate within the frequency zone between two neighbouring resonances, allowing for even greater flexibility and control over the ultrasonic agitation process.

This cutting-edge method, known as MMM agitation, is particularly effective for arbitrarily shaped solid bodies with complex geometries. The ability to excite multiple resonant modes simultaneously is key to achieving uniform ultrasonic energy distribution throughout the material. Our AMMM ultrasonic generators are specifically designed to harness the full potential of MMM technology, delivering superior results in applications that demand precision and adaptability.

The effectiveness of our systems is backed by the European Patent Application EP 1 238 715 A1, titled Multifrequency Ultrasonic Structural Actuator. This patent, filed by Prokic Miodrag of MP Interconsulting (5.03.2001 – 11.09.2002), lays the foundation for the MMM technology that powers our ultrasonic solutions. By integrating this patented technology, MPI Ultrasonic Power Supplies offer a unique competitive edge in the field of high-power ultrasonics, ensuring reliable performance and exceptional versatility for a wide range of industrial applications.



3. Important Safety and Operating Instructions

Please read these operating instructions carefully and in their entirety before installing, commissioning, or operating your MPI Ultrasonic equipment. Strict adherence to these guidelines is essential to ensure the safety of personnel, the proper functioning of the equipment, and to maintain warranty coverage. Failure to follow these instructions may result in serious injury, equipment damage, or even pose a risk to life.

This equipment is designed to be operated exclusively by trained and qualified personnel. Operators must possess the necessary technical knowledge and have undergone appropriate training to handle ultrasonic equipment safely and effectively. Untrained or unauthorized personnel are strictly prohibited from operating or servicing the device. Non-compliance with this requirement will result in the immediate voiding of all warranty rights and could lead to hazardous operating conditions.

Before any operation or maintenance is performed, all personnel must:

- Thoroughly read and understand this operating manual. This includes familiarity with all safety warnings, operational procedures, and maintenance requirements.
- Be knowledgeable of and compliant with all local, national, and international safety regulations that apply to the use of ultrasonic equipment, including accident prevention measures and workplace safety standards.
- Ensure that all legal regulations related to electrical safety, high-frequency equipment, and mechanical handling are strictly observed.

Improper installation, operation, or maintenance of this equipment can lead to:

- Mechanical failures resulting from improper assembly, incorrect handling, or failure to follow specified procedures.
- Thermal risks, especially when dealing with high-frequency ultrasonic transducers, which may cause overheating if not handled correctly.
- Voidance of the manufacturer's warranty, resulting in additional repair or replacement costs.

It is the responsibility of the equipment owner and operator to ensure that:

- All individuals involved in the installation, operation, and maintenance of this device are qualified, trained, and authorized.
- The equipment is operated under conditions that comply with the technical specifications outlined in this manual.



- Regular inspections and maintenance are performed according to the schedule provided in the manual, and any irregularities are reported immediately.

By following these instructions and ensuring that all safety measures are in place, you will not only protect personnel and equipment but also ensure optimal performance, longevity, and reliability of your MPI Ultrasonic system.

Safety is not optional. It is a critical part of ensuring successful operation and maintaining the integrity of your equipment and warranty.

4. Assembly Electrical Cables

In addition, ambient temperatures of over 30°C should be avoided. Choose a suitable location that will protect the device from moisture, water, excessive sunlight and heat.

ATTENTION:

- Choose a location that will prevent steam or any other aggressive vapors from penetrating the device.
- Over a period of time, chemically contaminated ambient air can lead to the device being irreparably damaged.

Power supply

The ultrasonic generator draws its power (230 V / 50 / 60 Hz) via the connection cable.



It has an internal main fuse (10 AF).

If you need to change the fuses, unscrew the top of the housing.

- For safety reasons, always disconnect the unit from the mains before changing fuses.
- Plug racks into earthed sockets only.
- Always replace blown fuses with new fuses of the same type.
- This should only be performed by qualified, skilled personnel.



