PCT SYSTEMS
by White Knight

SERIES 6000 HYPERCLEAN MEGASONIC SYSTEM USER MANUAL

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Contact Information

MAIL	PCT Systems By White Knight Fluid Handling
	187 East 670 South
	Kamas, UT 84036
TELEPHONE	888.796.2476
E-MAIL	customer.support@wkfluidhandling.com
WEBSITE	www.pctsystems.com
	www.wkfluidhandling.com

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ABOUT THIS BOOK

Purpose

The purpose of *PCT HyperClean Megasonic System Manual* is:

- To provide the Operator with a sufficient understanding of the PCT HyperClean Megasonic System.
- To enable the Operator to operate the station productively and safely.
- Incorporate the PCT HyperClean Megasonic System into the communications interface chosen by the End User

Audience

The PCT HyperClean Megasonic System Manual is intended for use by the various Engineers, Technicians, Operators, and other personnel involved in installing, operating and maintaining this equipment.

Review & Revision Policy

When appropriate, *The PCT HyperClean Megasonic System Manual* and its supporting documentation will be reviewed and updated accordingly.

When appropriate, the revised information will be sent to the affected parties.

Questions/Comments/Contact Information

Your comments are important to us. If you have any questions, comments or other feedback regarding *The PCT HyperClean Megasonic System Manual, please contact us.*

Mail	PCT Systems By White Knight Fluid Handling
	187 East 670 South
	Kamas, UT 84036
Telephone	888.796.2476
Email	customer.support@wkfluidhandling.com
Website	www.pctsystems.com
	www.wkfluidhandling.com

Notes

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CHAPTER 1
SYSTEM & SAFETY OVERVIEW

Purpose

This chapter:

- Defines the System's Designed & Intended Use.
- Provides a Cleaning Process Overview of the PCT HyperClean Megasonic System and its components.
- Explains the Safety Concerns and the Safety Features available with this System.

Designed & Intended Use

The PCT HyperClean Megasonic System (***system***, for short) is to be used in a manner that is consistent with the contents of this Manual, the supporting drawings and diagrams, and any additional information or instruction separate from this Manual.

This system is not to be used for any other purpose.

Operating this system in any way that is contrary to its original designed and intended use, without prior authorization from White Knight Fluid Handling, may constitute a deviation from and violation of the original designed and intended use.

If any unauthorized deviation or alteration occurs, the warranty, be it expressed, implied or statutory, may become invalid.

The results of such actions may also expose the End User and its employees to unsafe conditions and other negative consequences.

IMPORTANT:
We strongly encourage you to contact White Knight, before making any alterations or deviations to this equipment or its operation.

For more information about the warranty or repair information, please see Chapter 9: Receipt, Warranty, & Repair Information.

Cleaning Process Overview

The Megasonic HyperClean System uses an ultrasonic frequency to generate a controlled agitation of a chemical cleaning liquid to clean semiconductor wafers of particulate contamination—down to the submicron-size particle (particles less than 1 micron in size).

Key Component Descriptions

This section provides an overview of the system components and important features.

The key components of the PCT HyperClean Megasonic System are the:

- Controller/Generator
- Multiplexed Array of Transducers
- Process Tank
- Heater
- Other Optional Features

Controller/Generator

The ***Controller/Generator*** is the "brain" of and the frequency generator for the system.

A ***Central Processing Unit*** and an ***RF-Generator*** compose this dual-purpose device.

The *Central Processing Unit* (***CPU***) controls the system's operation. The microprocessor controls the optimum frequency for each Transducing Array. The CPU stores the customer-defined parameters for its processes. It also enables the Operator to change and monitor these process parameters, and to conduct diagnostic routines on the system.

The *RF-Generator* creates the electronic signal, in the radio frequency range, to power the Transducers.

Advanced Features

Advanced features of this Controller include:

- Microprocessor program controlled cleaning processes
- Memory backup for up to 9 recipes (with battery power backup)
- Keypad input and a ***liquid crystal display*** (***LCD***) for diagnostics
- Pre-tuned Generator with dual Array power for optimum cleaning

- Programmable power output in 1% increment adjustments
- Up to 16 independent Transducers with separate frequencies
- Programmed outputs:
  - Overtemp alarm
  - Undertemp alarm
  - Process started indicator
- RTD sensor interface
- Thermocouple interface for fault control and safety
- Loop back wiring prevents a power-on condition if cables are unplugged
- Liquid Level Sensor interface
- Multiple interfaces: SECSII, RS-232 ASCII, and CANOpen
- Optional inputs and outputs for custom interface

Multiplexed Array of Transducers

A ***multiplexed Array of Transducers*** (***Transducers*** or ***Arrays***) generate a high-energy, acoustic beam at the required frequency. This direction-specific beam moves across the wafer's surface and removes submicron-sized contaminants from the wafer's surface.

The Controller/Generator controls each Array to ensure the optimum frequency is used. These Megasonic Transducers operate between 600 kHz and 900 kHz, yielding exceptional, tested and proven, cleaning results.

The Array can also be set up for remote operation with an audible or visual alarm up to 12 feet from the Bath.

Process Tank

Megasonic cleaning occurs in the Process Tank (***Tank***, for short).

The contaminant-free vessel uses an *approved cleaning solution* which aids in the cleaning of the submerged wafers. Because of its design, there are no induced contaminants from the process, which also inhibits redepositing particles from the Cleaning Bath.

Tank Options

Based on your needs, a **VARIETY OF TANK MATERIALS** are available:

- Poly
- Quartz
- PVDF
- Stainless Steel

In addition to the various Tank materials, the Tanks can also be **HEATED OR NOT HEATED**:

- ***Non-Heated-Type Process Tank***
  A non-heated-type system has a standard Tank with high frequency Transducers. It **CANNOT** be converted to heated-type system.

NOTE:
All plastic Tanks are non-heated.

- ***Heated-Type Process Tank Option***
  The heated-system option integrates the Tank with high frequency Transducers, Heater elements, an overtemperature sensing Thermocouple, and a Safety Switch which shuts off the power if the temperature exceeds a safe range.

Quick Dumprinser Option

Lastly, another Tank option is the ***Quick Dumprinser***. This type of Megasonic system is available in a variety of vessel materials and has a 4-sided overflow weir. It is designed for low water volume, while providing the ultimate in megasonic cleaning.

Please contact PCT Customer Service for more information about the Quick Dumprinser or the other items discussed.

Heater

The system's ***Heater*** gradually heats the Tank's liquid to the temperature defined by the End User.

Because the heated liquid is a critical component to effective cleaning, a built-in safety/quality feature, the presence of a ***thermocouple***, protects the system from over-temperature conditions.

