

MASTERSONIC[®]



MASTERSONIC[®]
MSG.X00.IX.YF
ULTRASONIC GENERATOR
AND POWER SUPPLY
MMM, Wideband Multifrequency Technology

SYSTEM OPERATION
MANUAL

April 2007

MSG.X00.IX.YF

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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 100W up to many kW.

Multifrequency, Multimode, Modulated 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. Packing

Mastersonic MGS.x00.IX.yF generator is delivered packed in a carton box equipped with HF power connector, power supply cable, remote control connector.

Please, check the delivery completeness with the delivery.

1.2. Delivery completeness:

1. Mastersonic MSG.x00.IX.yF generator - 1 pc
2. HF Power Connector T3108001 - 1 pc
3. Power Supply cable - 1 pc
4. Remote Control Connector -1 pc
5. Hexagonal key - 1 pc
6. Mastersonic Support Data Disk with operating manual (see here): http://www.mastersonics.com/documents/mmm_basics/mmm_power_supplies/msg-ix-generators/latest/
7. Handheld Control Unit MSH-1 equipped with interface cable - 1 pc (optional)
8. RS485-232 Adapter to PC - 1 pc (optional)
9. RS485-USB Adapter to PC - 1 pc (optional)
10. Acoustic load (on user's demand). In this case the HF Power Connector is mounted on the cable connecting the generator and the acoustic load. (optional)

1. INTRODUCTION

1.3. Features:

All MSG modular ultrasonic generators (MSG x00.IX.yF) utilize the MMM Technology and are constructed with a separate housing for an independent power supply of acoustic loads. Presently available modules are made for driving the following piezoelectric loads:

MSG 1200.IX.yF for driving 1200W piezoelectric load

MSG 600.IX.yF for driving 600W piezoelectric load

Modules differ in the operating frequency range, as follows:

MSG x00.IX.LF for operation in Low Frequency range

MSG x00.IX.MF for operation in Middle Frequency range

MSG x00.IX.HF for operation in High Frequency range

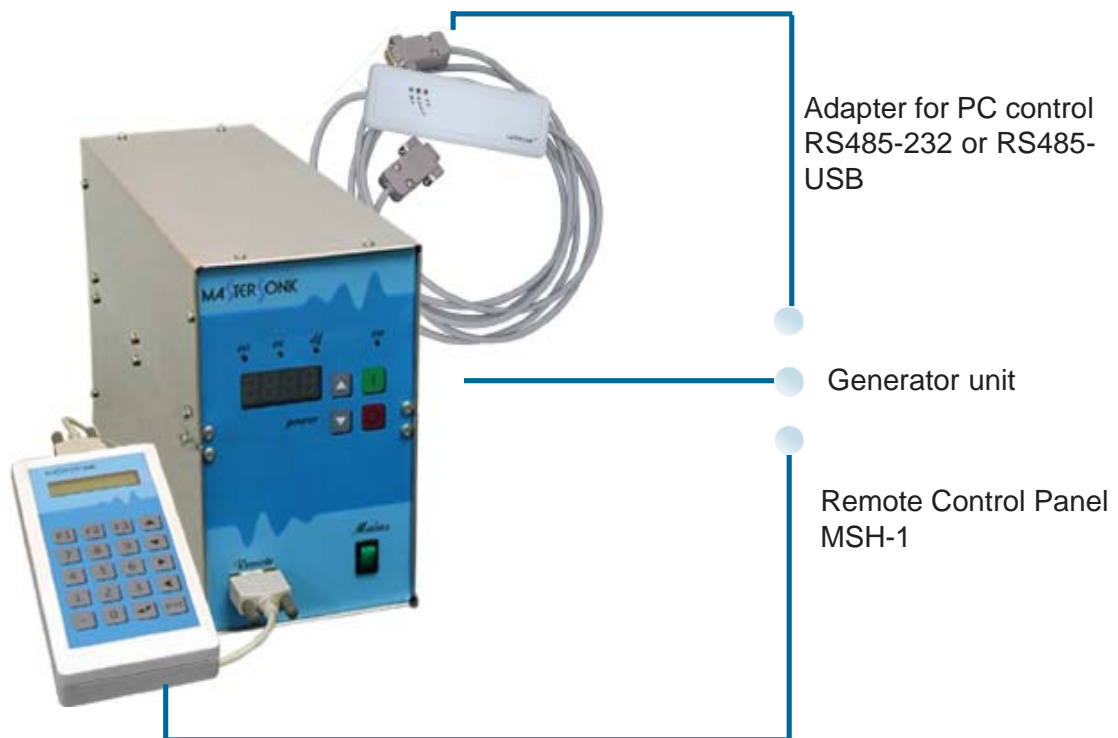


Fig. 1.1. MSG.x00.IX.yF Generator Module and Accessories

The MSG x00.IX.yF system with optional accessories is shown on fig. 1.1. It consists of:

- Generator unit
- Remote Control Panel for parameterization. (Optional)
- Adapter for direct PC or PLC control (Optional)

1. INTRODUCTION

1.4. Technical Characteristics of MSG x00.IX.yF:

| Technical Characteristics | LF | MF | HF |
|--|-------------------------------|-------------|-------------|
| Main Supply Voltage | 208V / 60Hz; 220/230V / 50Hz; | | |
| Max. Input Power | 700 W | 1300 W | 1300 W |
| Non-modulated, carrier frequency range | 17,500-28,500kHz | 22 - 30 kHz | 38 - 45 kHz |
| Modulated acoustic frequency range | Wideband, from Hz to MHz | | |
| Average Continuous Output Power | 600 W | 1200 W | 1200 W |
| Peak Output (max. pulsed power) | 3000 W | 6000 W | 6000 W |
| Output HF Voltage | ~ 500 V-rms | | |
| Dimensions (h x w x d) | 250mm x 150mm x 450mm | | |
| Weight | 10kg | | |

1.5. System safety:

Read this manual thoroughly and follow all directives 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. DESCRIPTION

2.1. Mains Power Switch:

The generator is switched on by the green MAINS switch on the front panel. When the generator is switched on, the MAINS switch lights.

2.2. Ultrasonic Power Control Buttons:

2.2.1. Ultrasonics Power ON (green button)

2.2.2. Ultrasonics Power OFF (red button)

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

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

optional



Fig 2.1. Front Panel

2.3. Ultrasonic Power Level Display:

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

2.4. Light indicators:

2.4.1. 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.

2.4.2. 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 must STOP the ultrasonic operation immediately by pressing the Red Button on the front panel and must follow these instructions:

- In production or repetitive test environment: Check if all parameters (Frequency, Power, Sweep Range, PWM period, and PWM ratio) keep their values and resume operation. (See Sections 5 and 6 of this manual)
- For Laboratory experiments where operating conditions and parameter limits are being tested, reset one or more parameter and resume operation. (See Sections 5 and 6 of this manual)
- Check for loose or damaged studs connecting the mechanical components.

2. DESCRIPTION

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

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

2.4.3. OV - Over Voltage indicator:

- The OV Light is Normally not illuminated (OFF) during normal operating conditions.
- Illuminated 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 limits 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 above.

2.4.4. OC - Over Current indicator:

- The OC Light is Normally not illuminated (OFF) during normal 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 is not automatically stopped, the operator must immediately STOP ultrasonic operation by pressing the Red Button on the front panel and follow instructions above.

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

- The DF Light is Normally not illuminated (OFF) during normal 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 is not automatically stopped, the operator must immediately STOP ultrasonic operation by pressing the Red Button on the front panel and follow instructions above.

2. DESCRIPTION

2.5. Interface Connector Port for Remote Control:

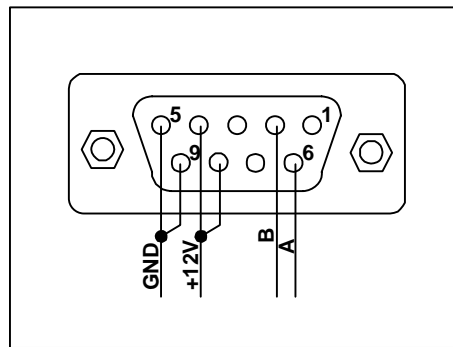
2.5.1. The standard Remote Control port provides an interface for connection of the generator to a MasterSonic Remote Control Panel, by using a special interface adaptor box (optional). This port may also be connected to a Personal Computer (PC) serial port, or to Remote Control panel, or to custom designed controllers

2.5.2. When MSA2684-USB (or MSA2339) adapter is used to connect the generator to a PC, the transfer protocol is semi-duplex and data transfer (reading/writing) is controlled by RTS signaling.

2.5.3. Only one external device must 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.

2.5.4. Pin-Out Details for Interface Connector Port



2.6. BNC Signal Analysis Ports (optional):

2.6.1. The MasterSonic MSG.x00.IX.yF 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.

The left BNC port is a voltage output, proportional to the HF current, passing through the Acoustic load.

The right BNC port is a voltage output, proportional to the voltage on the Acoustic load.

2. DESCRIPTION

2.7. Rear Panel

There are three connectors, placed on the MSG.x00.IX.yF rear panel:

- Transducer HF power connector;
- PLC system connector;
- Mains power supply connector.

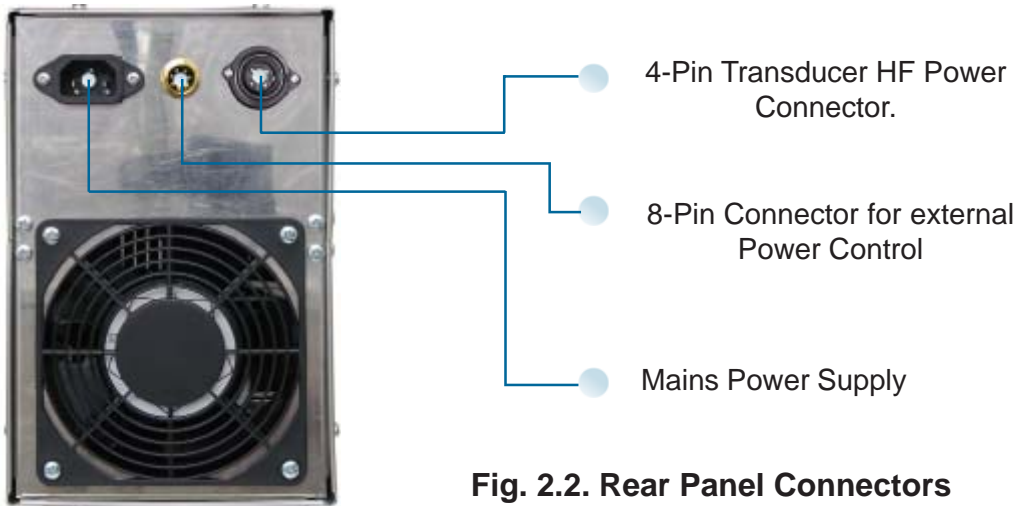


Fig. 2.2. Rear Panel Connectors

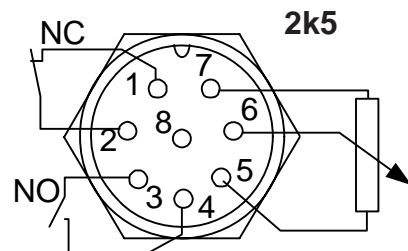
2.8. External On/Off Power Control:

The 8-Pin connector on the rear panel can be wired for external On/Off Generator Power Control by remote controller or relay.

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

2.8.2. For external control are used Pins 3, 4, 5,6 and 7. Pins 3 and 4 must be wired to a controller or relay that will control opening (Power OFF) and closing (Power ON) contact of these two pins.

Fig. 2.3. Connector for external ON/OFF Power Control



2.9. Transducer Power Connection:

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

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

2. DESCRIPTION

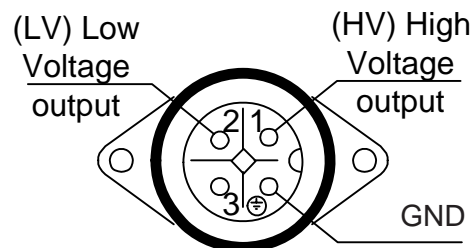
2.10. Acoustic Load Connection.

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 cable.

