MASTERSONIC®

MSG.X00.IX
ULTRASONIC GENERATOR AND POWER SUPPLY

MMM, Wideband Multifrequency Technology

SYSTEM OPERATION MANUAL

April 2003

CONTENTS

DEAR CUSTOMER,

The **MASTERSONIC** program represents a brand new approach in **Sonic and Ultrasonic power supplies and equipment**.

The **MASTERSONIC power supply equipment** is based on **MMM** Technology, which produces high efficiency active power in wide-band sonic and ultrasonic vibrations.
Wide-band sonic and ultrasonic energy (ranging in frequency from infrasonic up to the MHz domain) propagates through arbitrary shaped solid structures, heavy and very-thick-walls metal containers, pressurized reservoirs, very thick metal walls of autoclaves, etc. in many different mechanical structures and in liquids, such as ultrasonic cleaning systems. The secret to its application is a novel sonic / ultrasonic, multifrequency power supply (**MMM Technology**) that can initiate ringing and relaxing, modulated, multimode mechanical oscillations including harmonics and sub-harmonics. The system offers fine control and excellent repeatability from its programmable interface and produces high efficiency active power ranging from below 100 W up to many kW.

Multifrequency, **M**ultimode, **M**odulated Sonic & Ultrasonic Vibrations (**MMM** Technology) can be excited in any heavy-duty conditions, 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. Such multifrequency ultrasonic structural excitation is ideal for agitating arbitrary shaped liquid and solid masses at arbitrary distances and placed in open or pressurized vessels, containers, autoclaves, reservoirs and pipes, at any temperature, while maintaining optimum efficiency of electrical to acoustic energy transfer.

The oscillations of here-described sonic and ultrasonic source are not random - rather they follow a consistent pulse-repetitive pattern, being in the same time frequency, phase and amplitude-modulated by the control system. This avoids the creation of stationary or standing waves (typically produced by traditional ultrasonic systems operating at a single frequency) that generate regions of high and low acoustic activity. **MMM** technology provides great freedom of control, regulation and programming over all vibration, frequency and power parameters.

Fields of possible applications related to **MMM** Technology are: Advanced Ultrasonic Cleaning, Material Processing, Sonochemistry, Liquid Metals and Plastics treatment, Casting, Molding, Injection, Ultrasonically assisted sintering, Liquids Atomization, Liquids Mixing and Homogenization, Materials Testing, Accelerated Aging and Stress Release, Plastic and Metals Welding, etc.

In traditional ultrasonics technology, transducers have been designed to satisfy precise resonant conditions: In order to achieve maximal efficiency, all oscillating elements should operate on the same frequency. **MMM** technology can drive with high efficiency any complex mechanical system up to a mass of several tonnes, consisting of arbitrary resonating elements. **MMM** technology, instead of optimizing transducers to accept certain resonant frequency operation, optimizes the complex electrical driving (or signal shape) to be applicable to any specific oscillating structure, in a wide-band frequency domain, allowing mechanical designers to optimize their mechanical structures without limits.

1. INTRODUCTION

1.1. Features:

All MSG modular ultrasonic generators (MSG XXX.IX) utilize the MMM Technology and are constructed with a separate housing for an indipenedent power supply of acoustic loads. Presently available modules are made for driving the following piezoelectric loads:

- MSG 1200.IX for driving 1200W piezoelectric load

Fig. 1.1. MSG.X00.IX Generator Module and Accessories

The MSG X00.IX system with optional accessories is shown on fig. 1.1. It consists of:

- Generator unit
- Optional Remote Control Panel for parameterization.
- Optional adapter for direct PC or PLC control

1. INTRODUCTION

1.2. Technical Characteristics of MSG X00.IX:

Technical Characteristics	MSG 1200.IX
Main Supply Voltage	220/230 V; 50/60 Hz
Max. Input Power	1300 W
Non-modulated, carrier frequency range	19.020kHz ÷ 46.728 kHz
Modulated acoustic frequency range	Wideband, from Hz to MHz
Average Continuous Output Power	1200 W
Peak Output (max. pulsed power)	6000 W
Output HF Voltage	~ 500 V-rms
Dimensions (h x w x d)	250mm x 150mm x 450mm
Weight	10kg

1.3. System safety:

Read this manual thoroughly and follow all directions and instructions to assure maximum safety during operation.

- Installation of the MasterSonic (generator/power supply) and associated transducers, the “MasterSonic System”, is to be performed by qualified technical personnel only.
- The MasterSonic System is an electro-mechanical device that under certain circumstances could present an electrical shock hazard to the operator.
- The MasterSonic System should only be used and operated by properly trained and qualified technicians.
- Qualified technicians licensed by the manufacturer should only perform servicing of the MasterSonic System.
- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous exposure to ultrasonic energy.
- To avoid electric shock, do not remove the case covers from the MasterSonic System. There are no user-serviceable parts inside any of these devices.
- Connecting the Generator unit to mains that supplies improper voltage may cause the Generator to malfunction or create a shock or fire hazard.
- Plugging the Generator into a socket that supplies improper voltage may cause the Generator to malfunction or create a shock of fire hazard.
- Proper system grounding cannot be insured unless unit is connected to properly wired three prong 220 - 230 VAC single-phase outlet with a sufficient current rating.
- Do not remove the grounding prong on the line cord plug.

1. INTRODUCTION

- The Generator Electrical Supply cord should not be plugged into a device (e.g. “power strips”, “gang plugs”, etc.) other than an industrial grade wall socket. Such other use could cause significant changes in voltage that could result in an electrical fault indication. This condition may occur even though other equipment plugged into multi-outlet sockets continues to operate.

- Do not restrict airflow to the MasterSonic System by covering or enclosing in a sealed housing while in operation. Airflow must circulate through the unit during operation to facilitate proper cooling of electronic components.

- Do not place Generator on towel, foam or other soft surface since the material may block air vents. Blocking vents may cause Generator to overheat and malfunction or create a shock hazard.

- Do not expose or immerse the MasterSonic System or the transducer (if not immersible) in water or liquids. The system is not sealed against liquids and exposure may result in damage to the equipment, create a shock hazard, or fire hazard.

- Due to the general operating principles of the MasterSonic System and ultrasonics, this equipment is not suitable for use in environments where danger of explosion exists.

- The Generator should not be turned on until the Transducer Cable has been connected to both the Generator and Transducer. Otherwise, damage to the Generator may result.

- When ultrasound output power is on, do not touch the transducer, booster, sonotrode, waveguide, or any device directly connected to these components; doing so may result in injury.

- Ear protection during operation of the system is highly recommended. Do not position the transducer, booster, sonotrode, waveguide, or any device directly connected to these components near the technician or operators ears. The operating frequency of the MasterSonic System is below, within, and above the range of human hearing, and emits acoustic energy. Do not activate the system if system components are within 4 feet (122 cm) of the ears of technician or operators.

- If one of the MasterSonic fault indicators illuminates, promptly suspend operation. Turn the ultrasonic power switch (Square Red Button on front panel of Generator) to the off position. Verify all components are securely connected and adjust system parameters to accommodate the load before resuming operation.

1. INTRODUCTION

CAUTION: Do not place Generator on towel, foam or other soft surface that may block generator air vents. Blocking any vents may cause the Generator to overheat, malfunction, or create a shock hazard.

CAUTION: Plugging the Generator unit into a socket which supplies improper voltage may cause the Generator to malfunction or create a shock or fire hazard.

CAUTION: The Generator should not be turned on until the Transducer Cable has been connected to both the Generator and Transducer. Otherwise, damage to the Generator may result.

CAUTION: The Generator Electrical Supply cord should not be plugged into a device (e.g. “power strips”, “gang plugs”, etc.) other than an industrial grade wall socket. Such other use could cause significant changes in voltage that could result in an electrical fault indication. This condition may occur even though other equipment plugged into multi-outlet sockets continues to operate.

2. SYSTEM SET-UP

2.1. Mains Power Connection:

Verify that the Mains Power Switch on the front panel of the Generator is in the “OFF” position. Plug the female end of the supplied line cord into the Mains Power Supply Connector in the rear of the Generator. Plug the other end of line cord into a properly grounded three prong 220 VAC (single phase) socket receptacle. MasterSonic systems with output power up to 1200 Watts require a mains power circuit with a fuse rating of at least 10 Amps.