Both the Quartz and Stainless Steel Tanks can be equipped with embedded Heaters.

Optional Features

Remote Operator Panel Option

The optional Remote Operator Panel provides total Operator control in the Process Area.

The optional Remote Operator Panel connects directly to J2 on the Controller electronics back panel.

For more information, see Chapter 3: System Interfaces*, the* "Remote Interface" *section.*

Temperature Transducers Option (FOR HEATED-TYPE SYSTEM)

A heated system has a platinum RTD sensor and an embedded thermocouple sensor.

N_2 L/L Sensor Option

The standard sensor option is an Nitrogen (N_2 or, also written, N2) bubble-type pressure sensor switch.

This system can accommodate other level sensors for your custom applications. Optical and capacitive-type sensors are acceptable level sensors.

For more information, please see Chapter 3: System Interfaces*, the* "Controller Interfaces" *section.*

Other Custom Features

PCT Systems can design other custom features into your system, like filtration or recirculation capability.

Please contact our Engineering department to discuss your custom needs.

Safety Concerns

The generated frequency is relatively safe. The energy does not appreciably transmit from a liquid to a gas (in this case, air).

WARNING:

Do not stick your fingers into the running Megasonic Tank. The energy may cause damage to deep tissue or bone marrow.

Safety Features

Amplifier Electronics Interlock

The RF-output connectors—J6 for Array 1 and J7 for Array 2—have individual loop back wires. These wires apply control voltage to each Array individually. If either plug is disconnected, the associated Array cannot energize. The Heater, in a heated system, is not affected by this interlock.

Liquid Level and RTD Interface Interlock

A loop back-wired plug is required on J3, enabling voltage to both Arrays and the Fans—and in heated systems, to the Heater. If this connector is unplugged, the Arrays, the Fans—and, if applicable, the Heater—are disabled.

PCT Systems provides a loop back plug for non-heated systems. Heated systems have this feature built into the system. The plug must be connected in order for the Arrays and Fans to operate.

Bath Overtemp Interface Interlock

A loop back-wired plug is required on J4, enabling control voltage to each Array and, in heated systems, to the Heater. If this connector is unplugged, the Arrays, the Fans—and, if applicable, the Heater—are disabled.

PCT Systems provides a loop back plug for non-heated systems. Heated systems have this feature built into OT snap switch. The plug must be connected in order for the Arrays and Fans to operate.

Heater Safety

The Tank Heater has 3 levels of redundant safety:

1. Overtemp Alarm:
   The Controller prevents a process from starting, or will stop a process in progress, if the conditions (parameters) entered by the Operator are not met. This condition creates the **OVERTEMP** alarm.

2. Internal Overtemp Circuit:
   A thermocouple embedded in the Tank connects to an independent solid-state circuit in the Controller. If the Bath Temperature exceeds the factory pre-set value, the Heater and both Arrays are de-energized.

3. The open-on-rise, bi-metallic snap switch embedded in the Tank opens if the Bath Temperature continues to rise. This condition causes the Heater and both Arrays to de-energize, and stops the Fans.

Notes

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CHAPTER 2
FACILITIES & INSTALLATION INFORMATION

Purpose

This chapter describes:

- The Facilities Requirements
- The Liquid Level Sensor Requirement
- General Installation Notes
- The Process Tank Installation Procedure
- The Drain Installation Procedure
- The Controller Installation Procedure
- The Non-Heated-Type System Installation Test
- The Heated-Type System Installation Test

NOTE:
Only qualified electricians and facilities installation personnel should work on this system.

Facilities Requirements

Electrical Ground

Earth ground is required for electrical safety and to reduce AC and RF emissions.

Nitrogen or CDA Requirements

A Nitrogen (N_2 or N2) or CDA (clean dry air) purge of the Transducers is an important part of maintaining the Megasonic system. Purging prevents corrosion of the Transducers and flushes the vessel of gas or fume build-up created by process chemistries.

This system requires Teflon®, Polypropylene, Tygon®, or similar tubing to the inlet and outlet for Nitrogen gas or CDA, using the 1/4” tube fittings on the Tank. The outlet tubing should extend beyond the wet plenum area and terminates in a fume-free, dry environment so that moisture and chemical fumes cannot enter the tube.

Exhaust venting instructions located in the "Post-Installation Notes" section of this chapter.

CDA or N_2 specification:

- **NORMAL:** 3 psig at 0.75 scfm
- **MAXIMUM:** 5 psig at 1 scfm

WARNING:

Nitrogen or CDA pressure **MUST NOT** exceed 5 psig, unless otherwise specified

Power Requirements

Heated or non-heated systems operate from all power sources between 208–230 VAC, 50–60 Hz, single-phase, and 6 amp nominal (up to 30 amps maximum).

Non-heated systems draw 6 amps nominal with a 10 amp surge during the power-up sequence.

Depending on the Heater size, heated systems draw from 20–30 amps.

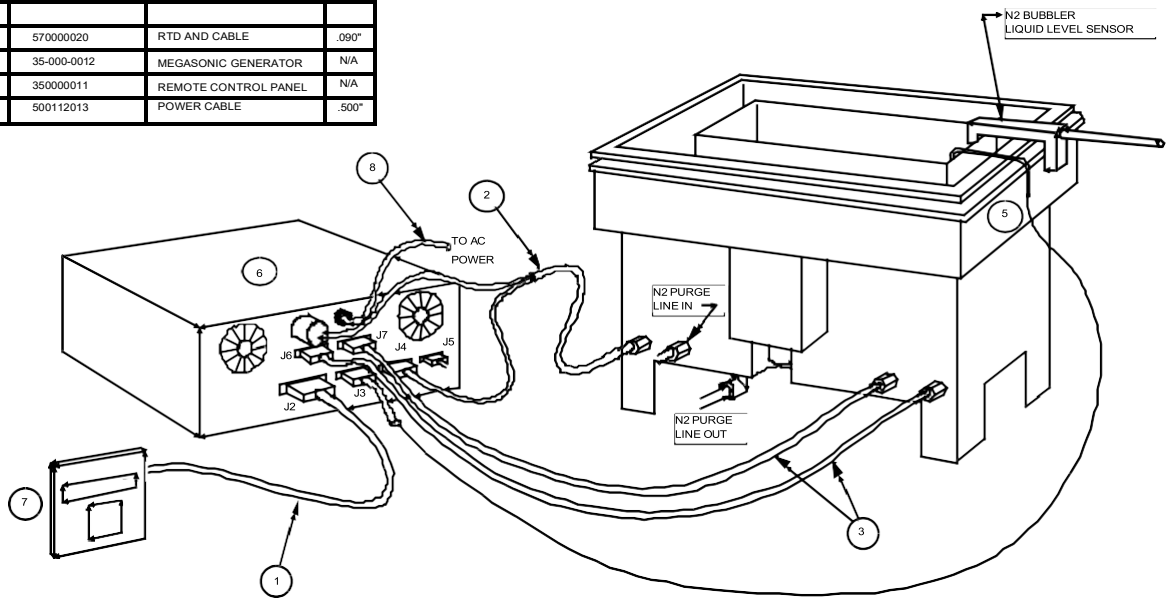
The Controller provides RF power for the Transducers and controlled AC power to the Heater.