Componentes - Cables

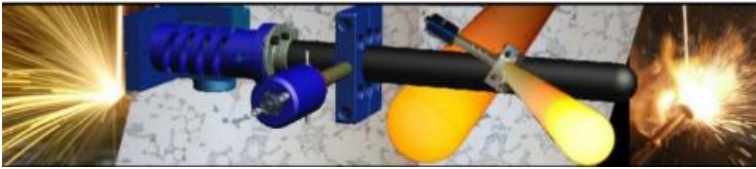


Componentes - Generator



Specifications of Generator

Frequency	SONOROD 2000 20 kHz	
Operating voltage	230 V +/- 15%	
Power consumption	9 A	
Effective power output	1500 W	
Maximum output	2,000 W	
Fuse protection	10 A	
Dimension casing	W x H x D/mm/ 125x371x252	Weight 6 kg
Operating Temperature range	-10 to +40°C	Protection class IP 20, IEC 60 529, EN 60 525



4. Assembly Cables & Generator & Transducer



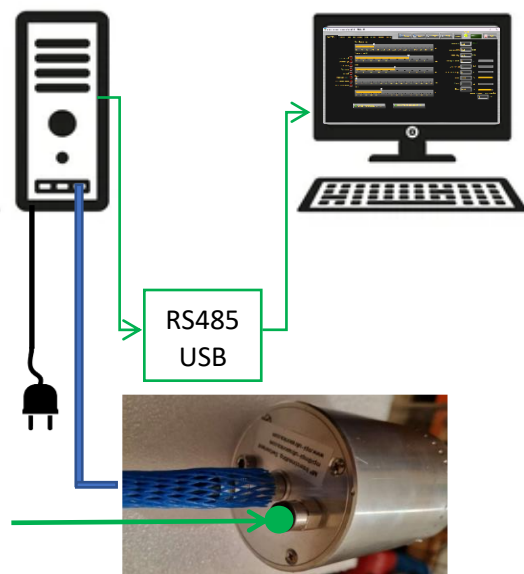
MMM Generator
[20 kHz]

Plug 220 V

Coaxial cable



RS485 USB



Air Cooling
Pressure 4-6 bar

Transducer
[20 kHz]



5. MMM Generators Software

This is National Instruments, LabView-based operating software for controlling and setting our ultrasonic generators. To operate such software from a personal computer, it is necessary to install Lab View Run-Time and NI serial port drivers (before using our ultrasonic generators software). NI software can be downloaded from the web links listed below:

1. Lab View Run-Time Engine 2012 – Windows 10 (64-bit)

Standard download.

<https://www.ni.com/en-pt/support/downloads/drivers/download.ni-visa.html#409839>

2. The generator communicates with LabView software through USB to RS485 adapter. Install the latest driver from here:

<https://ftdichip.com/drivers/>

3. Software for our ultrasonic generators is here:

https://www.mastersonics.com/documents/mmm_basics/mmm_power_supplies/SONOROD-generators/

 [SONORODE sonicator.zip](#) 182.8 Mb Jun. 2021

Create a Folder. Place inside the folder the following files:

 bin	09 Jun 2021
 license	09 Jun 2021
 supportfiles	09 Jun 2021
 nidist.id	310 bytes 09 Jun 2021
 setup.exe	5.2 Mb 09 Jun 2021
 setup.ini	16.7 Kb 09 Jun 2021

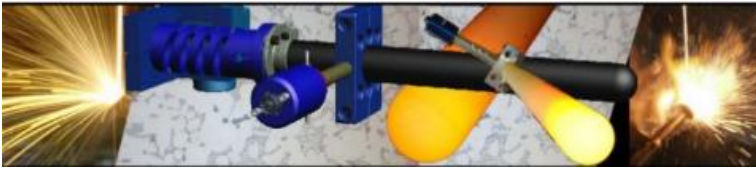
4. Manual of Sonorod MMM Generator

Download the manual here:

 [SONOROD GENERATOR user manual_18072019.pdf](#) 1.3 Mb 2021

https://mastersonics.com/documents/mmm_basics/mmm_power_supplies/SONOROD-generators/SONOROD_GENERATOR%20user%20manual_18072019.pdf