As show in figure below, 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 must be connected to the Isolated Terminal of the transducer.
- Terminal 2-LV must be connected to the inductive compensation of the transducer and to the acoustic system grounding (transducer housing or acoustic load mass).
- Terminal 4-GND must be connected to EARTH of the transducer.

Fig. 2.4. Acoustic Load connector



CAUTION: The MasterSonic System must 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.

ATTENTION! No liability is assumed for any damages caused by operating the system with acoustic loads not delivered by the producer.

2 Wire Connections: (NOT RECOMMENDED)

If the acoustic load can only be connected with a two-wire cable, mark 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-GND 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: (RECOMMENDED METHOD)

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

2. DESCRIPTION

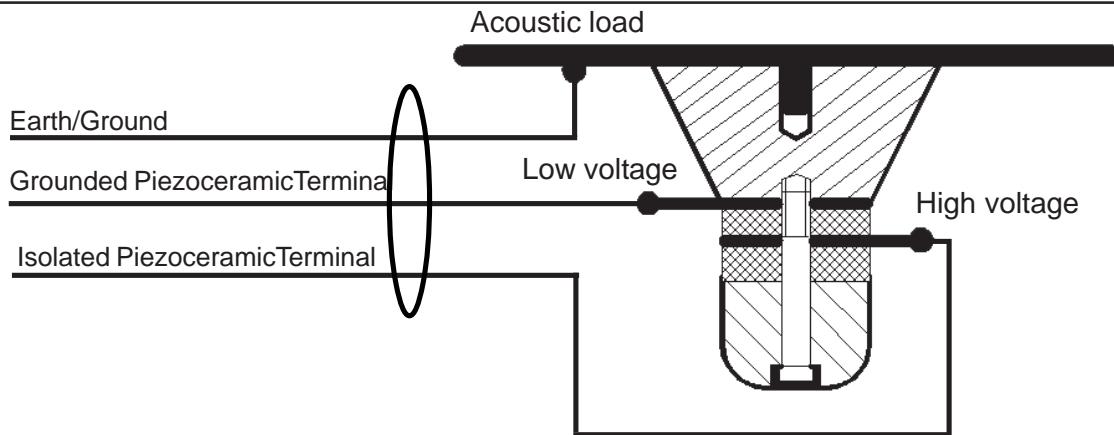


Fig. 2.5. Recommended 3-wire Acoustic Load connection.

- 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.yF 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 - GND.



Use HF Power Connector: **AMP C16-1, PG 9, 3+PE, Amphenol C016 20H003 110 10** to assemble the connection cable for connecting the generator and the ultrasonic load.

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.

2. DESCRIPTION

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.

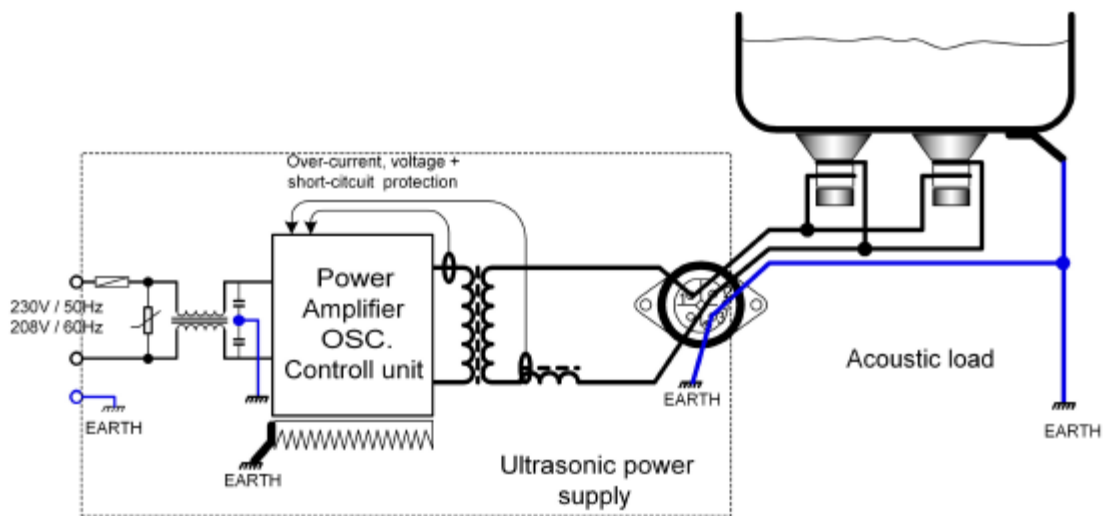


Fig. 2.6. Recommended 3-wire Acoustic Load connection.

● The correct method for connecting MSG.x00.IX.yF to the acoustic load with three-wire connection as well as all grounding points of the system are shown on the figure above.

CAUTION: To avoid electric shock make sure that the ultrasonic generator and the acoustic load are properly grounded.

2. DESCRIPTION

2.11. Acoustic Load Mounting:

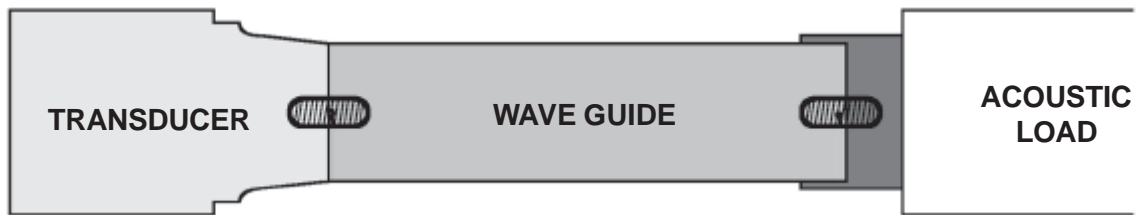


Figure 2.7. Acoustic Load Assembly

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 the figure, 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.

2.12. Flexible Transducer Option

The MSG.x00.IX.yF 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. 2.8. Mastersonic Transducers

3. SYSTEM SET-UP

3.1. System Assembly:

In case the generator is purchased to operate with a certain type of transducer, the operating parameters are factory set according user's requirements and there is no need to set or change parameters before work.

In case the generator is intended to work with different acoustic loads or to develop private projects, it is necessary to equip the generator either with MSH-1 Remote Control or with an Adapter for PC control (RS485-232, or RS485-USB), in order to set necessary operating parameters.

After connecting the MSG.x00.IX.yF to the mains and to the acoustic load, connect the generator to the Control System.

According to its completeness, the system can be controlled in three different ways:

● By the buttons on the front panel of the generator (in case the system consists only from generator and acoustic load)

● Using the Handheld Control Unit MSH-1 (Remote Control Panel);

● Connecting the generator to the USB port or serial port of a PC and controlling the system operation from the PC with the provided interface software.

Last two options will produce the same results, but using the PC and control software is presenting much more flexible and comfortable way with additional visual and real time information about all operating system parameters.

3.1.1. System Assembly with generator and acoustic load only.

In case the system consists only from generator and acoustic load, usually the operating parameters of the generator are preliminary set according to the characteristics of the acoustic load.

For assembling the system, follow the steps:

1. After unpacking, plug in the HF connecting cable of the acoustic load into the correspondent terminal of the generator on the rear panel.
2. Plug the Remote control connector into the 8-pin terminal on the rear panel of the generator.
3. Plug the power supply cable into the socket on the rear panel of the generator.
4. Check all connections before to plug the power supply cable into the mains.
5. Plug the power supply cable into the mains.
6. Switch ON the generator by the green switch MAINS on the front panel of the generator. When the genertor is switched on, the green MAINS switch lights.
7. LED display indicated the Power in percents. If it is not set to 30%, set it using the up and down arrow button to increase or decrease the value.
8. Switch ON the Ultrasonic Power of the generator by pressing the green button on the front panel. The light indicator ON on the front panel lights. Proper operation is indicated by the specific sound of the acoustic load.
9. After these preliminary actions you can proceed with increasing the ultrasonic power of the generator by the arrow buttons on the front panel.
10. To stop work press the red OFF button on the front panel. The ultrasonic power is switched off and ON light indicator dies out.
11. Turn OFF the system by pressing the green MAINS switch. After turning the system OFF, the green switch dies out.

3. SYSTEM SET-UP

3.1.2. System Assembly with Remote Control Panel

For assembling the system, follow the steps:

1. After unpacking, plug in the HF connecting cable of the acoustic load into the correspondent terminal of the generator.
 2. Plug the Remote control connector into the 8-pin terminal on the rear panel of the generator.
 3. Plug the power supply cable into the socket on the rear panel of the generator.
 4. Check all connections before to plug the power supply cable into the mains.
 5. Plug the power supply cable into the mains.
 6. Switch ON the generator by the green switch MAINS on the front panel of the generator. When the generator is switched on, the green MAINS switch lights.
 7. LED display indicated the Power in percents. If it is not set to 30%, set it using the up and down arrow button to increase or decrease the value.
 8. Switch ON the Ultrasonic Power of the generator by pressing the green button on the front panel. The light indicator ON on the front panel lights. Proper operation is indicated by the specific sound of the acoustic load.
 9. All these preliminary actions test if everything with the system connection is correct.
- Plug-in the connectors between the Handheld Control Unit MSH-1 and REMOTE terminal on the front panel of the MSG.x00.IX.yF generator. Handheld Control Unit MSH-1 will operate getting the power directly from the generator (no need for external DC power supply). 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.

After switching of Remote Control panel, ultrasonic power is switched on by the green button on the MSH-1 and is switched off by the red button on MSH-1. System control is monitored from the MSH-1.



Fig. 3.1. Generator Control using the MSH-1. Connection method.

Switching MSH-1 during work does not influence on generator operation.

3. SYSTEM SET-UP

3.1.3. System Assembly with Personal Computer

Figure 3.1.2. below shows the connection of MSG.x00.IX.yF to a Personal Computer.



Fig. 3.2. Generator Control using the PC serial port. Connection method.

Before connecting MSG.x00.IX.yF to your PC, download the MSG_IX software on your computer from the CD. The latest version of MSG_IX.exe could be downloaded from the following Internet address:

http://www.mastersonics.com/documents/mmm_basics/mmm_power_supplies/msg-ix-generators/latest/

If you have any problems downloading the software, please, do not hesitate to contact us. We will e-mail it to you.

Note: The software for MSG.x00.IX.yF control does not need installation. You can place it directly on your PC Desktop (the first screen you will see on your monitor, after initiating MS



Windows, before using any software). You will see on your PC desktop the following Integrated Circuit Icon:

Later, by clicking on that icon you will be able to activate the interface software for MSG.1200.IX control.

Take the RS485-USB (or RS485-232) Adapter and plug its cable-connectors between the USB PC port for RS485-USB Adapter (serial port for RS485-232 Adapter) and Remote connector on the front panel of the MSG.1200.IX.yF generator.

Note: RS485-USB Adapter needs to install its driver before operation. Refer to Appendix C for instructions how to install the USB driver.

Note: If you work with laptop PC with a combined USB/PS2 port, do not use this port! The only port that can be used must be ONLY USB port!

If all connections between MSG.x00.IX.yF, acoustic load, control block (MSH-1 or PC) are made you can connect the system to the Mains Power Supply.

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT










4.1. System set up:

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

4.2. Remote Control Panel Description:

The remote control panel has an LCD display with 2 lines 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 cancel current operation.
-  **Up** and **Down Arrow** buttons for increasing and decreasing display values.
-  **Left** and **Right Arrow** buttons for reading the LCD menu.
-  **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 Control Panel (intended for future applications).
-  **Run** Button Starts the generator.
-  **Off** Button Stops the generator.

Functions buttons:




-  **F1** - reads parameter data stored in the controller memory. Press F1 then select a memory position (0 to 8) to view stored parameters.
-  **F2** - stores new parameter data from the buffer to a selected memory position (0 to 8) in the controller.
-  **F3** - downloads parameter data from the buffer to the MasterSonic generator memory.



Fig. 4.1. MSH-1 Remote Control Panel

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.

