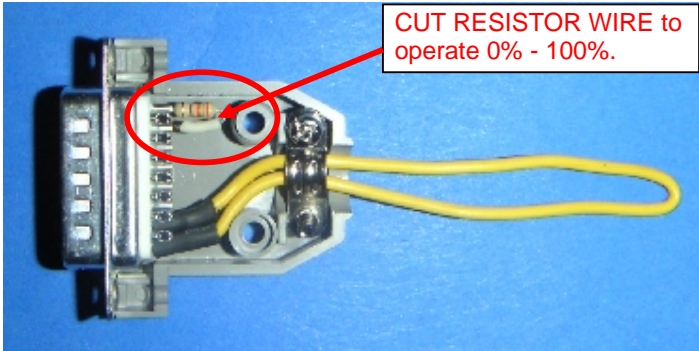


## MMM generators ***OF series*** Set-Up

- 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).
    - a. **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.
- 
- 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 to level 2 or 3.
  - 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.

The Power level is given in percentage units (%) from 0% to 100% of the installed load power. For example:

- If the total installed transducer power is only 120 W (3 transducers, each 40 W) and the generator is capable of producing a maximum of 300 W, by setting the generator power to 50% we will not get more than 60 W of ultrasonic power output (not 150 W).
- If we install a transducer group that is able to draw 300 W, and if we are using the generator that is capable of delivering 300 W, by setting the power to 50% we will produce approximately 150 W of ultrasonic power output.

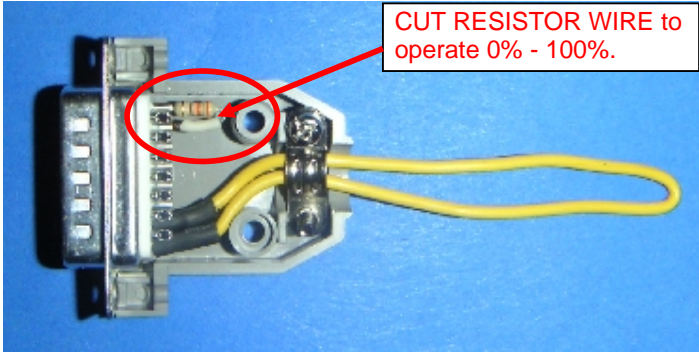
The described power control is only a rough load power estimation under optimal loading conditions. The load power is also dependent on liquid temperature, transducers temperature, liquid density and viscosity, etc. When we are talking about power levels and regulation, usually only water loading is taken into account.

In the process of degassing ultrasonic power will continuously grow until degassing is completed and will stay constant if the water temperature and water level is constant. Increasing water temperature to an optimum point will also increase cleaning effects. Temperatures above the optimum point will start to diminish the cleaning effects.

OF - Generator example settings for a small cleaning tank with 40 kHz transducers

- Frequency = 39.007 kHz
- Power: between 50% and 100% (100% Only if the tank is full with water)
- PWM period = minimum = 10 ms.
- PWM ratio = maximum = 100%
- Fast sweeping = 12
- Sweeping = 4
- Tracking range = 30

## 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).
    - a. 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.
- 
- 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.

The Power level is given in percentage units (%) from 0% to 100% of the installed load power. For example:

- If the total installed transducer power is only 120 W (3 transducers, each 40 W) and the generator is capable of producing a maximum of 300 W, by setting the generator power to 50% we will not get more than 60 W of ultrasonic power output (not 150 W).
- If we install a transducer group that is able to draw 300 W, and if we are using the generator that is capable of delivering 300 W, by setting the power to 50% we will produce approximately 150 W of ultrasonic power output.

The described power control is only a rough load power estimation under optimal loading conditions. The load power is also dependent on liquid temperature, transducers temperature, liquid density and viscosity, etc. When we are talking about power levels and regulation, usually only water loading is taken into account.

In the process of degassing ultrasonic power will continuously grow until degassing is completed and will stay constant if the water temperature and water level is constant. Increasing water temperature to an optimum point will also increase cleaning effects. Temperatures above the optimum point will start to diminish the cleaning effects.

OW - Generator example settings for a small cleaning tank with 40 kHz transducers

- Frequency = 38.555 kHz
- Ultrasonic power = 4095
- Power between 50% and 100% (100% Only if the tank is full with water)
- PWM period = minimum = 10 ms.
- PWM ratio = maximum = 100%
- Fast sweeping = 35 to 40
- Sweeping = 200 to 255
- Tracking range = 30