Table 2-1: Power Requirements Chart

Power	208–230 VAC 50/60 Hz
Frequency	600 kHz–1000 kHz at resonant levels
Heater Wattage	Maximum 4000W/Controller heated operation. Only use the Heater wattage specified for this system.
RF Wattage	600W nominal 700W maximum
Non-Heated Operation	6 amp nominal, single phase 10 amp maximum, single phase
Heated Tank Operation	30 amp maximum, single phase

Figure 2-1: System Assembly, Including Optional Fittings & Remote Panel

	PCT SYSTEMS PART NUMBER	DESCRIPTION	CABLE DIAMETER
1	502010005	CONTROL PANEL CABLE	.400"
2	500112004	HEATER CABLE	.409"
3	500112006	RF CABLES (2)	.250"
4			
5	570000020	RTD AND CABLE	.090"
6	35-000-0012	MEGASONIC GENERATOR	N/A
7	350000011	REMOTE CONTROL PANEL	N/A
8	500112013	POWER CABLE	.500"



Liquid Level Sensor Requirement

IMPORTANT:
This system requires a Liquid Level Sensor.

Some of the recommended sensor types include:

- Float Switch
- N2 Bubble-Type Liquid Level Sensor (information provided in the next section)

N2 Bubble-Type Liquid Level Sensor

An N2 Bubble-type Liquid Level Sensor is the option available from PCT Systems.

Figure 2-2: Nitrogen Liquid Level Bubble Sensor Assembly Information

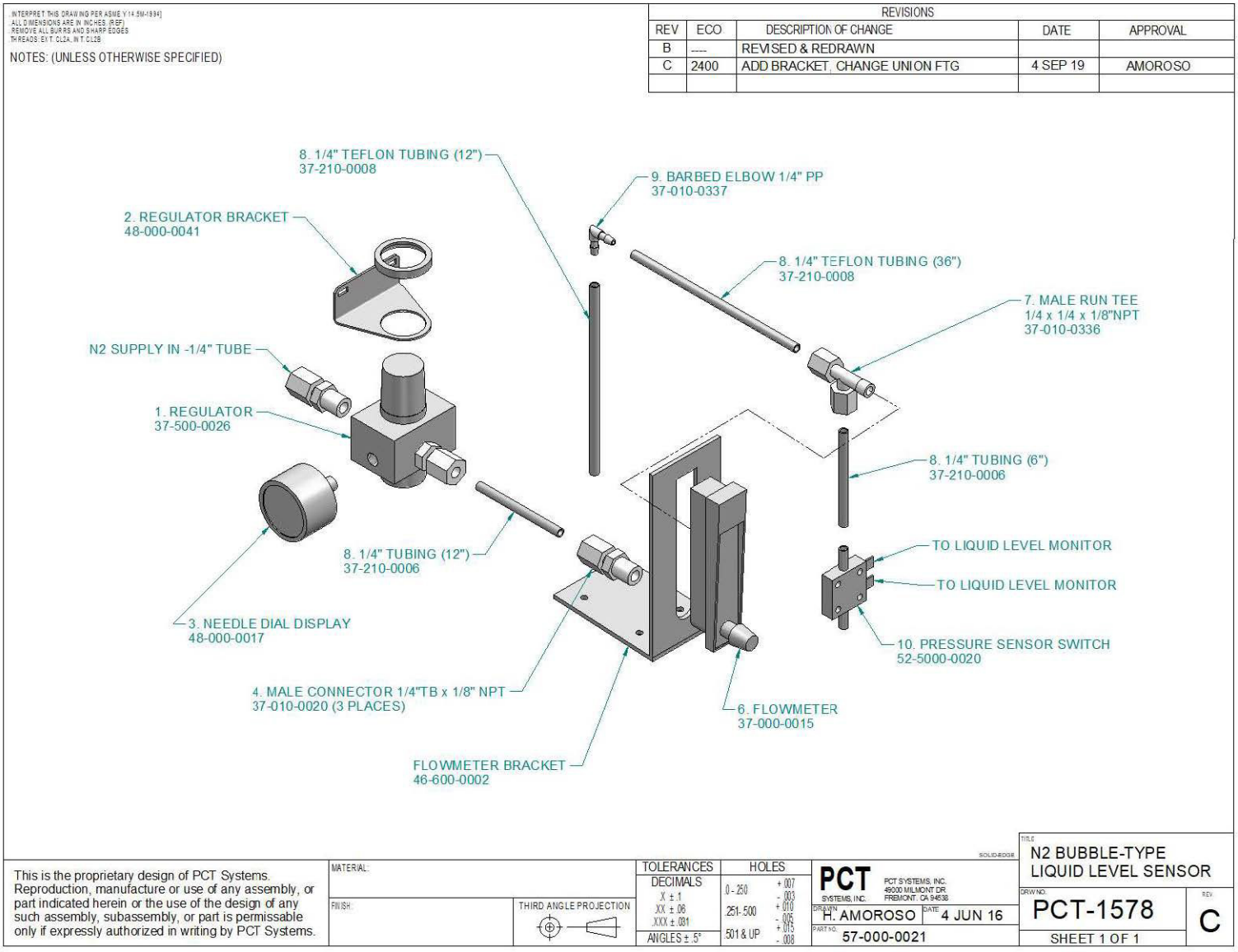
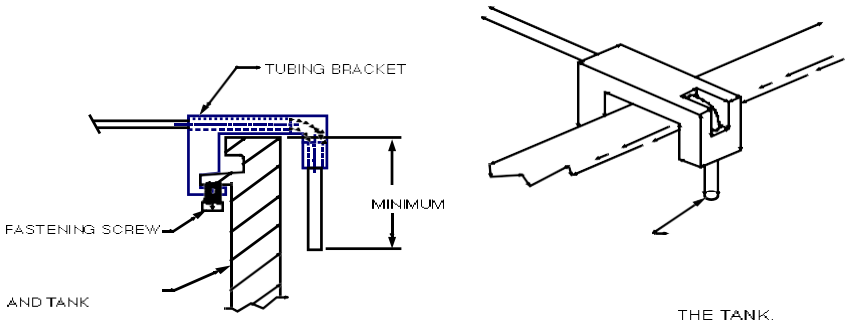


Figure 2-3: Example of a Method to Secure Sensor Tubing to the Tank



USE A SIMILAR BRACKET OR A BARBED ELBOW FITTING TO SECURE THE TUBING TO THE SIDE OF THE TANK.