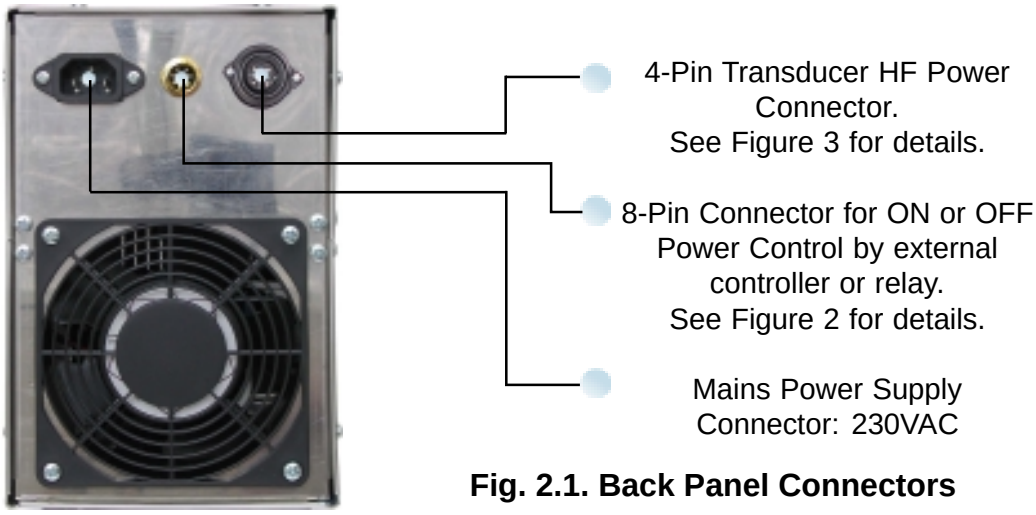


Fig. 2.1. Back Panel Connectors

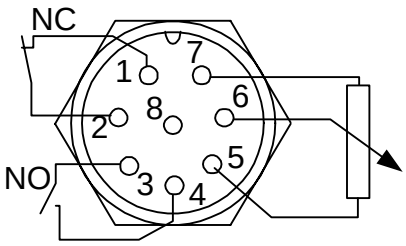
2.2. External On/Off Power Control:

The 8-Pin connector in the center position of the back panel may be wired for external On/Off Generator Power Control by remote controller or relay.

2.2.1. If external control is not desired Pins 1 and 2 must be connected to operate the generator with the front panel On/Off buttons. This is the MasterSonic Generator factory default setting. No action is necessary for normal operation of the system

2.2.2. For external control Pins 3 and 4 should be wired to a controller or relay that will control opening (Power OFF) and closing (Power ON) contact of these two pins.

Fig. 2.2 Connector for external ON/OFF Power Control



2.3. Transducer Power Connection:

The 4-Pin connector in the right position of the back panel is used to supply ultrasonic power to the piezoelectric system transducer.

CAUTION: The MasterSonic System should only be operated with the supplied transducer and cable.

2.3.1. Thread the supplied ultrasonic power cable into the transducer connector by hand until snug.

2.3.2. Thread by hand until snug the other end of the ultrasonic power cable onto the MasterSonic 4-Pin power connector located on the back panel.

2. SYSTEM SET-UP

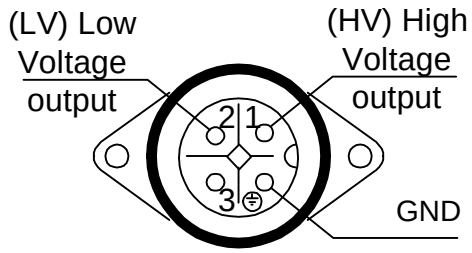
2.4. Acoustic Load Connection.

The acoustic load can be connected with two-wire or three-wire cable. For improved safety the manufacturer strongly recommends connecting the acoustic load using the three wire connection method.

As show in figure 2.1. above the 4-Pin transducer connector in the higher right side of the MSG.X00.IX terminals 1-HV (High Voltage) and 2-LV (Low Voltage) are used to supply ultrasonic power to the Acoustic Load (piezoelectric transducer).

- Terminal 1-HV is the high voltage ultrasonic signal output from the power transformer of the generator and should be connected to the Isolated Terminal of the transducer.
- Terminal 2-LV should be connected to the inductive compensation of the transducer and to the acoustic system grounding (transducer housing or acoustic load mass).
- Terminal 2-LV should be short-circuited to pin 4 of the connector.

Fig. 2.4. Acoustic Load connector



CAUTION: The MasterSonic System should only be operated with manufacture approved transducers and cable.

ATTENTION! Do not connect the High Voltage (pin. 1) to grounding. This will damage the System.

2 Wire Connections:

If the acoustic load can only be connected with a two-wire cable, identify the wire that is connected to the acoustic load's ground (Low Voltage - LV) and the one connected to the isolated terminal (High Voltage - HV). Connect the wire that is connected to the acoustic load's ground/mass/housing to pin 2-LV and the isolated terminal wire to pin 1-HV. Connect terminal 1-LV and terminal 4-EARTH together. This will ground the acoustic load internally.

Note: The manufacturer does not recommend this connection method and it should only be used if a three wire connection is not possible. Two wire connections should only be made by a qualified electrical technician.

3 Wire Connections: (PREFERRED METHOD)

The preferred method for connecting MasterSonic generator power supplies to acoustic loads is with a three-wire cable, as shown on the following schematic.

2. SYSTEM SET-UP

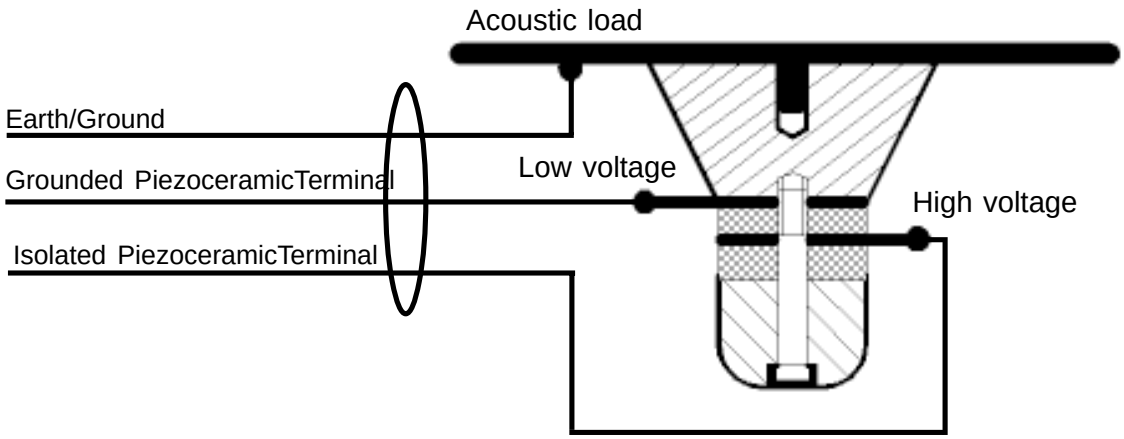


Fig. 2.4.1. Preferred 3-wire Acoustic Load connection.

- Isolated Terminal (terminals between ceramic disks or rings without contact to front or back mass of the converter) – This wire (normally Red / White / Black depending on supply source) is the HV (High Voltage) terminal of the ultrasonic transducer.
- Ground Terminal (terminals in contact with the front or back mass of the converter) – This wire (normally Green or Blue depending on supply source) is the LV (Low Voltage) terminal of the ultrasonic transducer.
- Earth/Ground/Mass (normally Yellow / Green / Blue) – This wire is connected to the metal part of the Acoustic Load.

Connect the acoustic load to the MSG.X00.IX as follows:

- Connect the Isolated Terminal (normally Red Black or White) wire to pin 1 of the connector - HV.
- Connect the Ground Terminal (normally Green, Blue or Yellow) wire to pin 2 of the connector - LV.
- Connect the Earth/Ground/Mass (normally Yellow/Green/Blue) wire to pin 4 of the connector - EARTH.

CAUTION: Be careful when handling the acoustic load transducers or cable. The acoustic load may be charged with electro-static high voltage that may produce an electrical shock to the installer if not handled properly. Before installation or before connecting the acoustic load to the Mastersonic generator carefully touch the High Voltage Black wire to the Low Voltage Blue wire to short circuit and discharge electro-static build-up.

CAUTION: Do not place Generator on towel, foam or other soft surface that may block generator air vents. Blocking any vents may cause the Generator to overheat, malfunction, or create a shock hazard.

