IMTEC®

ACCUMEG™

Megasonic System Operating Manual

For Accumeg Systems with UO1200PMCA RF Generators

IMTEC Acculine
49036 Milmont Dr
Fremont, CA 94538 USA

Tel: 510-770-1800
Fax: 510-770-1800
imtec@imtecacculine.com

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1. Unpacking Procedures

1.1. Description

This section describes the procedures required for unpacking the IMTEC Megasonic System. The information is presented in these parts:

- Inspecting the Packaging
- Checking the Contents
- Unpacking Procedures

1.2. Inspecting the Shipping Container

Before opening the shipping container, please look for evidence of transportation damage. It is your responsibility to notify the shipper promptly of any claims of freight damage. Although IMTEC takes no responsibility for components damaged in transit, we ask that we be notified as soon as possible of any damaged components so that we may help with the damage claim and with an expeditious repair or replacement of the damaged parts.

IMPORTANT:

Keep the shipping container and packaging in which the system components where shipped. If any system component should ever need to be returned to IMTEC, it ***must*** be returned in an appropriate container to minimize risk of shipping damage. If the original container is not available, a packaging kit may be purchased from IMTEC for a nominal fee.

1.3. Checking the Contents

Review the equipment list for completeness. The following components should be present:

- Tank
- Tank Frame (including coupling tray for indirect systems)
- Transducer(s) Assembly (Mounted to Tank for Direct systems, mounted to coupling tray for Indirect systems)
- Generator(s)
- Cables (one per Generator output)
- This document (Operation Manual)
- Warranty card
- Any other options or components shown on the receiving documents and/or additional manuals

NOTE: If any of the above items are missing, contact IMTEC immediately.

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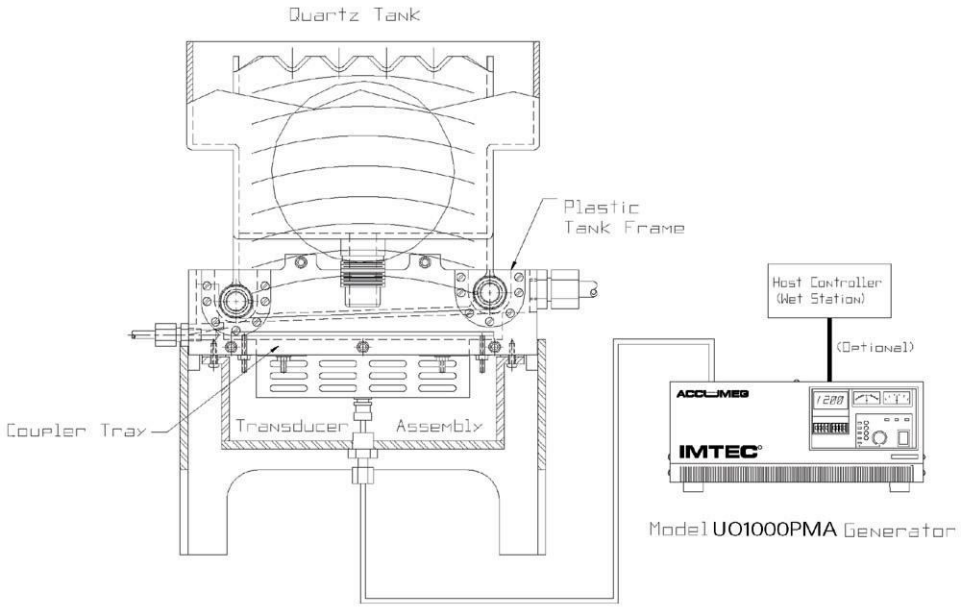
Figure 1-1: Megasonic Components



1.4. Unpacking Procedure

The unpacking of the components requires careful handling of the quartz tank to prevent breakage and to prevent “kinking” or crushing of the RF cables. All RF cables must be in excellent condition, free of creases, sharp bends, or crushing. A defective cable will not transmit maximum energy (wattage) from generator to transducer. If it is necessary to move or replace any RF cabling, great care must be taken to avoid the any damage.

Remember that quartz — **is fragile**. Place all quartz components on a level, padded surface with ample space at all times. Always wear protective gloves when handling Quartz components to insure cleanliness.

This concludes Section 1, Unpacking Procedures.

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2. Introduction

2.1. Description

This section describes the IMTEC Megasonic System in general terms and what information about it is contained within this manual. The information is presented in these parts:

- The Megasonic Cleaning System
- What this Manual Contains
- System Configurations

2.2. The Megasonic Cleaning System

The IMTEC Megasonic System is a non-contact, sonic cleaning system, which removes micron- and submicron-sized particles from wafers and other substrates. Megasonic systems can be used in a number of applications including SC1, Solvent strip, post sulfuric and phosphoric rinse, and final rinse.

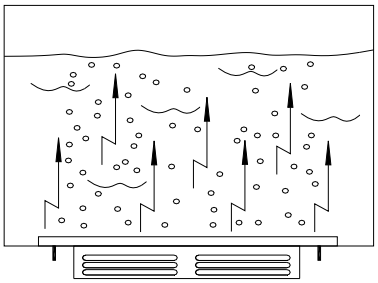
The IMTEC Megasonic System cleans wafers by transmitting sonic waves at a frequency of approximately 1 MHz through a liquid medium to augment the particle removal efficiency of a wet-cleaning process step. The force of the acoustic sound waves reduces the boundary layer on the surface of a wafer substrate to effectively lift more and smaller particles from the product surface. Particles are removed from the wafer surface and carried away via internal tank flow dynamics.

2.3. What this Manual Contains

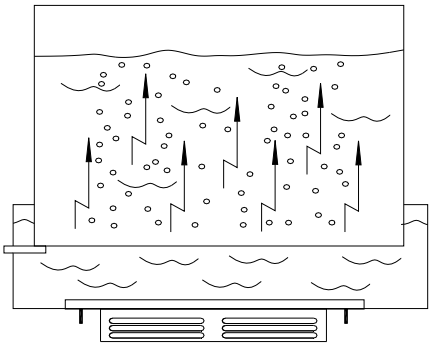
This document is meant to inform and instruct the reader about the procedures required for installing and operating the IMTEC Megasonic System. IMTEC recommends that it be read completely before any procedures are attempted.

2.4. System Configurations

This manual covers the Direct and Indirect Megasonic Cleaning Systems and should be read in conjunction with either the Model UO1000PMA (1000 Watt Digital Generator) Operating Manual or the Model UO1200PMQA (1200 Watt Digital Generator) Instruction Manual.



Direct



Indirect

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3. Safety Recommendations and Requirements

3.1. Description

This section describes the safety procedures recommended when using the Megasonic System. The information is presented in these parts:

- Regulations Check
- Electrical/Electromagnetic Safeguard Requirements
- In-Use Recommendations

NOTE: These recommendations are included for the Operator's safety and the protection of the Megasonic System. Please read through the recommendations completely before installing or operating the Megasonic System.

NOTE: These recommendations are advisory in scope; *IMTEC assumes no liability for the correct installation or use of this equipment.* It is the user's responsibility to ensure that facility preparation, system installation and operation are performed by properly licensed and trained personnel of the user's choosing.

3.2. Regulations Check

Prior to installation, IMTEC recommends a check of your company wet station Safety Regulations and Specifications, the local fire marshal codes and applicable electrical code requirements to be sure of compliance.

3.3. Electrical/Electromagnetic Safeguard Recommendations

The United States Department of Labor, through the provisions of the Occupations Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard, which applies to the use of this equipment. Proper use of this RF source results in exposure below the OSHA limit. The following precautions are recommended:

3.3.1. Observe common sense rules that apply when dealing with electricity.

3.3.2. Do not operate the RF Power Source unless all RF connectors are secure and any open connectors are properly terminated.

3.3.3. Ensure that all equipment is properly grounded.

3.4. In Use Requirements

3.4.1. For direct systems, make sure there is at least 50mm (2 inches) of fluid above the transducer before it is energized.

3.4.2. For indirect systems, never turn on the transducer without first ensuring that the boundary layer is full and the DI water flow (10-15 GPH) is functioning properly.

3.4.3 **Under no circumstances should a person put any part of his or her body into a bath while the Megasonic generator is turned on**. The RF energy, while apparently not harmful to skin, can severely damage bones and internal tissue.

NOTE: Additional safety information is located in pertinent sections of this manual.

This concludes Section 3, Safety Recommendations and Requirements.

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4. System Components and Specifications

4.1. Description

This section describes the components making up the Megasonic System and their respective specifications. The information is presented in these parts:

- The Tank
- Transducer Assembly
- Generator

4.2. Tank (Indirect)

4.2.1. All tanks used in the IMTEC Indirect Megasonic System are sloped bottom quartz tanks with a scalloped process chamber. Process chemistry is pumped through sparger tubes in the base of the tank.

4.2.2. The tank sits in a coupler tray supported by a plastic frame. The transducer arrays mount to the bottom of the coupler tray. The frame is designed to create a cavity between the bottom of the quartz tank and the top of the transducer array(s). DI water is circulated through this coupler tray to create a liquid medium for the transmission of energy from the transducers to the tank, and for cooling the transducers.

4.2.3. DI water feeds into the coupler tray through holes in the side or bottom of the coupler tray. To further remove any bubbles that form in the coupling tray, the flat bottom of the quartz tank is angled from side to side. This creates shallow and deep sides to the coupling water layer. Any bubbles that do form in the DI water migrate to the top of the deep side and escape to the atmosphere.

4.2.4. Strips of Teflon are used to cushion the quartz tank from the coupler tray to the bottom of the quartz tank.

4.3. Tank (Direct)

4.3.1 All tanks used in Direct Systems have the transducer assemblies mounted directly into the bottom of the tank.

4.4. Transducer Assemblies (a.k.a. Vibration plate or Oscillating Plate)

4.4.1 Either one or two transducer assemblies mount to the bottom of the systems. A gasket forms a seal between the fluid and the transducer assembly. The top of the transducer assembly may be specially coated — care should be taken not to scratch the transducer surface; **damage will result**.

4.4.2. Each transducer array contains a grid of piezoelectric crystals. The piezoelectric crystals are the oscillating devices of the system. When the power at the desired frequency is applied to the piezoelectric crystals, they vibrate at that frequency. This energy is transferred through the liquid medium.

4.4.3. Each set of piezoelectric crystals is matched to the Generator to provide maximum transmission electrical efficiency. The serial number of the matched transducer is noted on the generator.

4.4.4 A regulated flow of nitrogen gas or CDA of 10 PSI (3.4 kg/cm^2) delivered to the transducer housing orifice creates. .75 in. H^20 (1.9 cm H^20) internal to the housing. This purge

creates a positive pressure inside the housing to prevent corrosive gases or liquids from entering.

4.4.5 Special coaxial cables connect the transducer(s) to the RF Generator.

4.5 Generator

The Generator is specifically designed for driving the piezoelectric transducers for Megasonic Cleaning applications. (See Generator Model UO1000PMA or UO1200PMQA Manual for details).

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5. Facility Requirements

5.1. Description

This section describes the facilities required for successfully installing and operating the IMTEC Megasonic Cleaning System. The information is presented in these parts:

- Electrical Requirements
- Cooling Requirements
- Mounting Requirements
- Plumbing Requirements

5.2. Electrical Requirements

5.2.1. The Generator for the IMTEC Megasonic Cleaning System is wired for 200V+-4%, 208V ± 10% 10 amps (1000 W) or 12 amp (1200 W) operation. Contact IMTEC Technical Support before attempting any changes.

5.3. Cooling Requirements

5.3.1. To adequately cool the Generator, sufficient space must be allowed for air circulation. The air-intake is through the front of the unit and the exhaust at the rear. The area around intake and outlet openings must not be blocked.

5.3.2. *If the Generator is to be placed in a cabinet:* The ambient temperature within the cabinet must be no higher than 40°C. Cooling air must move continuously in and out of the cabinet. If ventilation is inadequate, temperatures may exceed safe limits.

5.4. Mounting Requirements

5.4.1. Place the generator where the front panel can be easily read and accessible for operation. The generator location must be free of corrosive liquid and fumes.

5.4.2. Ensure adequate access to the generator rear panel and cables.

5.4.3. Multiple generators should not be stacked higher than two. Place side by side with appropriate spacing.

5.5. Plumbing Requirements

In addition to plumbing for the tank, the following are also required:

5.5.1. DI Water for Boundary Layer (Indirect systems only): ¼" Compression fitting, (10-15 GPH) (38-57 LPH).

5.5.2. N_2: ¼"Compression fitting 10 PSI dynamic (3.4 kg / cm^2) (for transducer housing).

5.5.3. N_2: 1/8" NPT, 60 PSI (20.5 kg 1 cm^2) with regulation (plastics) (QDR systems only – for actuating dump doors).

5.5.4. Tank inlet, ¾" flared tube fitting, 15-25 liters/min.

5.5.5. Tank sump 1.0" QUARTZ flared stem, process chamber drains ¾" flared tube fitting.

5.5.6. Boundary layer outlet (indirect systems only), ½" Compression fitting.

This concludes Section 5, Facility Requirements.

6. Installing the System

6.1. Description

NOTE: Please read through all of the procedures before beginning installation.

This section describes the procedures required for installing the Megasonic System. The information is presented in these parts:

- Attaching the Transducers
- Mounting the Tank Frame in the Wet bench
- Routing the RF Cables
- Installing the Tank
- Mounting the Generator
- Installing the Interconnects

6.2. Attaching the Transducers

6.2.1. The system is shipped with the transducers already mounted to the coupler tray (indirect) of the tank frame or the tank itself (direct). If this is not the case, please contact IMTEC Technical Support.

6.3. Mounting the Tank Frame in the Wet bench

6.3.1. The tank frame is designed to be supported by either the upper flange or the frame legs. Place the tank frame into the wet bench cradle or rails so that the flange is well supported and the leveling screws can adjust the height of the frame without binding.

6.3.2. Ensure that there is sufficient clearance for the frame, transducers and cables.

6.4. Routing the RF Cables

6.4.1. Make sure all cables are labeled at both ends.

6.4.2. Drill and tap 3/8” NPT holes in the inside of bulkhead of the headcase or rear plenum to match the threaded fitting attached to the end of the cable.

6.4.3. Loosen the nut on the fitting so that the cable slides easily through the fitting and route the cable through the headcase or rear plenum holes, ensuring that no tension is applied to the transducer connection.

6.4.4. Tighten the fitting in the threaded hole at the pass-through, and then tighten the nut on the fitting to seal around cable. **Do not use pliers to tighten!**

IMPORTANT: Handle cables carefully to avoid crimping or kinking them.

6.5. Installing the tank

6.5.1. Carefully place the tank into the previously installed tank frame so that the weight of the tank is resting on the Teflon™ gasket (Indirect Systems only)

6.5.2. Attach ¼” O.D. DI water feed line to the male connector located underneath the coupler tray. (Indirect systems only)

6.5.3. Make sure the tank is positioned correctly and tighten the adjustment screws on the end of the tank frame to take up free play between quartz tank and the frame. *Do not over tighten. (Indirect systems only)*

6.5.4. Turn on the DI water to a flow rate of (10-15 GPH) (38-57 LPH). The boundary layer between the tank and the transducer should fill with water. (Indirect systems only)

IMPORTANT: The boundary layer must be completely filled with DI water and the DI water feed must continue to replenish that water at the prescribed flow rate during operation of the system. Without continuous water flow in the boundary layer(s), proper coupling cannot be achieved and the transducers will overheat!