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT

4.3. System Operation

4.3.1. Remote Control Panel Operation

Initial starting:

1. When the Handheld control unit MSH-1 is switched on, the following message appears on the displays:



V.XX.XX.XX - indicates the installed software version

2. The following message appears on the display after a few seconds, indicating that all data stored in the generator memory is transferred into the memory of MSH-1:



3. LED display indicated the current Frequency value set on the generator:



4.3.2. Example of Appropriate Parameters Step by Step Settings for MMM Ultrasonic System Operation with Remote Control Panel MSH-1

● Power:

To set 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. The display shows the set “Power” between 20% and 30% (preferably minimum value). This is to ensure that during regulations and settings generator would produce low power output, in order to avoid damaging mechanical system and acoustic load.



The current power as a percent of nominal power of ultrasonic generator.

● MAX Current:

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.

Set “MAX Current” to 2.000 A

After a period of safe operation you may gradually increase the setting to 3 A if you change mechanical system and loading. This is the safe operating margin for your system.



The max current level which activates current-restriction operating mode of the generator.

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT

● PWM period:

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.

Set at its minimum 0.010 s setting to start. When the PWM ratio is set to less than 100%, you may experiment by increasing it until 0.100 s), while reducing the Power in order to avoid pulsed over-current.

A green LCD display showing the text "PWM Period" on the top line and "0.010s" on the bottom line.

Period of Pulse Width Modulation (PWM in seconds).

● PWM ratio:

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.

A green LCD display showing the text "PWM Ratio" on the top line and "65%" on the bottom line.

Ratio of Pulse Width Modulation (PWM percent)

Keep at 100% until more experience is gained in using this system. When you are fully aware of all parameters and safe operation conditions you may reduce the PWM ration to 20% to realize low frequency pulsing (ON – OFF) liquid processing regimes.

After experimenting in a real operating regime you may increase the power (if becomes necessary). Increasing power over system's safe-operating power limit would mechanically over-stress the system and could cause damage. Increase the power until smooth and continuous oscillations are present.

Note: If the ultrasonic system starts producing cracking and sharp noise, stop increasing the power. Always set power to stay within a relatively smooth and quiet operating regime of the mechanical system. Increasing the power over the suggested limits will only produce heating and may damage transducer. Entering into a regime of non-linear and clipping oscillations is not producing better ultrasonic effects (it is producing only high noise level, high thermal losses and possibly damaging the system).

Adjust the operating frequency again to find the maximum load current and power. Later repeat all setting steps to find better operating conditions.

PWM modulation is creating low frequency **ON** and **OFF** pulse-train regime. Basically, with PWM settings you will create pulse-train-repetitive signal with certain ON-time and certain OFF-time. This looks like hammering. ON and OFF time are programmable, and also repetition frequency of such pulse trains is programmable.

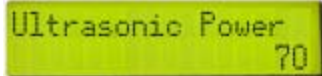
You would probably never need PWM modulation in most of ordinary applications. Try to always to operate the system in a continuous regime (when PWM-ratio = 100%). PWM modulation would change average and pulsed output power, but this is not an interesting option in the very beginning, until you get fully familiar with system operations (just keep it in a continuous regime).

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT

● **Ultrasonic power:**

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.

Set the output “Ultrasonic Power” between 10 and 100 (preferably minimal value). This is to ensure that during regulations and settings generator would produce very low power-output in order to avoid damaging mechanical system. Do not activate the generator



Ultrasonic Power
70

After experimenting in a real operating regime you may increase the “US power” (if becomes necessary). Increasing US power over system’s safe-operating power limit would mechanically over-stress the system and could cause damage. Increase the power until smooth and continuous oscillations are present.

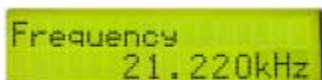
Note: If the ultrasonic system starts producing cracking and sharp noise, stop increasing the US power. Always set power to stay within a relatively smooth and quiet operating regime of the mechanical system. Increasing the US power over the suggested limits will only produce heating and may damage transducer. Entering into a regime of non-linear and clipping oscillations is not producing better ultrasonic effects (it is producing only high noise level, high thermal losses and possibly damaging the system).

Adjust the operating frequency again to find the maximum load current and power. Later repeat all setting steps to find better operating conditions.

● **Frequency:**

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.

In case of your system always set the central operating frequency in the vicinity of 20 kHz (between 19 and 22 kHz; -for instance 21.220 kHz). Preliminary testing shows an efficient central frequency range for the MMM ultrasonic system between 21.000 kHz and 21.500 kHz. Set frequency to 21.220 kHz to start. Using up and down arrow keys slowly change the frequency in 1 Hz steps to find the best central frequency point for every new test environment.



Frequency
21.220kHz

The average frequency of the ultrasonic transducers (resonant mode).

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT

● Sweeping:

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.

Set "Sweeping" to minimum value or to zero (for instance to less than 0.1 kHz). As above, find the best interval by slowly sweeping across this defined range. The Best setting is when the input system DC Power is maximized, providing that System is producing uniform and continuous sound, without whistling, impulsive, non-periodical and cracking noise.



Sweep Range
0.150 kHz

Sweep Range
0 ÷ 1.000kHz

● FSWM range:

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.

Set the "FSWM range" to minimum or zero value (for instance to 0.070 kHz). Start with 0.000 kHz and later experiment by going higher until reaching maximal input DC Power, or best ultrasonic processing effects.

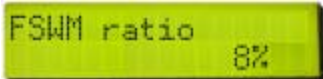


FSWM range
0.000 kHz

● FSWM ratio:

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.

Set "FSWM ratio" between zero and 50% (for instance to 8%). Experiment with different values, until getting the highest input DC Power. Often the best value is 50%.




FSWM ratio
8%

● FSWM period:

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.

Set between 0.020 s and 0.200 s. Start testing with 0.020 s and higher to reach the highest input DC Power (set, for instance to 0.030 s).



FSWM period
0.030 s

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT

A good reference to understand the significance of the FSWM adjustments of range, ratio, and period are explained here:

http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/mmm-explanations/modulation_explanatoi.pdf

MMM technology is explained here:

http://mastersonic.com/documents/mmm_basics/general_info/mmm_basics_presentation.pdf

● **Q factor:**

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.

Set the “Q factor” between 100 and 200 (start with 30, and later go higher; -for instance 106). For processing low viscosity and low density liquids, Q-values should be higher. For processing high density and high viscosity liquids, Q-values should be lower. Experiment with different values, until getting the highest input DC Power.



DMMM Q Factor
30

Amplifier's quality factor in the DMMM feedback.

● **Frequency correction:**

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.

Set “Frequency correction” between 50 and 100 (for instance to 76). Experiment with different values, until getting the highest input DC Power.



DMMM FCorrection
76

Amplifier's frequency correction in the DMMM feedback.

● **Amplification factor:**

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.

Set “Amplification factor” between 50 and 100 (for instance to 80). Start testing with 50 and later adjust until getting highest input DC Power and smooth, cold operation. See the picture below.



DMMM Gain
50

Amplifier's gain in the DMMM feedback.

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT

Single converter applications with relatively high mechanical quality factor of the oscillating system should have settings for Q-factor higher than 100, and also amplification factor in the first half of the total range. Frequency correction is related to the range of the total frequency modulation: If we would like to operate the system in a narrow frequency range (almost at constant frequency), frequency correction would be closer to the beginning of its interval. If we would like to increase the range/s of frequency modulation/s, frequency correction should be selected closer to maximum. Select the frequency correction by optimizing the mechanical output.

Information screen:

To select Information screen press consequently LEFT or RIGHT ARROW buttons.



```

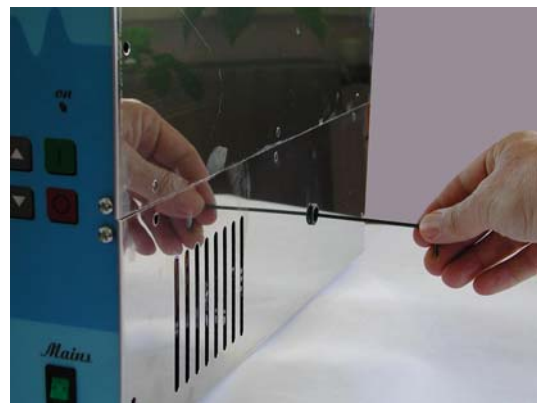
DCCurrent 0.02 A
DCPower   0.00kW
  
```

DC Current and DC Power value in the DC electric circuit of the generator.

The information screen displays information about the DC Current and DC Power value in the DC electric circuit of the generator. The information displayed on the screen cannot be changed.

After setting all the parameters in the desired ranges start the ultrasonic power of the generator by pressing the green Run button on the MSH-1 or the green ON button on the generator front panel. The ultrasonic system starts to produce specific sound. If the sound is uniform and continuous, without whistling, impulsive, non-periodical and cracking noise, everything is OK and the system works well. Stop changing certain parameter when you achieve maximization of mentioned indications and when you are satisfied how your end-piece is oscillating in MMM ultrasonic regime.

Note: When you operate with MSH-1 Handset Control Unit, it is not convenient for you to switch between the Frequency screen and Information screen, you can mount an ampermeter to the mains supply of the generator and follow its maximum values.



Take the hexagonal key from the service set and put it in the hole for the adjustment of the inductive compensation. If till now the generator has not been adjusted, the inductive compensation is maximum, as the generator is in transportation position. Turn the key counterclockwise and watch on the Information screen when DC Current and DC Power will reach their maximum values. The key must turn smoothly, without exertions, otherwise the coil could be damaged. If the key could not turn counterclockwise, try clockwise direction, as some preliminary adjustments could have been made. If everything is normal, the sound generated by the ultrasonic system is increased during the adjustment. After reaching maximum values of DC Current and DC Power, turn the key of the inductive compensation adjustment 1-2 revs clockwise. With this it is accepted that the inductive compensation is adjusted correctly towards the acoustic load.

4. SYSTEM SET-UP WITH MSH-1 HANDSET CONTROL UNIT

Once DDS, DMMM, and FSWM settings are optimized you can increase gradually both, the US power and the input power in order to get more energy into the system.

Once the settings are optimized for the one system, if you introduce mechanical parts of different size or geometry, then you need to repeat the entire sequence again since the different geometry (or horn) may have a different best operating frequency. Different sizes of mechanical parts would require certain changes to settings (all settings are very much unique and best determined by experimentation).

In every case, mentioned or not mentioned here, please be careful not to overpower or overload the system, because your generator and converter would be able to give much higher mechanical output than you would need.

5. SYSTEM SET-UP WITH PC

5.1. MSG.x00.IX.yF generator set-up:

5.2. MSG.x00.IX .yF generator set-up by using PC. Preliminary steps.

- First, switch-ON the PC and place the generator software “MSG_IX” on the PC desktop (by copy & paste). Then switch-ON the generator (only main voltage supply = ON). Generator is still not producing ultrasonic output (not started).

- Connect the MMM generator to ultrasonic converter.

- Connect the PC Interface Adapter RS485-USB between the USB port of the PC and the Remote connector on the generator front panel, as described above (or RS485-232 between the PC serial port and the Remote connector on the generator front panel).

- Provide mains power to the generator and switch on the generator at the front panel.

- Start the MMM PC Interface Control Software by activating the icon “MSG_IX”. All initial settings will be made using the PC Interface Control Software (before activating the System).

- Do not activate the generator to produce an ultrasonic signal. Do not press the Start button provided by the software.

- 1.) Set all sweeping parameters to 0. This will enable generator to operate with constant frequency.

- 2.) Set generator input and operating power to max. 30% (safe level for initial parameters setting).

- 3.) Adjust the Operating Frequency (center frequency) to the point where the load (transducer) current is maximum and where at the same time the phase is minimum. At this point the ultrasonic activity in the mechanical system should be maximized.

- 4.) Adjust the inductive compensation in order to get higher load current and maximum acoustic activity. (After final adjustment the internal inductive compensating ferrite gap may be fixed with a silicone spacer.)

- 5.) Set all Sweeping adjustments to the levels which are producing best ultrasonic effects.

- 6.) Increase gradually the power until smooth and continuous oscillations are still present. If the ultrasonic system starts producing cracking and sharp noise, stop increasing the power. Always set operating 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 (since system would enter non-linear and unstable regimes). Entering into a regime of non-linear and clipping oscillations is not producing better effects (it is producing only very high noise level, high thermal losses and possibly damaging ultrasonic converter and other mechanical parts).