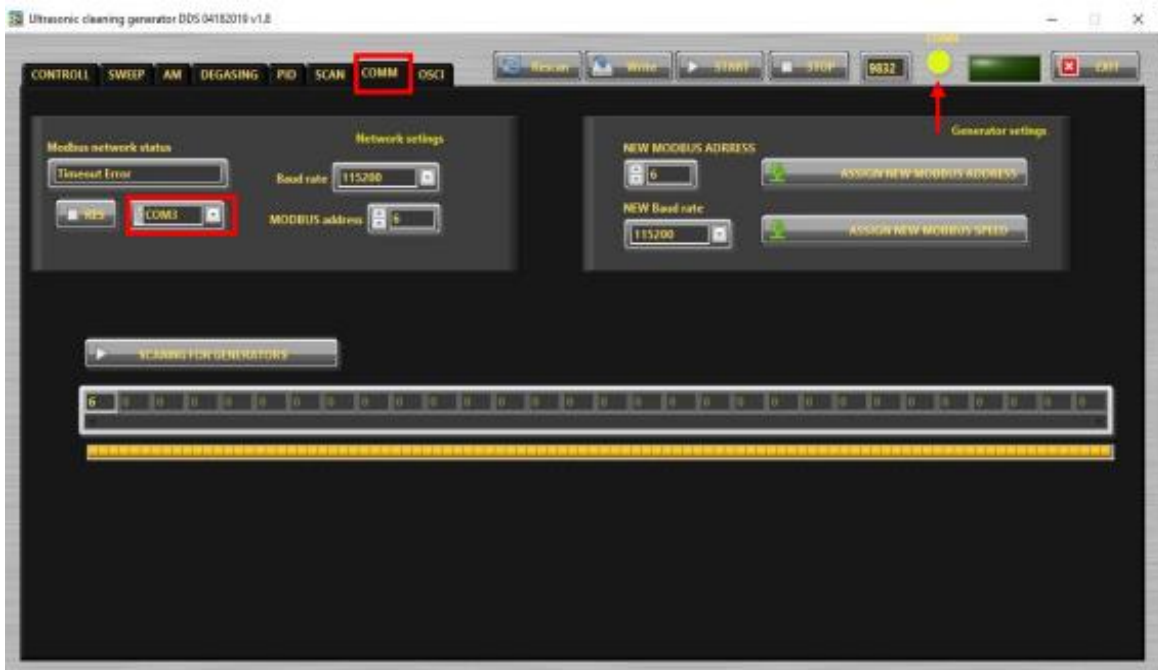
Note: This should be the download and installation sequence. Following a different one will cause installation issues.