6.5.5. Attach ¼" O.D. tubing for $N_{2\ or}$ CDA input to the bottom center of each transducer and turn on the N_2 feed to a pressure of (10 psi) (3.4 KG/CMZ) regulated.

6.5.6. Attach the balance of the plumbing for working fluid in-flow, drain, boundary layer trough (dry plenum only), and QDR spray bars (QDR systems only), working carefully around the RF cables (see Section 5.5).

6.6. Mounting the Generator

6.6.1. The Generator is a high powered electronic device and, as such, should be located in a dry, well-ventilated area free of corrosive fumes with an operating temperature of $0\text{-}40^0$ c.

6.6.2. The generator is wired for either 208VAC or 230VAC. Both have a tolerance of +/-10%. Make sure the supply voltage matches the input power specified on the generator label Contact IMTEC Technical Support about operating the generator at other voltages.

6.6.3. Ensure the front panel power switch is in the OFF (out) position.

6.6.4. Attach cables to the appropriate outputs on the back of the Generator according to the cable tags labeled earlier (see Section 6.4.1), being careful not to crimp or kink the cables.

6.6.5 Plug in power cord to the Generator and the appropriate power receptacle

6.7 Installing the Interlocks

6.7.1 All Imtec Indirectly Coupled Megasonic Cleaning Systems are shipped with a boundary layer sensor that will open if the boundary layer level is too low or the water temperature exceeds 70°C.

6.7.2 All systems include an N2 pressure switch to monitor the transducer housing N2 Purge.

6.7.3 At least one normally closed switch (i.e. closed in a safe condition) must be connected to the generator parallel port in order for the system to function.

6.7.4 For directly coupled systems (i.e. tanks that have transducers in the process vessel) it is the user's responsibility to provide a means of monitoring liquid level to ensure that the transducer cannot be run without being covered by at least 0.5 inches of liquid.

6.7.5 All customer supplied sensing devices should be of a dry contact type.

6.7.6 Refer to the Generator Manual section for proper connection of sensors.

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IMTEC MEGASONIC CLEANING SYSTEM LIMITED WARRANTY

(NON-WARRANTY OF MERCHANTABLILITY, FITNESS AND LIMITATION OF LIABILITY)

7.0 IMTEC warrants the Imtec Megasonic Cleaning System to be free from manufacturing defects in materials and workmanship for a period of *36 months* **from the date of original shipment from our factory with the following exceptions:**

1. ***IMTEC quartz ware is guaranteed to remain sound and whole in normal usage for a period of 45 days from the date of initial shipment.***

2. ***Any Teflon®or other coating of the transducer shall be warranted for a period of (1) ONE YEAR.***

Such warranty of IMTEC is limited as follows: In the event of such defect, IMTEC agrees at its option, to either repair or replace the defective unit or to refund the purchase price and IMTEC's liability is limited thereto. Units repaired or replaced under warranty will bear the remainder of the original equipment warranty.

All repairs will be made at IMTEC's place of business. Buyer shall pay the cost of returning the product to IMTEC's factory. Any such return must be pre-authorized by IMTEC, through issuance of an IMTEC RGA number. That number must be shown on the returned merchandise.

IT IS THE BUYER'S RESPONSIBILITY TO CAREFULLY INSPECT ALL PRODUCTS OR DAMAGE UPON RECEIPT. CLAIMS FOR DAMAGE IN SHIPMENT SHOULD BE SUBMITTED TO YOUR CARRIER. RETAIN ALL OF ORIGINAL PACKAGING AS THE CLAIMS ADJUSTOR WILL NEED TO INSPECT. IT ISS RECOMMENDED THAT ALL CLAIMS BE SUBMITTED WITHIN 5 DAYS OF RECEIPT OF SHIPMENT.

A. WHAT IS INCLUDED IN THE WARRANTY

IMTEC guarantees its equipment only if used with compatible chemistries, within proper temperature ranges for these chemistries, in proper environments, temperature, and voltage ranges for the equipment. With these conditions met, IMTEC guarantees:

1. Megasonic generator
2. Transducer
3. Built-in sensors
4. General workmanship

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B. WARRANTY EXCLUSIONS

While other exclusions may apply, IMTEC specifically does not guarantee and accepts no responsibility for:

1. Penetration or chemical attack of any material by unauthorized or non-approved user chemistries.
2. Chemical attack on quartz components.
3. Breakage of quartz or other product by impact, improper facility/wet-station installation, handling or other abusive treatment, or damage related to such impact-related or physically induced damage, such as internal corrosion.
4. Damage to the transducer or coating due to operating the transducer without fluid above it.
5. Damage to the transducer or coating due to operation above 70°C. (Max Chemical temperature in direct systems). (Max boundary layer water temperature in " in-direct" systems).
6. Damage to the transducer or coating due to operation without specified nitrogen or CDA.
7. Damage to the transducer or coating from physical contact.
8. Unauthorized customer modifications to any portion of the system (this may disqualify all warranties).
9. Generator or hardware failures caused by installation directly within the process-sink hood or other fume areas where it is subjected to corrosive environments in violation of normally accepted industry practice in appropriate sink control areas.
10. External temperature sensors where the protective outer coating has been torn, cut or abraded.
11. Where failure is due to negligence, abuse or vandalism.
12. Submersion of the unit or other non-standard practices.
13. Damage to the cables due to excessive bending.

IMTEC DOES NOT WARRANT MERCHANTABILITY OR FITNESS FOR ANY PURPOSE AND THERE ARE NO WARRANTIES, EXPRESSED OR IMPLIED, OTHER THAN THOSE EXPRESSLY STATED HEREIN. IMTEC IS NOT RESPONSIBLE FOR ANY CONSEQUENTIAL, INCIDENTAL OR OTHER DAMAGES WHATSOEVER. IMTEC'S LIABILITY IS LIMITED TO THE REPAIR OR REPLACEMENT OF SUCH DEFECTIVE PRODUCT OR REFUND OR PURCHASE PROCE AT IMTEC'S SOLE OPTION, AS STATED ABOVE. ALL CLAIMS MUST BE MADE TIMELY AND WITHIN THE WARRANTY PERIOD.

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IMTEC®

ACCUMEG™

Megasonic Generator Manual
Model # UO1200PMCA

Rev. 5

IMTEC Acculine
49036 Milmont Dr
Fremont, CA 94538 USA

Tel: 510-770-1800
Fax: 510-770-1800
Email: imtec@imtecacculine.com

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Disclaimer

This manual provides instruction for the operating, support and safekeeping of the megasonic acoustic generator powering your ACCUMEG™ System. It should be kept available for operating, maintenance and training purposes and may be reproduced as necessary for internal use only.

The Model UO1200 PMCA Megasonic Generator has been manufactured by Kokusai Corporation for IMTEC Acculine. The following is the information as provided by Kokusai and reproduced here with their permission. Inevitably, some conflicts will occur between Kokusai's general instructions / recommendations and that provided by the IMTEC System Operating Manual. Where this occurs, please follow the IMTEC directions; if in doubt, contact the IMTEC factory for clarification.

We thank you for purchasing this IMTEC ACCUMEG™ system and are confident that, with proper use, it will give you many years of trouble-free service.

Safety Information

1. This Megasonic generator is designed and manufactured to conform to the requirements under the European low-voltage Directive and the EMC Directive. KOKUSAI ELECTRIC ALPHA has declared the conformation and, therefore, attaches a "CE marking" to its generators.
   The user should read the manual carefully and understand the content, (especially precautions in chapter 2) so that the user and its property can be protected.

2. Keep the manual nearby for quick reference when operating the Megasonic generator.

3. This manual is indispensable for the operation of the Megasonic generator. The manual should be kept near the system for ready reference.

⚠ CAUTION

The owner of this Megasonic generator needs to apply for a use permit to the General Telecommunication Bureau of the Japanese Government. Fill in the attached form before applying for a use permit to the bureau. For details, read the accompanying "Procedures for Using High Frequency Facilities." Do not hesitate to contact us when you have any questions.

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1. Outline, Features, Configuration, and Specification

1.1. Outline

This Megasonic generator (or simply referred to as the "generator") is the major component of the MIKRO-SONIC cleaning system.

This Megasonic generator is connected to the Megasonic transducer to generate up to 1200W.

1.2. Features

(1) Stable output power

The Megasonic generator has a built-in CPU to perform power feedback control for stable output power. This enables the Megasonic generator to radiate stable Megasonic energy to the transducer.

(2) Versatile remote operation (Control mode set at Imtec Factory)

When two generators are used in a system, they are designated as Master and Slave. Remote operation of the Master generator leads to controlling the Slave generator simultaneously. A Master/Slave Cable is provided in this case.

When configured this way, labels indicating "MASTER" or "SLAVE" will be placed on the front of the generators.

(3) CPU control mode

There are three CPU control modes to control the generator, as follows:

- o Local operation mode

  This mode is applied when a single generator is used.

- o Operation setting mode

  This mode is applied when setting the operation of the generator.

- o Remote operation mode

  This mode is applied when the Megasonic generator is controlled from the user's equipment.

⚠ CAUTION

1. There are two ways to control remote operation. One way is to use REMOTE connector (Parallel interface), the other way is to use P1, P2 connector (RS485 interface). That is fixed by manufacture.
P1, P2 connector (RS485 interface) can not be used when the generator is set up to use the REMOTE connector (Parallel interface).
The REMOTE connector (Parallel interface) has limited functionality

(ALARM terminal and output monitor terminal,) when using the P1,P2 connector (RS485 interface).
2. Liquid level detection function is necessary with all operating modes (local, parallel, and RS485). It must be connected for operation.

1.3. Host Communication Capabilities

1.3.1. Communication Protocols.

(1) The generator may be configured at the Imtec Factory for either Parallel or RS-485 communications with a Host controller. The Parallel interface may also be referred to as a discrete I/O interface typically used in conjunction with a PLC.
When set up for Parallel control, each generator must be controlled by separate sets of contacts unless the Master / Slave feature is used (see 2 below)
When setup for RS485 control, one host can control multiple generators.

(2) The Accumeg Generator may also be configured for MASTER/SLAVE operation where a host will communicate to one generator (designated as MASTER) and it will control the second generator (designated as SLAVE).

(3) By combining features 1 and 2, 4 different communications setups can be used for Host control.
Based on the configuration that you chose, your Generators were setup in one of the following configurations:

ConfigurationNo.1. :RS485 control without MASTER/SLAVE function

ConfigurationNo.2. :RS485 control with MASTER/SLAVE function

ConfigurationNo.3. :Parallel control without MASTER/SLAVE function

ConfigurationNo.4. :Parallel control with MASTER/SLAVE function

Drawings of each configuration are found in APPENDIX-1 thru APPENDIX-4.

Please refer to them for proper connection and operational information.

<Important information regarding Host Communications>

1. When setup for Host Communication, the generator can be setup for either Parallel or RS-485 communications. It cannot do both simultaneously. The Host Communication mode is set at the factory.
2. In Parallel mode, the RS-485 port is completely non-functional.
3. In RS485 mode, the REMOTE connector has limited functionality. Specifically, the Liquid Level input (required) and Alarm monitor terminals are active as well as the 4-20mA “Output Power Level” signal.
4. Liquid level detection terminals are necessary to operation in all modes (local,

RS485 and parallel). A level sensor that supplies a closed contact when liquid is present must be used for the Generator to operate.

1.4. The composition of the shipment.

(1) Megasonic generator : 1

(2) Standard accessories

Power cable : 1

Master/Slave cable
(Only the MASTER/SLAVE operate composition is attached.) : 1

RS485 cable
(Only the RS485 control composition is attached.) : 1

RS485 terminator
(Only the RS485 control composition is attached.) : 1

DSUB37pin connector cable : 1

(3) Accompanying documents

Instruction Manual : 1

RS485 Software Specification : 1

Inspection certificate : 1

Warranty : 1

1.5. Main Specification

1.5.1. Megasonic Generator

1) Rating power supply : 208 V ac ± 10%,12A,single phase 50 Hz or 60 Hz±2%
2) Rating power consumption : 2.5 kVA
3) Rush current : 60A or less
4) Rated output : 1200 W
5) Generating frequency :700.0 kHz to 760.0 kHz or 950.0 kHz to 999.9 kHz
6) External dimensions : 380 (W) x 550 (D) x 175 (H) mm except projecting parts
7) Mass : Less than 25 kg per Megasonic generator

2. Safety Information (be sure to observe it)

2.1. General

(1) Securing safety

Securing safety means that the operators, livestock, and property are not exposed to hazardous conditions. Thus, a means to prevent such hazard shall be set up and maintained. A warning marking on this Megasonic generator and warnings in this manual are for the normal use of the Megasonic generator.

The type of hazard and level vary depending on the operator and its use conditions. Our safety precautions in this manual will contribute to safety operation of the Megasonic generator. The user should read this manual carefully and understand the content, and apply these safety precautions to the use conditions. In addition, the user shall abide by the public and private safety requirements when operating the Megasonic generator.

(2) Meaning of waning markings

The following indicate the warning markings and precautions used in this manual for safety operation.

Meaning of Warning Markings

Warning marking	Description
⚠ WARNING	Follow the instruction of the warning. Disregarding the warning can cause accidental death or serous injury.
⚠ CAUTION	Follow the instruction of the caution. Disregarding the caution can cause bodily injury or property damage.
WARNING	Avoid blanketing and abide by the warning.
CAUTION	Follow the instruction in the manual. Disregarding the instruction can cause property damage.

Meaning of Pictograms

Pictogram	Name	Description
	Exclamation in triangle	General precautions, alarming, noticing hazard Refer to the user's manual.
	Lightning in triangle	Avoid electric shock. Refer to the user's manual.

	Grounding marking in circle	Be sure to ground to the protective system.

(3) Hazard for Use Other Than Authorized

WARNING Electric shock, bodily burn, interference with another system, and hazardous malfunction

Be sure to connect this Megasonic generator to the specified transducer so that the Megasonic generator can perform Megasonic cleaning in the given cleaning tank. Unauthorized use can break the conformation symbolized by the CE marking, bringing about hazardous conditions.

Examples of hazard:

1) Burn due to high frequency high voltage
2) Failure of the Megasonic generator
3) Interference to transmission line
4) Interference to the computer system
5) Interference to another industrial equipment: bodily injury due to malfunctioning of, for example, an industrial robot.

(4) Hazard due to Dissemble or modification

WARNING Electric shock, bodily burn, failure, hazardous radio interference

A person authorized by KOKUSAI ELECTRIC ALPHA may dissemble or modify the Megasonic generator. It is extremely hazardous for other people to uncover the panel to contact circuits inside the Megasonic generator. High voltage can cause electric shock.

The repair or modification by a person not authorized by KOKUSAI ELECTRIC ALPHA breaks the conformation expressed in the EC marking, falling in "Hazard for Use Other Than Authorized."