- 7.) Adjust the center operating frequency again to find the maximum load current and minimum phase point.

- 8.) Repeat all setting steps 1 through 8 above to find better operating conditions.

- 9.) Additional fine tuning, to get better ultrasonic activity may be made by readjusting all sweeping intervals while keeping the same, previously found, operating frequency (center frequency).

5. SYSTEM SET-UP WITH PC

After introducing all initial settings as detailed below you can press the software Start button. The Generator will start producing ultrasonic power and the system will start oscillating. You can continue adjusting generator settings when the system is operating.

Monitor the Input DC Power reading (lower right section of the software screen), which is indicating the input power level.

Systematically repeat the fine tuning process for all parameters (slightly varying them within the specified ranges) until reaching the highest input DC Power level.

When you reach the maximum input power, memorize the parameters by clicking on the Write button on the control software window. All parameters will be stored in an active memory. Now you can start active liquid processing tests. After switching-OFF the system (pressing the software Stop button), and after re-activating the generator for subsequent tests, you can recall all previously stored parameters by clicking on the Read software button. These parameter settings will be read from the generator memory and displayed on the PC control software window.

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 Remote serial interface via the optional adaptor box.

NOTE: Only one device may be connected to the Remote 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 Remote serial interface.

6.2.1. Installation Instructions for the MasterSonic Control Panel Window: (Windows 98, XP 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_ix.exe" from the MasterSonic CD and paste in your new file folder.
- c) Right click the copied file "mastersonic_ix.exe" and left click the "make a shortcut" option. Drag the shortcut to your PC desktop or another convenient location.
- d) If you use RS485-USB Adapter install the USB driver first. The driver assigns the Adapter to the first free COM port. Note the COM port, as it must be specified later when starting the software for the first time.

6.2.2. To run the MasterSonic PC Control Panel Window:

Before starting the software initial settings of the communication interface must be made.

- a) Press the "CONFIGURE" button in the bottom right corner of the display. Specify the COM port to which the adapter is connected. When you use RS485-USB Adapter specify the COM port, which was set when installing the USB driver. (COM1, COM2 ...).
- b) Double click the "mastersonic_ix.exe" shortcut icon.
- c) 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.

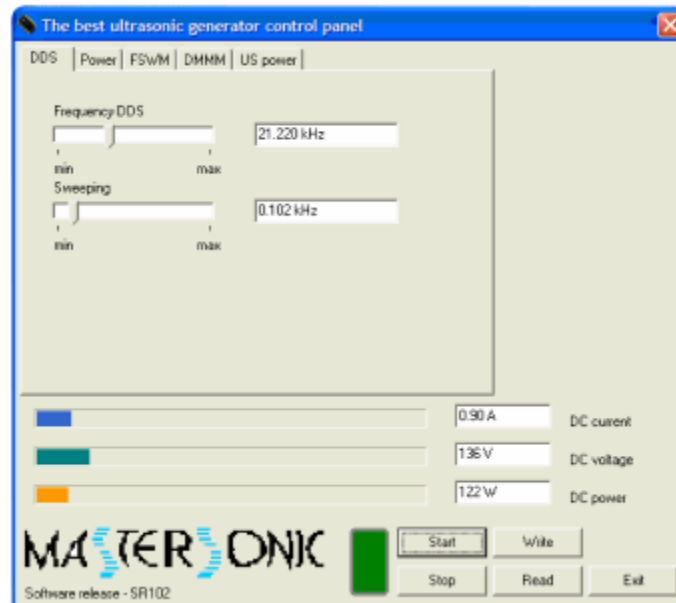


Fig. 6.1. PC Windows Control Panel

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

- 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.)
- When all parameters are set to the desired value Click the PC control panel “Write” button.
- 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. PC SOFTWARE CONTROL OPTION

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 MSA2684-USB Adapter USB/RS485 interface (or MSA2339 Adapter RS232/RS485 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 can be connected to the Remote serial interface - terminals 7, 8, 9 and 10. A Custom Controller and the remote control panel cannot 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.



Fig. 6.2. MasterSonic RS485-USB



Fig. 6.3. MasterSonic MSA2339 Adapter

6. PC SOFTWARE CONTROL OPTION

6.4. Example of Appropriate Parameters Step by Step Settings for MMM Ultra-sonic System Operation

Note: This example is only applicable to the MMM ultrasonic system delivered with these instructions. This procedure will allow you find the best operating conditions quickly without wasted efforts and without making improper settings that could harm the system. You may make slight parameter variations within the given range. When making new settings and system testing (with new mechanical components and different loads), please reduce the power to 30% and first search for the best operating conditions under low power.

6.4.1. Click on the second page tab “Power”:

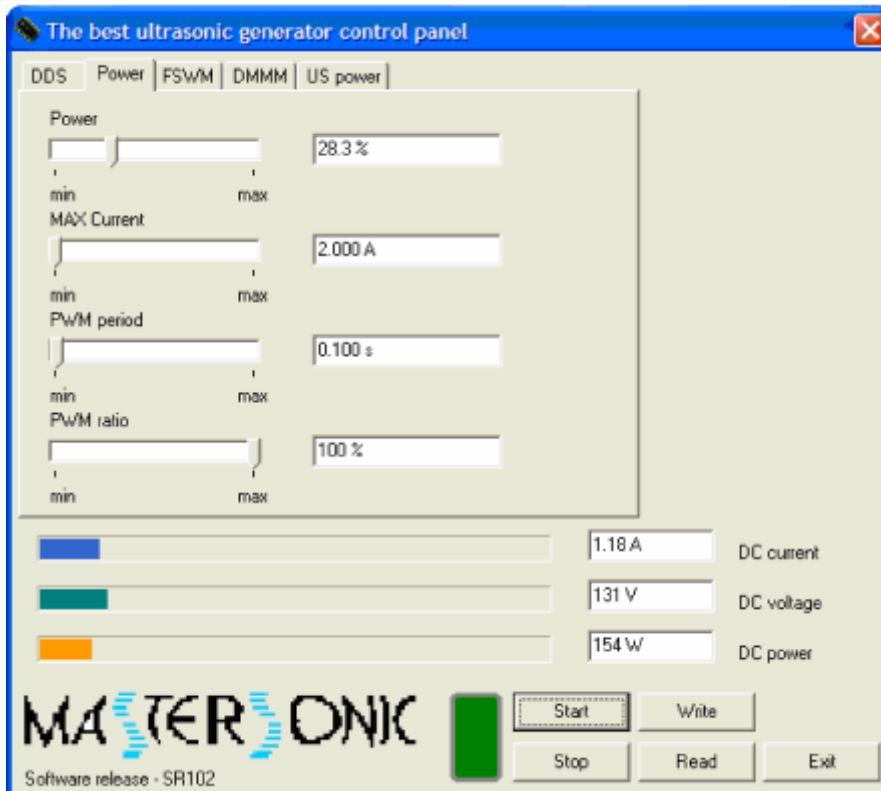


Fig. 6.4. MSG.x00.IX.yF software. Power Panel.

- **Power:**

Click on the Power Tab at the top of the PC Interface Control Software and set the input “Power” between 20% and 30% (preferably minimum value) by moving the sliding bar to the left position to max. 30%. This is to ensure that during regulations and settings generator would produce low power output, in order to avoid damaging mechanical system. Do not activate the generator (do not click the Start button on the control panel).

- **MAX Current:**

Set “MAX Current” to 2.000 A

After a period of safe operation you may gradually increase the setting to 3 A if you change mechanical system and loading. This is the safe operating margin for your system.

6. PC SOFTWARE CONTROL OPTION

● PWM period:

Set at its minimum 0.010 s setting to start. When the PWM ratio is set to less than 100%, you may experiment by increasing it until 0.100 s), while reducing the Power in order to avoid pulsed over-current.

● PWM ratio:

Keep at 100% until more experience is gained in using this system. When you are fully aware of all parameters and safe operation conditions you may reduce the PWM ratio to 20% to realize low frequency pulsing (ON – OFF) liquid processing regimes.

After experimenting in a real operating regime you may increase the power (if becomes necessary). Increasing power over system's safe-operating power limit would mechanically over-stress the system and could cause damage. Increase the power until smooth and continuous oscillations are present.

Note: If the ultrasonic system starts producing cracking and sharp noise, stop increasing the power. Always set power to stay within a relatively smooth and quiet operating regime of the mechanical system. Increasing the power over the suggested limits will only produce heating and may damage transducer. Entering into a regime of non-linear and clipping oscillations is not producing better ultrasonic effects (it is producing only high noise level, high thermal losses and possibly damaging the system).

Adjust the operating frequency again to find the maximum load current and power. Later repeat all setting steps to find better operating conditions.

PWM modulation is creating low frequency **ON** and **OFF** pulse-train regime. Basically, with PWM settings you will create pulse-train-repetitive signal with certain ON-time and certain OFF-time. This looks like hammering. ON and OFF time are programmable, and also repetition frequency of such pulse trains is programmable.

You would probably never need PWM modulation in most of ordinary applications. Try to always to operate the system in a continuous regime (when PWM-ratio = 100%). PWM modulation would change average and pulsed output power, but this is not an interesting option in the very beginning, until you get fully familiar with system operations (just keep it in a continuous regime).

6. PC SOFTWARE CONTROL OPTION

6.4.2. Open the fifth page tab “US power”:

Set the output “US Power” between 10 and 100 (preferably minimum value). This is to ensure that during regulations and settings generator would produce very low power-output in order to avoid damaging mechanical system. Do not activate the generator (do not click the Start button on the control panel).

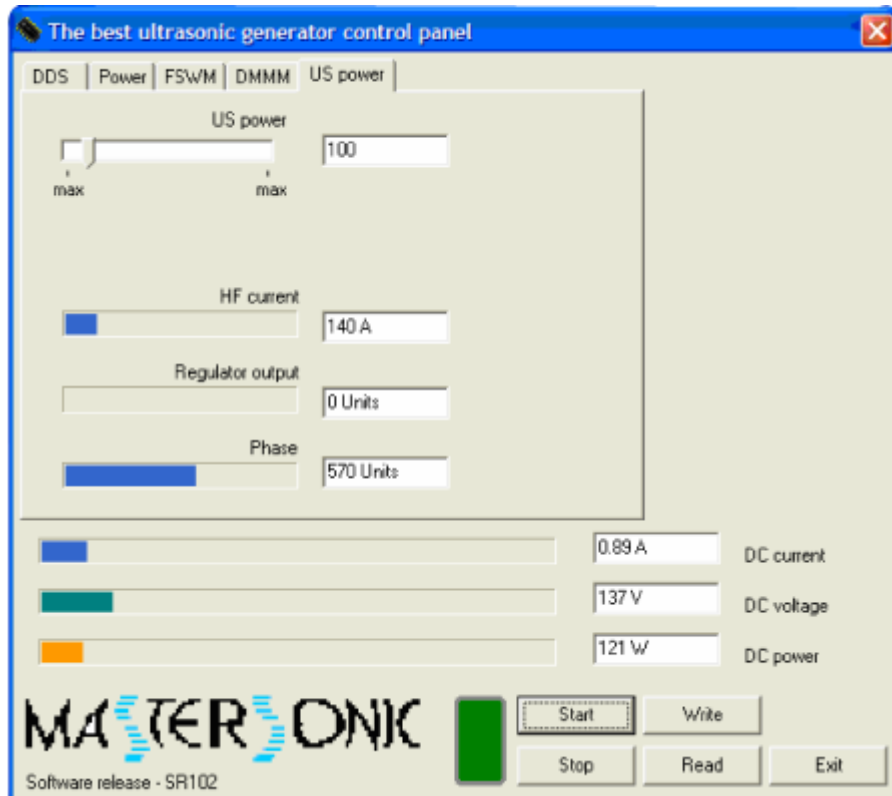


Fig. 6.5. MSG.x00.IX.yF software. US Power Panel.

After experimenting in a real operating regime you may increase the “US power” (if becomes necessary). Increasing US power over system’s safe-operating power limit would mechanically over-stress the system and could cause damage. Increase the power until smooth and continuous oscillations are present.