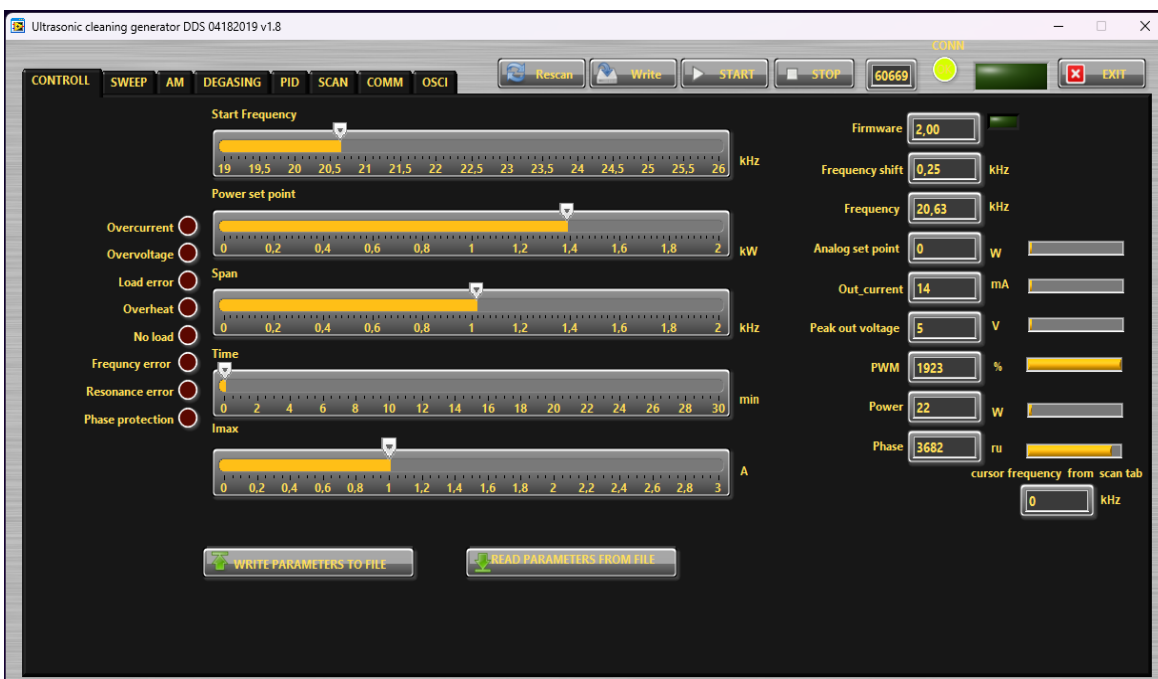
Procedure to Connect Generator to PC

1. COMM Tab

COMM (1) → Choose the correct COM, (2) → Red light will change to green (3)