(5) Precaution upon start

CAUTION Failure, smoking, or firing of the Megasonic generator and the transducer

1) Don't start the generator without connecting to the transducer.
2) Don't start the generator when the cleaning tank doesn't have sufficient
cleaning fluid. Disregarding the instruction will bring about the failure of
the generator and the transducer, sometimes leading to smoking or firing.

(6) Precaution for the Megasonic output cable (between the generator and the transducer)

CAUTION Bodily burn due to high-frequency high-voltage, failure of the generator

During operation, don't disconnect the Megasonic output cable. Such disconnection can cause bodily burn due to high-frequency voltage or failure of the generator.

(7) Precaution for handling the Megasonic generator

⚠ CAUTION Hazard due to load on the human body

The Megasonic generator weights approx. 25 kg.

Don't try to lift it up by alone.

Use an appropriate means, for example, hand truck, to carry the generator.

Assign a forwarder for distant transportation of the generator.

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2.2. Safety Precautions for Installation

2.2.1. Environmental conditions

⚠ WARNING Electric shock, fire, smoking, failure

This product is designed to safely operate in the environment conditions described below. Use in other conditions may result in death by electric shock, critical human injury, serious physical damage including fire and failures, or any combinations of these.

Always use this product under the environmental conditions described below. Control environmental conditions properly as necessary.

Environmental conditions

1) Indoor use:	Operate and store the product indoors.
2) Maximum altitude:	2,000m (1000m in applying mechanical directory)
3) Temperature:	5°C to 40°C
4) Maximum relative humidity:	80% up to 31°C, decreasing linearly to 50% at 40°C, No condensation is allowed.
5) Power voltage:	AC208V±10%, 50 or 60Hz±2Hz
6) Electric power line:	EN61010-1: 1993/A2: 1995 Installation Category II impulse withstand voltage transient over voltage
7) Pollution degree:	(1) No corrosive gas is allowed. (2) No foreign substances causing lowering of electric insulation such as dusts, vapor, water drips and oil mists are allowed. (environment equal or superior to that in ordinary offices)

2.2.2. Usage Environment

The Megasonic generator is designed for industrial applications. Since the generator is classified into Group 1, class A of the radio interference characteristics standard (EN55011/1998), it conforms to the relevant requirements.

(1)

WARNING Radio interference with residential, commercial, and light-industry areas

Don't use this generator in a residential area or commercial or light-industry areas. The generator can interfere with radios, TV sets, computers, and equipment for light industry.

In an extraordinary case, this generator can interfere with other nearby equipment extremely susceptible to radio interference when used in an industrial area, or when other equipment is positioned by the generator

even though the equipment conforms to the use in the industrial environment. In this case, the generator can damage products being processed and cause bodily injury as well.

(2)

⚠ WARNING Malfunction hazardous to other devices

1) Keep the following instructions when installing your generator. This will
reduce electromagnetic interference with other systems within the operating environment.
   - o Keep the generator as much as distant from other systems.
   - o Minimize the distance between the generator, remote control terminal, and power distribution panel.
   - o Keep the cables of the generator away from those of other systems.

2) Be sure to check the following before trial operation.
   - o Start the generator and set and keep the generator to maximum output. Check that the generator doesn't impact on other systems.

(3) How to reduce radio interference and electromagnetic interference

In addition to following the above instructions, when necessary, the user must take steps to reduce radio interference and electromagnetic interference, depending on the operating environment.

KOKUSAI ELECTRIC ALPHA is ready to assist the user to solve such problems. There are two cases; one is the case where we plan a measure and provide necessary materials for the user based on the information from the user; in the other case, we have to dispatch an engineer to the user to solve interference problems. In this case, the user shall bear all the costs.

2.2.3. Installation Personnel

⚠ WARNING Hazard to people, fire, etc.

The installation work until the user completes trial operation of the generator shall be conducted by a person who is familiar with the safety work standard and engineering work standard of your company.

2.2.4. Installing Place

(1) Precautions for inflammable gases and explosive gases

⚠ WARNING Explosion, fire

The Megasonic generator is not a explosion-proof product. Keep the following instructions to avoid an explosion or fire at the operating environment.

1) Be sure to have no inflammable gases and explosive gases.
2) Be sure to have no inflammable solvents and dusts.

(2) Installing your generator--1

⚠ CAUTION Danger of falling off, damage

Keep the following instructions to avoid hazard and damage caused the generator fallen off due to an earthquake or accidental contact by people.

1) Install the generator on a flat surface.
2) Don't pile objects on the generator.

(3) Installing your generator--2

⚠ CAUTION Danger due to overlooking a caution label

To avoid hazard due to overlooking a caution label, install your generator so
that workers can easily see the caution label. Also, keep appropriate illumination around the generator.

(4) Installing your generator--3

⚠ CAUTION Growing smoking, fire, or failure

The Megasonic generator has a power switch for overcurrent protection on
the rear panel. The witch lever automatically turns OFF when overcurrent
occurs. So, don't leave any stuff, including structure, cable, or wire, near the
switch lever that may hinder the switch lever from turning OFF.

(5) Wiring cables

⚠ WARNING Electric shock, fire

Select a pathway that can avoid disconnection, short, and insulation degradation of the protective ground line and cables; wear, damage, or deformation by external force; and corrosion and alteration due to water or
chemicals. When necessary, take appropriate steps to protect wired cables.

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2.2.5. Connection

(1) Connecting the generator with the transducer

CAUTION Failure and smoking of the generator, electromagnetic interference

The transducer that corresponds to the generator has electrical conformity at factory delivery, which is identified with a matching number.

Be sure to use match the numbers when connecting your generator with
the transducer cable. Don't shorten or extend the cable.

(2) Connecting the protective ground line and the power supply cable

WARNING Electric shock

Keep the following procedures to avoid electric shock.

1) Turn OFF the power of the Megasonic generator and then power distribution panel.
2) Connect the protective ground line in the power cable with the protective
ground line of the power distribution panel.
3) Connect the power line of the power cable with the corresponding power
terminal on the power distribution panel.

2.2.6. Precaution for Trial Operation

WARNING Danger on the body, fire, damage

Be sure to make trial operation in accordance with Section 2.3, Safety Precautions for Trial Operation.

Note Be sure not to start your generator with no cleaning fluid in the cleaning tank. This can burn and damage the transducer. KOKUSAI ELECTRIC ALPHA recommends you to formulate a safety system to avoid such careless mistakes.

2.2.7. Periodical Inspections

Among the "Safety Precautions for Installation" in this section, be sure to check the following points for their initial conditions.

(1) 2.2.1 Environmental Conditions: Necessary environmental conditions must be met.

(2) 2.2.2 Usage Environment: No troubles caused from radio interference or no electromagnetic interference

(3) 2.2.4 Installing Place: 1□ Necessary conditions and states are secured.

2) No damage, degraded insulation, and bad connection shall be found in the laid cables and wires.

2.3. Safety Precautions for Operation

2.3.1. Caution for the Cleaning Fluid--1

⚠ WARNING Hazard and damage due to explosion or fire, health hazard

The Megasonic generator has no explosion-proof design. In other words, electric energy used for the generator may ignite the inflammable atmosphere. Megasonic energy promotes to vaporize the cleaning fluid and spray it. Thus, keep the following instructions to avoid an explosion, fire, and health hazard.

1) Don't apply inflammable cleaning fluids.
2) Special care is necessary when using a cleaning fluid that is hazardous to health. Take special measures of preventing direct contact with the hazardous cleaning fluid and making appropriate ventilation.
3) Formulate procedures for handling hazardous stuff in accordance with the relevant public standards.

2.3.2. Precautions in Starting Operation

⚠ CAUTION Burning of the transducer, failure of the generator

Be sure to check the cleaning tanks (inner and outer tanks) for the specified quantity before starting your Megasonic generator.

Don't start the generator when there is no cleaning fluid or insufficient.

2.3.3. How to Handle an Abnormal Condition During Operation

⚠ CAUTION Growing fire and smoking

When you notice a bad smell, smoking, or abnormal heating, immediately
stop the generator and turn OFF the power switch.

3. Names of Parts and Their Operation

FRONT PANEL

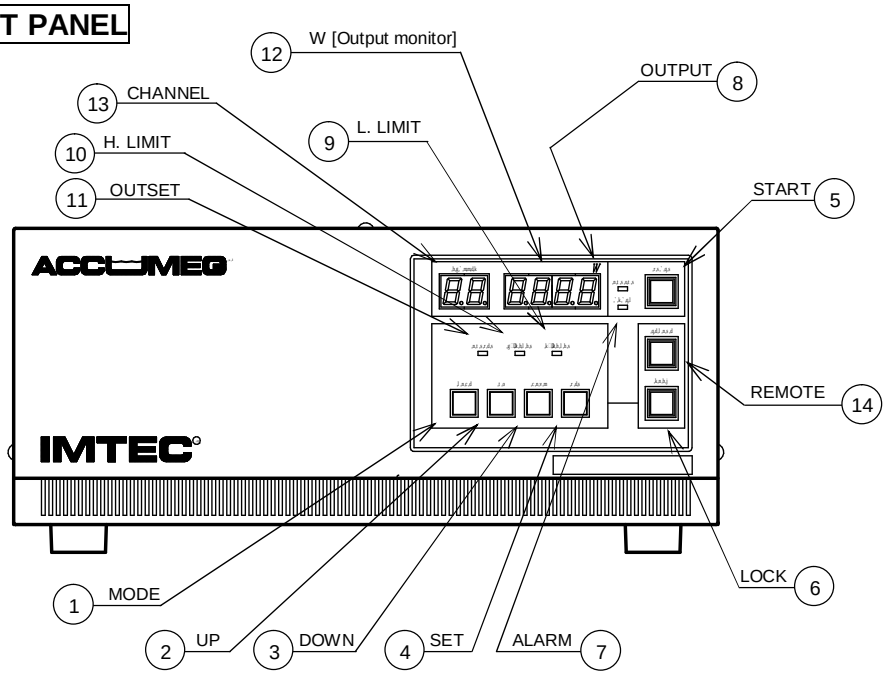

Figure 3-1 Controls and Displays on the Front Panel of the Megasonic Generator

1 MODE switch

changes over between the setting mode (preset output power value setting, upper limit power value setting, lower power value setting) and the local mode. Pressing the switch once changes over between the setting mode and the local mode. When the user starts in local mode, the target power value of the channel is the power value of the channel set in setting mode.

□The user may press the MODE switch while the LOCK lamp is off in local mode.

2 UP switch

increases the channel number and the power level in setting mode (preset output value setting, upper limit power value setting, lower limit power value setting). The UP switch allows you to increase the preset channel number while the generator is in wait mode.

□The user may press the UP switch while the LOCK lamp is off in local mode.

3 DOWN switch

Reduces the channel number and the power level in setting mode (preset output power value setting, upper limit power value setting, lower limit power value setting). The DOWN switch allows you to reduce the channel number in wait mode.

☞The user may press the DOWN switch while the LOCK lamp is off in local mode.

4 SET switch

Confirms the channel number of the preset channel in setting mode (preset output power value setting, upper limit power value setting, lower limit power value setting) and in wait mode.

The user may press the SET switch while the LOCK lamp is off in local mode.

5 START switch (with a lamp)

Turns ON/OFF the Megasonic generator.

Pressing the START switch when the switch is off turns ON Megasonic output. Likewise, pressing the START switch when the switch is ON turns OFF Megasonic output.

The START switch is disabled in REMOTE mode.

6 LOCK switch (with a lamp)

Disables the REMOTE switch, MODE switch, UP switch, DOWN switch, SET switch, and START swith in local mode. While the LOCK switch lamp is lit, the four switches from the MODE switch to the SET switch, and the REMOTE switch are disabled. Pressing the REMOTE switch when the LOCK lamp is off turns to REMOTE mode, making the lamp on. In REMOTE mode, the LOCK switch remains locked even when the switch is pressed.

7 ALARM lamp

Turns ON when the generator becomes abnormal.

The abnormal conditions mean when:

- The control box hardware becomes abnormal;
- The inside of the generator is overheated;
- Abnormal current conducts on the high voltage unit of the generator;
- Alignment with load becomes extremely abnormal;
- The FAN has stopped;
- The configuration is incorrect (example: single generation has been set despite Master/Slave generators);

- o SLAVE becomes abnormal in the MASTER/SLAVE configuration;
- o The power value measured has exceeded the upper limit setting value for the target power value of the preset channel being output;
- o The power value measured has gone lower than the lower limit setting value for the target power value of the preset channel being output.
- o The liquid level detection input has been opened.

In these case, the lamp turns ON and breaks Megasonic output.

8 OUTPUT lamp

Turns ON while a power level appears in the level display, and remains OFF while an error code, due to, for example, alarm, appears in the display.

9 L.LIMIT lamp

turns ON in lower limit power setting mode, and remains OFF in other mode.

10 H.LIMIT lamp

turns ON in upper limit power setting mode, and remains OFF in other mode.

11 OUTSET lamp

Turns ON in preset output power value setting mode, and remains OFF in other mode.

12 OUTPUT level display

Indicates the preset output power value, upper limit power value, and lower limit power value in setting mode.

The OUTPUT level display indicates the measurement value of the power being output while oscillation output does not starts in local mode or remote mode ("0" appears usually), whereas the display indicates the measurement value of the power being output while oscillation output has started. The display indicates the code of the alarm when it occurs.

13 Channel display

Indicates a channel number corresponding to the setting item in setting mode, whereas indicates the preset channel number being set in local mode. In remote mode, the channel display indicates a channel number directed by the upper interface.

14 REMOTE switch (with a lamp)

Enables the system to operate in remote mode. While the REMOTE switch lamp remains ON, the four switches from the MODE switch to SET switch, and the START switch are disabled. The LOCK switch lamp automatically turns ON and remains locked. In remote mode, the system follows the preset channel specified by the upper interface and the states of output enable signal and of output power selection signal. The user may press the REMOTE switch while the LOCK lamp remains OFF in local mode.