Note: If the ultrasonic system starts producing cracking and sharp noise, stop increasing the US power. Always set power to stay within a relatively smooth and quiet operating regime of the mechanical system. Increasing the US power over the suggested limits will only produce heating and may damage transducer. Entering into a regime of non-linear and clipping oscillations is not producing better ultrasonic effects (it is producing only high noise level, high thermal losses and possibly damaging the system).

Adjust the operating frequency again to find the maximum load current and power. Later repeat all setting steps to find better operating conditions.

6. PC SOFTWARE CONTROL OPTION

6.4.3. Open the first page tab “DDS”:

Make the following settings:

● **Frequency:**

In case of your system always set the central operating “Frequency DDS” to the frequency marked on the acoustic load. Using your keyboard Left/Right Arrows or your mouse scroll wheel slowly change the frequency in 1 Hz steps to find the best central frequency point for every new test environment. Experiment until reaching the highest input power by noting the DC Power indicator in the lower right section of the PC control window. As you pass through the best central operating frequency the higher system efficiency is exhibited by improved DC Power delivery.

Sweeping:

Then set “Sweeping” to minimum value or to zero (for instance to less than 0.1 kHz). As above, find the best interval by slowly sweeping across this defined range. The Best setting is when the input system DC Power is maximized, providing that System is producing uniform and continuous sound, without whistling, impulsive, non-periodical and cracking noise.

Still do not activate the generator (do not click the Start button on the control panel). See the picture below.

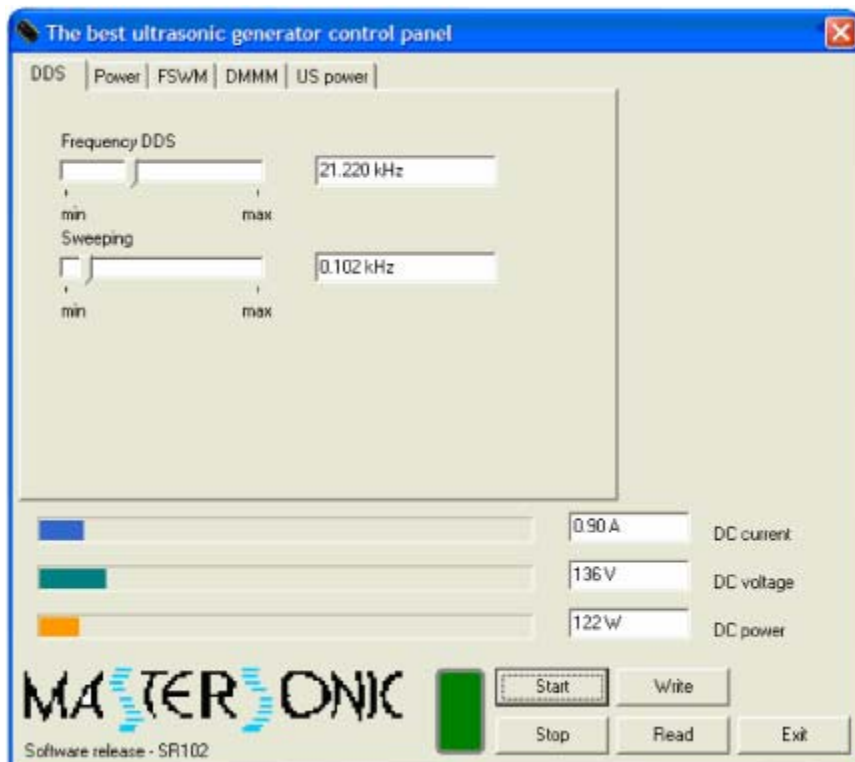


Fig. 6.6. MSG.x00.IX.yF software. DDS Panel.

6. PC SOFTWARE CONTROL OPTION

6.4.4. Open the third page tab “FSWM”:

Make settings:

- **FSWM range:**

Set the “FSWM range” to minimum or zero value (for instance to 0.070 kHz). Start with 0.000 kHz and later experiment by going higher until reaching maximum input DC Power, or best ultrasonic processing effects.

- **FSWM ratio:**

Then set “FSWM ratio” between zero and 50% (for instance to 8%). Experiment with different values, until getting the highest input DC Power. Often the best value is 50%.

- **FSWM period:**

Set between 0.020 s and 0.200 s. Start testing with 0.020 s and higher to reach the best processing effect. (set, for instance to 0.030 s).

Still do not activate the generator (do not click the “Start” button on the control panel). See the picture below.

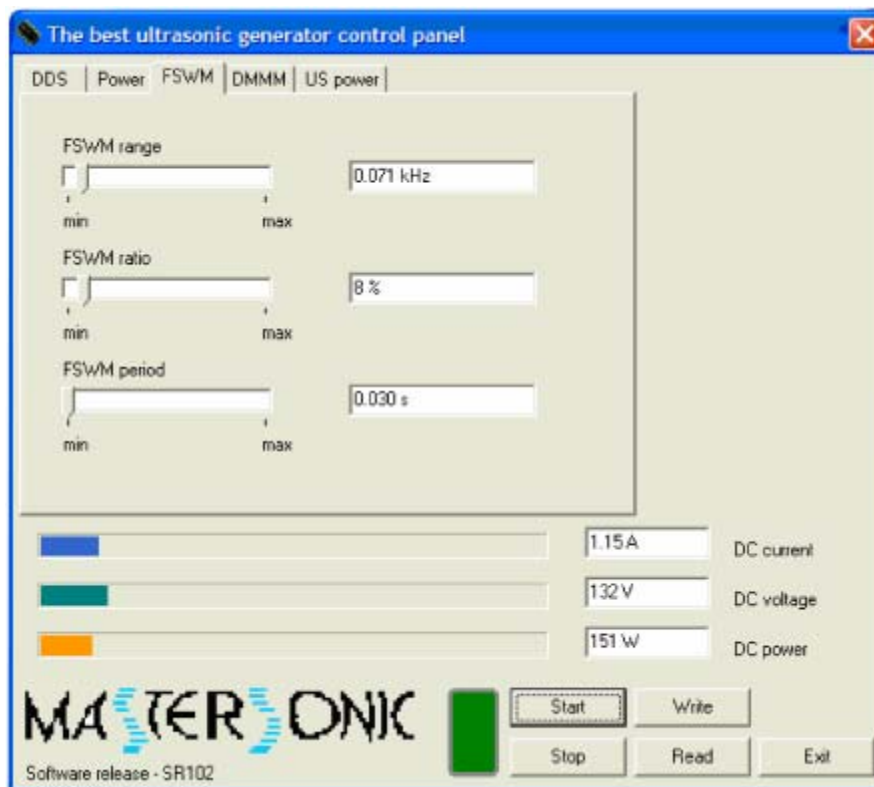


Fig. 6.7. MSG.x00.IX.yF software. FSWM Panel.

A good reference to understand the significance of the FSWM adjustments of range, ratio, and period are explained here:

http://mastersonic.com/documents/mmm_basics/mmm_power_supplies/mmm-explanations/modulation_explanatoi.pdf

MMM technology is explained here:

http://mastersonic.com/documents/mmm_basics/general_info/mmm_basics_presentation.pdf

6. PC SOFTWARE CONTROL OPTION

6.4.5. Open the fourth page tab “DMMM”:

Make settings:

- **Q factor:**

Set the “Q factor” between 100 and 200 (start with 30, and later go higher; -for instance 106). For processing low viscosity and low density liquids, Q-values should be higher. For processing high density and high viscosity liquids, Q-values should be lower. Experiment with different values, until getting the highest input DC Power.

- **Frequency correction:**

Then set “Frequency correction” between 50 and 100 (for instance to 76). Experiment with different values, until getting the highest input DC Power.

- **Amplification factor:**

Set “Amplification factor” between 50 and 100 (for instance to 80). Start testing with 50 and later adjust until getting highest input DC Power and smooth, cold operation. See the picture below.

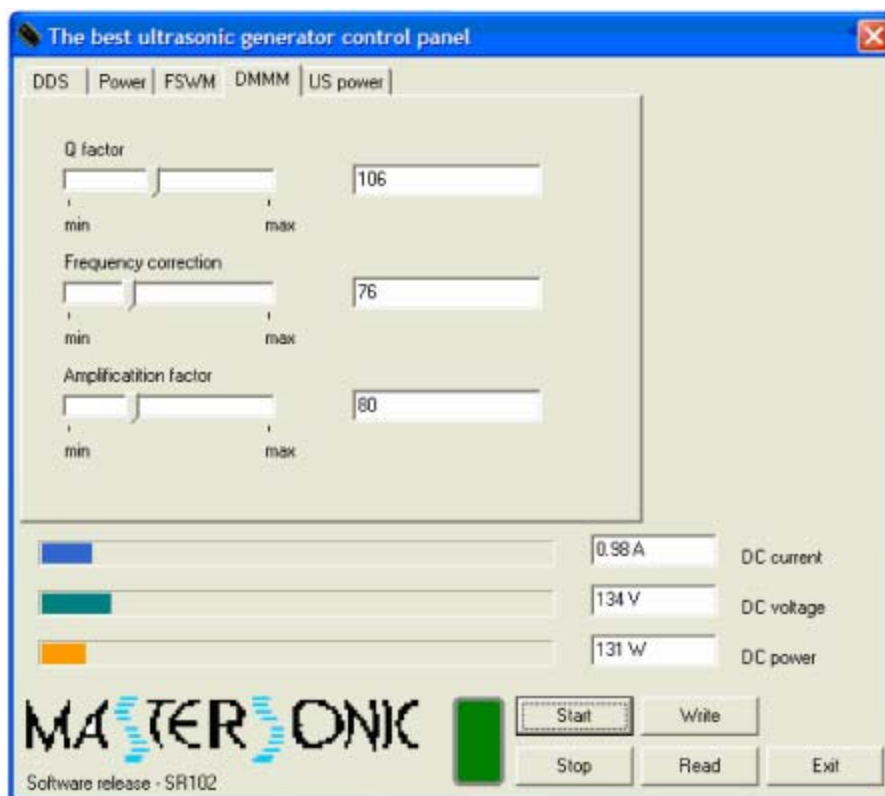


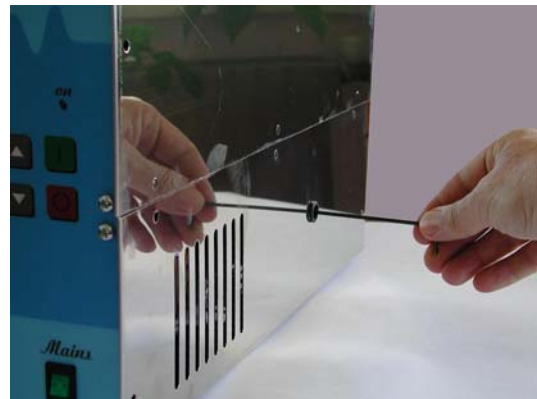
Fig. 6.8. MSG.x00.IX.yF software. DMMM Panel.

6. PC SOFTWARE CONTROL OPTION

Single converter applications with relatively high mechanical quality factor of the oscillating system should have settings for Q-factor higher than 100, and also amplification factor in the first half of the total range. Frequency correction is related to the range of the total frequency modulation: If we would like to operate the system in a narrow frequency range (almost at constant frequency), frequency correction would be closer to the beginning of its interval. If we would like to increase the range/s of frequency modulation/s, frequency correction should be selected closer to maximum. Select the frequency correction by optimizing the mechanical output.

Now go again to the first page tab “DDS” and activate the generator clicking on the “Start” button. The ultrasonic system starts to produce specific sound. If the sound is uniform and continuous, without whistling, impulsive, non-periodical and cracking noise, everything is OK and the system works well. Use the mouse and start fine-regulation of the central operating frequency (Frequency DDS) by trying to maximize the **blue DC current** and **orange DC power** indications. Open one by one all software panel tabs and start slightly varying (or increasing) all setting values, again trying to maximize the **blue DC current** and **orange DC power** indications. Stop changing certain parameter when you achieve maximization of mentioned indications and when you are satisfied how your end-piece is oscillating in MMM ultrasonic regime.

Note: If you operate with MSH-1 Handset Control Unit and it is not convenient for you to switch between the Frequency screen and Information screen, you can mount an ampermeter to the mains supply of the generator and follow its maximum values.