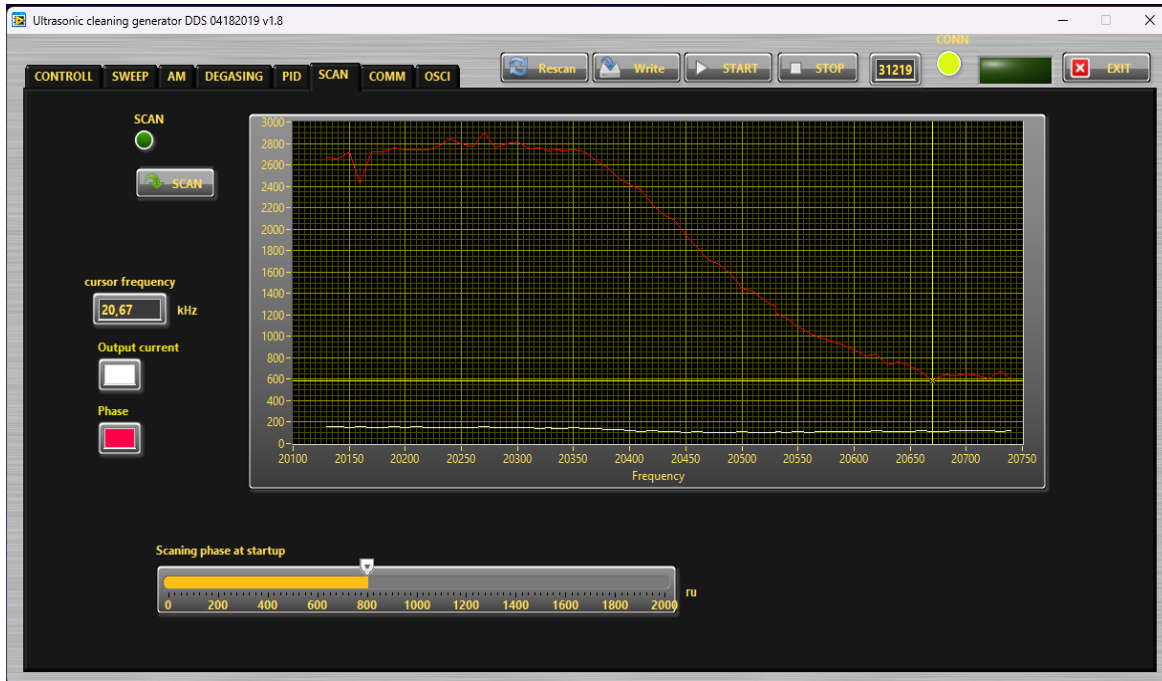


2. CONTROL Tab



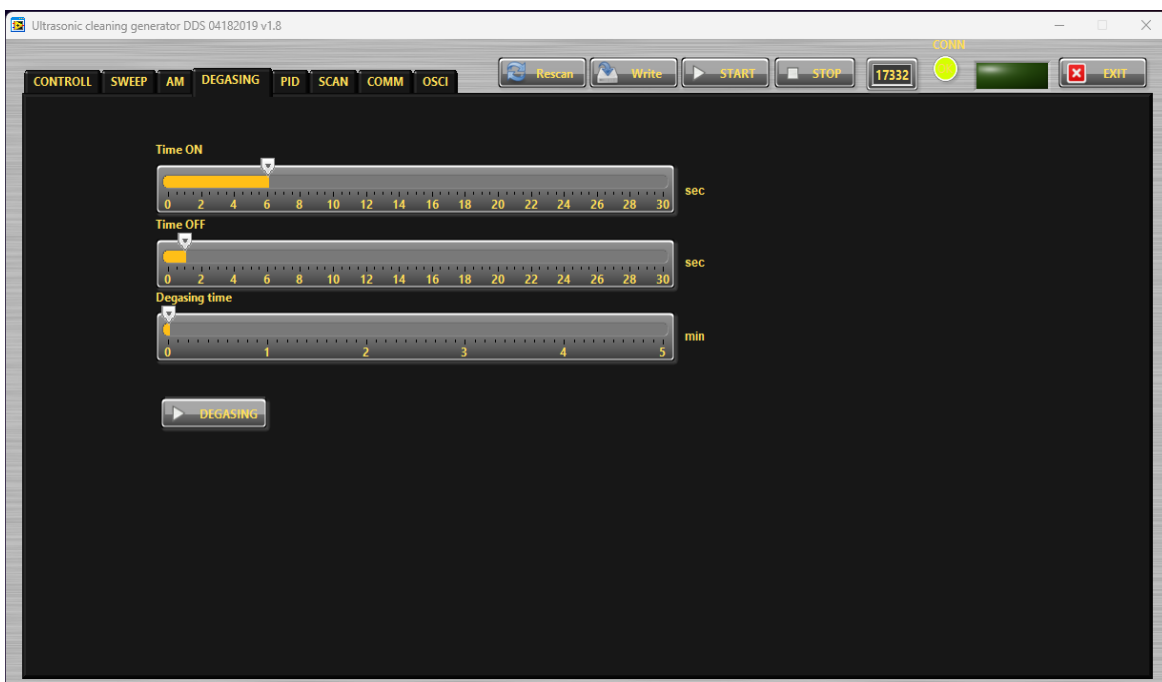


3. SCAN Tab



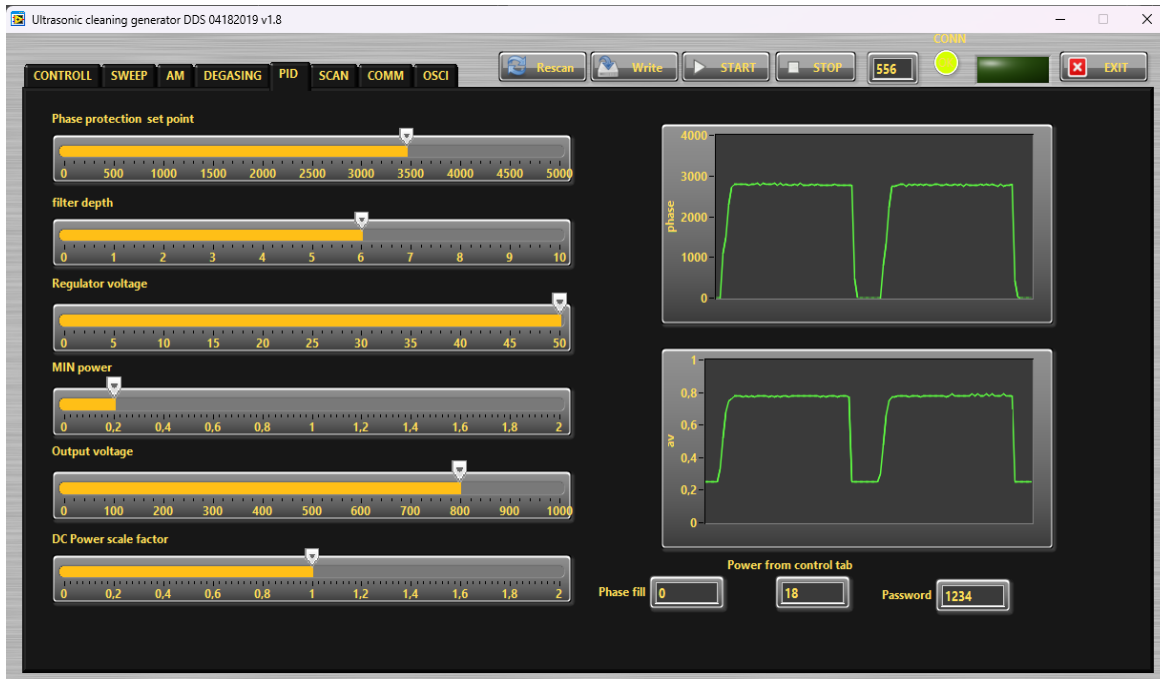
4. DEGASSING Tab

Find and activate the optimal Degassing regime when a cleaning liquid has a lot of dissolved gas (in cases of liquid processing). In other cases, this operating regime can be used to define pulse repetitive ultrasonic ON-OFF time-interval settings.