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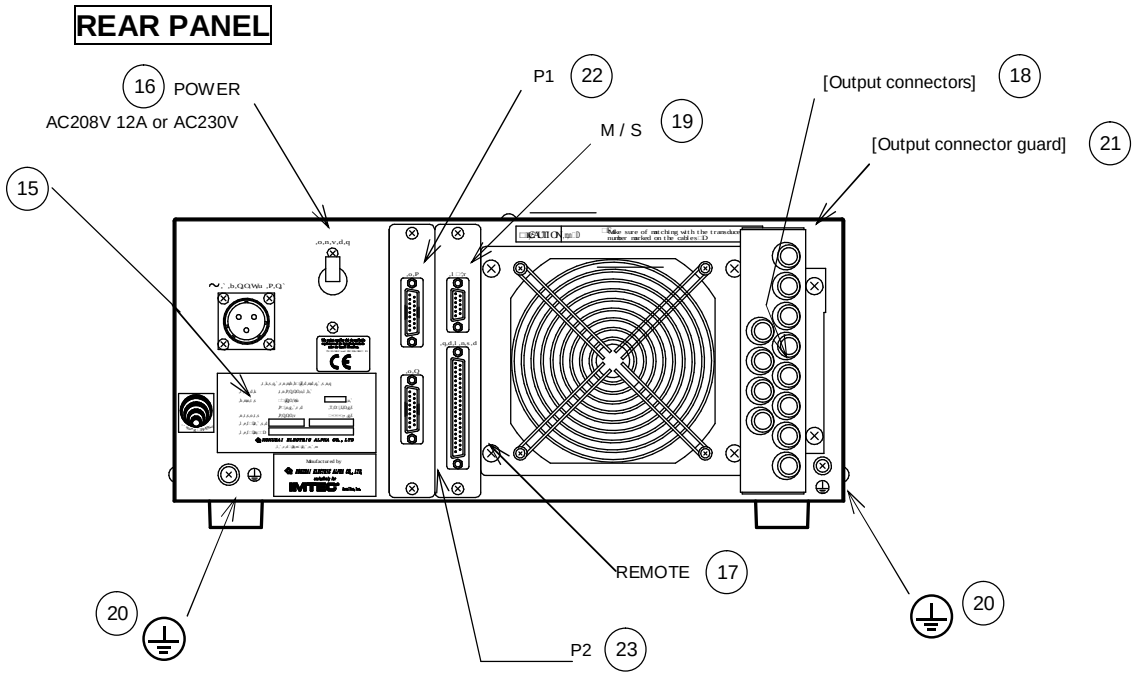

Figure 3-2 Rear Panel of the Megasonic Generator

15 Power connector

Is for the power cable attached. Firmly connect the connector with the power cable.

16 POWER switch

Turns ON/OFF the power of the Megasonic generator. The POWER switch has an overcurrent protection function.

17 REMOTE signal connector

Is used for selecting OUTPUT CONTROL and preset on the front panel, and for outputting the START control signal and error data of the generator. Connect the attached DSUB37pin connector cable to the connector.

18 Output connector

Is used for connecting the cable from the transducer.

19 Master/Slave connector

Is used for connecting the Master generator and the Slave generator. Use the dedicated cable to connect the generators.

20 Protective earthing terminal

Is connected with the PE⏚ of the power input connector inside.

Connect the terminal of the output connector to the protective earthing line of the transducer. Use the terminal of the power connector as a supplementary terminal of the protective earthing line (supplementary protective earthing) of the power cable.

⚠WARNING	The user may have electric shock if no protective earthing wire, mentioned above, is laid

21 Output connector guard

Prevents the user from accidentally removing/connecting the output connector during the operation of the generator. Without the connector guard fixed, no Megasonic is output.

22 RS485 upper side connector

Is used for connecting a cable near the upper side. The connector enables the generator to perform remote control via RS485 interface.

23 RS485 lower side connector

Is used for connecting a cable on the lower side equipment or the terminate connector. The connector enables the generator to perform remote control via RS485 interface.

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4. Precaution for Installation

The generator shall be installed by an engineer who is familiar with electrical hazard, your safety work standard, and authorized engineering work.

⚠WARNING ⚠CAUTION

Be sure to keep the instructions stated in Section 2.2,
Safety Precautions for Installation, besides the precautions stated here.

4.1. Generator - See Figures 4-1 and 4-2.

(1) **Avoid the place exposed to direct sunlight or where an heater is installed.**

(2) **Install the generator at a place in low humidity and less dust.**

(3) **The ambient temperature will increase when the generator works.**

(4) **Keep the generator 10 cm or more away from the wall or an object. Also keep a distance of 1 cm or more between two generators.**

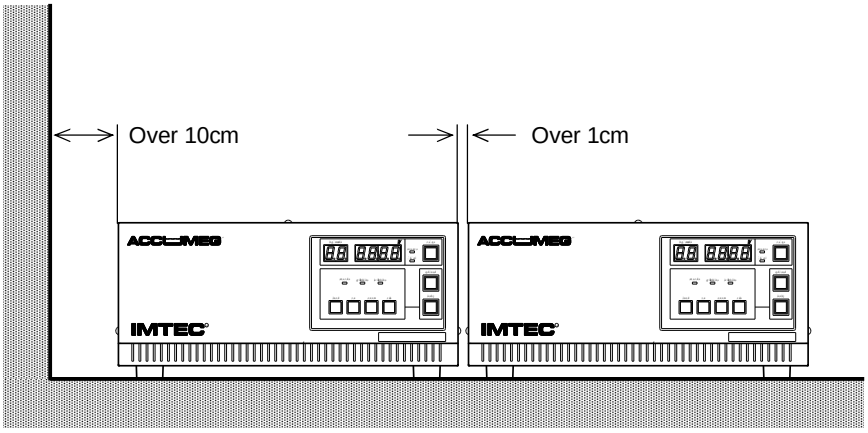

Figure 4-1 Position of the Generator

(5) **Don't pile your generators for use.**

(6) **The lower part of the front panel absorbs air and the rear part discharge air from inside. For air flow, secure a distance of 10 cm or more for the front side and 20 cm or more for the rear side of the generator. Arrange the generator so that the temperature at the air intake is 40□or less.**

(7) **Don't leave stuff on the top of the generator.**

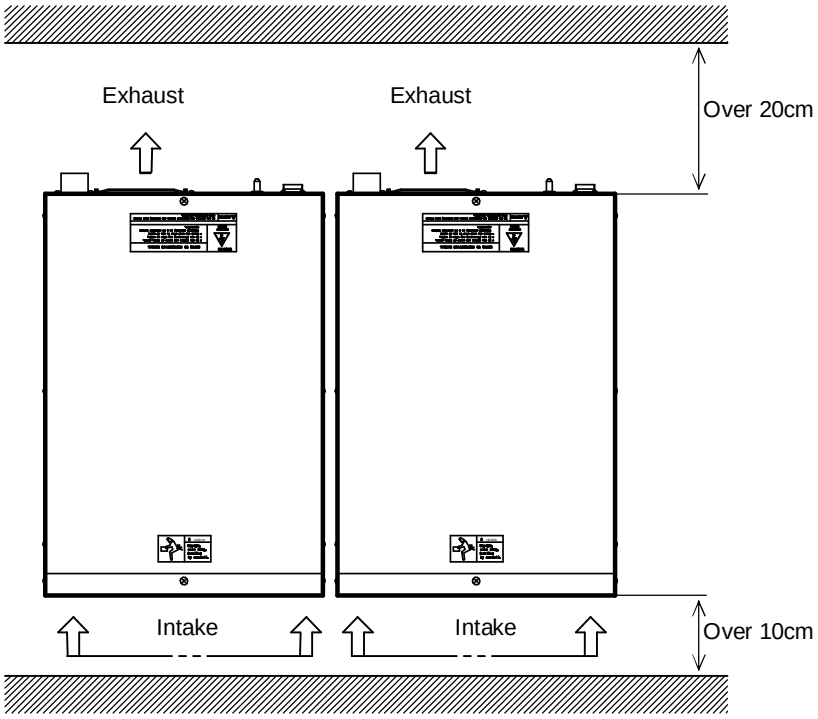

Figure 4-2

5. Connection

Connection and wiring shall be conducted by an engineer who is familiar with electrical hazard, your safety work standard, and authorized engineering work.

⚠ WARNING ⚠ \UTION

Be sure to keep the safety precautions stated in Section 2.2.5, Connection.

5.1. Connecting Output -: See Figure 5-1.

(1) Remove the output connector guard on the output connector on the rear panel of the generator.

(2) Connect the transducer cables (Megasonic power cable) coming out of the Megasonic generator through the hole of the connector guard with the output connectors . Rotate the connector clockwise and firmly lock it.

(3) Be sure to match the cable numbers of the cables with the numbers on the rear panel of the generator before connecting them.

(4) Firmly connect the output connector guard.

Note

1) The individual transducer cables of the coaxial cable have minimum bend
radius R of 40 mm.

2) Megasonic is not output when the output connector guard is not fixed.

5.2. Connecting the Protective Ground Line - See Figures 5-1 and 5-2.

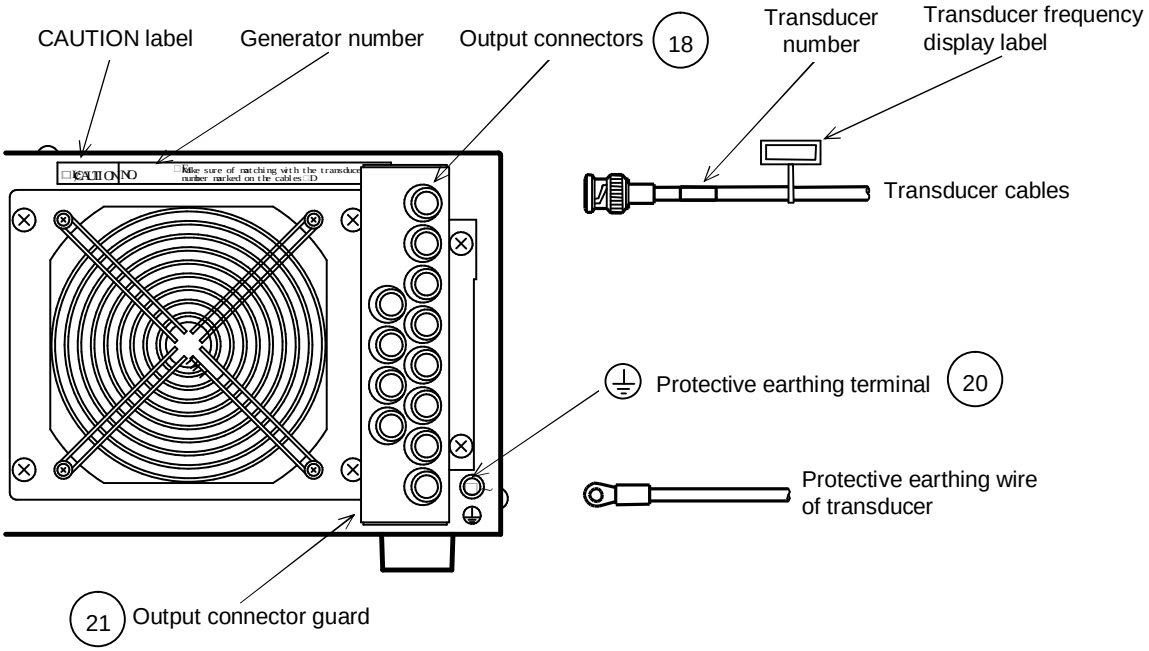

Figure 5-1

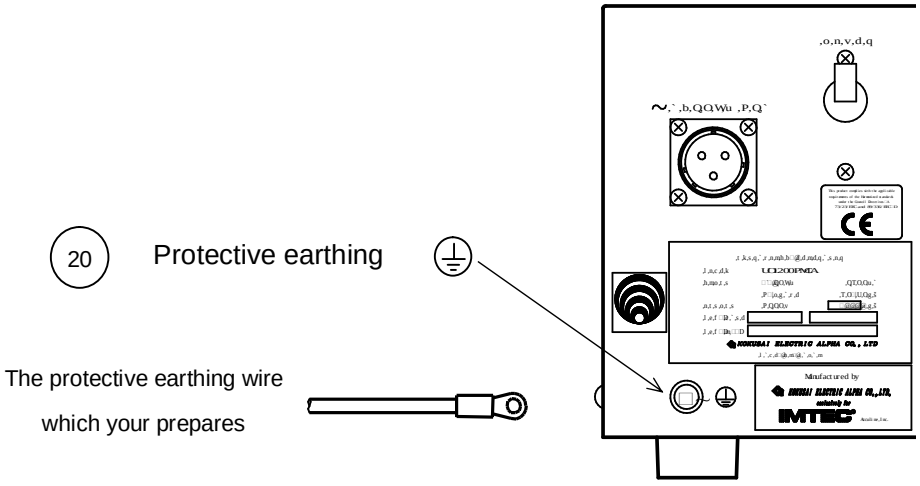

Figure 5-2

- **Connecting the Power Cable (power supply and protective earthing wire)**
  Connect the power cables (black-1, black-2) with the power distribution panel in your plant, and the protective earthing wire (green/yellow) with the protective earthing. Refer to Figure 5-2 for discriminating the power supply line and the protective earthing wire of the power cable.

⚠ WARNING Electric shock

- Turn the POWER switch to OFF on the rear panel by pressing down the lever.
- Leave wiring and connecting cables to an authorized engineer stated in Section 2.2.3, Installing Personnel.

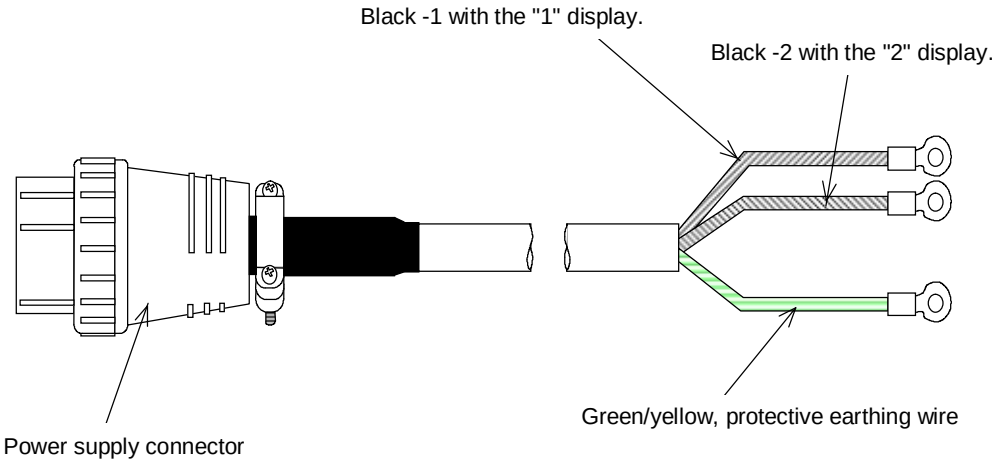

Figure 5-3 Discriminating Core Wires of the Power Cable

Black-1: Load wire

Black-2: Neutral wire

Green/Yellow: Protective earthing wire

Connection: Process the end of the power cable and connect the cable to the power distribution panel in your plant in accordance with your engineering work standard.

- **REMOTE Signal Connector**

Note Refer to Chapter 7, How to Use the REMOTE Signal Connector, besides precautions for use.

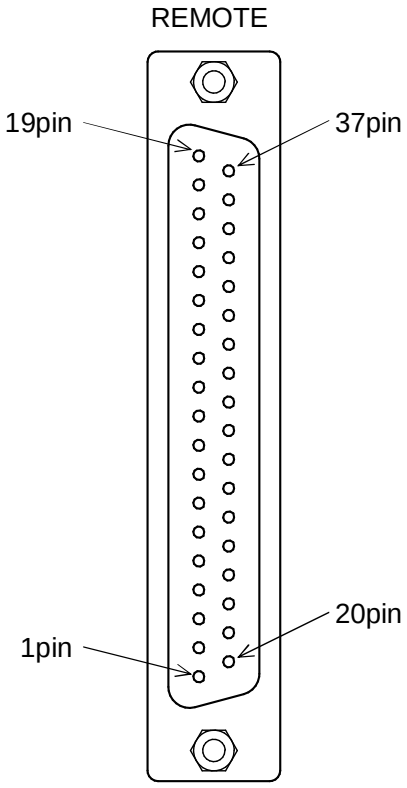

Figure 5-4

(1) REMOTE connector
It is used in REMOTE(Parallel) control configuration.
Is used for controlling the upper controller and for connecting status signals in parallel.
Use the attached DSUB37 pin connector cable to connect with the upper controller. See Chapter 7 for details.