Once the maximum values of the **blue DC current** and **orange DC power** are reached, take the hexagonal key from the service set and put it in the hole for the adjustment of the inductive compensation. If till now the generator has not been adjusted, the inductive compensation is maximum, as the generator is in transportation position. Turn the key counterclockwise and watch on the screen the **blue DC current** bar and **orange DC power** bar reach their maximum values. The key must turn smoothly, without exertions, otherwise the coil could be damaged. If the key could not turn counterclockwise, try clockwise direction, as some preliminary adjustments could have been made. If everything is normal, the sound generated by the ultrasonic system is increased during the adjustment. After reaching maximum values of **blue DC current** and **orange DC power** turn the key of the inductive compensation adjustment 1-2 revs clockwise. With this it is accepted that the inductive compensation is adjusted correctly towards the acoustic load.

6. PC SOFTWARE CONTROL OPTION

Once DDS, DMMM, and FSWM settings are optimized you can increase gradually both, the US power and the input power in order to get more energy into the system.

Once the settings are optimized for the one system, if you introduce mechanical parts of different size or geometry, then you need to repeat the entire sequence again since the different geometry (or horn) may have a different best operating frequency. Different sizes of mechanical parts would require certain changes to settings (all settings are very much unique and best determined by experimentation).

In every case, mentioned or not mentioned here, please be careful not to overpower or overload the system, because your generator and converter would be able to give much higher mechanical output than you would need.

7. INDUCTIVE COMPENSATION AND INITIAL SETTINGS

7.1. 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.yF 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. THE INDUCTIVITY SHOULD THEN BE SET WITH A HEXAGON WRENCH KEY INSERTED INTO THE TOP OF THE MSG XXX.IX.yF WHERE IT IS LABELED (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 7.1. 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.

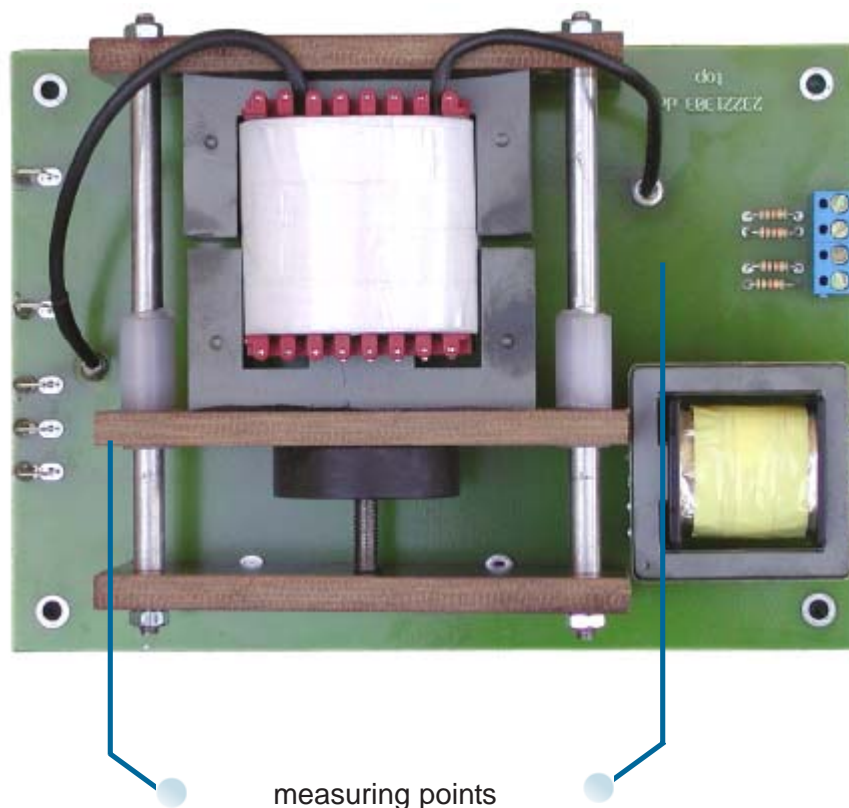


Fig. 7.1. Compensating Inductivity measuring

7. INDUCTIVE COMPENSATION AND INITIAL SETTINGS

7.2. Factory Settings and Initial Generator Start Up.

The MasterSonic MSG.x00.IX.yF 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.yF 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.yF 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.

7.2.1. Simplified methods for adjustment of MSG.x00.IX.yF

Using the **Remote Control Panel** set the generator 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:

$$L = 1.05[(1/4\pi^2f^2C) - L_s]$$

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

7. INDUCTIVE COMPENSATION AND INITIAL SETTINGS

- 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 to 30 | “Tracking” = 0 to 5 |
| “Sweeping” = 0 to 7 | “Sweeping” < = 0 to 4 |
| “Fast Sweeping” = 0 to 255 | “Fast Sweeping” = 0 to 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.

8. PC SOFTWARE CONTROL COMMANDS

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 |

8. PC SOFTWARE CONTROL COMMANDS

| 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. |

8. PC SOFTWARE CONTROL COMMANDS

| 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 paramewtters in the generator memory. (except "Power") |
| @03wr(CR) | Writes current "Power" paramewtter in the rectifier memory. |

NOTE: The maximum number of writing cycles is 100 000.

8. PC SOFTWARE CONTROL COMMANDS

Data transfer:

For RS485-USB Adapter - according to USB / RS485 interface.

For RS485-232 Adapter - according to RS232 / RS485 interface.

Note: The manufacturer recommends that only original MasterSonic RS485-USB (or RS485-232) Adapter to be used with the MasterSonic generator.

Comments:

MODE: Asynchronous

DATA: 8 data bits

Stop: 1

Baud rate: 19200

Parity: No

9. ADVANCED SETTINGS

NOTE: ADVANCED SETTINGS ARE INTERNAL SETTINGS OF THE GENERATOR WHICH MUST BE MADE ONLY BY AUTHORIZED PERSONNEL!

9.1. 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.yF generator.

Sweep Range and Jumper 2 (shown on fig. 9.1.) 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.yF generator into a conventional generator, operating on resonant frequency of the acoustic load. All other combinations are defined below.

9.2. Control Board Jumpers

Fig. 9.1. shows the position of Jumpers J1, J2 and J3 on the control PCB.



Jumper 1 ON;



Jumper 2; Position 1;
Positive DMMM Sweeping



Jumper 3; Position 1;
VCF



Jumper 2; Position 2;
Negative DMMM Sweeping



Jumper 3; Position 1;
XCO



Jumper 3



Jumper 2



Jumper 1



Fig 9.1. Controll Board Jumpers

9. 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 microprocessor, 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 homogeneously 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.9.1. and Table 9.1. show the position of J1 and J2 and the adjustment of different operating modes of MSG.x00.IX.yF ultrasonic generator.

Table 9.1.

| 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).

9. ADVANCED SETTINGS

9.3. Sweeping Adjustment

The MSGxXX.IX.yF 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.yF 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 9.2.

| 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) |



9. ADVANCED SETTINGS

Table 9.2.

| 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 |

9. 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 parameters:

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 parameters:

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 parameters:

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 parameters:

Sweep Range > 0

DMMM Gain = 0

Power: from 0 to 100%

PWM Period = 0.010s

PWM Ratio = 100%

Frequency: from 19 to 45 kHz

9. ADVANCED SETTINGS

9.4. MSG.x00.IX.yF Generator Parameters.

Programming and parameter adjustments of the MSG.XXX.IX.yF is done through the MasterSonic Remote Control Panel MSH-1 or the RS485-USB (or RS485-232) Adapter for PC/PLC control in combination with the MasterSonic PC software program.

The following generator parameters can be set and adjusted:

Table 9.3.

| 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 percentage 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 MSA2339 Adapter is described in the following chapters.

9. ADVANCED SETTINGS

Important notices regarding usage of PWM timing options.

- In most of applications for driving different piezoelectric loads it is not necessary or recommended 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.

9.5. 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 9.2. 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.

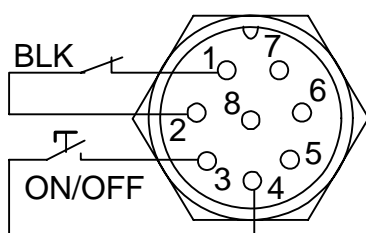


Fig. 9.2. External On/Off Power Control

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.

9. ADVANCED SETTINGS

9.6. 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 5 and 6, as shown on picture 4.6., the power is set from 0 to 100%.

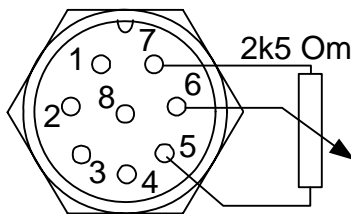


Fig. 9.3. Analog Input Power Control

10. 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.

The warranty does not apply when advanced settings are made by unauthorized personnel. User takes the liability for all damages caused by unauthorized advanced settings.

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.

11. 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 A

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 A

- 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 ultra-sonic 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.

APPENDIX B

Some examples of good frequency and modulations settings for your MMM MSG.x00.IX.yF generator:

| Parameter | Range for selection |
|--|---------------------|
| Frequency | |
| Sweep Range | |
| FSWM Period | |
| FSWM Ratio | |
| FSWM Range | |
| Power | |
| PWM Period | |
| PWM Ratio | |
| Max. Current | |
| DMM Q Factor | |
| DMM Fcorrection | |
| DMM Gain | |
| Selection to be made in order to produce the best acoustic activity effects in treated liquid. | |

APPENDIX C

MASTERSONIC RS485-USB USB to RS-485 insulated interface converter

DRIVER INSTALLATION MANUAL

INTRODUCTION

The MasterSonic RS485-USB (USB to RS-485) insulated interface converter utilizes an FT232BM USB to RS 232/RS 485 converter chip, which, upon plug-in into a USB port of a personal computer, activates a virtual serial port. The user software then uses this port to interface the converter.

Upon the first plug-in of the converter to a PC drivers must be installed in order to create the virtual serial port. The procedure for installing the drivers on Windows XP is presented in this manual.

INSTALLING FTDI DEVICE DRIVERS

FTDI have previously provided two types of driver for Windows: a D2XX direct driver and a virtual COM port (VCP) driver. Previously, these drivers were mutually exclusive and could not be installed at the same time. The new Windows combined driver model (CDM) allows applications to access FTDI devices through either the D2XX DLL or a COM port without having to change driver type. However, it should be noted that an application can only communicate through one of these interfaces at a time and cannot send commands to the D2XX DLL and the associated COM port at the same time.

The CDM driver comes in two parts. The bus layer provides D2XX style functionality and is always installed. The CDM driver will determine whether a COM port should be exposed by reading the EEPROM of FT232R, FT245R and FT2232C devices. In the case of FT232BM, FT245BM, FT8U232AM and FT8U245AM devices, the CDM driver will default to always installing a COM port. This behavior can be changed and EEPROM settings ignored by changing the driver INF files as detailed in [AN232B-10 Advanced Driver Options](#). Please note that modifying the INF files of a Microsoft WHQL certified driver will invalidate the certification.