CAUTION: Connecting the Generator unit to mains which supplies improper voltage may cause the Generator to malfunction or create a shock or fire hazard.

CAUTION: The Generator should not be turned on until the Transducer Cable has been connected to both the Generator and Transducer. Otherwise, damage to the Generator may result.

CAUTION: The Generator Electrical Supply cord should not be plugged into a device (e.g. “power strips”, “gang plugs”, etc.) other than an industrial grade wall socket. Such other use could cause significant changes in voltage that could result in an electrical fault indication. This condition may occur even though other equipment plugged into multi-outlet sockets continues to operate.

2. SYSTEM SET-UP

2.5. Waveguide and Accessories Mounting:

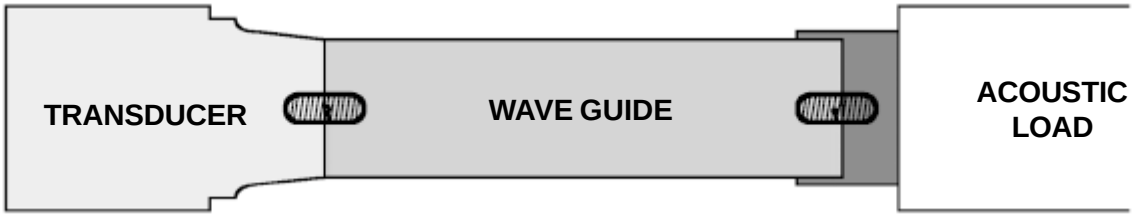


Figure 2.5. System Assembly

CAUTION: Ensure all connections and mating surfaces are clean and dry before assembly.

Use the supplied studs to interconnect the mechanical components. All components should be threaded by hand until snug, DO NOT force the threads, they must turn in smoothly all the way until the mating faces touch. Use two open end pin (spanner) wrenches and make final tightening.

As depicted in Figure 2.5. the Wave Guide or Booster should be connected to the transducer tip. Acoustic loads (probes, sonotrodes, etc.) are connected to the opposite end of the waveguide or Booster.

2.6. Flexible Transducer Option

The MSG.X00.IX systems offer a new and unique controllable inductive compensation option that enables driving of a large range of ultrasonic mechanical systems with any number of ultrasonic transducers. Acoustic load electrical parameters are the following:

- Average Operating frequency: 20kHz ÷ 40 kHz.
- Static capacity of the complex ultrasonic transducer: 3nF ÷ 30nF.

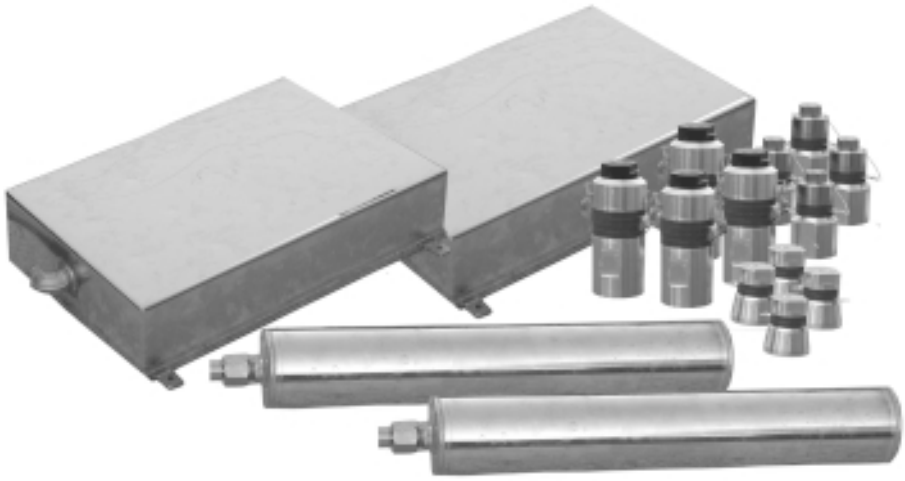


Fig. 2.6. Mastersonic Transducers

2. SYSTEM SET-UP

2.7. Inductive compensation.

Note: If your MasterSonic system was purchased completed with the acoustic load all settings below are factory made.

THE ULTRASONIC MODULAR GENERATORS MSG X00.IX ARE DESIGNED TO SUPPLY POWER LOADS UP TO 1200W IN THE FREQUENCY RANGE OF 18KHZ ÷ 45KHZ.

Reduce the generator power to 50% or less when adjusting the inductivity and operating frequency first time, in order to avoid any over-load situation.

THE RESONANT FREQUENCY IS SELECTED DURING PARAMETER SETTING WITH THE REMOTE CONTROL PANEL (CHAPTER 5.) THE INDUCTIVITY SHOULD THEN BE SET WITH A HEXAGON WRENCH KEY INSERTED INTO THE TOP OF THE MSG XXX.IX WHERE IT IS LABLED (L). INDUCTIVITY IS CHANGED AS THE FERRITE CORE IS OPENED OR CLOSED (core opening decreases the inductivity and vice versa).

THE INDUCTIVE COMPENSATION DEPENDS ON THE SYSTEM CENTER FREQUENCY, THE STATIC (shunt) CAPACITY OF TRANSDUCERS AND THEIR OPERATING MODE.

The inductivity of compensating coil can be measured by an inductivity meter, placed between the LV terminal and a control feather to its right, as shown in Figure 2.7. below (when the generator is not connected to a main power supply: fully OFF). If we know the desired central operating frequency of the transducer and its static capacitance, compensating inductance can be calculated and set in advance.

Fig. 2.7. Compensating Inductivity measuring

2. SYSTEM SET-UP

2.8. Factory Settings and Initial Generator Start Up.

The MasterSonic MSG.X00.IX generator includes an optional external power on safety circuit control that may be implemented through relay control of pins 1 and 2 of the 8-pin connector. These pins may be connected to a temperature control circuit, door panel switches, operator proximity safety switches, etc. To operate the generator module these pins must be normally closed. An open circuit will stop all generator operations. If the installation does not require such external control these pins 1 and 2 should be short circuited with a hard wire connection.

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

The initial settings of MSG.X00.IX are made by the manufacturer in order to ensure maximum safety at start up and testing of the generator. The power is low and the frequency is equal to the resonant frequency of the acoustic load. If the MasterSonic system is completed by the manufacturer, generator's settings are adjusted to the transducer and prepared for initial start up. If the generator is purchased separately its initial settings are compatible to the acoustic load, described in the purchaser's order.

2.8.1. Simplified methods for adjustment of MSG.X00.IX

Using the **Remote Control Panel** set the generatot parameters as follows: (see section 5 below for Remote Control Panel connection and operation instructions)

- **1**. Set the **"FREQUENCY"** equal to the nominal frequency of the ultrasonic transducer (equal to central operating frequency of the generator).
- **2**. Set **"FAST SWEEPING"** to 32 (Dynamic MMM Sweeping).
- **3**. Set **"SWEEPING"** to 2 (forced sweeping range).
- **4**. Set **"POWER"** to 40%.
- **5**. Set **"PWM PERIOD"** to 0.010s.
- **6**. Set **"PWM RATIO"** to 100%
- **7**. Set **"TRACKING RANGE"** to 30.
- **8.** Calculate compensating inductance:

Compensating Inductivity Setting Sequence:

- **1.** The **"COMPENSATING INDUCTIVITY"** initial value is determined by the following formula:

$$L = 1.05 \left(\frac{1}{4\pi^2 f^2 . C} - Ls \right)$$

where:

L - inductivity of compensating coil in , H;

f - central operating frequency in Hz;

C - static (1 kHz) capacitance of ultrasonic transducer in , F;

Ls - Leakage Inductivity of the output transformer: approx. 300. 10^{-6} H

2. SYSTEM SET-UP

- **9**.After the generator is started the output voltage and current should be checked. The load HF current should vary in the range between 1.1 and 1.5 A-rms approximately.
- **10**. The compensating inductivity should be readjusted using the Hex Key until the “TRACKING” starts fluctuating around zero.
- **11**. When tracking is near zero the system should be ready for operation.

ATTENTION!

PLEASE, READ CAREFULLY THE WHOLE MANUAL BEFORE ADJUSTING THE MSG.X00.IX GENERATOR.