(2) The control from Remote Controller is not possible, because the setting of generator is RS485 control. But, the status of generator can be timely watched by Remote Controller.

(3) Please refer to APPENDIX-3 and APPENDIX-4.

Note

1) The contact capacity of an output relay is 24Vdc, 0.2A.
2) Don't apply a voltage exceeding 42V between a terminal and the earth.
3) Two control way from upper controller. One is to use REMOTE connector, and other is to use RS485 connector. It is set at the factory shipments which use.

- **Master/Slave Connector**

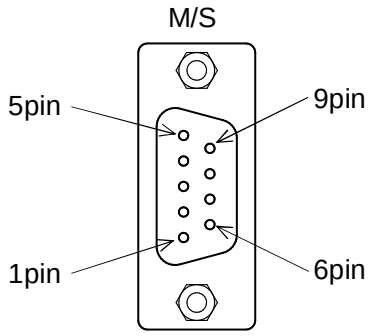

Figure 5-5

(1) Master/Slave connector

It is used in MASTER/SLAVE operate configuration.

Is a pin connector that connects between the MASTER generator and the SLAVE generator.

Use the dedicated cable, described in Chapter 8, Connector Specification for the Master/Slave Connection.

Please refer to APPENDIX-2 and APPENDIX-4.

- **RS485 Connector (P1,P2)**

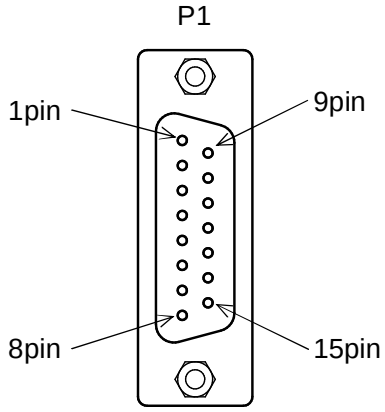

Figure 5-6

(1) RS485 connector

It is used in RS485 control configuration.

Is a pin connector used for connecting between the RS485 interface and the upper control device.

Use the dedicated cable, described in Chapter9.

Please refer to APPENDIX-1 and APPENDIX-2.

Note

1) Two control way from upper controller. One is to use REMOTE connector, and other is to use RS485 connector. It is set at the factory shipments which use.

6. Operation

⚠ WARNING ⚠ CAUTION Explosion, fire, and other hazard and damage

Be sure to keep Section 2.3, Safety Precautions for Operation.

6.1. Preparation

(1) Fill the cleaning fluid in the Megasonic tank (outer tank) and the cleaning tank (inner tank).Don't start the generator with no cleaning fluid on the vibraiting plate. Otherwise, the transducer will be damaged.

(2) Confirm that the generator and the transducer are firmly connected. (refer to Section 2.2.5, Connection, for details.)

(3) Turn OFF the POWER switch on the rear panel of the generator (downward).

(4) Check that the protective ground line is firmly connected.

(5) Turn ON the power switch of the power distribution panel.

6.2. Local Operation

(Operation)

(1) Turn ON the POWER switch (upward) on the rear panel of the generator. The exhaust fan starts rotating and the REMOTE switch lamp turn ON. Once press the REMOTE switch on the front panel to turn OFF.

(2) The channel number "01" appears in the channel display on the front panel. The initial set power value "0200" of preset channel 1 appears blinking in the OUTPUT level display for three seconds, before "0" appears in the level display as the current output power value (START switch lamp is not lit).

(3) Once press the START switch on the front panel to turn ON the switch. The START lamp turns ON.

(4) Change the value in the OUTPUT level display so that the value gradually approaches the set power value of preset channel 1.

(5) In a few seconds, the generator performs stable output at near the set power value, and continues oscillation.

6.3. Setting a Preset Output Power Value

The preset output power value is set at factory delivery. However, when the user wants to use another power value, the power value must be entered for the preset channel. (See to "6.4 Initial preset value" to know the output power value at factory delivery.)

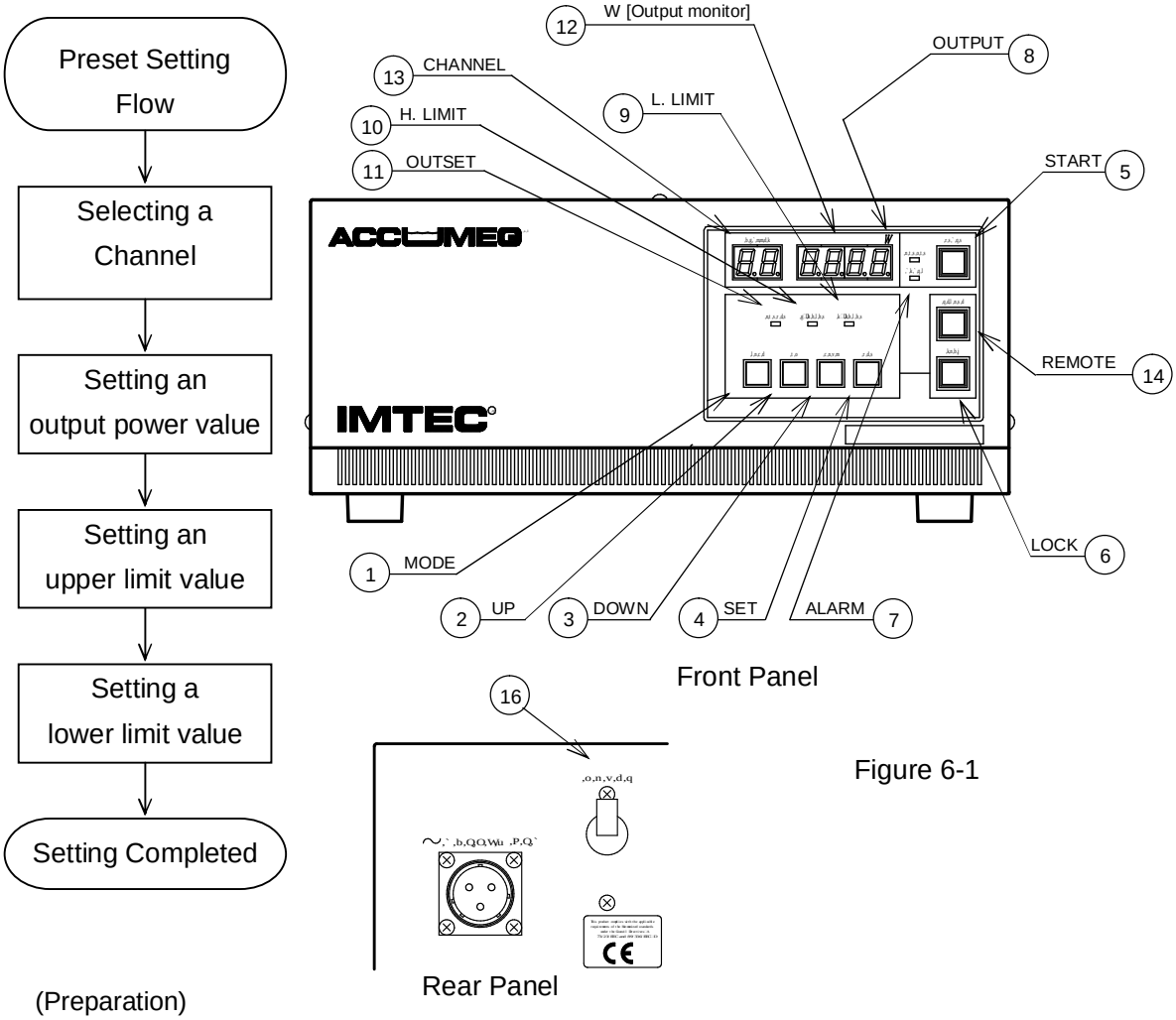

Figure 6-1

(Preparation)

(1) Turn ON the POWER switch on the front panel (upward).

(2) Confirm that the START lamp on the front panel is off.

(3) Confirm that the LOCK lamp on the front panel is off.

(Operation)

(1) Once press the MODE switch on the front panel.

(2) channel display on the front panel starts blinking.

(3) To select the preset output channel that performs settings, use the UP switch and the DOWN switch to match the channel number.

(4) Press the SET switch to confirm the preset output channel.
(5) The channel display stops blinking, and the OUTPUT level display starts blinking.
(6) Use the UP switch and the DOWN switch to match the power value to be set for this
channel.
(7) Press the SET switch to confirm the power value.
(8) The power value in the OUTPUT level display stops blinking for 0.5 second before proceeding to the next setting.
(9) The OUTSET lamp goes off, and the H.LIMIT lamp turns ON.
(10) The upper limit value for the power value set for this channel appears blinking in the OUTPUT level display.
(11) Use the UP switch and the DOWN switch to match the upper limit value to be set for this channel.
(12) Press the SET switch to confirm the upper limit value.
(13) The upper limit value in the OUTPUT level display stops blinking for 0.5 second before proceeding to the next setting.
(14) The H.LIMIT lamp goes off and the L.LIMIT lamp turns on.
(15) The lower limit value for the power value set for this channel appears blinking in the OUTPUT level display.
(16) Use the UP switch and the DOWN switch to match the lower limit value to be set for
this channel.
(17) Press the SET switch to confirm the lower limit value.
(18) The lower limit value in the OUTPUT level display stops blinking for 0.5 second before proceeding to the next setting.
(19) Use the UP switch and the DOWN switch to select an output channel.
(20) Press the SET switch to confirm the preset channel for output.
(21) The above settings have completed the preset power value setting, which are stored
on the internal memory. When the user turns ON the switch next time, the system starts operation with the current settings.
(22) Pressing the START switch with a lamp starts oscillation.

Note The ALARM lamp may turn on when your upper limit power value or lower limit power value is too close to the output setting value. This we recommend that your upper and lower limit power values should be lower than the power setting value by ±5%.

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6.4. Initial preset value

	1200W			1000W		
Preset No.	Output Power	Upper Limit	Lower Limit	Output Power	Upper Limit	Lower Limit
1	200	230	100	100	115	50
2	400	440	200	200	230	100
3	600	660	300	300	330	150
4	800	880	400	400	440	200
5	1000	1100	500	500	550	250
6	1200	1320	600	600	660	300
7	50	65	12	700	770	350
8	75	98	18	800	880	400
9	100	115	50	900	990	450
10	125	144	62	1000	1100	500
11	150	173	75	50	65	12
12	200	230	100	75	98	18
13	250	288	125	100	115	50
14	300	330	150	125	144	62
15	350	385	175	150	173	75
16	400	440	200	200	230	100
17	450	495	225	250	288	125
18	500	550	250	300	330	150
19	550	605	275	350	385	175
20	600	660	300	400	440	200
21	650	715	325	450	495	225
22	700	770	350	500	550	250
23	750	825	375	550	605	275
24	800	880	400	600	660	300
25	850	935	425	650	715	325
26	900	990	450	700	770	350
27	950	1045	475	750	825	375
28	1000	1100	500	800	880	400
29	1050	1155	525	850	935	425
30	1100	1210	550	900	990	450
31	1150	1265	575	950	1045	475
32	1200	1320	600	1000	1100	500

6.5. Setting range of the presetting value.

The rating power value.	1200W		1000W	
Setting range of the output power.	20W to 1200W		20W to 1000W	
Setting range of the lower limit.	Output power set value.	Possible setting range.	Output power set value.	Possible setting range.
	20W to 99W	~75% to Output power set value ~10W	20W to 99W	~75% to Output power set value ~10W
	100W to 1200W	20W to Output power set value ~10W	100W to 1000W	20W to Output power set value ~10W
Setting range of the upper limit.	Output power set value.	Possible setting range.	Output power set value.	Possible setting range.
	20W to 49W	+75% to Output power set value +10W	20W to 49W	+75% to Output power set value +10W
	50W to 99W	+30%to Output power set value +10W	50W to 99W	+30% to Output power set value +10W
	100W to 299W	+15%to Output power set value +10W	100W to 299W	+15% to Output power set value +10W
	300W to 1200W	+10% to Output power set value +10W	300W to 1000W	+10% to Output power set value +10W

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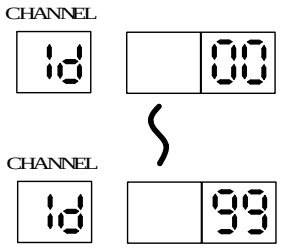
6.6. Setting an ID Number and a Baud Rate for RS485

6.6.1. Setting an Device ID

To move to device ID setting mode, keep pressing the MODE switch for two seconds in normal state (non-oscillation, non-preset setting) of local mode.

(1) Keep pressing the MODE switch for two seconds.
(2) "1d" appears in the CH 7SEG LED, and the current device ID appears in the power 7SEG LED (2 digits at right).
(3) Use the UP/DOWN switches to select an ID number within 00 to 99.
(4) Press the SET switch to store the set data on flash memory before exiting from device IDS setting mode.

The 7SEG LED shows the following:

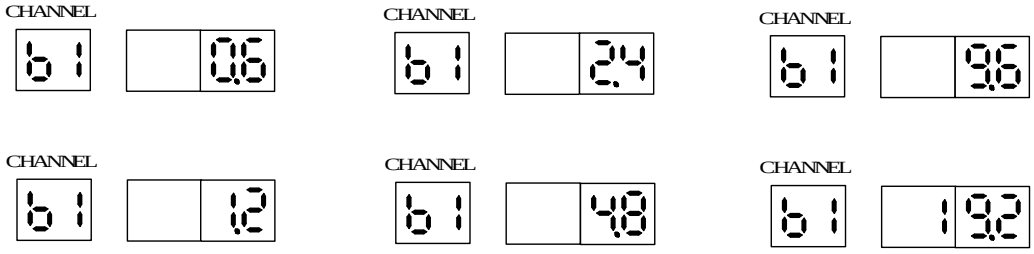


6.6.2. Setting a Baud Rate

After exiting from device ID setting mode, move to baud rate setting mode.

(1) "b1" appears in the CH 7SEG LED, and the current baud rate appears in the power 7SEG LED (3 digits at right).
(2) Use the UP/DOWN switches to select a the baud rate (0.6k, 1.2k, 2.4k, 4.8k, 9.6k, 19.2k).
(3) Press the SET switch to store the set data on flash memory before exiting from baud rate setting mode to normal mode.

The 7SEG LED displays the following:



6.7. Remote Operation 1 (connecting parallel signals)

(Preparation)

(1) Connect the attached control cable with the control signal connection connector on the rear panel of the generator.
(2) Connect the control cable with your device. (refer to Chapter 7, How to Use the Control Signal Connector.)
(3) Turn ON the POWER switch of the generator (upward).
(4) Confirm that the START switch lamp on the front panel is off.