Installing CDM Drivers

To install CDM drivers for an FTDI device under Windows XP, follow the instructions below:

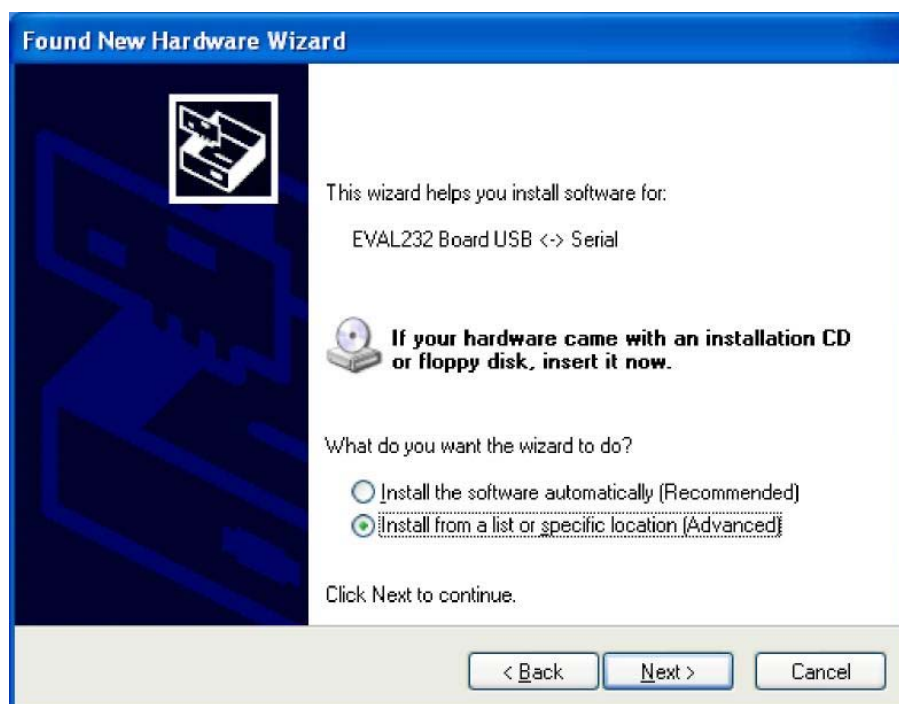
- * If a device of the same type has been installed on your machine before and the drivers that are about to be installed are different from those installed already, the original drivers need to be uninstalled. Please refer to the Uninstalling CDM Drivers section of this document for further details of this procedure.
- * Download the latest available CDM drivers from the [FTDI web site](#) and unzip them to a location on your PC (if you do not have an Internet access you could use the CDM drivers, provided with the device, but downloading the latest drivers is recommended).
- * If you are running Windows XP or Windows XP SP 1, temporarily disconnect your PC from the Internet. This can be done by either removing the network cable from your PC or by disabling your network card by going to the "Control Panel\Network and Dial-Up Connections", right-clicking on the appropriate connection and selecting "Disable" from the menu. The connection can be re-enabled after the installation is complete. This is not necessary under Windows XP SP 2 if configured to ask before connecting to Windows Update. Windows XP SP 2 can have the settings for Windows Update changed through "Control Panel\System" then select the "Hardware" tab and click "Windows Update".

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- * Connect the device to a spare USB port on your PC. Once the composite driver has been installed Windows Found New Hardware Wizard will launch. If there is no available Internet connection or Windows XP SP 2 is configured to ask before connecting to Windows Update, the screen below is shown. Select “No, not this time” from the options available and then click “Next” to proceed with the installation. If there is an available Internet connection, Windows XP will silently connect to the Windows Update website and install any suitable driver it finds for the device in preference to the driver manually selected.

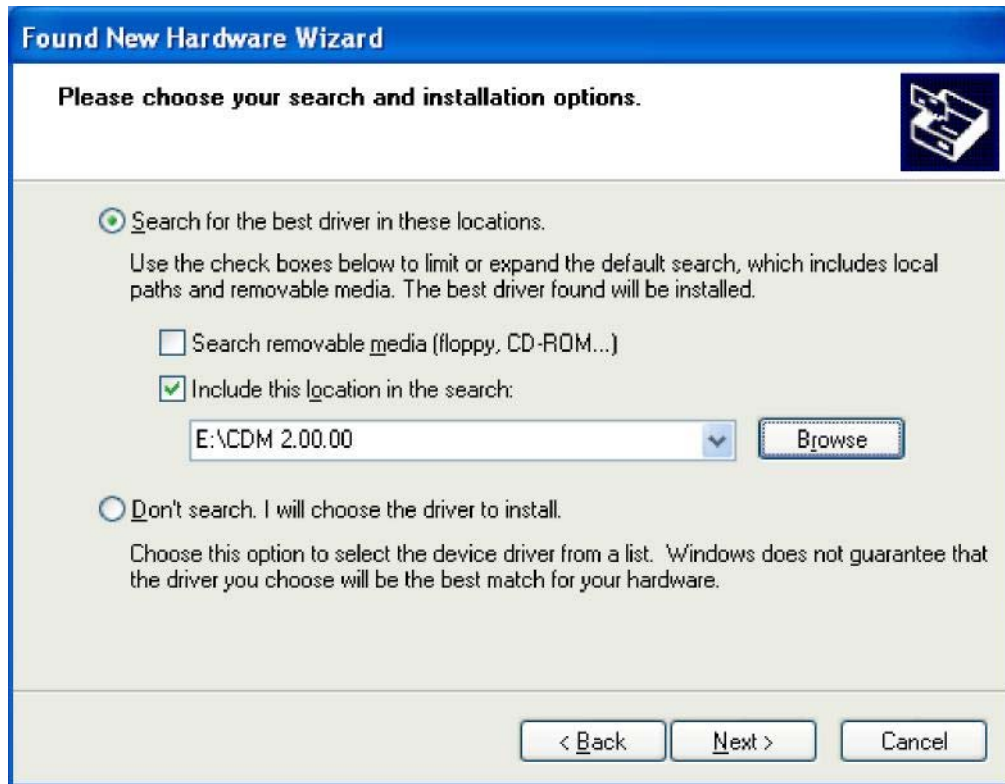


- * Select “Install from a list or specific location (Advanced)” as shown below and then click “Next”.



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- * Select “Search for the best driver in these locations” and enter the file path in the combo-box (“E:\CDM 2.00.00” in the example below) or browse to it by clicking the browse button. Once the file path has been entered in the box, click next to proceed.

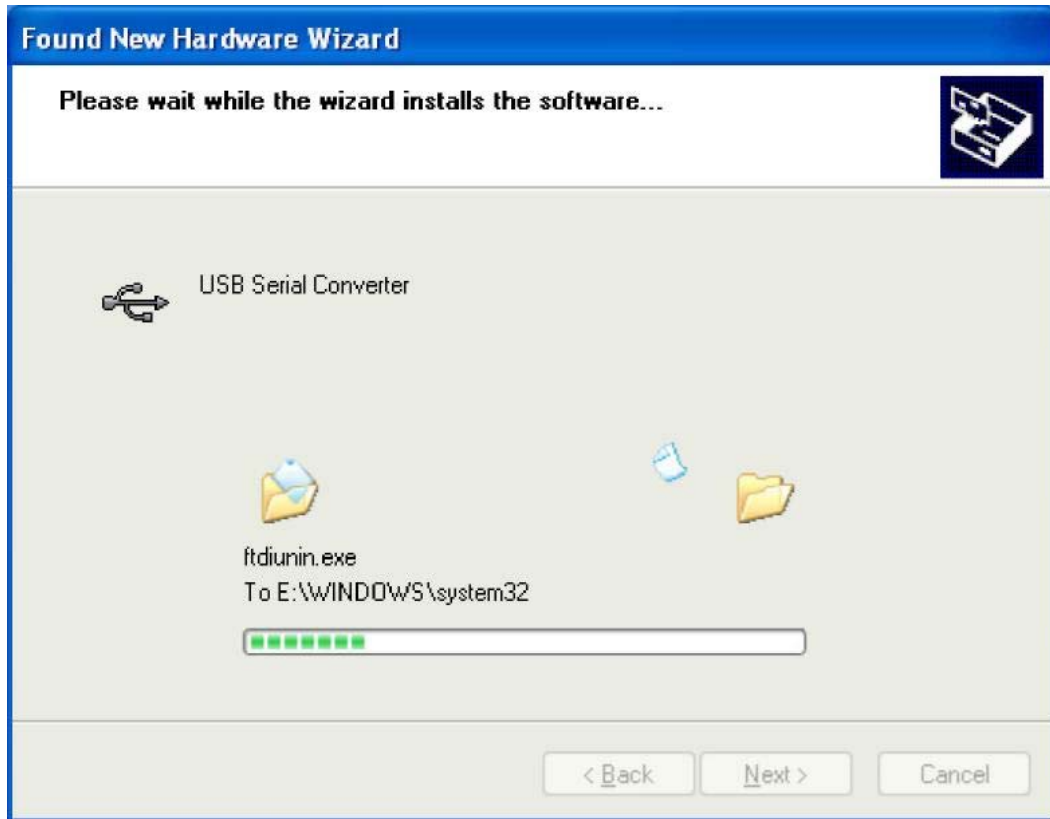


- * If Windows XP is configured to warn when unsigned (non-WHQL certified) drivers are about to be installed, the following screen will be displayed unless installing a Microsoft WHQL certified driver. Click on “Continue Anyway” to continue with the installation. If Windows XP is configured to ignore file signature warnings, no message will appear.



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- * The following screen will be displayed as Windows XP copies the required driver files:



- * Windows should then display a message indicating that the installation was successful. Click "Finish" to complete the installation for the first port of the device

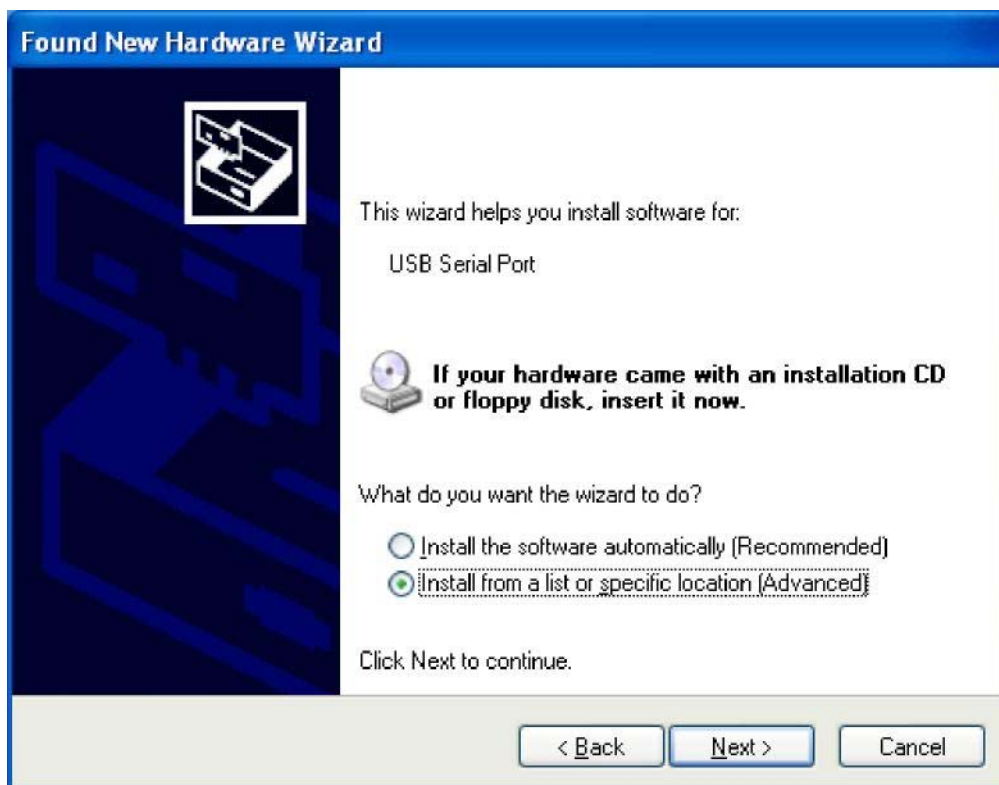


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- * Next, the COM port emulation driver is loaded as indicated in the following steps:
- * The Found New Hardware Wizard will launch automatically to install the COM port emulation drivers. As above, select “No, not this time” From the options and click “Next” to proceed with the installation.