OBSERVE THE FOLLOWING REQUIREMENTS DURING PARAMETER SETTING:

Table of Critical Settings	
“PWM-ratio” = 100% No limits regarding all other parameters.	“PWM-ratio” < 100% The following limits (below) should be respected. Reduce the load power to less than 50%
“Tracking” = 0÷30	“Tracking” = 0÷5
“Sweeping” = 0÷7	“Sweeping”< = 0÷4
“Fast Sweeping” = 0÷255	“Fast Sweeping” = 0÷40

For “PWM-ratio” < 100% The following limits (below) should be respected.
Reduce the load power to less than 50%

“PWM-ratio” = 100%
No limits regarding all other parameters.

3. FRONT PANEL OPERATION

3.1. Mains Power Switch:

The green colored Mains power switch controls all electrical power to the system.

3.2. Ultrasonic Power Control Buttons:

3.2.1. Ultrasonics Power ON (green button)

3.2.2. Ultrasonics Power OFF (red button)

3.2.3. Ultrasonics Power Level UP (grey up arrow button). Press to increase power level.

3.2.4. Ultrasonics Power Level Down (grey down arrow button). Press to decrease power level.

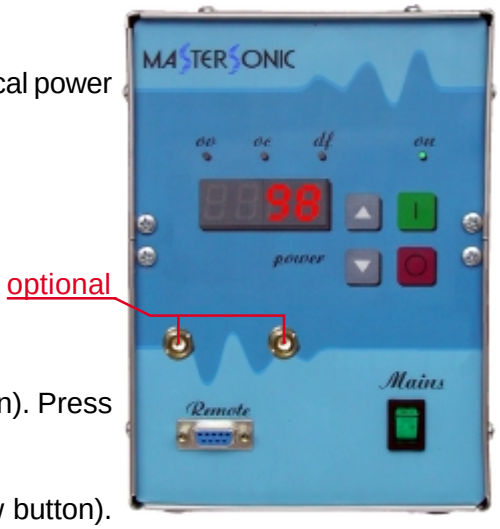


Fig 3. Front Panel

3.3. Ultrasonic Power Level Display:

The red LED display indicates the ultrasonic generator power level as a percentage of its nominal (maximum) power.

3.4. Indicator lights:

3.4.1. *ON* - Ultrasonic Power On/Off indicator: This green light is illuminated (on) when the generator is turned ON and producing ultrasonic power output to the transducer. When the generator output power is turned OFF this light is not illuminated.

3.4.2. OVERLOAD PROTECTION (*OV, OC, DF*): The following three sections describe MasterSonic's built in protection circuits. When any one of these red lights is illuminated (On) the generator is experiencing an internal problem or detecting a problem with the mechanical ultrasonic components and will automatically stop ultrasonic power generation. If the ultrasonic power is not automatically stopped the operator should STOP the ultrasonic operation immediately by pressing the Red Button on the front panel and follow these instructions:

- In production or repetitive test environment: Verify all parameters (Frequency, Power, Sweep Range, PWM period, and PWM ratio) are set to previously established ranges and resume operation. (See Sections 5 and 6 of this manual)

- For Laboratory experiments where operating conditions and parameter boundaries are being tested, reset one or more parameter and resume operation. (See Sections 5 and 6 of this manual)

- Check for loose or broken studs linking the mechanical components.

3. FRONT PANEL OPERATION

- Check the coupling surfaces between transducer, booster, horn, sonotrode, waveguide, and attached mechanical systems.

- Check for cracked booster, horn, sonotrode, waveguide, and attached mechanical systems.

3.4.3. OV - Over Voltage indicator:

- The OV Light is Normally not illuminated (OFF) during good operating conditions.

- lluminated Red Light (ON) indicates the auto- protection for Over Voltage is activated. This built-in safeguard protects the MasterSonic system from over voltage conditions resulting from extreme production environments or in laboratory testing where experiments test the operational boundaries and effects of MastersSonic's flexible operational parameters.

> **CAUTION:** If OV light is ON and power is not automatically stopped the operator must immediately STOP ultrasonic operation by pressing the Red Button on the front panel and follow instructions in section 3.4.2 above.

3.4.4. OC - Over Current indicator:

- The OC Light is Normally not illuminated (OFF) during good operating conditions.

- Illuminated Red Light (ON) indicates the auto- protection for Over Current is activated. This built-in safeguard protects the MasterSonic system from over current conditions resulting from extreme production environments or in laboratory testing where experiments test the operational boundaries and effects of MastersSonic's flexible operational parameters.

> **CAUTION:** If OC light is ON and power was not automatically stopped the operator must immediately STOP ultrasonic operation by pressing the Red Button on the front panel and follow instructions in section 3.4.2 above.

3.4.5. DF - Driver fault indicator: failure of voltage supplying drivers.

- The DF Light is Normally not illuminated (OFF) during good operating conditions.

- Illuminated Red Light (ON) indicates a system Driver Fault (failure of the system to supply voltage to the drivers).

> **CAUTION:** If DF light is ON and power was not automatically stopped the operator must immediately STOP ultrasonic operation by pressing the Red Button on the front panel and follow instructions in section 3.4.2 above.

3. FRONT PANEL OPERATION

3.5. Interface Connector Port for Remote Control:

3.5.1. This standard RS232C serial port provides an interface for connection of the generator to a MasterSonic Remote Control Panel, by using a special interface adaptor box option this port may also be connected to a Personal Computer (PC) serial port, or a custom controller serial port.

3.5.2. The transfer protocol is semi-duplex and data transfer (reading/writing) is controlled by RTS signaling.

3.5.3. Only one external device may be connected to this port.

- See section 5 for the MasterSonic Remote Control Panel connection and operation.
- See section 6 for PC or Custom Controller connection and operation.

3.5.4. Pin-Out Details for Interface Connector Port

3.6. BNC Signal Analysis Ports (optional):

3.6.1. The MasterSonic MSG.X00.IX generator has a special configuration of two BNC connectors on the front panel enabling output system analysis through the signals extracted from the ultrasonic generator.

4. ADVANCED SETTINGS

4.1. Control Block

The Control Block of the generator is built on a separate PCB that also holds the control terminals and sweeping function control jumpers.

The generator's control is designed using several microprocessors and a Field programmable logic. These provide the intelligence necessary for the generation of sonic and ultrasonic frequencies, according to the assignment and the selection of feedbacks.

Through selection of various signal generation/control and feedback options to the system you can achieve extraordinary control of the acoustic system connected to the MSG.X00.IX generator.

Sweep Range and Jumper 2 (shown on fig. 4.2.) allow you to choose between two modulation techniques applied to of the acoustic load's resonant frequency. By switching one or both types of modulation (called "Sweep Range"= Forced Sweeping Mode and "Dynamic MMM Mode") you can obtain both traditional modulation and new dynamic signal modulation applied to the acoustic load.

Placing the two jumper blocks to the OFF position turns your MSG.XXX.IX generator into a conventional generator, operating on resonant frequency of the acoustic load. All other combinations are defined below.

4.2. Control Board Jumpers

Fig. 4.2. shows the position of Jumpers J1, J2 and J3 on the control PCB.