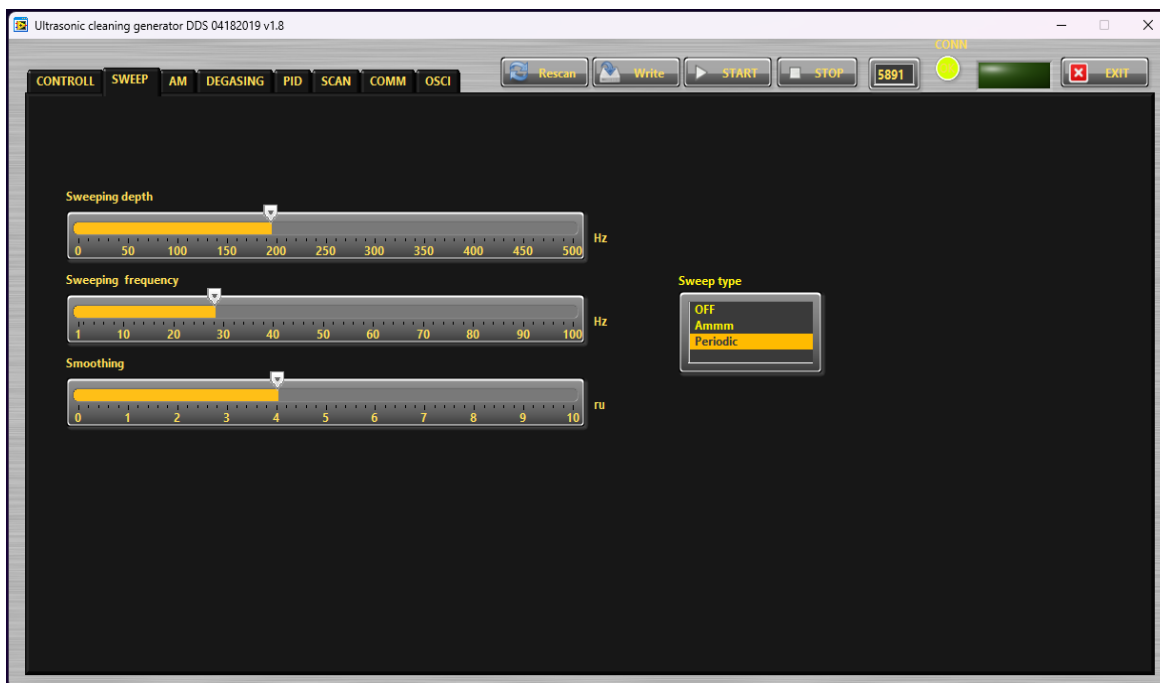




5. PID Tab



6. SWEEP Tab (Carrier frequency sweeping)



Sweeping depth – This is the deviation of the sweeping frequency around the central operation frequency in Hz.