(Operation)

(1) Confirm that the REMOTE lamp is lit, if not then press the REMOTE switch on the front pannel.
(2) Your remote device enables to control the generator.

6.8. Remote Operation 2 (connecting serial signals)

(Preparation)

(1) Connect the attached control cable with the RS485 upper connector on the rear panel of the generator.
(2) Connect the control cable with your device.
(3) Connect the attached terminator with the RS485 lower connector on the rear panel of the generator.
(4) Turn ON the POWER switch of the generator (upward).
(5) Confirm that the START lamp is off on the front panel.

(Operation)

(1) Confirm that the REMOTE lamp is lit, if not then press the REMOTE switch on the front pannel.

(2) Your remote device enables to control the generator.

6.9. Stop

(1) In remote control, turn OFF the START control of the remote control terminal.

(2) In local control, turn OFF the START switch on the front panel of the generator. (Turn OFF the START switch lamp.)

(3) Turn OFF the POWER switch on the front panel of the generator.

Note

- To turn ON/OFF Megasonic output, turn OFF the START switch on the front panel in local control, and with the contact connected with the START control of the remote controller.
- Megasonic output will be unstable for 30 seconds right after operation. This does not mean the generator is abnormal.
- The value 1080 to 1320 appears as power control MAX in the OUTPUT level display. In this case, the conditions are:
  1) The temperature of the fluid in the Megasonic tank (city water) must be as specified.
  2) No stuff except water (beaker, work, etc. that reflects Megasonic) must be in the tank.
  3) The atmosphere temperature must be 20 to 40°C.
  4) Power supply must be rated voltage.

  In case where any one of your operating conditions are different from the above conditions, output power can vary, and any of your operating conditions may exceed the above values.

6.10. Precautions for Operation

⚠ CAUTION

- Be sure to match ID numbers of your generator and transducer.
- Don't start your generator when no fluid is found in the Megasonic tank (outer tank). Otherwise, the generator will fail. Furnish a safety mechanism
  so that the generator is disabled when no fluid is found in the outer tank.
  You need to check the mechanism from time to time.

7. How to Use the REMOTE Signal Connection Connector

Note

Connect the REMOTE signal connection connector to the master generator when a composition of MASTER/SLAVE operate.

7.1. Pin Assignment of the REMOTE Signal Connector

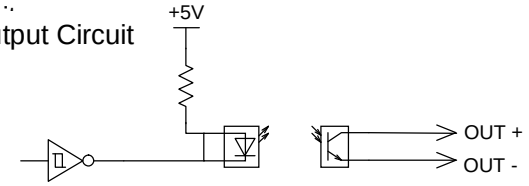
Pin No.	Signal name	Input/ Output	Description	Operation in RS485
1	PRS0(+)	IN	Output preset input bit0	Disable
2	PRS2(+)	IN	Output preset input bit2	Disable
3	PRS4(+)	IN	Output preset input bit4	Disable
4	OE(+)	IN	Output enable input	Disable
5	OPSEL(+)	IN	Output power select (master/slave)	Disable
6	WATT4(+)	OUT	Output power display bit4	Disable
7	WATT6(+)	OUT	Output power display bit6	Disable
8	WATT8(+)	OUT	Output power display bit8	Disable
9	WATT10(+)	OUT	Output power display bit10	Disable
10	WATT12(+)	OUT	Output power display bit12	Disable
11	Output monitor (+)	OUT	Analog output monitor(4□20mA)(+)	Active
12	STBY	OUT	Standby output	Active
13	COM	OUT	Standby signal, OSCOUT signal COMMON	Active
14	LLDS(+)	IN	Liquid Level Detection Sensor	Active
15	Lower limit A	OUT	Lower limit alarm A	Active
16	Lower limit COM	OUT	Lower limit ALARM signal COMMON	Active
17	Alarm B	OUT	Alarm B	Active
18	NFB trip A	OUT	AC input overcurrent A	Active
19	Trip COM	OUT	AC input overcurrent COMMON	Active
20	PRS1(+)	IN	Output preset input bit1	Disable
21	PRS3(+)	IN	Output preset input bit3	Disable
22	COMPRS	IN	Preset signal COMMON	Disable
23	COMOE	IN	Output enable signal COMMON	Disable
24	COMOPSEL	IN	Output select signal COMMON	Disable
25	WATT5(+)	OUT	Output power display bit5	Disable
26	WATT7(+)	OUT	Output power display bit7	Disable
27	WATT9(+)	OUT	Output power display bit9	Disable
28	WATT11(+)	OUT	Output power display bit11	Disable
29	COMWATT	OUT	Output power display signal COMMON	Disable
30	Output monitor(-)	OUT	Analog output monitor(4-20mA)(-)	Active
31	OSCOUT	OUT	Outgoing output status	Active
32	Upper limit A	OUT	Upper limit alarm A	Active
33	Upper limit COM	OUT	Upper limit ALARM signal COMMON	Active
34	LLDS COM	IN	Liquid Level Detection Sensor COMMON	Active
35	Alarm A	OUT	Alarm A	Active
36	Alarm COM	OUT	Alarm signal COMMON	Active
37	NFB trip B	OUT	AC input overcurrent B	Active

7.2. Hardware Connection of Control Signals

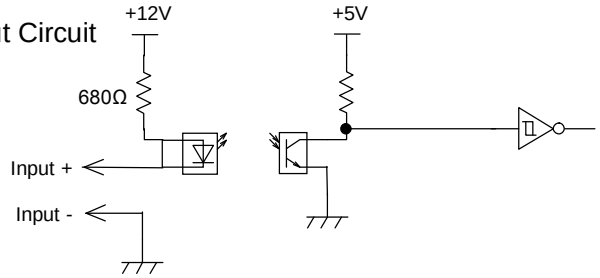
Signal Name: PRS0, PRS1, PRS2, PRS3, PRS4, OE, OPSEL, WATT4, WATT5, WATT6,

WATT7, WATT8, WATT9, WATT10, WATT11, WATT12,LLDS internal Input/Output Circuit

Output Circuit



Input Circuit

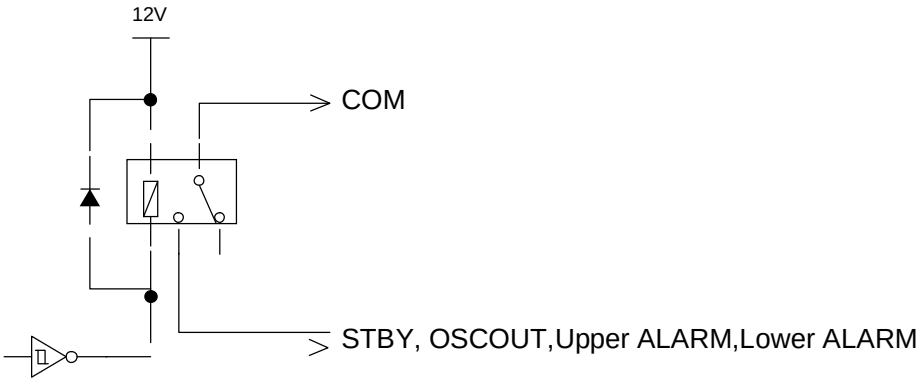


Current capacity of output circuit □MAX300mA

ON resistance of output circuit 2Ω

Maximum Voltage of output circuit: 42V

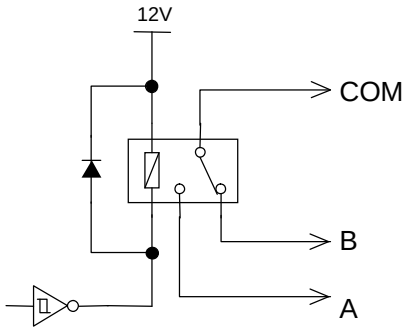
Signal Name: STBY,OSCOUT,Upper ALARM,Lower ALARM internal Output Circuit



Current capacity of output circuit : Max. 0.3A Min. 100μA

Maximum Voltage of output circuit : 42V

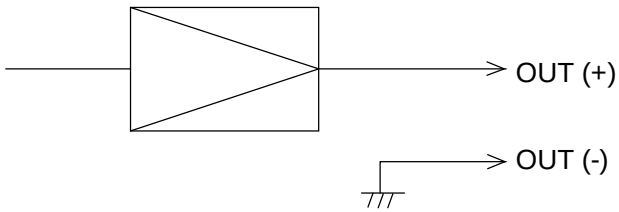
Signal Name: ALARM,NFB Trip internal Output Circuit



Current capacity of output circuit : Max. 0.3A Min. 100µA

Maximum Voltage of output circuit : 42V

Signal Name: OUTPUT MONITOR internal Output Circuit



Current of output circuit : 4mA to 20mA

Voltage of output circuit : MAX 15V(When OPEN)

Connection resistance : 600Ω or less

7.3. Description of Control Connection Signals

The contact point to be connected must have no voltage.

Use a gold contact point that weak current can conduct.

Use the dedicated cable attached.

On the connection attached cable, please reffer to chapter 7-(4) ”REMOTE CABLE CIRCUIT DIAGRAM (3CD02147)”.

NOTE Use the dedicated cable to connection to the CE standard.

(1) OE terminal(valid on parallel operation)

Use an OE terminal when turning ON/OFF Megasonic output from a remote place.

NOTE a circle means closed and x means opened.

OE terminal --COMOE terminal	Megasonic output
○	Yes
×	No

(2) LLDS terminal(valid on all operation)

Surely connect Liquid Level Detection Sensor. Caution ultra sonic power is not output when also local operation or RS485 operation, if do not connect this terminal.

(Note) a circle means closed and x means opened.

LLDS terminal --LLDS COM terminal	Liquid in the transducer
○	Yes
×	No

(3) Selecting an output channel (PRS0 to 4)(valid on parallel operation)

Use this channel when changing over Megasonic output channels.

The PRS terminals in the following table indicates the channel with the COMPRS terminal is closed or open.

NOTE A circle indicates the channel is closed and x indicates the channel is open.

PRS4	PRS3	PRS2	PRS1	PRS0	Megasonic output channel
×	×	×	×	×	1
×	×	×	×	○	2
×	×	×	○	×	3
×	×	×	○	○	4
×	×	○	×	×	5
×	×	○	×	○	6
×	×	○	○	×	7
×	×	○	○	○	8
×	○	×	×	×	9
×	○	×	×	○	10
×	○	×	○	×	11
×	○	×	○	○	12
×	○	○	×	×	13
×	○	○	×	○	14
×	○	○	○	×	15
×	○	○	○	○	16
○	×	×	×	×	17
○	×	×	×	○	18
○	×	×	○	×	19
○	×	×	○	○	20
○	×	○	×	×	21
○	×	○	×	○	22
○	×	○	○	×	23
○	×	○	○	○	24
○	○	×	×	×	25
○	○	×	×	○	26
○	○	×	○	×	27
○	○	×	○	○	28
○	○	○	×	×	29
○	○	○	×	○	30
○	○	○	○	×	31
○	○	○	○	○	32

NOTE

Connect this control signal to remote control device, up to 32 types of signals from a remote place.

(4) OPSEL terminal(valid on parallel operation with Master/Slave composition)

Use this OPSEL terminal to specify WATT terminal power values on the master and slave generators to monitor the Megasonic output power from a remote place.

NOTE Circles in the table indicate closed, and x, open.

OPSEL terminal--COMOPSEL terminal	Megasonic output monitor power value
○	Salve side
×	Master side

(5) WATT terminal (WATT4 to 12)(valid on parallel operation)

When monitoring Megasonic output power from a remote place, the most significant 3 bits of the power value is output in decimal. Use the terminal when monitoring output power.

The WATT terminals in the following table indicate closed or open with the COMWATT terminal.

NOTE A circle in the table indicates the contact point is closed, and X, open.

WATT terminal number									Value in BCD	Output power value (W)
12	11	10	9	8	7	6	5	4		
×	×	×	×	×	×	×	×	×	000	0 ~ 4
×	×	×	×	×	×	×	×	○	001	5 ~ 14
~									~	~
○	×	×	×	○	○	×	×	○	119	1,185 ~ 1,194
○	×	×	○	×	×	×	×	×	120	1,195 ~ 1,204
○	×	×	○	×	×	×	×	○	121	1,205 ~ 1,214
○	×	×	○	×	×	×	○	×	122	1,215 ~ 1,224
~									~	~
○	×	×	○	○	×	×	×	○	131	1,305 ~ 1,314
○	×	×	○	○	×	×	○	×	132	1,315 ~ 1,324

NOTE The setting range for power displays up to 1200W. However, a value over 1200W may be displayed.

WATT terminal number, 4 to 7 indicate rank of 10W, 8 to 11 indicate rank of 100W, 12 indicate rank of 1000W.

(6) STBY terminal(valid on parallel and RS485 operation)

Use this terminal for monitoring whether the Megasonic generator is workable or not from a remote place.

NOTE The circles in the following table indicate that the contact point is closed, and
that x, open.

STBY terminal--COM terminal	Megasonic generator's state
○	Oscillation is enabled
×	Oscillation is disabled.

(7) OSCOUT terminal(valid on parallel and RS485 operation)

Use this terminal for monitoring whether the Megasonic generator is workable or not from a remote place.

NOTE The circles in the following table indicate that the contact point is closed, and that x, open.

OSCOUT terminal--COM terminal	Megasonic generator's state
○	Oscillation has started
×	Oscillation has stopped

(8) Upper limit alarm terminal(valid on all operation)

Use this terminal for monitoring whether an upper limit alarm is generated or not from a remote place.

NOTE The circles in the following table indicate that the contact point is closed, and that x, open.

Upper limit A terminal-- Upper limit COM terminal	Occurrence of upper limit alarms
○	Yes
×	No

(9) Lower limit alarm terminal(valid on all operation)

Use this terminal for monitoring whether an lower limit alarm is generated or not from a remote place.

NOTE The circles in the following table indicate that the contact point is closed, and that x, open.

Lower limit A terminal-- Lower limit COM terminal	Occurrence of lower limit alarms
○	Yes
×	No

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(10) Alarm terminal(valid on all operation)

Use this terminal for monitoring whether an alarm occurs or not from a remote place.

NOTE The circles in the following table indicate that the contact point is closed, and that x, open.