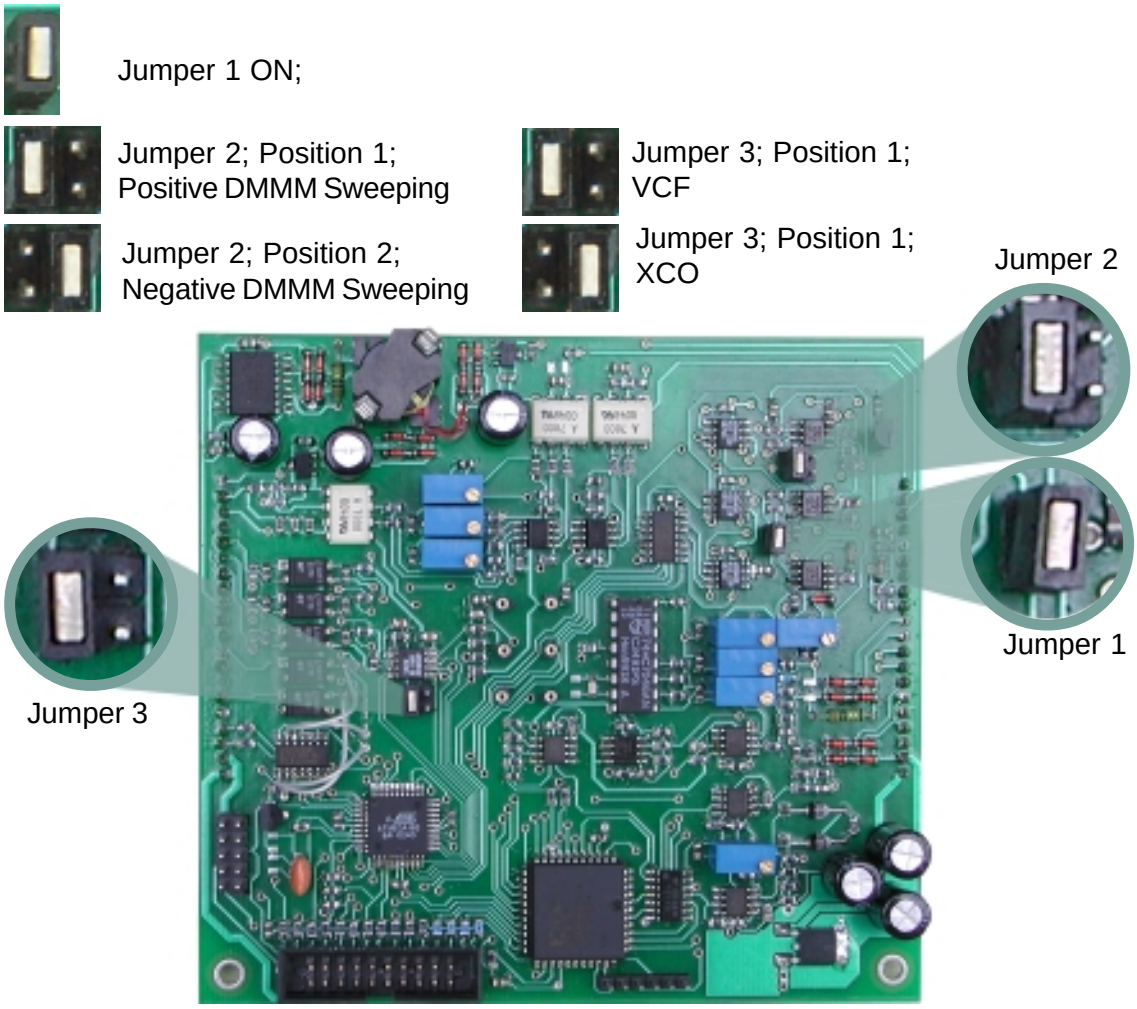


Fig 4.2. Controll Board Jumpers

4. ADVANCED SETTINGS

The selection of Forced Sweeping – modulation called “Sweep Range” – generates forced MMM ultrasonic oscillations in the acoustic load. The algorithm implemented in the micro-processor, using the feedback from the Acoustic Load, calculates specifically modulated frequency output, which generates stable and forced MMM oscillations into the acoustic load.

The Dynamic MMM (DMMM) Sweeping modulation block will normally provide excellent results, because this is designed to excite an Acoustic Load of any size and shape in many of its resonant modes, at the same time. The optimally selected feedback from the acoustic load (specifically transformed with MMM signal processing block) will initiate real time Dynamic change of MMM oscillations by tracking the time-evolving load properties in a wide-band and multifrequency regime of oscillations. This will generate completely homogenous 3-Dimensional (3D) ultrasonic activity in an ultrasonic cleaner.

The optimal selection of feedback-parameters is very important for generation of homogenously distributed 3D ultrasonic activity field. The acoustic load's feedback-phase (positive and negative leading edge of DMMM) will significantly effect the dynamic mode and is therefore also very important for the proper operation of DMMM Sweeping.

Consequently, the optimal method for obtaining homogenous 3D ultrasonic activity in mechanically different acoustic loads is the heuristic method where the systems integrator will determine the best settings by testing and discovering results themselves.

Fig.4.2. and Table 4.2. show the position of J1 and J2 and the adjustment of different operating modes of MSG.X00.IX ultrasonic generator.

Table 4.2.

T.1	Sweep Range	J 2		Resulting Operating Regimes
		J 2 - 1	J 2 - 2	
1	= 0	on	off	Forced Sweeping = OFF DMMM Sweeping = ON Activates Positive Leading Edge of the DMMM-Sweeping
2	= 0	off	on	Forced Sweeping = OFF DMMM Sweeping = ON Activates Negative Leading Edge of the DMMM-Sweeping
3	1Hz÷1kHz	on	off	Forced Sweeping = ON Activates Positive Leading Edge of the DMMM-Sweeping with Math Sweeping
4	1Hz÷1kHz	off	on	Forced Sweeping = ON DMMM Sweeping = ON Activates Negative Leading Edge of the DMMM-Sweeping with Math Sweeping
5	1Hz÷1kHz	off	off	Forced Sweeping = ON DMMM Sweeping = OFF Only Math Sweeping is activated.
6	= 0	off	off	Forced Sweeping = OFF DMMM Sweeping = OFF The generator operates on Constant frequency.
NOTE: J3 is factory selected (not to be changed by end user).				

4. ADVANCED SETTINGS

4.3. Sweeping Adjustment

The MSGXXX.IX are designed for complex purposes and complex loads.

It is not recommended that MSGXX.IX are used in constant resonant frequency operating, such as plastic-welding applications. For that purpose the manufacturer offers the MSGXXX.OW ultrasonic generator type that is especially designed for operating plastic welding and similar type transducers.

The MSGX00.IX is designed to operate in DMMM Frequency regimes, as well as in Constant Frequency regimes. The table below describes all operating modes:

TERMINOLOGY:

DMMM Gain:
Load feedback signal amplification factor. Given in relative units from 0 to 255.

DMMM Q Factor:
Load feedback signal, filtering Quality factor. Given in relative units from 0 to 255.

- Q (=) Low (=) high signal attenuation and wider frequency bandwidth.
- Q (=) High (=) low signal attenuation and narrow frequency bandwidth.

DMMM F Correction:
Low cutting filtering frequency of the High-Pass feedback signal. Given in relative units from 0 to 255.

- DMMM F correction (=) Low (=) Cutting Frequency (=) Low (min 0 Hz)
- DMMM F correction (=) High (=) Cutting Frequency (=) High (max 1 kHz)

Table 4.3.

T.1 options	Sweep Range	J 2		Resulting Operating Regimes
		J 2 - 1	J 2 - 2	
1	= 0	on	off	Math-Sweeping = OFF DMMM-Sweeping = ON Activates Positive Leading Edge of the DMMM-Sweeping; Significant Handy keyboard settings are: “Sweep Range” = 0 “DMMM Gain” = 30÷80 (the best is 65) “DMMM Q Factor” = 20÷50 (the best is 30) “DMMM F Correction” = 70÷150 (the best is 100)
2	= 0	off	on	Math-Sweeping = OFF DMMM-Sweeping = OFF Activates Negative Leading Edge of the DMMM-Sweeping;Significant Handy keyboard settings are: “Sweep Range” = 0 “DMMM Gain” = 30÷80 (the best is 65) “DMMM Q Factor” = 20÷50 (the best is 30) “DMMM F Correction” = 70÷150 (the best is 10)

4. ADVANCED SETTINGS

Table 4.3.

T.1	Sweep Range	J 2		Resulting Operating Regimes
		J 2 - 1	J 2 - 2	
3	1Hz÷1kHz	on	off	Math-Sweeping = ON Activates Positive Leading Edge of the DMMM-Sweeping with Math Sweeping; Settings: “Sweep Range” = 0,001÷1kHz (the best is 0,6kHz) “DMMM Gain” = 30÷80 (the best is 65) “DMMM Q Factor” = 20÷50 (the best is 30) “DMMM F Correction” = 70÷150 (the best is 10)
4	1Hz÷1kHz	off	on	Math-Sweeping = ON DMMM-Sweeping = ON Activates Negative Leading Edge of the DMMM-Sweeping with Math Sweeping; Settings: “Sweep Range” = 0,001÷1kHz (the best is 0,6kHz) “DMMM Gain” = 30÷80 (the best is 65) “DMMM Q Factor” = 20÷50 (the best is 30) “DMMM F Correction” = 70÷150 (the best is 10)
5	1Hz÷1kHz	off	off	Math-Sweeping = ON DMMM-Sweeping = OFF Only Math Sweeping is activated; Significant Handy keyboard settings are: “Sweep Range” = 0,001÷1kHz “DMMM Gain” = 0 “DMMM Q Factor” = 0 “DMMM F Correction” = 255
6	= 0	off	off	Math-Sweeping = OFF DMMM-Sweeping = OFF Constant frequency operation = ON Significant Handy keyboard settings are: “Sweep Range” = 0 “DMMM Gain” = 0 “DMMM Q Factor” = 0 “DMMM F Correction” = 255