General Installation Notes

- The protective plastic seal on the Tank **MUST** remain intact until installation is finished.
- Cover the Quartz Vessel/Tank with a sheet of rigid material to protect it from tools or objects which may fall in or on it during installation.
- Connect all cables **BEFORE** turning the power ON. Power must be in the OFF position before plugging the cables into the outlet.
- Broken or damaged cables may cause equipment failure. Protect the cables from breakage, stress, or tension. Protect the ground shield.
- Do not use cable extensions to the power cable. Construct an outlet within range of the system cable.
    - The operation of the equipment may be compromised by extending the cable length.
    - A protected GFIC (6 mA preferred, 30 mA acceptable) breaker should be installed near this system.
- This system was tested as a unit before shipping from PCT. Alterations could cause malfunctions or permanent damage which will void your warranty—unless the modifications are performed by PCT Systems technicians.
    - Consult with PCT Customer Service before making modifications. We can advise you on your proposed modification.

- Operators must wear appropriate clean room safety apparel.
    - This system is an ultra-clean chemical processing system. Apparel must provide protection from the chemicals used in your process.
- Fill the Vessel with liquid to the minimum level before turning on the Unit.
- **BEFORE INSTALLATION**, read the programming information appropriate to your system (Chapter 6: FTune Programming).
- System start-up requires input using the Keypad on the Control unit to set the parameters for your installation test.
- High voltage is present at J6 and J7 when the Controller/Generator is in operation.
    - The top and bottom panels must not be removed.
    - The hoods on the RF cable connectors must be undamaged and in place.

Process Tank Installation

Suggested Tank Mounting Methods

Tank Capacity	Mounting Method
< 15 liter	Process Tanks with capacity less than 15 liters have no overflow weir. Mount the Tank using a plastic flange around the top edge of the Tank.
15–50 liter	Process Tanks with an overflow weir or which will be filled with more than 15 liters of liquid must be mounted on a support base to prevent stress to the Quartz Vessel. See Figure 2-4 for suggested methods.
> 50 liter	Tanks with greater than 50 liter capacity require special support mounting. Contact PCT Systems Customer Service for assistance and mounting methods designed for your system.

Pre-Installation Notes

The Tank Housing and Flange require special handling.

> **IMPORTANT:**
> Protect the Tank Assembly from damage. Even a very small hole can cause a leak of chemical or fumes into the housing and damage the Heaters and Transducers.

Post-Installation Notes

There are 2 important considerations **AFTER** Tank installation:

- **EXHAUST VENTING**

  Process fumes require venting from the work area.

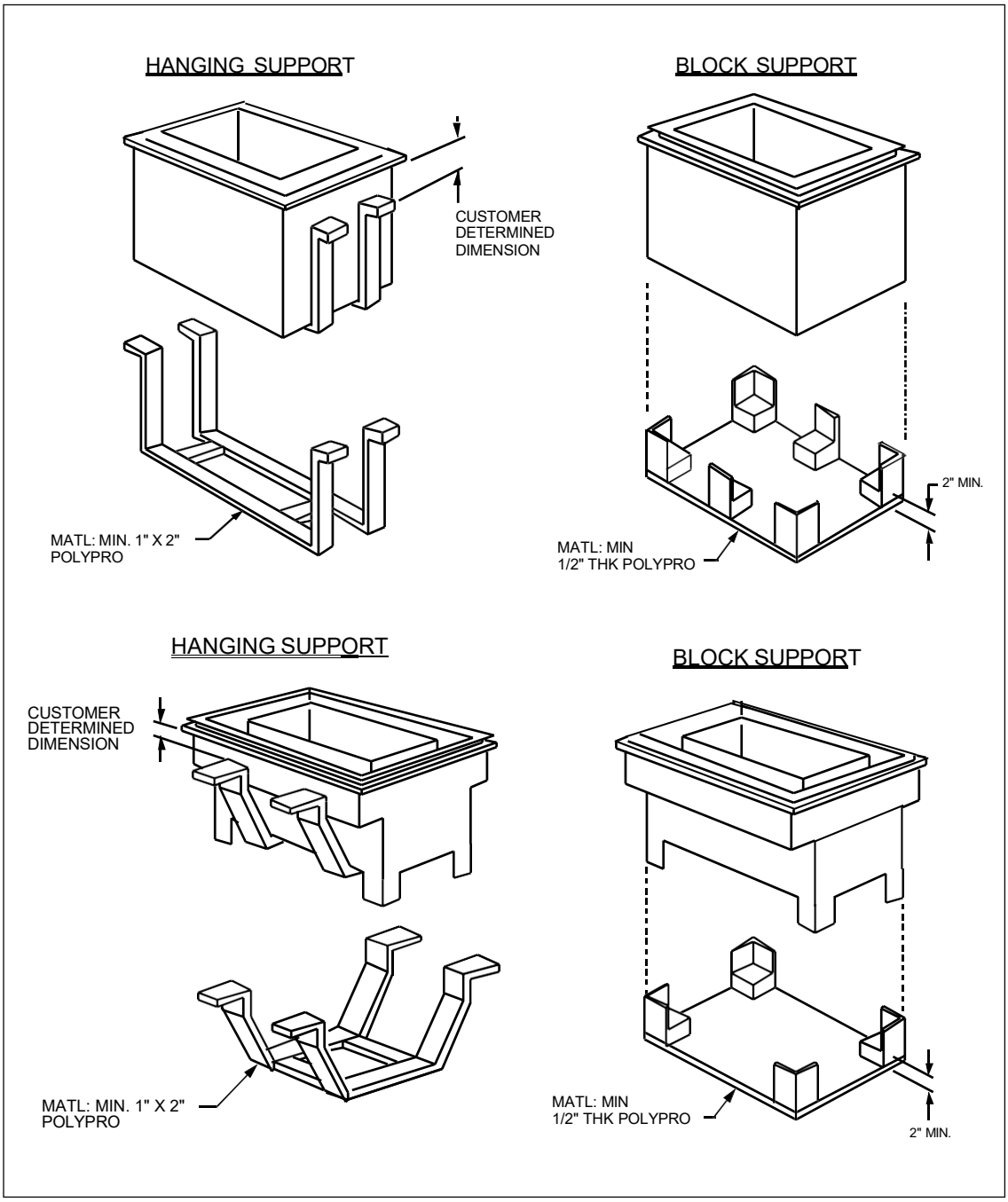
  Fumes cause the RTV seal around the quartz flange to fail prematurely and the fumes are harmful to the Operators.