Alarm A terminal--Alarm COM terminal	Alarm B terminal--Alarm COM terminal	Occurrence of alarms
○	×	Yes
×	○	No

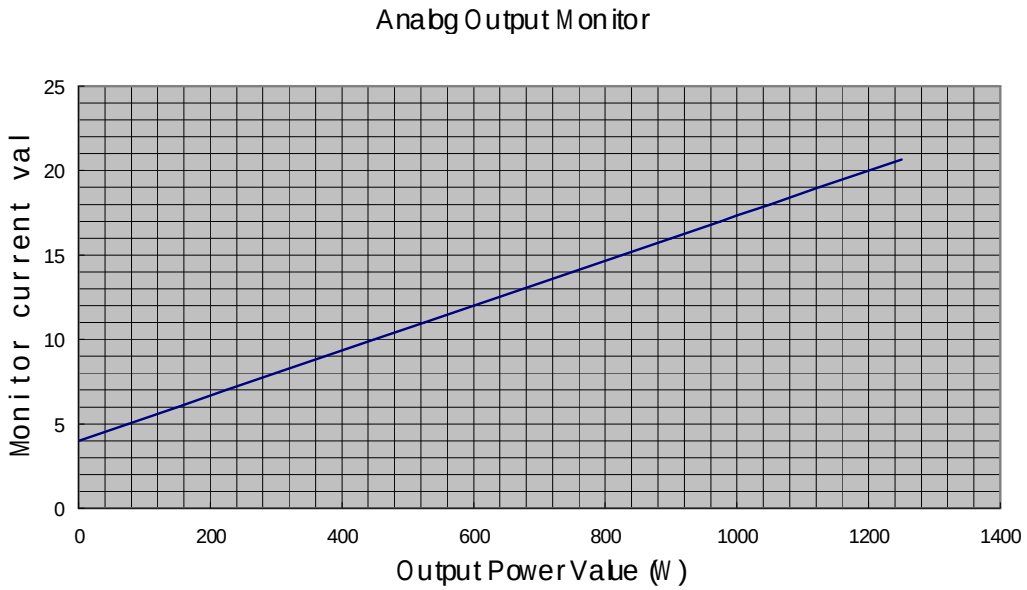
(11) NFB trip terminal(valid on all operation)

Use this terminal for monitoring whether an NFB trip occurs or not from a remote place.

NOTE The circles in the following table indicate that the contact point is closed, and that x, open.

NFB trip A terminal--Trip COM terminal	NFB trip B terminal--TRIP COM terminal	Occurrence of NFB trip
○	×	Yes
×	○	No

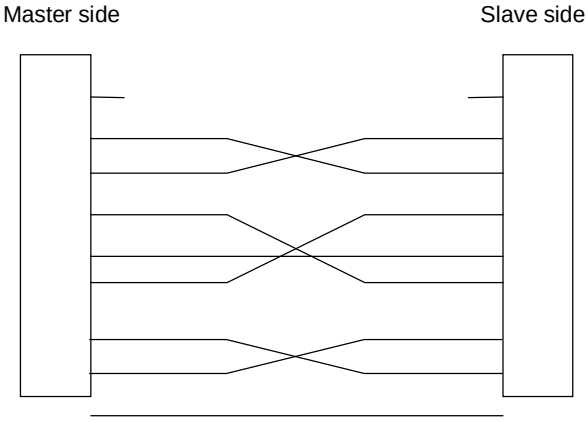
(12) Analog output monitor terminal(valid on all operation with single mode or master of master/slave mode)



8. Connector Specification for Master/Slave Connection

Pin No.	Signal name	Input/Output	Description
1	CD	NC	Carrier Detect
2	RXD	IN	Received Data
3	TXD	OUT	Transmitted data
4	DTR	IN	Data Terminal Ready
5	SG	-	Signal Ground
6	DSR	OUT	Data Set Ready
7	RTS	NC	Request to Send
8	CTS	NC	Clear to Send
9	NC	NC	NC

Use the dedicated cable attached.



(Cable length: 2m)

NOTE Use the dedicated cable to conform to the CE standard.

9. Connector Specification for RS485 Connection (for upper and lower sides)

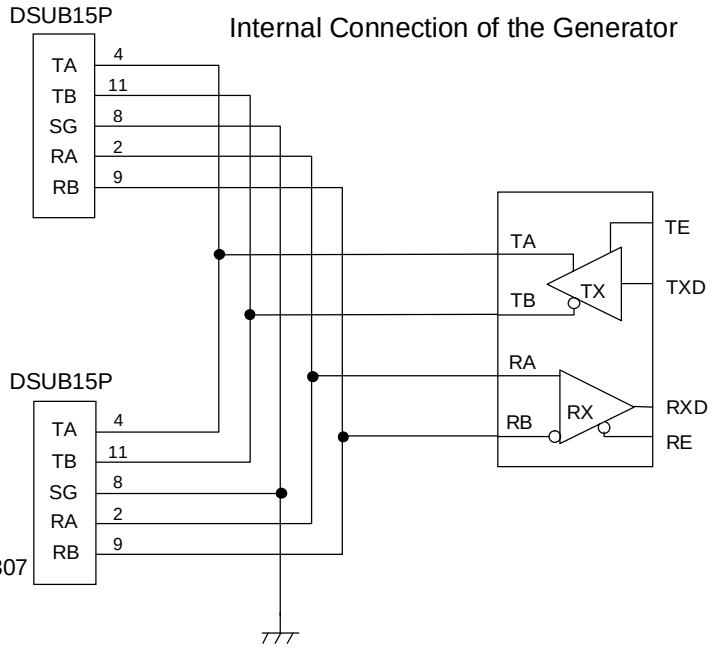
Pin No.	Signal name	Input/Output	Description
1	FG	□	Frame Ground
2	RA	IN	Receive A(+)
3			
4	TA	OUT	Transmission A(+)
5			
6			
7			
8	SG	-	Signal Ground
9	RB	IN	Receive B(-)
10			
11	TB	OUT	Transmission B(-)
12			
13			
14			
15	FG	-	Fame Ground

Use the dedicated cable.

NOTE Use the dedicated cable to conform to the CE standard.

(Cable length: 5 m)

The internal connections of the connector are as follows:



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10. Countermeasures When the Protective Circuit Is Working or When an Error Is Displayed

Break Megasonic output when the protective circuit is working.

Table 10-1

	Display	Cause	Protecting work	Control signal connection connector	Recovery operation
1	ALARM is lit. "E01" appears in the level display.	System RAM error	keystroking is disabled. Megasonic output is broken.	The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open.	An error has taken in the circuitry of the CPU. The generator must be repaired or replaced with a new one.
2	ALARM is lit. "E02" appears in the level display.	The fan stopped.			The fan has stopped because of failure. It must be replaced with a new one.
3	ALARM is lit. "E03" appears in the level display.	The output protective circuit worked.			The protective function for Megasonic output worked. Turn OFF the POWER switch and check the connection with the transducer unit. After confirming the connection, turn ON the POWER switch.
4	ALARM is lit. "E04" appears in the level display.	The radiator plate of the output unit has been heated abnormally.			The temperature has abnormally risen with the Megasonic output unit. Turn OFF the POWER switch and wait until the temperature of the output unit cools down before turning ON the POWER switch.
	ALARM is lit. "E05" appears in the level display.	High voltage power output shorted.			The high voltage power protect function has detected. Turn OFF the POWER switch and turn ON it.
	ALARM is lit. "E07" appears in the level display.	Interlock error			Turn OFF the POWER switch if no front panel or output connector cover is fixed. Fix the front panel or the output connector cover before turning ON the POWER switch.

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	Display	Cause	Protecting work	Control signal connection connector	Recovery operation
	ALARM is lit. "E08" appears in the level display.	Switch error	Key stroking is disabled. Megasonic output is broken.	The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open.	Operation switch on the front pannel is always pushed. If something pushes the switch, please remove it.
	ALARM is lit on the salve side only. "E09" appears in the level display.	Master/Salve connection error		The ALARM A terminal (between 35-36) on the master side is closed. The ALARM B terminal (between 17-36) on the master side is open.	Check for the power supply on the master side. After turning OFF the POWER switch, check of connect the master/slave cable between the two generators before turning ON the POWER switch.
	ALARM is lit on the master side only. "E10" appears in the level display.	Master/Salve connection error		The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open.	Check for the power supply on the master side. After turning OFF the POWER switch, check of connect the master/slave cable between the two generators before turning ON the POWER switch.
	ALARM is lit. "E11" appears in the level display.	Single mode error			This generator is not Master/Slave composition. Turn OFF the POWER switch and remove the master/slave cable from the generators. Turn ON the POWER switch.
	ALARM is lit. "E12" appears in the level display.	Slave error			The alarm has occurred on the slave side. Remove the cause of the alarm before turning ON the POWER switch.
	ALARM is lit. "E13" appears in the level display.	Upper limit error		The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open. The upper limit A terminal (between 15-16) is closed.	Megasonic output power has exceeded the preset upper limit value. Turn OFF the POWER switch and check for the cleaning fluid in the cleaning tank, the connection with the transducer unit, and the upper limit value (whether it is reasonable). After confirming these conditions, turn ON the POWER switch.

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	Display	Cause	Protecting work	Control signal connection connector	Recovery operation
	ALARM is lit. "E14" appears in the level display.	Lower limit error	Key stroking is disabled. Megasonic output is broken.	The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open. The lower limit A terminal (between 15-16) is closed.	Megasonic output power has lowered the preset lower limit value. Turn OFF the POWER switch and check for the cleaning fluid in the cleaning tank, the connection with the transducer unit, and the lower limit value (whether it is reasonable). After confirming these conditions, turn ON the POWER switch.
	ALARM is lit. "E15" appears in the level display.	Power detection error	Key stroking is disabled. Megasonic output is broken.	The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open.	Output from the power detection unit is abnormal. The generator must be repaired or replaced with a new one.
15	Nothing is displayed. The POWER switch automatically turns OFF.	Power (AC) input overcurrent	AC power failure	The NFB trip A terminal (between 18-19) is closed. The NFB trip B terminal (between 37-19) is open.	Overcurrent has been detected with the AC power input unit. Turn ON the POWER switch.
16	The POWER switch remains ON and nothing is displayed.	Internal power error	Megasonic output is broken.	No terminal outputting	The internal power supply has malfunctioned. The generator must be repaired or replaced with a new one.
17	ALARM is lit. "E06" appears in the level display.	Liquid Level Detection Error	keystroking is disabled. Megasonic output is broken.	The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open.	If there is no liquid in the transducer, you must put liquid into the transducer. If there is liquid in the transducer the liquid level detection sensor has malfunctioned.
18	ALARM is lit "E16" appears in the level display.	Internal switch setting error.	Keystroking is disabled. Megasonic output is shutdown.	The ALARM A terminal (between 35-36) is closed. The ALARM B terminal (between 17-36) is open.	Internal switch has malfunctioned. An error has taken in the circuitry of the CPU unit. The control unit must be replaced.

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NOTE

When the same error occurs after taking the above recovery measure, the generator or the cleaning system has failed.
Immediately turn
OFF the power switch and contact the maker of the cleaning system.

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11. Specification

- **Megasonic Generator**

MODEL		UO1200PMCA	
Rated output Power		1200W	
Output arranging range		60~1200W	
Oscillation frequency		710.0kHz~750.0kHz 0.1kHz step	950.0kHz~999.9kHz 0.1kHz step
Oscillation system		Crystal controlled synthesizer	
Output circuit		FET class D P.P system	
Rating power supply		208Vac±10%, 12A, single phase 50 or 60Hz	
Rush current		60A or less	
Rating power consumption		2500VA *	
Control	Front panel	Output (ON/OFF), Output setting (7 push buttons)	
	Remote control	Output (ON/OFF), changeover of output settings on the front panel	
Display	Front panel	Output level display (7 segment LED, 2 digits)	
		Output channel display (7 segment LED, 2 digits)	
		Output start display, alarm display, remote display	
		key lock display, setting mode display	
	External output	Output level data, Operating, Alarm	
		Megasonic upper and lower alarms	
External dimensions		380 mm (W) x 550 mm (D) x 175 mm (H) (Not including connectors, fan, switches, and other projecting parts. The legs are included.)	
Mass		Less than 25kg	
Operating ambient condition		See Section 2.2.1, Environmental Conditions.	
Applied Megasonic transducer	Connection transducer	Limited for our UO1200PMCA	
	Transducer type	Specified by KOKUSAI ELECTRIC ALPHA	
	Allowable input	1200W or more	
	Frequency range	710kHz~750kHz	950kHz~1000kHz
	Transducer element	PZT	

* It sometimes reaches the maximum of the +10% by an actual use state.(Alteration of

power supply, alteration of liquid temperature)

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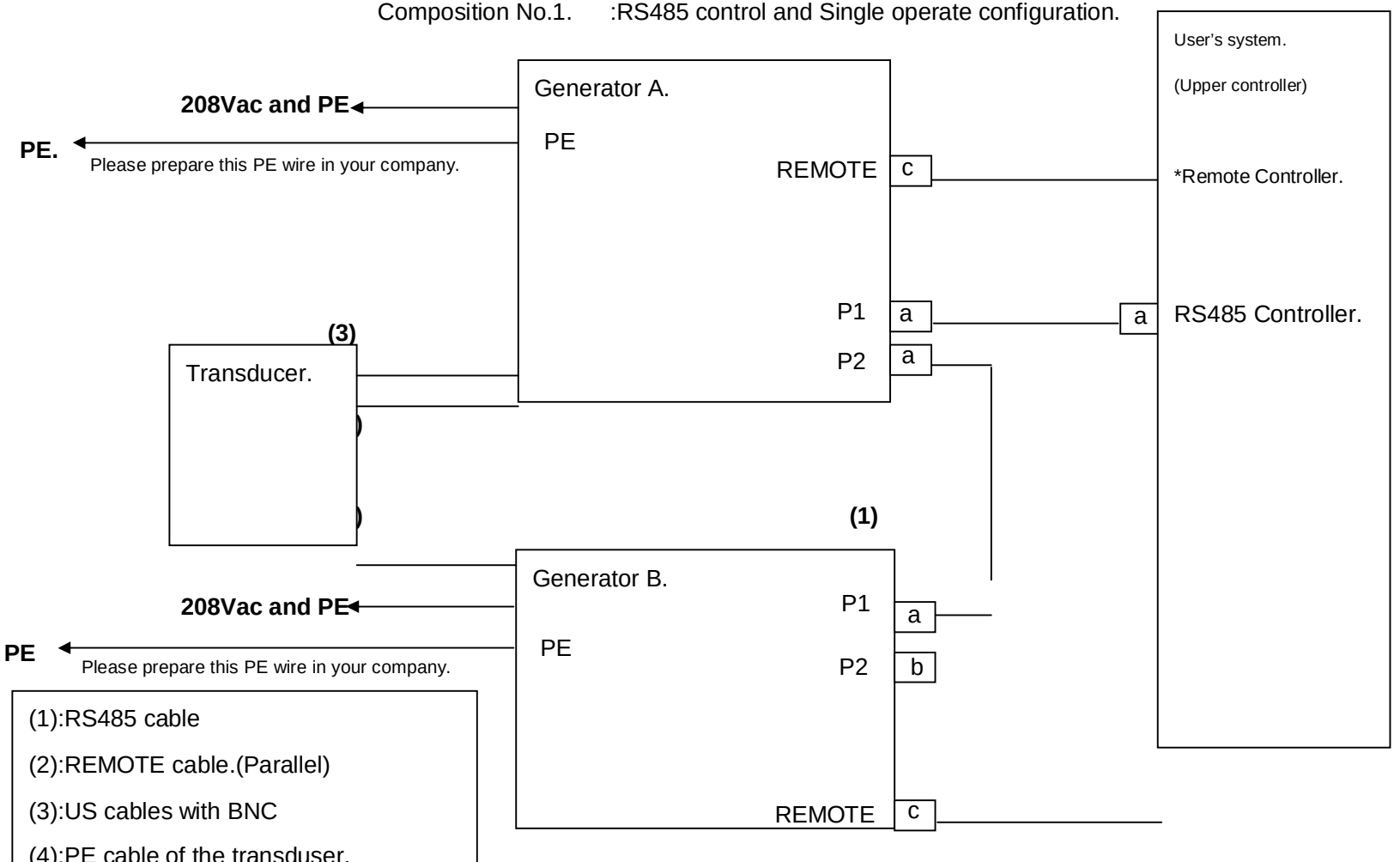
12. Appendix drawing

Composition No.1. :RS485 control and Single operate configuration.