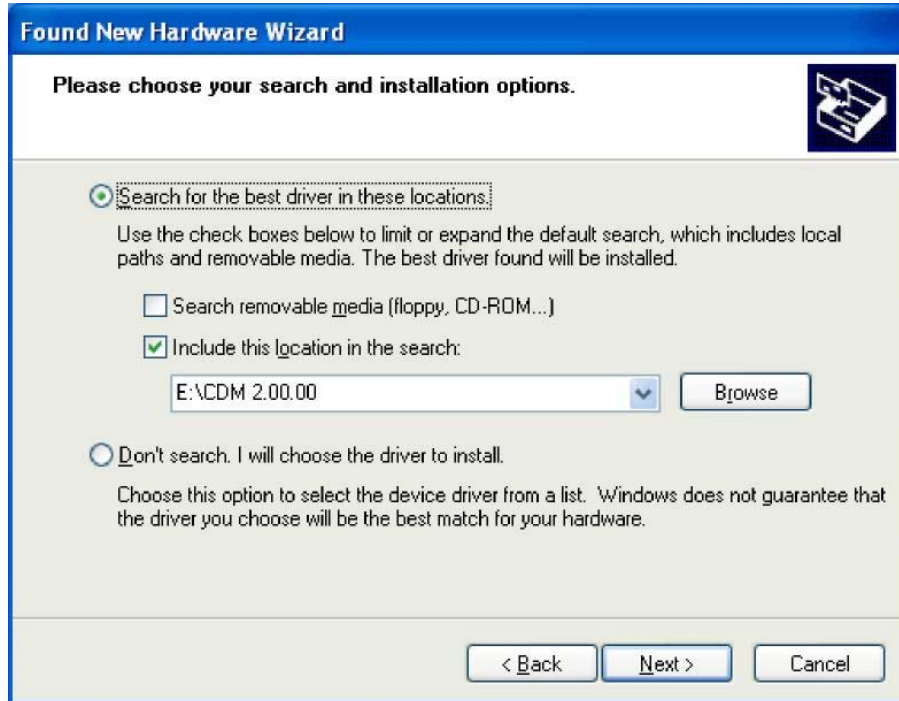


- * Select “Install from a list or specific location (Advanced)” as shown below and then click “Next”.



APPENDIX C

- * Select “Search for the best driver in these locations” and enter the file path in the combo-box (“E:\CDM 2.00.00” in the example below) or browse to it by clicking the browse button. Once the file path has been entered in the box, click next to proceed.

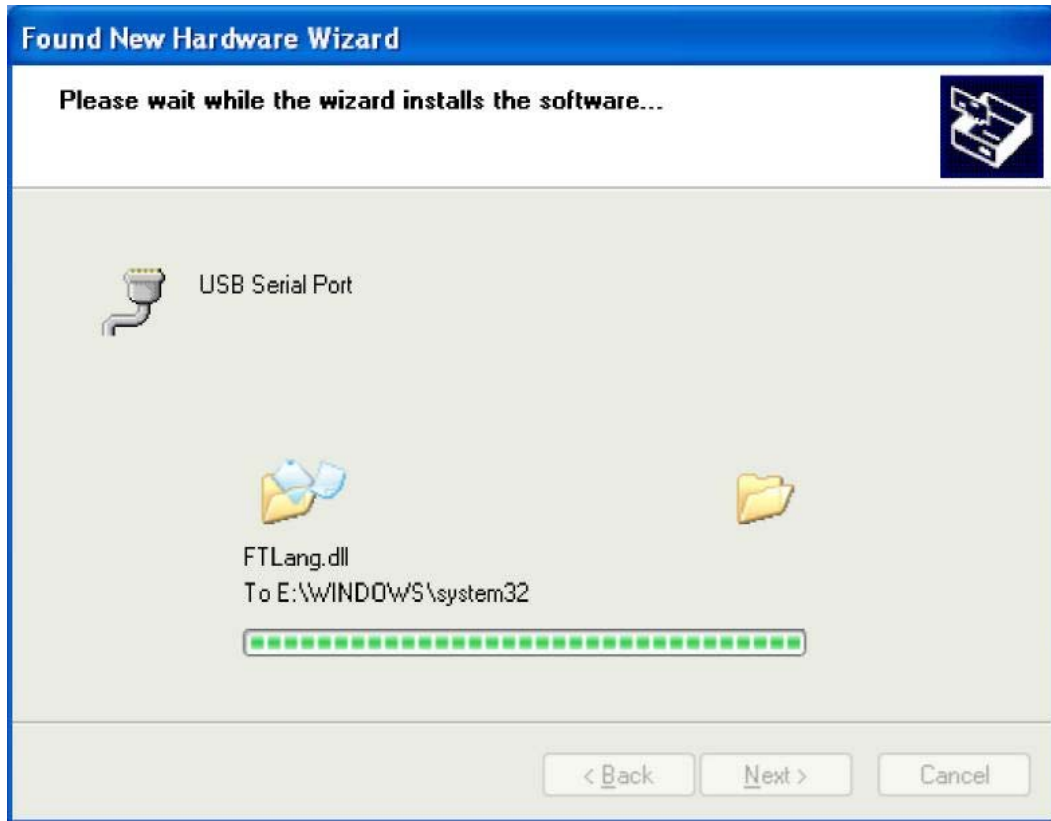


- * If Windows XP is configured to warn when unsigned (non-WHQL certified) drivers are about to be installed, the following screen will be displayed unless installing a Microsoft WHQL certified driver. Click on “Continue Anyway” to continue with the installation. If Windows XP is configured to ignore file signature warnings, no message will appear



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- * The following screen will be displayed as Windows XP copies the required driver files.

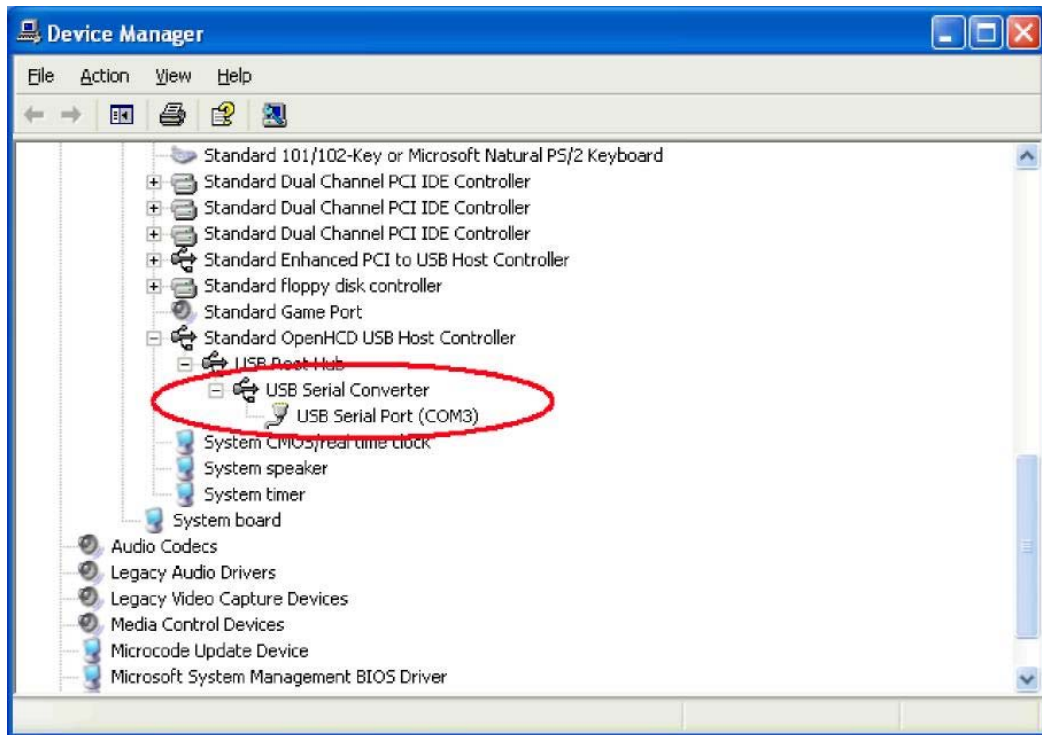


- * Windows should then display a message indicating that the installation was successful. Click "Finish" to complete the installation for the first port of the device.



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- * Open the Device Manager (located in “Control Panel\System”) then select the “Hardware” tab and click “Device Manger”) and select “View > Devices by Connection”, the device appears as a “USB Serial Converter” with an additional COM port with the label “USB Serial Port”



UNINSTALLING FTDI DEVICES

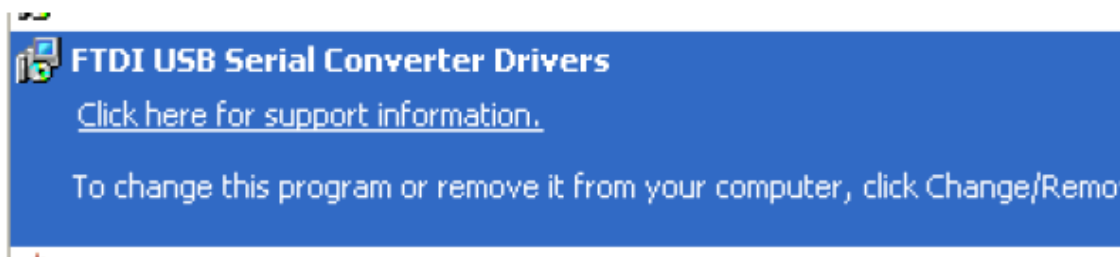
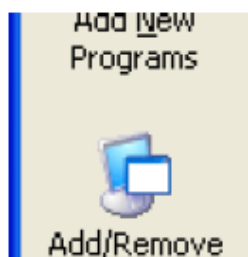
When uninstalling devices from Windows XP, it should always be done through the Add/Remove Programs utility as this uses the FTDI driver uninstaller program to remove files and registry entries to leave a clean system. Other methods may leave fragments of the driver that may interfere with future installations.

The FTDI uninstaller will also remove drivers which were pre-installed using DPInst.

Uninstalling CDM Drivers

To uninstall CDM drivers for FTDI devices, follow the instructions below:

- * Disconnect any FTDI devices that are attached to the PC.
- * Open the Add/Remove Programs utility located in “Control Panel\Add/Remove Programs”. Select “FTDI USB Serial Converter Drivers” from the list of installed programs.

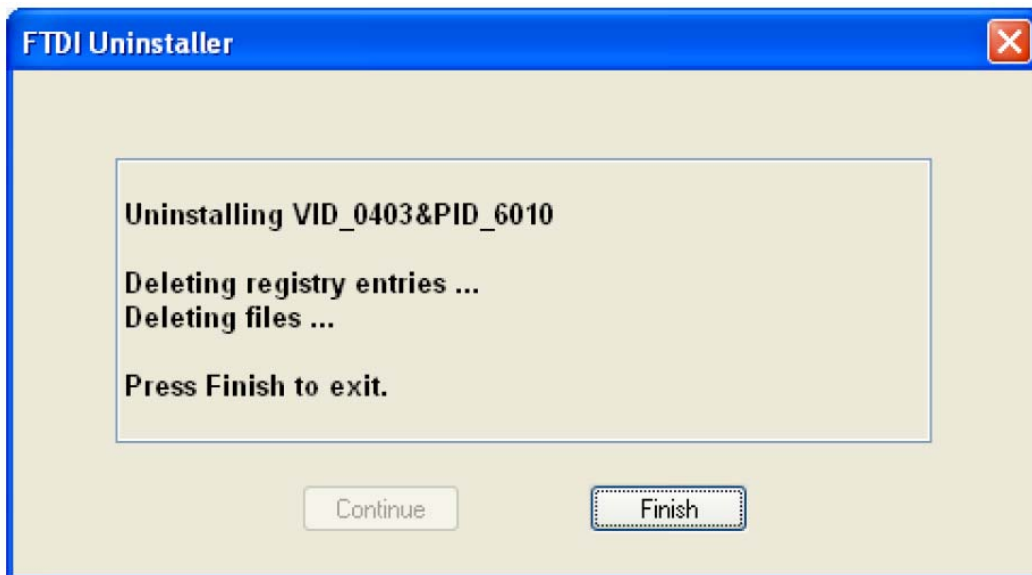


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- * Click the “Change/Remove” button. This will run the FTDI uninstaller program. Click “Continue” to run the uninstaller or “Cancel” to exit.



- * When the uninstaller has finished removing the device from the system, the caption on the “Cancel” button will change to “Finish”. Click “Finish” to complete the process



TROUBLESHOOTING

Windows XP displays an error and then terminates installation

If the following screen is displayed with this message, Windows XP has been configured to block the installation of any drivers that are not WHQL certified.

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Two options are available to successfully install the device. Either a certified version of the driver can be installed (if available) or the driver signing options can be changed to either warn or ignore to allow the installation to complete.

To change the current driver signing setting, go to "Control Panel\System", click on the "Hardware" tab and then click "Driver Signing". The desired signing option may then be selected.