- **MOVING THE VESSEL**

  Empty the liquid from the vessel prior to moving it to prevent any liquid from splashing on the seal or on people.

  Because hot liquid is dangerous, cool the liquid before moving the vessel.

Figure 2-4: Suggested Methods for Tank Support



Drain Installation

The Tank Drain has a PTFE flexible drain stem to prevent stress to the Quartz Vessel.

NOTE:
Some systems have quartz drains.

Attach the mating FNPT, MNPT, or Flaretek® fitting by hand.

REMINDER:
Only tighten the fitting by hand. Do not use wrenches or other tools to tighten the fitting to the Tank.

Damage may result, voiding the warranty.

The NPT-style may need Teflon tape used on the fitting threads.

The Drain fitting information for your system is located on the installation drawing in Appendix A.

Controller Installation

IMPORTANT:
Read these requirements before installing the electronics.

1. Power Receptacle & Cable Reach

The Controller requires a 208–230 VAC receptacle located within reach of the 6-foot power cord.

Heated systems must be located within reach of the 12-foot Heater cable (P/N 25-010-0016) and the RF cables (P/N 25-010-0051).

2. Air Flow

Leave space for air flow to the Fans and cables on the back panel.

Figure 2-6 shows an unheated Controller, and Figure 2-7 shows a heated Controller.

3. Enabling Safety Features

Non-heated systems have factory installed jumper plugs on J3 and J4, enabling the safety features described in Chapter 1: System & Safety Overview, the "Safety Features" section.

Verify these plugs are properly connected.

4. Serial Number Verification

The Generator and Tank are tuned as a set—the Generator contains a frequency established for a particular Tank.

As such, make sure the Tank and Generator Serial Numbers are correct. This information can be verified by checking the startup sheet.

If the Controller Serial Number is not correct for this Tank, you must reset the system variables as listed in Appendix B *before connecting the Tank.*

REMINDER:

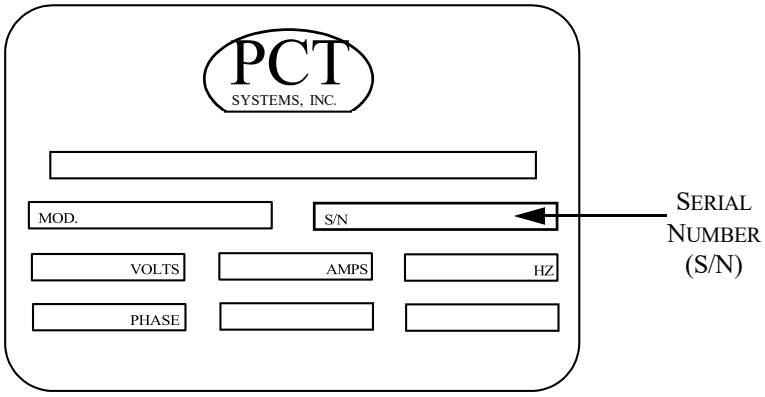
The Tank Cables are labeled with frequency and Generator location information.

TIP:

The Generator's Serial Number is printed on the labels located on the top cover of the Controller. The Serial Number for the Tank is located on the Tank. (These numbers are also on the cover of this manual.)

Also, a copy of the Quality Control Sheet, listing the Serial Numbers, is taped to the inside of the bottom panel of the Generator.

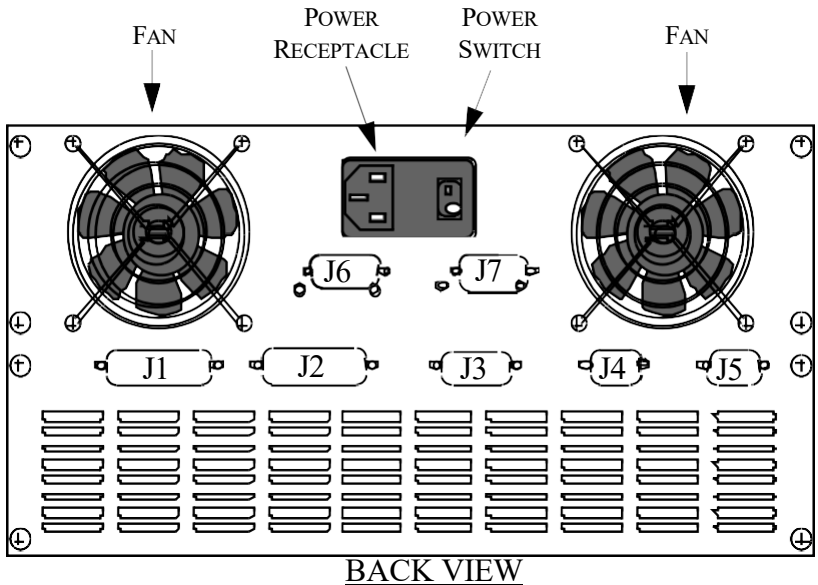
Figure 2-5: Identification Labels with Serial Number