4. ADVANCED SETTINGS

Activating Only Dynamic MMM- Sweeping (without Math Sweeping): T.1 (1 + 2)

Sweep Range = 0 = Math Sweeping is deactivated,
Jumper J2 = position 1 = Activates Positive Leading Edge of the DMMM-Sweeping
Jumper J2 = position 2 = Activates Negative Leading Edge of the DMMM-Sweeping

Use the handheld control panel or PC control to set the following perameters:
Sweep Range = 0; DMMM Gain = 30 to 150 (best between 60 and 80); Power = 0 to 100%; PWM Period = 0.010s to 0.2s (best between 0.01s to 0.1s); PWM Ratio = 50% to 90% (best from 85% to 90%); Frequency = 19 to 45 kHz;

Activating Mixed Dynamic MMM- Sweeping and Math-Sweeping: T.1 (3 + 4)

Sweep Range ≥ 1 = Math Sweeping is activated,
Jumper J2 = position 1 = Activates Positive Leading Edge of the Dynamic MMM-Sweeping
Jumper J2 = position 2 = Activates Negative Leading Edge of the MMM-Sweeping 2

Use the handheld control panel or PC control to set the following perameters:
Sweep Range = 1 to 5 (best between 2 and 4); DMMM Gain = 30 to 150 (best between 60 and 80); Power = 0 to 100% (best between 85% and 90%); PWM Period = 0.010s to 0.1s; PWM Ratio = 50% to 100% (best at 100%); Frequency = 19 to 45 kHz;

Activating Only Math-Sweeping (without Dynamic MMM-Sweeping): T.1 (5)

Sweep Range ≥ 1 = Math Sweeping is activated,
Jumper J2 = OFF, (OPEN)
Jumper J2 = OFF, (OPEN)

Use the handheld control panel or PC control to set the following perameters:
Sweep Range = 1 to 5 (best between 2 and 4); DMMM Gain = 0; Power = 0 to 100%; PWM Period = 0.010s to 0.2s (best between 0.01s and 0.1s); PWM Ratio = 50% to 100% (best from 85% to 100%); Frequency = 19 to 45 kHz;

Activating Fixed Frequency Operating Regime: T.1 (6)

Sweep Range = 0 = Dynamic MMM-Sweeping is deactivated,
Jumper J2 = position 1 = OPEN,
Jumper J2 = position 2 = OPEN

Use the handheld control panel or PC control to set the following perameters:
Sweep Range > 0
DMMM Gain = 0
Power: from 0 to 100%
PWM Period = 0.010s
PWM Ratio = 100%
Frequency: from 19 to 45 kHz

4. ADVANCED SETTINGS

4.4. MSG.X00.IX Generator Parameters.

Programming and parameter adjustments to the MSG.XXXIX is done through the MasterSonic Remote Control Panel MSH-1 or the MSA2218 Adapter for PC/PLC control in combination with the MasterSonic PC software program.

The following generator parameters can be set and adjusted:

Table 4.4.

Parameter	Description	Parameter Range
Frequency	Central Operating Frequency of the ultrasonic generator	19kHz ÷ 45kHz
Sweep Range (= Math Sweeping)	The amplification coefficient proportional to the Sweeping range of the Central Operating Frequency	0 ÷ 1.000kHz
Power	The power of the generator as a percent of the nominal power.	0 ÷ 100 %
PWM Period	PWM Period duration at operation in ON/OFF mode of the generator.	0.010s ÷ 10s
PWM Ratio	The ON period as a percent of the PWM Period.	0 ÷ 100 %
Max Current	The maximum current value (selectable).	2 ÷ 5 A
FSWM Period	Frequency Shift Width Modulation Period	0,01÷10s
FSWM Ratio	Frequency Shift Width Modulation Ratio	0÷100%
FSWM Range	Frequency Shift Width Modulation Range	0÷1,000kHz
DMMM Q Factor	Q Factor of the DMMM Filter	0 ÷ 255
DMMM F Correction	Frequency Correction of the DMMM	0 ÷ 255
DMMM Gain	Amplifier's amplification in the DMMM feedback.	0 ÷ 255

The operation with the Remote Control Panel or the MasterSonic software through the MSA2218 Adapter is described in the following chapters.

4. ADVANCED SETTINGS

4.4.1. Important notices regarding using PWM timing options.

- In most of applications for driving different piezoelectric loads it is not necessary or recommendable to use PWM, output-signal modulating options (just set PWM Ratio = 100%).

- The safest choices when using PWM options is necessary or beneficial for application are to set the output generator power to 50% of nominal power, and then set the PWM Ratio in the range between 75% and 95%, and PWM Period from 0.01sec to 1sec (for instance in cleaning applications, liquids processing and Sonochemistry). Even in liquid processing and cleaning applications PWM ratio should be kept to 100%, and preferable cleaning effects adjusted by other frequency modulating options (just to underline that PWM output signal modulation should be used only exceptionally and under well controlled conditions)

- PWM signal modulation presents Low frequency output power, ON – OFF modulation. Such modulation is basically producing high electrical and mechanical shocking (on both generator and transducer), equal to a kind of pulse – repetitive “hammering” effects, producing unpleasant and cracking, low frequency acoustic effects, and if not well selected could shorten the total operating life of the ultrasonic system. When generator power is set to low or very low values, PWM modulation can be applied without limits. Also when PWM period is set to very long values (PWM frequency = very low), generator can be set to operate high power.

4.5. External On/Off Power Control:

External ON/OFF control of the generator is possible through connection of terminals 1, 2, 3, 4 as shown in figure 4.5. below. The generator is switched ON or OFF by relay or circuit control between terminals 3 and 4. When the terminals are closed the generator is switched on and when the terminals are open, the generator is switched off.

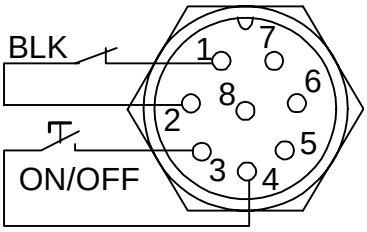


Fig. 4.5. External On/Off Power Control

NOTE: If the generator has been switched off because of activation of some internal blocking or external protection the terminals remain closed. Next starting of the machine should be done by opening and closing the terminals again.

NOTE: Terminals on pins 1 and 2 are protection inputs and they should be connected through short circuit enabling the generator to operate. If this circuit is open, the generator will stop operating.

4. ADVANCED SETTINGS

4.6. Analog Input Power Control:

The power of the generator can be controlled in the following three ways:

- The power can be set during the parameter setting of the generator.
- The power can be set through the RS 485 serial interface by the changing power command of the Remote Control Panel or PLC.
- The power can be set through the analog input - terminals 5 and 6. When a 2.5 k-Ohm potentiometer is connected to terminals 5and 6, as shown on picture 4.6., the power is set from 0 to 100%.

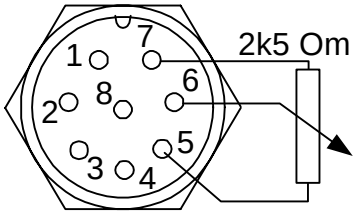


Fig. 4.6. Analog Input Power Control

5. REMOTE CONTROL PANEL

5.1. Remote Control Panel Description:

The remote control panel is designed for rapid parameter setting and tuning of the ultrasonic generator while connected to the oscillating mechanical system.

5.2. Remote Control Panel Operation:

The remote control panel has an LCD display with 2 rows of 16 symbols and keyboard with 24 buttons that have the following functions:

Numeric keyboard from 0 to 9 and decimal point for entering new parameters.

Enter button to input parameters or initiate a Function.

"esc" button to escape or cancel current operation.

Up and **Down Arrow** buttons for increasing and decreasing display values.

Left and **Right Arrow** buttons for reading the LCD menu.

Power On Button - switches the Power Supply of the Remote Control Panel.

Alt Button for extending the functions of the Remote Contrrol Panel (intended for future applications).

Run Button Starts the generator.

Off Button Stops the generator.

Fig. 5. Remote Control Panel

Functions buttons:

F1 - reads parameter data stored in the controller memory. Press F1 then select a memory position (0 to 20) to view stored parameters.