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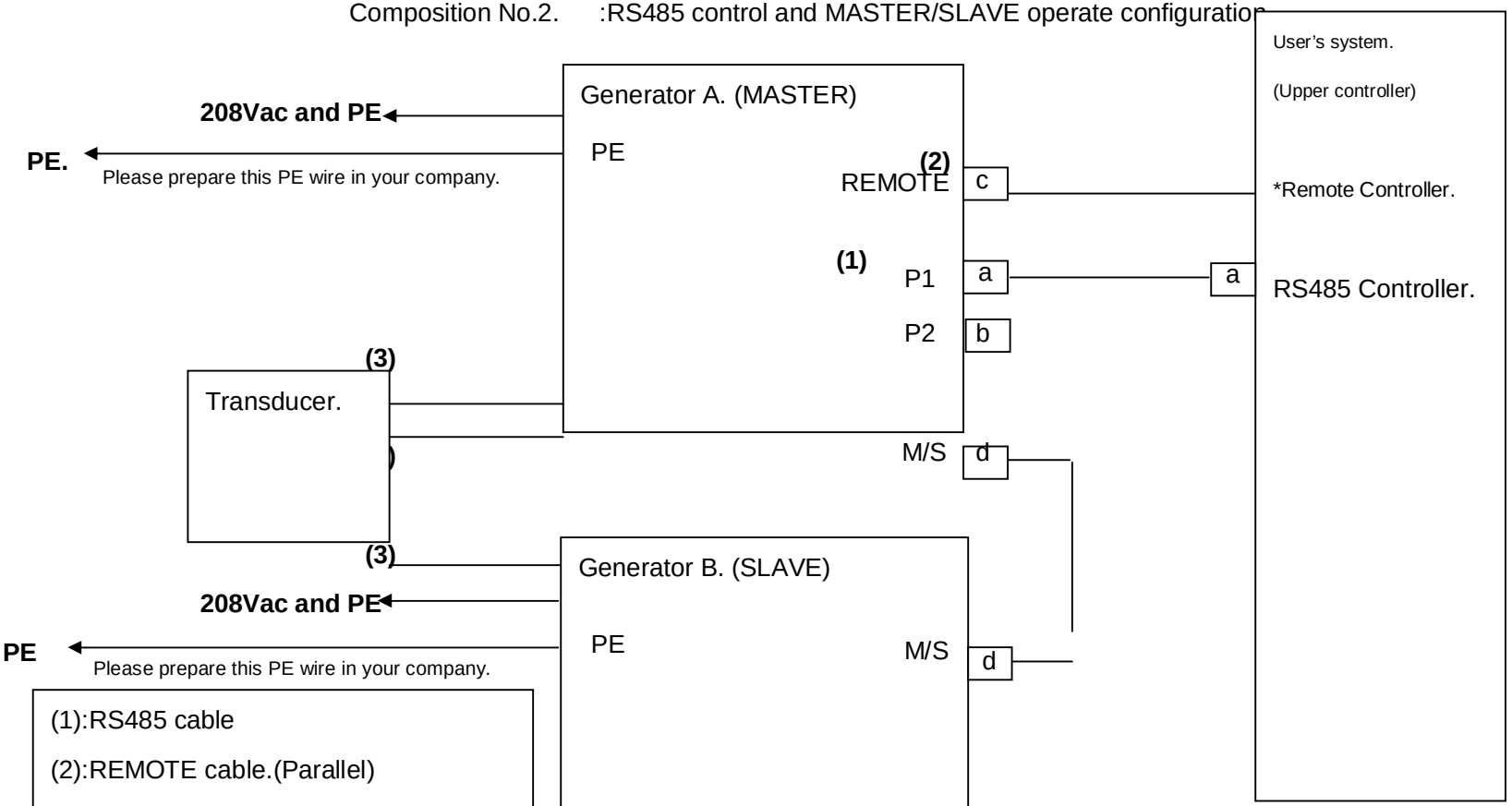
APPENDIX-1

Composition No.2. :RS485 control and MASTER/SLAVE operate configuration



(1):RS485 cable

(2):REMOTE cable.(Parallel)

(3):US cables with BNC

(4):PE cable of the transduser.

(5):MASTER/SLAVE cable

a: D-sub 15 pins. (RS485)

b: RS485 terminator. (D-sub 15 pins.)

c: D-sub 37 pins. (REMOTE)

* The control from Remote Controller is not possible, because the setting of generator is RS485 control. But, the status of generator can be timely watched by Remote Controller .

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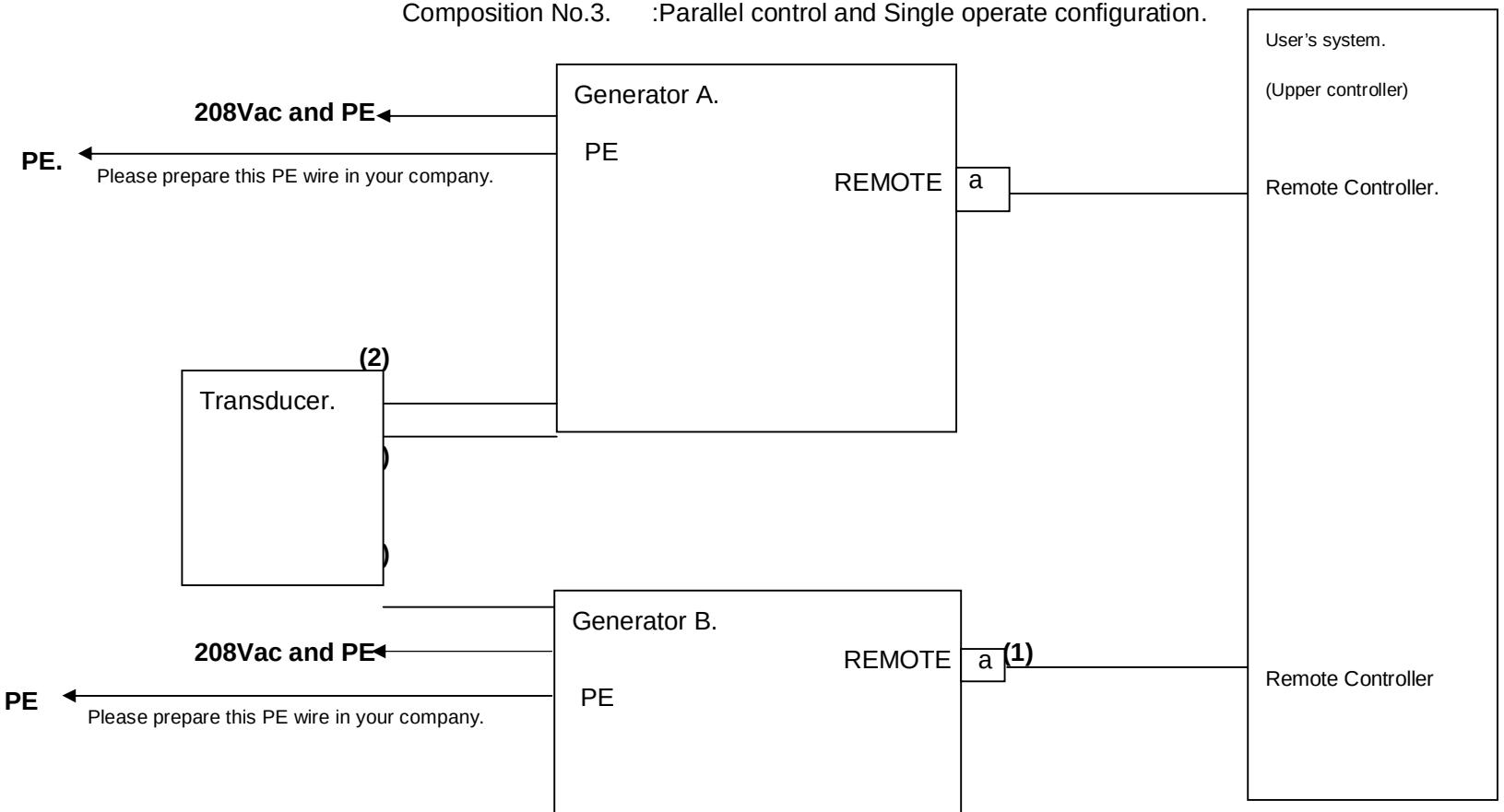
ISO 9001
A4203

APPENDIX-2

Composition No.3. :Parallel control and Single operate configuration.



(1):REMOTE cable.(Parallel)

(2):US cables with BNC (6 Cables)

(3):PE cable of the transduser.

a: D-sub 37 pins. (REMOTE)

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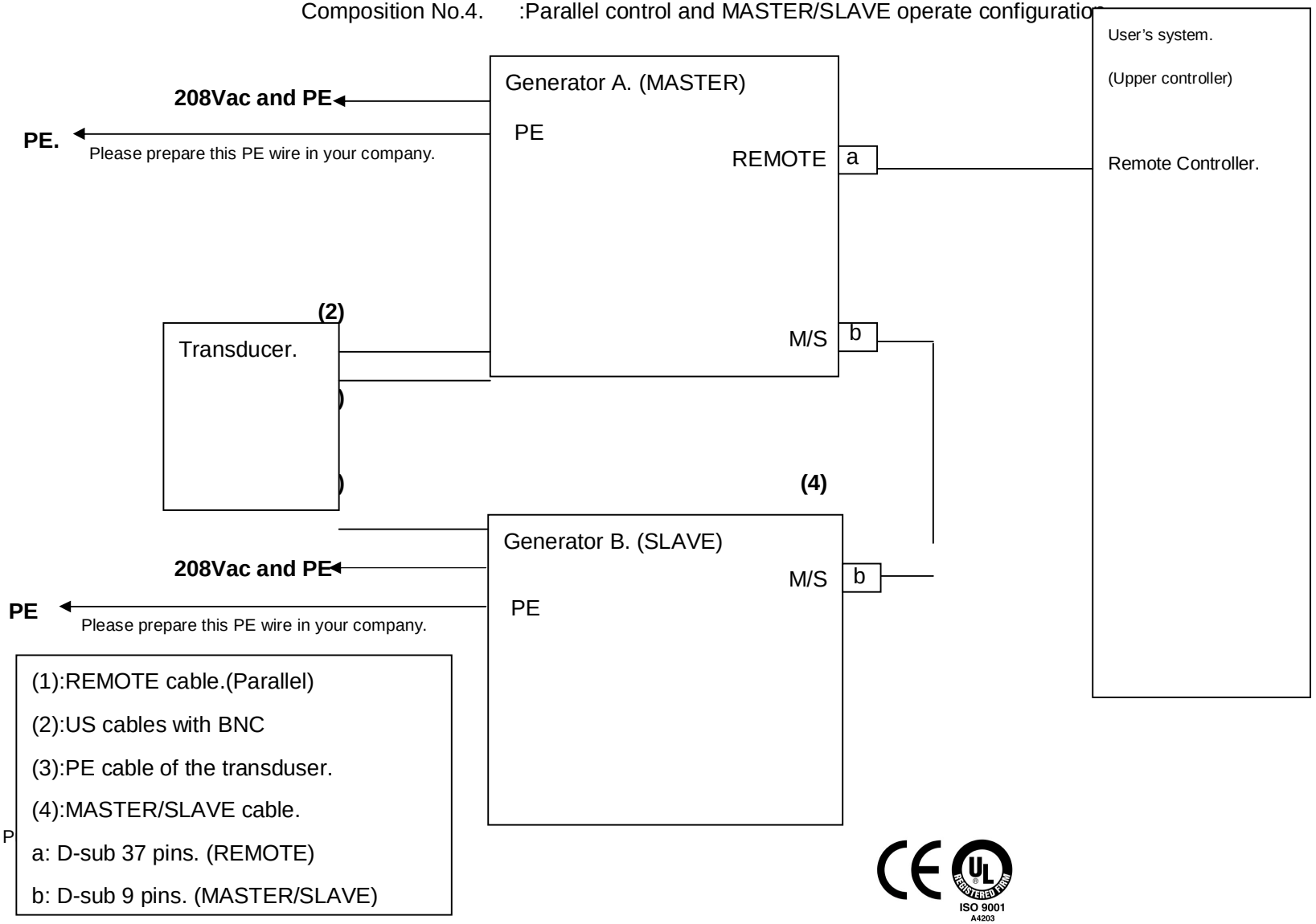
APPENDIX-3

Composition No.4. :Parallel control and MASTER/SLAVE operate configuration



APPENDIX-4

13. Accompanying Drawing

(1) GENERAL VIEW 3CK16178 revision No. 1
(2) BLOCK DIAGRAM 3CD02080 revision No. 0
(3) LABELLING DIAGRAM 3CK16214 revision No. 1
(4) REMOTE CABLE CIRCUIT DIAGRAM 3CD02187 revision No. 0
(5) RS485 SOFTWARE SPECIFICATION SCD00485 revision No. 0

14. Address of the Maker

KOKUSAI ELECTRIC ALPHA Co., Ltd.

Head office and plant:

4th floor, Kokusai Building No.6, Hitachi Kokusai Denki Corporation,
Shinmeidai 2-6-13, Hamura-shi, Tokyo, Japan

Phone: 042-554-1171 Fax: 042-555-7751 (inside Japan)

Phone: 81-42-554-1171 Fax: 81-42-555-7751 (outside Japan)

URL http://www.ke-alpha.co.jp/

e-mail sales@ke-alpha.co.jp

15. Revision and Revision Log

Rev. No.		Description	Prepared by	Approved by
	Dec, 26,2001	First version	Kikuta	Tsurusaki
1	Jan,18,2002	Correction (description error). o START switch action o LOCK switch action o Explanation of display value on page 28 was not correct. o Recovery operation of error display was not correct.	Kikuta	Tsurusaki
2	Jan,31,2002	Describe Setting range of the presetting value.	Kikuta	Tsurusaki
3	Fev,13,2002	Correction (description error) o Control Signal Connector Figure o 5-4, 5-5, 5-6 on page 21 and page 22 o GENERAL VIEW 3CK16178 Rev.0 → Rev.1	Kinoshita	Tsurusaki
4	Mar,1,2002	The description was added on the composition of generator. (RS485 control, Parallel control,	Nakama	Tsurusaki

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		Single operate and MASTER/SLAVE operate)		
5	April 17, 2002	Add function of liquid level detection sensor input. Corrected input resistance of photo-coupler, 1Kohm to 680ohm. REMOTE CABLE CIRCUIT DIAGRAM 3CD02147 Rev No.1 3CD02187	Kikuta	

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