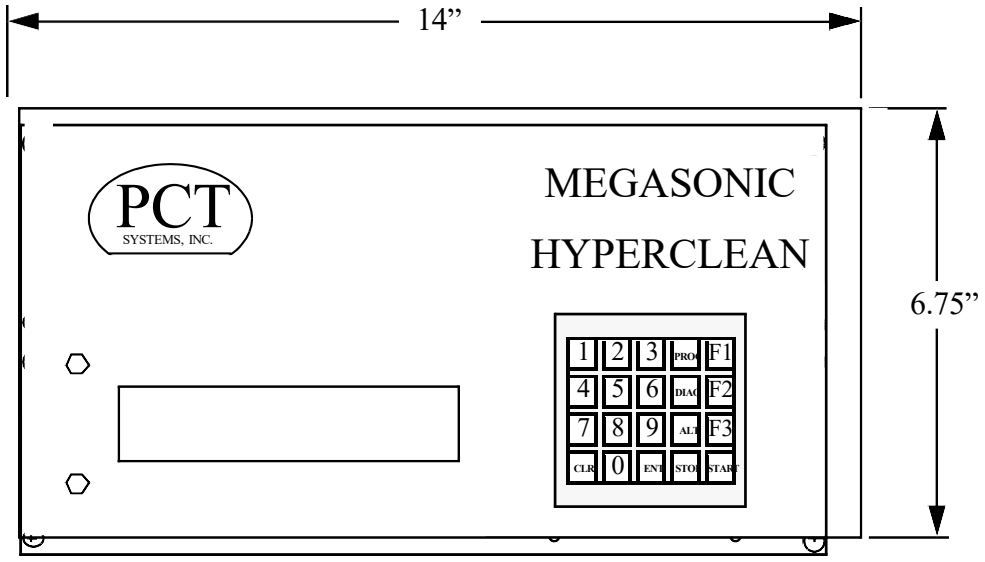
5. Other Installation Items

Cable Installation	Bring the cables through the wet station cutout for the vessel before lowering the Tank onto the mounting supports.
Connectors & Housing	Before removing any connectors or housing parts, take note of their location. This observation will facilitate installation of the vessel. Verify that these parts are reassembled exactly as they were prior to removing them. Improper assembly could cause premature failure of these connections. *See the cable diagram in* Appendix A *for connector pin assignments.*
Cable Protection	Protect cable ends from corrosion. Do not expose them to fumes or chemicals.

Figure 2-6: Unheated System Controller: Front & Back Panels



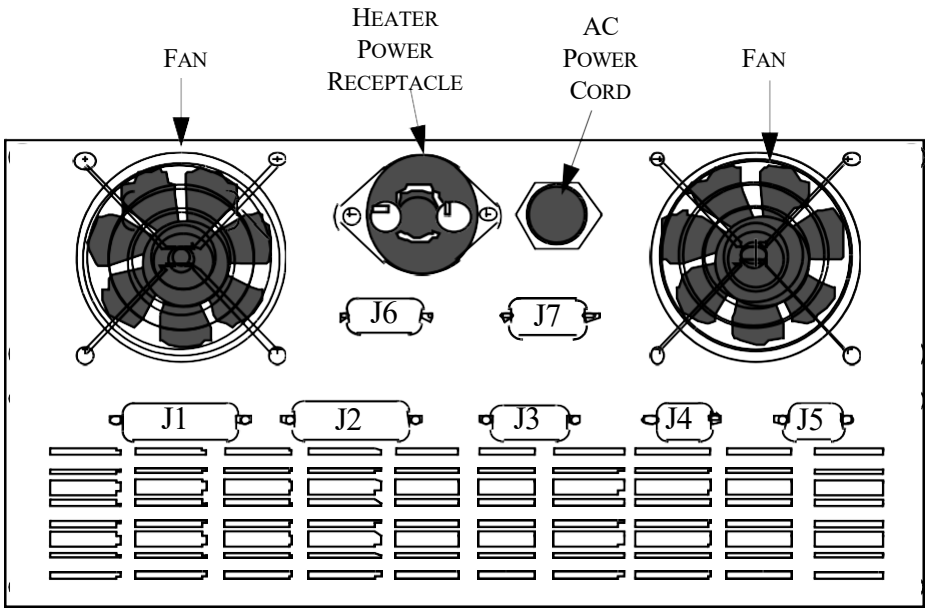
BACK VIEW



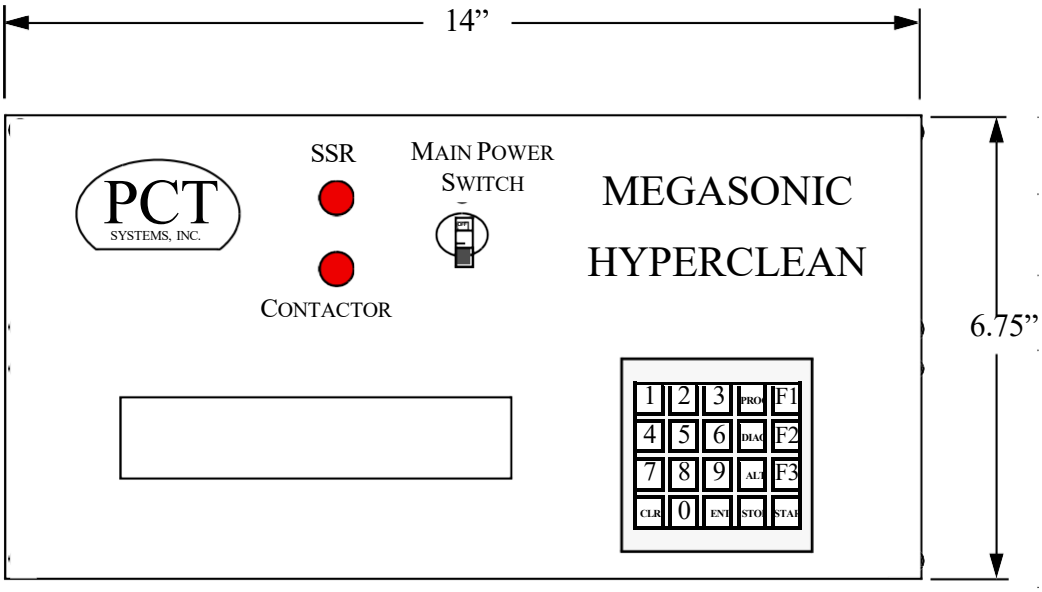
FRONT VIEW

Allow 16” depth for ventilation and space for cable.

Figure 2-7: Heated System Controller: Front & Back Panels



BACK VIEW



FRONT VIEW

Allow 16” depth for ventilation and space for cable.

Optional Remote Control Panel

The Remote Control Panel includes mounting hardware.