F2 - stores new parameter data from the buffer to a selected memory position (0 to 20) in the controller.

F3 - downloads parameter data from the buffer to the MasterSonic generator memory.

NOTE: If the Mastersonic generator is in operation (ultrasonic power is ON) when downloading data from the remote control panel the generator will automatically turn OFF the ultrasonic power for system safety. The generator may be restarted manually by switching the ON/OFF switch, connected to terminals 1 and 2, or by pressing the RUN button of the Remote Control Panel.

5.2.1. When the remote control panel is connected to the MasterSonic generator, the active set of generator parameters that are in its memory are automatically transferred to the buffer of the control panel.

5.2.2. To set Operating Frequency – select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5. REMOTE CONTROL PANEL

5.2.3. To set Ultrasonic Output Power – select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.4. To set PWM Period– select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.5. To set PWM Ratio– select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.6. To set Sweep Range select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.7. To set Max Current select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.8. To set FSWM Period select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.9. To set FSWM Ratio select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.10. To set FSWM Range select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.11. To set DMMM Q Factor select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.12. To set DMMM F Correction select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5.2.13. To set DMMM Gain select desired parameter with LEFT and RIGHT ARROW buttons. Select parameter value with UP and DOWN ARROW buttons, or with numeric keyboard. The ENTER button downloads the current parameter value in the generator.

5. REMOTE CONTROL PANEL

Table 5.

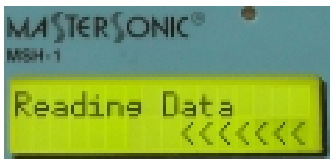
Function	LCD Display Pictures	LCD Displays	Description of Action
Reading Data		<<<<<<<	Uploading parameters from the generator memory to the remote control panel buffer.
Sending Data		>>>>>>>	Downloading parameters from the remote control panel buffer to the generator memory.
Read Memory		Location xx	Reading parameters from a remote control panel memory location (1 to 20) to the remote control panel buffer.
Write Memory		Location xx	Writing parameters from the remote control panel buffer to the remote control panel memory location (1 to 20).
Frequency		xx.xxx kHz (example: 21.940 kHz)	The average frequency of the ultrasonic transducers (resonant mode).
Fast Sweeping		xx stp (example:25 stp)	Fast Sweeping 0÷255 steps
Sweep Range		x.xxx (example: 0.150 kHz)	Sweep Range 0 ÷ 1.000kHz
Information Screen		x.xx A (example:1.02A); +x (example: +3)	DC Current and DC Power value in the DC electric circuit of the generator.
Power		xxx %(example: 50%)	The current power as a percent of nominal power of ultrasonic generator.
PWM Period		x.xxxs (example: 1.190 s)	Period of Pulse Width Modulation (PWM in seconds).
PWM Ratio		xx% (example: 65%)	Ratio of Pulse Width Modulation (PWM percent)
Tracking Range		xx (example: 25)	Tracking Range of DLL tracking (auto tune range 0÷30)

Table 5.

Function	LCD Display Pictures	LCD Displays	Description of Action
Max Current		x.000A (example: 5.000 A)	The max current level which activates current-restriction operating mode of the generator.
DMMM Q Factor		xxx (example: 12)	Amplifier's quality factor in the DMMM feedback.
DMMM F Correction		xxx (example: 22)	Amplifier's frequency correction in the DMMM feedback.
DMMM Gain		xxx (example: 60)	Amplifier's gain in the DMMM feedback.

6. PC SOFTWARE CONTROL OPTION

6.1. PC and Custom Software Control Description:

MasterSonic generator parameters may be automatically controlled through a PC or other custom controller connected to the RS485 serial interface via the optional adaptor box.

NOTE: Only one device may be connected to the RS 485 serial interface. The optional PC control adapter box and the remote control panel may not be used at the same time.

6.2. PC Graphical User Interface Window:

The optional PC software control accessory is used to control generator parameters through a PC connected via the special interface adaptor box to the MasterSonic RS485 serial interface.

6.2.1. Installation Instructions for the MasterSonic Control Panel Window: (Windows 98 compatible)

a) Create a new file folder on your PC in a location where you prefer to store the executable software files.

b) Copy the file “mastersonic.exe” from the MasterSonic CD and paste in your new file folder.

c) Right click the copied file “mastersonic.exe” and left click the “make a shortcut” option. Drag the shortcut to your PC desktop or another convenient location.

6.2.2. To run the MasterSonic PC Control Panel Window:

a) Double click the “mastersonic.exe” shortcut icon.

b) The MasterSonic Generator Control Panel window will appear. If the PC serial port is properly connected to the MasterSonic Generator the active set of generator parameters that are in its memory are automatically uploaded and displayed in the Control Panel window.

6.2.3. To READ Currently loaded Parameters in the MasterSonic Generator memory:

a) Click the PC control panel “Read” button.

b) Parameters are uploaded from the MasterSonic generator memory and displayed on the PC Control Panel window.

Fig. 6.2. PC Windows Control Panel

6. PC SOFTWARE CONTROL OPTION

6.2.4. To Set New Parameters and WRITE them to the MasterSonic Generator:

a) Each parameter may be set by either the sliding graphic bar or by typing specific numerical values. (Parameter setting limitations are as described for the control panel above.)

b) When all parameters are set to the desired value Click the PC control panel “Write” button.

c) All parameters will be downloaded from the PC Control software to the MasterSonic generator.

NOTE: If the Mastersonic generator is in operation (ultrasonic power is ON) when downloading data from the PC control panel the generator will automatically turn OFF the ultrasonic power for system safety. After downloading is completed the generator may be restarted manually by pressing the front panel Green ON button or via the control panel start button.

6.2.5. Start or Stop the MasterSonic Generator:

a) After desired parameters have been set Click the “START” button.

b) Press the “STOP” button to stop ultrasonic power generation.

6.2.6. To Quit or Exit from the PC Control Window:
• Click the “EXIT” button.

6.3. Custom Controller or Special PC Command Options:

Using MasterSonic MSA2218 Adapter RS485 / RS232C interface, users may develop or use industry standard controllers and PCs for programming and controlling the MasterSonic generator via the optional interface adaptor box.

NOTE: Only one device may be connected to the MSG RS485 serial interface - terminals 7, 8, 9 and 10. A Custom Controller and the remote control panel may not be used at the same time.

NOTE: This option is not a part of the standard support. Assistance for hardware interface and programming are quoted by the manufacturer or distributor on a case by case basis.

6.3.1. The RS232C transfer protocol is semi-duplex and data transfer (reading/writing) and is controlled by RTS signaling.

Fig. 6.3. MasterSonic MSA2218 Adapter

6. PC SOFTWARE CONTROL OPTION

6.3.2. MasterSonic Generator Commands.

NOTE: Each command is terminated with carriage return (CR) ASCII code HEX =”0D “ or decimal = 13

Inquiry Commands:	
%01f(CR)	inquire for Current Frequency of the generator
%01s(CR)	inquire for Current Sweep Range of the generator
%01w(CR)	inquire for Current PWM Period of the generator
%01f(CR)	inquire for Current PWM Ratio of the generator
%03p(CR)	inquire for Current Power of the generator
%01a(CR)	inquire for Current FSWM Period of the generator
%01b(CR)	inquire for Current FSWM Ratio of the generator
%01c(CR)	inquire for Current FSWM Range of the generator
%01q(CR)	inquire for Current DMMM Q Factor of the generator
%01v(CR)	inquire for Current DMMM F Correction of the generator
%01g(CR)	inquire for Current DMMM Gain of the generator
%03y(CR)	inquire for Current Max Current of the generator
%03?(CR)	inquire for Current DC Current and DC Power of the generator