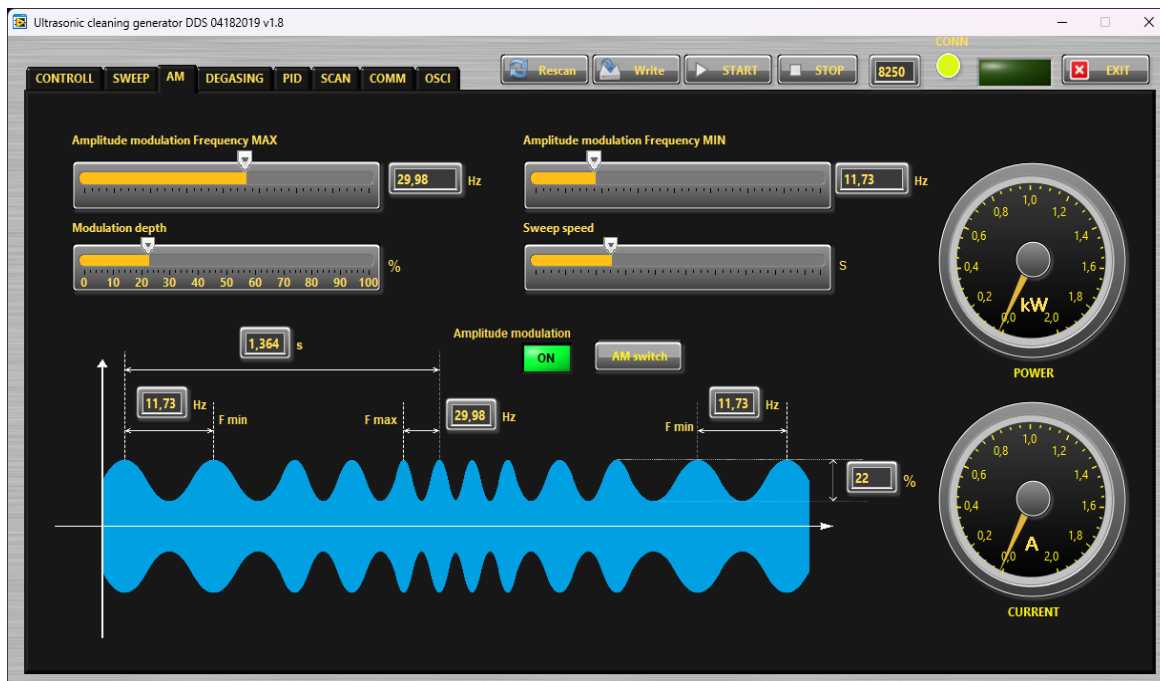
Sweeping frequency – Here you can set the desired sweeping frequency in Hz.

Smoothing – This changes the shape of the sweeping frequency from rectangular to like sinusoidal.

Sweeping Type – in three possible modes: OFF – no sweeping; AMMM – semi-random sweeping.

Periodic – periodic sweeping

7. AM Tab (Amplitude Modulation Tab)



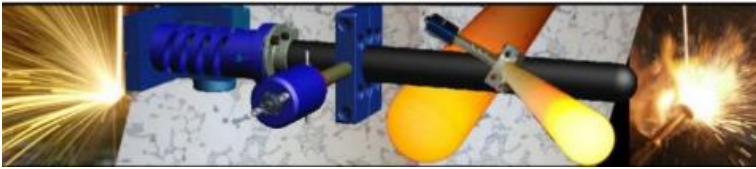
Amplitude modulation frequency MAX – the maximum value of the frequency of the amplitude modulation.

Modulation Depth – This the the depth of the amplitude modulation.

Amplitude modulation frequency MIN – This the maximum value of the frequency of the amplitude modulation.

Sweep speed – This the speed of changing from Amplitude modulation frequency MIN to Amplitude modulation frequency MAX.

Find and activate the optimal AM regime, when you need it.



8. OSCI (Tab)



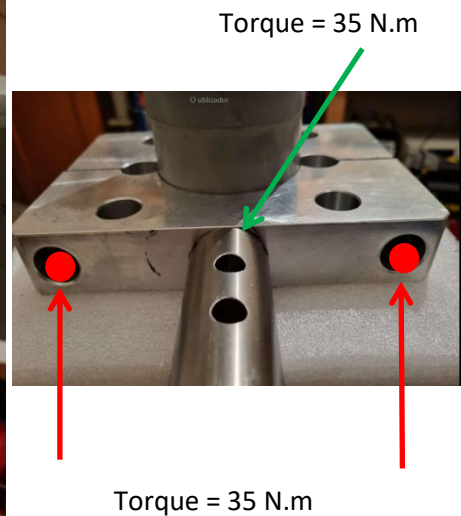


6. Assembly Sialon Tube

The "Mechanical" assembly includes: Transducer + Waveguide + Clamp + Teflon spacer for Clamps forced air cooling + Ceramic tube.