Figure 2-8: Installation Instructions for the Optional Remote Control Panel

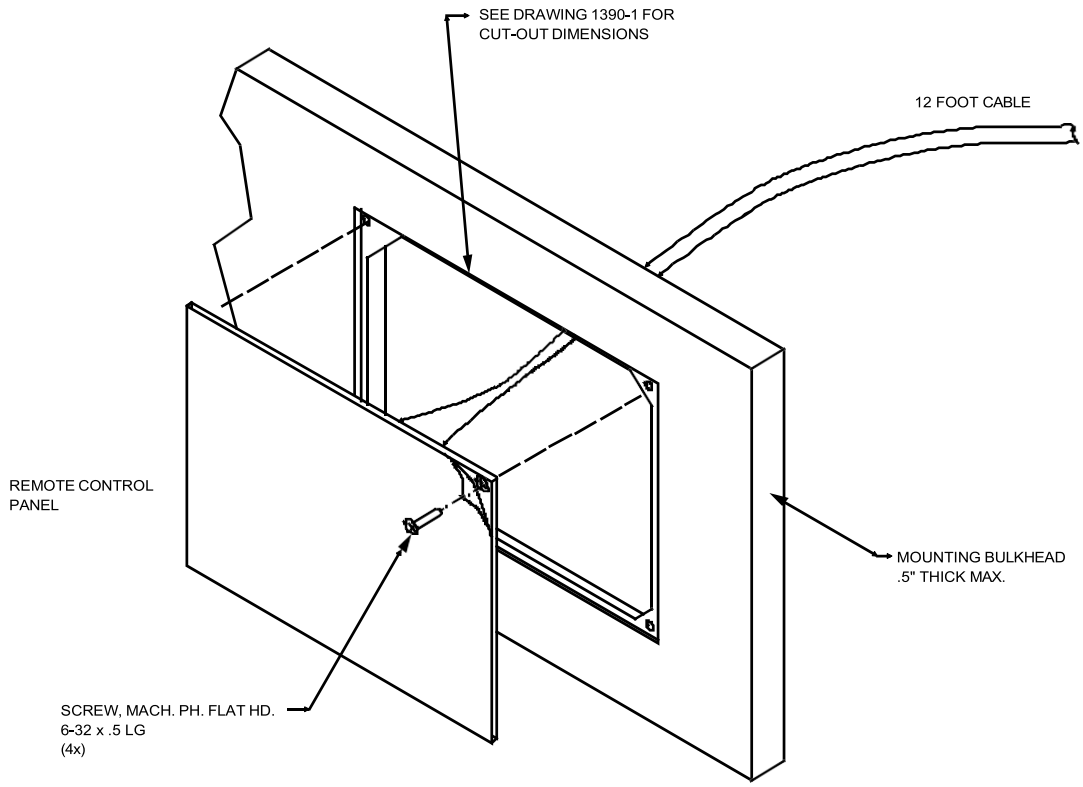


Figure 2-9 shows a recommended mounting plate configuration with mounting dimensions to attach the panel to a surface. The 12-foot cable connects to J2 on the Controller.

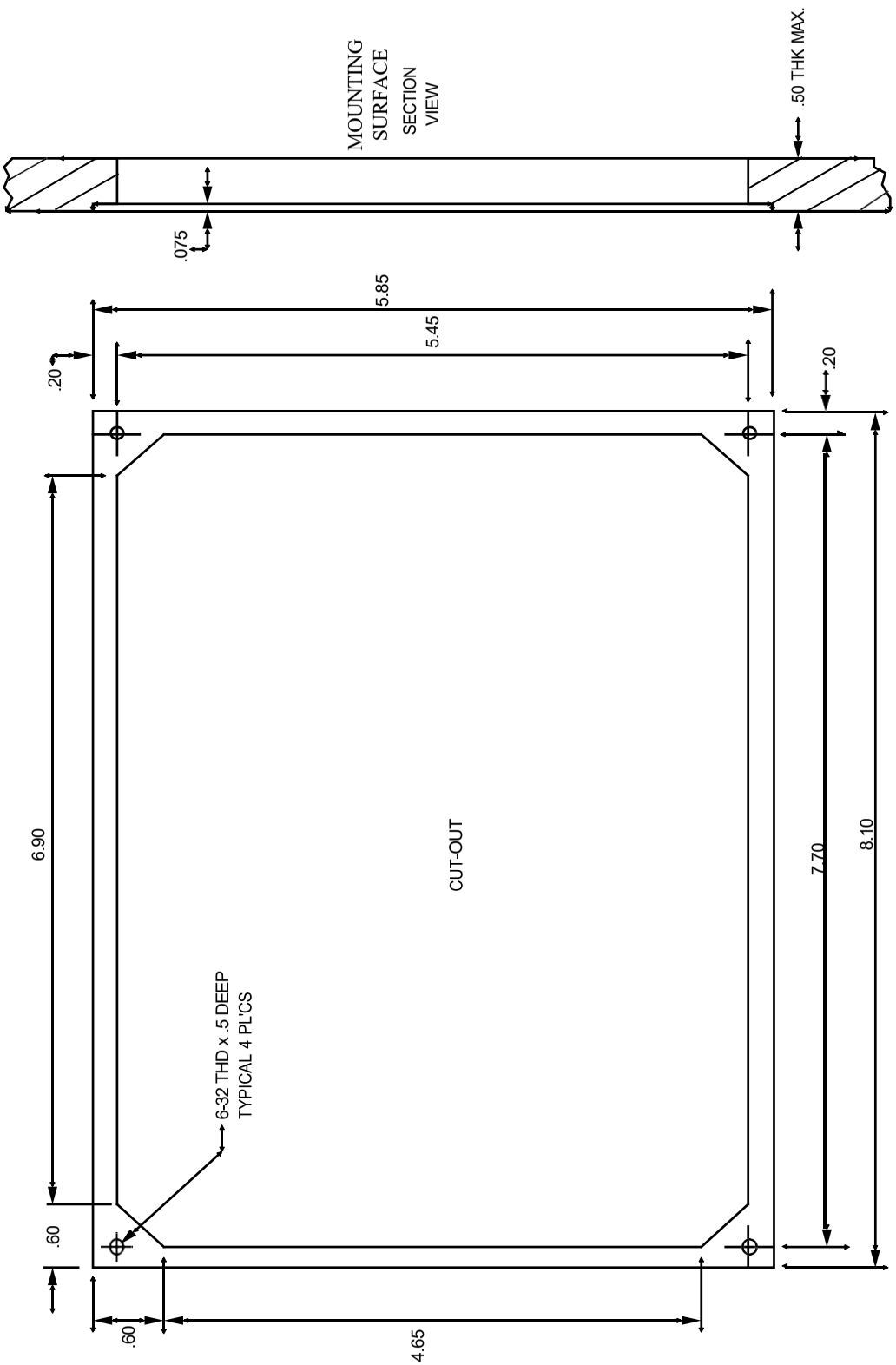


Figure 2-9: Recommended Mounting Pattern for the Remote Panel

Non-Heated-Type System Installation Test

Non-heated systems have a jumper plug installed at the factory on J3 and J4. These 2 plugs are required for the system to operate. Verify they are connected.

Perform the following procedure/checklist to ensure the equipment functions correctly:

1. Install the Process Tank.
2. Route the RF cables from the Bath to the Controller.
3. Install the Liquid Level Sensor Assembly to the Process Tank.
4. If it is ordered with your system, install the Remote Operator Panel.
   See Figure 2-8 *and* Figure 2-9 *for more information.*
5. Verify the power is OFF, then plug in all the cables to the back panel of the Controller.
   See Figure 2-6 *or* Figure 2-7*, as appropriate.*
6. Fill the Tank with DI water to the level indicated by the grey to white color change inside the Tank.
   - Verify the water is up to the minimum level indicator line **BEFORE** turning ON the power.
7. Turn ON the power to the Controller.