6. PC SOFTWARE CONTROL OPTION

Inquiry Reply Formats:	
#02fxx.xxx(CR)	Current Frequency reply (xx.xxx is frequency in kHz) o Example: #02f20.100(CR) - means current frequency is equal to 20100 Hz or 20.100 kHz
#02sxx.xxx(CR)	Current Sweep Range reply. o Example: #02s00.300(CR) means current Sweep Range is equal to 300Hz
#02wxx.xxx(CR)	Current PWM Period reply. o Example: #02w00.100(CR) - means the current PWM period is equal to 0.100sec. o Note: The PWM period must be between 10mSec and 10sec
#02m00.xxx(CR)	Current PWM Ratio reply. o Example: #02m00.075(CR) - means the current PWM ratio is equal to 75%
#02p00.xxx(CR)	Current Power of generator reply. o Example: #02p00.085(CR) - means the current power is equal to 85% from nominal power
#02a00.xxx(CR)	Current FSWM Period reply. o Example: #02a00.100(CR) - means the current FSWM Period is equal to 0.100sec. Note: The FSWM period must be between 10mSec and 10sec.
#02b00.xxx(CR)	Current FSWM Ratio reply. o Example: #02b00.075(CR) - means the current FSWM Ratio is equal to 75%.
#02c00.xxx(CR)	Current FSWM Range reply. o Example: #02c00.300(CR) - means the current FSWM Range is equal to 300Hz. Note: The FSWM Range must be between 0-1kHz.
#02q00.xxx(CR)	Current DMMM Q Factor reply. o Example: #02q00.012(CR) - means the current DMMM Q Factor is equal to 12. Note: The DMMM Q Factor must be between 0÷255.
#02v00.xxx(CR)	Current DMMM F Correction reply. o Example: #02v00.022(CR) - means the current DMMM F Correction is equal to 22. Note: The DMMM F Correction must be between 0÷255.
#02g00.xxx(CR)	Current DMMM Gain reply. o Example: #02g00.060(CR) - means the current DMMM Gain is equal to 60. Note: The DMMM Gain must be between 0÷255.
#02y0x.000(CR)	Max Current reply. o Example: #02y05.000(CR) - means the Max Current is equal to 5A. Note: The Max Current must be between 2÷5A.
#02?xxx.yyy.z(CR)	Current DC Power and DC Current reply, where xxx=DC Curent value; yyy = DC Power value. If z =1 - ON, if z = 0 - OFF . o Example: #022743031(CR) - means the DC Current is equal to 2.74A, Voltage is equal to 3.03V and DC Power is equal to 0.83kW.

6. PC SOFTWARE CONTROL OPTION

Start/Stop Generator Ultrasonic Power Commands:	
@01start(CR)	Start command - ultrasonic generator
@01stop(CR)	Stop command - ultrasonic generator
@03start(CR)	Start command - rectifier
@03stop(CR)	Stop command - rectifier

Set New Parameter Value Commands:	
#01fxx.xxx(CR)	Sets a new Operating Frequency for the generator
#01sxx.xxx(CR)	Sets a new Sweep Range
#01wxx.xxx(CR)	Sets a new PWM Period
#01m00.xxx(CR)	Sets a new PWM Ratio
#03p00.xxx(CR)	Sets a new Operating Power for the generator
#01a00.xxx(CR)	Sets a new FSWM Period for the generator
#01b00.xxx(CR)	Sets a new FSWM Ratio for the generator
#01c00.xxx(CR)	Sets a new FSWM Range for the generator
#01q00.xxx(CR)	Sets a new DMMM Q Factor for the generator
#01v00.xxx(CR)	Sets a new DMMM F Correction for the generator
#01g00.xxx(CR)	Sets a new DMMM Gain for the generator
#03y0x.000(CR)	Sets a new Max Current for the generator
NOTE: The generator replies with a character “>(CR)” after receiving the setting parameters. The reply is not controlled.	

Write Commands:	
@01wr(CR)	Writes all current paramewters in the generator memory. (except “Power”)
@03wr(CR)	Writes current “Power” paramewter in the rectifier memory.
NOTE: The maximum number of writing cycles is 100 000.	

Data transfer: According to RS232 / RS485 Protocol.

Note: The manufacturer recommends that only original MasterSonic MSA2218 Adapter is used with the MasterSonic generator.

Comments:

MODE: Asynchronous
DATA: 8 data bits
Stop: 1
Baud rate: 19200
Parity: No
Txd - 1 = Send
Rxd - 0 = Receive

7. LIMITATION OF WARRANTY

The product warranty is detailed in the general conditions of sale or as part of a special sale agreement.

The warranty does not apply and may be voided for equipment subject to unauthorized modifications, repair, misuse, abuse, negligence or accident.

Equipment that, in our judgment, shows evidence of having been used in violation of operating instructions will be ineligible for service under this warranty.

The MasterSonic equipment is designed for maximum operator safety and incorporates built-in safety devices. Any modifications to these safety features will void the warranty. The Manufacturer assumes no responsibilities for consequential damages incurred due to modifications to the said equipment.

Under no circumstances shall the Manufacturer be liable to the purchaser or to any other person for any incidental or consequential damages or loss of profit or product resulting from any malfunction or failure of this MasterSonic product.

No liability is assumed for expenses or damages resulting from interruptions in operation of the product or damages to material in process.

The Manufacturer reserves the rights not to warrant horns, sonotrodes, and waveguides of unusual or experimental design that in our judgment are more likely to fail in use.

Within the period guaranteed, we will repair or replace free of charge, at our sole discretion, all parts that are defective because of material or workmanship, not including costs for removing or installing parts.

Liability, whether based on warranty, negligence or other cause, arising out of and/or incidental to sale, use or operation of the transducer elements, or any part thereof, shall not in any case exceed the cost of repair or replacement of the defective equipment, and such repair or replacement shall be the exclusive remedy of the purchaser, and in no case will we be responsible for any and/or all consequential or incidental damages including without limitation, and/or all consequential damages arising out of commercial losses.

8. SERVICE

WARNING: To avoid electric shock, do not remove the case cover from the Generator or Transducer. There are no user-serviceable parts inside any of these components.

IMPORTANT NOTICE: For the protection of employees, shippers, receivers, various personnel, and to remain in compliance with Transit Laws, material returned to the Manufacturer or its designated representatives must be rendered free of any hazardous, noxious or radioactive contamination.

Should the user of this device have any questions or comments as to its specifications, use, limitations, or maintenance, the Manufacturers Service Representative can be contacted as follows:

By Post/Mail: MP Interconsulting
Attn: MasterSonic Service
Marais 36
2400 Le Locle, Switzerland

Telephone/Fax: +41 32 9314045
E-mail: mastersonic@mpi-ultrasonics.com;
www.mpi-ultrasonics.com

APPENDIX

Some examples of good frequency and modulations settings for immersible transducers (28 kHz) that are driven with MMM generators:

Parameter	Range for selection
Frequency	28.000 to 28.400 kHz
Sweep Range	0.100 to 0.400 kHz
FSWM Period	0.020 to 0.040 s
FSWM Ratio	30% to 50%
FSWM Range	0.100 to 0.500 kHz
Power	0 to 100%
PWM Period	n/a (0.02 to 0.05 s)
PWM Ratio	100%
Max. Current	3 Amps. (2 to 4 Amps.)
DMM Q Factor	100 to 200
DMM Fcorrection	100 to 200
DMM Gain	100 to 150
Selection to be made in order to produce the best acoustic activity effects in treated liquid.	

- First, reduce all modulating (time and frequency) settings to zero, enabling the system to operate at constant frequency. Then find, by changing (carrier) frequency, the best operating frequency. Then start gradually introducing different (time and frequency) modulations, following (and optimizing) the acoustical and technological results obtained in the mechanical system, or liquid processing chamber (or cleaning results in a cleaning tank).

- PWM ratio should in most of cases stay 100%. In case of using PWM ratio settings (to be less than 100%), reduce the generator power to 50%.

- Select every setting parameter in the range where ultrasonic mechanical system would not produce loud, sharp and high, squeezing, braking and cracking, low frequency, non-stationary noise. Appearance of such non-stationary, high intensity, low frequency noise is the sign that settings are not well selected and that mechanical system (ultrasonic transducers) is under high mechanical and electrical stress. Prolonged driving of the system under such conditions would damage transducers and generator. Particularly critical setting parameter for producing such high-risk conditions is PWM Ratio (when adjusted less than 100%). Try to keep PWM ratio 100%, whenever applicable.

APPENDIX

- Do not increase operating power to 100% in all applications. The same comment is also applicable to Max. Current (do not increase it to its maximum). For every liquid and acoustic load there is certain upper power threshold when all positive acoustic effects are already optimized. Increasing power (or load current) above such maximum would only produce losses and thermal dissipation in total mechanical and electrical system (and shorten the total operating life of the system). Every well operating MMM, sonic and ultrasonic regime is followed by smooth, stationary, regular and low-level acoustic noise. Whenever this is not the case, certain modulating parameter/s should be reduced, until smooth system operation is achieved.

- After best setting parameters are found, one by one, try again to readjust all of them, since they are all mutually interrelated and slightly changing resulting operating regime.