When working with the ceramic tube in molten aluminium alloy, tube must be preheated evenly and gradually (we recommend placing it to touch the surface of the liquid metal bath for 7 to 10 minutes, and then gradually immersing it into the bath to the desired depth; -not deeper than 10 cm). This operation is extremely critical and serious due to thermal shock. However, we assume you are familiar **with this type of situation (advance slowly with immersion in a liquid metal)**.

For assembly, please use a Torque Wrench to tighten: Transducer – to – Waveguide – to – Clamp.
Use a Torque of 35 N.m



Utilise the same tool and torque to tighten the M12 x 1.75 screws in the clamp. The gaps on both sides of the clamp must be identical to avoid creating asymmetry.

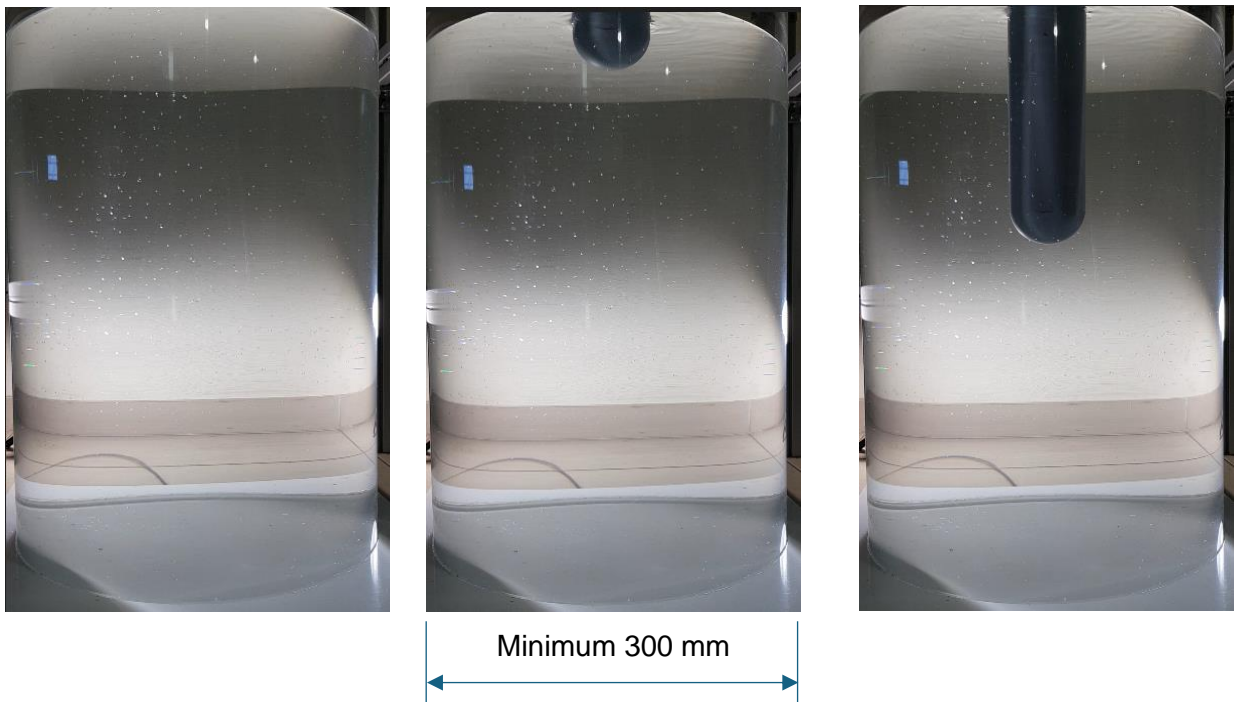
Please refer to the example here:

<https://www.youtube.com/watch?v=pbqv0pjeFks>



7. Water Test

Once everything is prepared, we must conduct a water test before transitioning to liquid aluminium. To do this, we need to organise functional testing of the MMM sonicator in water (within a transparent Plexiglas tube) to verify whether it is properly assembled and producing cavitation. You will need to use a Plexiglas tube (diameter between 300 and 500 mm, with bottom end closed).





8. Remote Control

We recommend that you install AnyDesk software as soon as possible, so that we can help you with your first trials and optimizations.

Afterwards, you must provide us with the “YOUR AnyDesk software Address” so that we can access your PC to work with the MPI generator software