   Verify that the Display and the Keypad are operating.

   Press the Diagnostic key (DIAG).
   - The lower 2 lines of the Display change when it is working correctly. Press the CLR key to show the default information.

   For the FTune Program, see Chapter 6: FTune Programming.
8. Test the Liquid Level (L/L) Sensor.

   Pull the end of the L/L sensor tubing out of the liquid in the Tank.
   - If the sensor is operating correctly, the Display shows “LOW LIQUID LEVEL” within 10 seconds.
   - If using a different type sensor, perform an equivalent test.
9. Program a standard cleaning process for a duration of 600 seconds.

   Observe the energy pattern visible on the surface of the liquid in the Tank over each Crystal (Transducer).
   - The pattern of surface disruption should form a smoothly rippling, uniformly distributed, effervescent area on the

liquid surface above the full width of each activated Crystal. The energy pattern should be similar for all Crystals.

- If any energy pattern is shorter, dissimilar, or not as active, record the Crystal location and immediately call PCT Systems Customer Support for assistance.

Heated-Type System Installation Test

Perform the following procedure/checklist to ensure the equipment functions correctly:

1. Install the Process Tank.
2. Route the Heater power cable and RF cables from the Bath to the Controller unit.
3. Install the RTD/Liquid Level Sensor assembly to the Process Tank.

   For more information, see the N2 Bubble-type Sensor Assembly diagram in Figure 2-2 *and the Installation Diagram in* Figure 2-3.

4. If it is ordered with this system, install the Remote Operator Panel.

   See Figure 2-8 *and* Figure 2-9 *for more information.*

5. Verify the power is OFF, then plug in all the cables to the back panel of the Controller.

   See Figure 2-6 *or* Figure 2-7*, as appropriate.*

6. Fill the Tank with DI water to the level indicated by the grey to white color change inside the Tank.
   - Verify the water is up to the minimum level indicator line **BEFORE** turning ON the power.
7. Turn ON the power to the Controller.

   Verify that the Display and Keypad are operating.

   Press the Diagnostic key (DIAG).
   - The lower 2 lines of the Display change when it is working correctly. Press the CLR key to show the default information.

8. Test the Liquid Level (L/L) Sensor.

   Pull the end of the L/L sensor tubing out of the liquid in the Tank.

   - If the sensor is operating correctly, the display shows "LOW LIQUID LEVEL" within 10 seconds.
   - If using a different type sensor, perform an equivalent test.

9. Verify the RTD and thermocouple are reading accurately.
   - The temperature should display a stable value $+2^0$C to -2^0C of the programmed temperature.

10. Program the vessel liquid temperature for 55^0C.

    Verify that the bath is heating using the "Diagnostic Displays" section in the appropriate Programming Chapter.

11. Program a standard cleaning process with the temperature at 55^0C for the time duration of 600 seconds.

    When the water temperature reaches 55^0C, the energy created by the Transducers should form a smoothly rippling, uniformly distributed, effervescent area on the liquid surface above the full width of each activated Crystal. The energy pattern should be similar for all Crystals.

    - If any energy pattern is shorter than the others, dissimilar, or is not as active as the others, record the Crystal location and immediately call PCT Systems Customer Support for assistance.

CHAPTER 3
SYSTEM INTERFACES

Purpose

This chapter describes the interface options available:

- Controller Interfaces
- Remote Interface
- SECS II Interface Protocol
- RS-232 Software Protocol

Controller Interfaces

NOTE:
Digital I/O points from a Programmable Logic Controller (***PLC***) are connected to the Controller via J5 and J1. The standard interface wiring for J5 is shown in Figure 3-3.

Connector J1 is reserved for custom programming.

Remote Operator Panel (OPTIONAL)

The ***Remote Operator Panel*** provides the Operator total control in the process area. It is an option available with all systems and provides an additional Display and Keypad.

This Remote Panel provides direct start, stop, and program access identical to the Controller's front panel.

The interface hardware to the Remote Panel Cable, connected to the J2 receptacle, is located on the back panel of the Controller unit.

For more information, see Chapter 2: Facilities & Installation Information*,* Figure 2-6 *or* Figure 2-7*, as appropriate.*

An illustration showing the Remote Panel connected to the Controller is shown in Chapter 2: Facilities & Installation Information*,* Figure 2-8*.*

Remote Interface

A PLC-type interface can be used with this system's standard inputs and outputs.

> *See the following section discussing* Quick On/Off Option*. The standard wiring configuration is shown in* Figure 3-1.

The Generator requires 8 seconds to become ready, at full power, from the time a process is started.

When a START or STOP function is initiated, the contacts must be CLOSED for a minimum time of 1 second before the system responds.

Quick On/Off Option

One signal from a single relay turns the Megasonic System ON and OFF.

The system is in a CLOSED/ON state when pins J5-1 and J5-6 are CLOSED. This state is static until either the contact is opened or the process time expires.

To terminate a process before the programmed time has expired (OFF), open the contacts between J5-1 and J5-6.

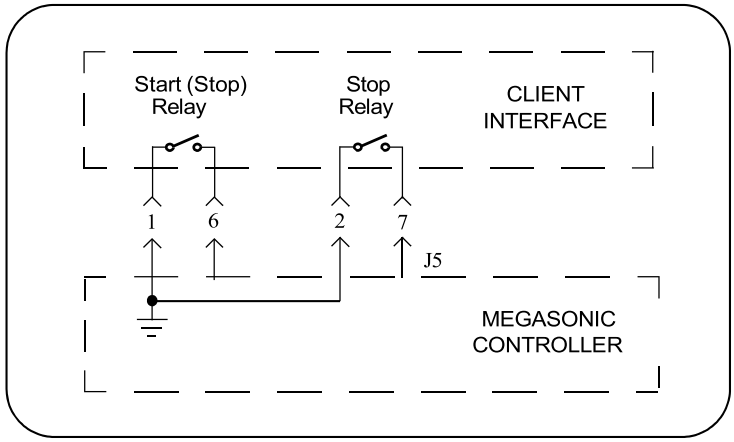
Normal Option

The NORMAL option has dual line controls with 2 momentary contacts: one contact is START, the other is STOP.

The function operations are:

START	Momentary contact closure of J5-1 and J5-6 turns ON the Megasonic System.
STOP	Momentary contact closure of J5-2 and J5-7 turns OFF the Megasonic System. **or** The program for this process sends a signal at the end of the time cycle programmed by the Operator. This signal turns OFF the Megasonic System.

Figure 3-1: Controller J5 Interface to Client Control

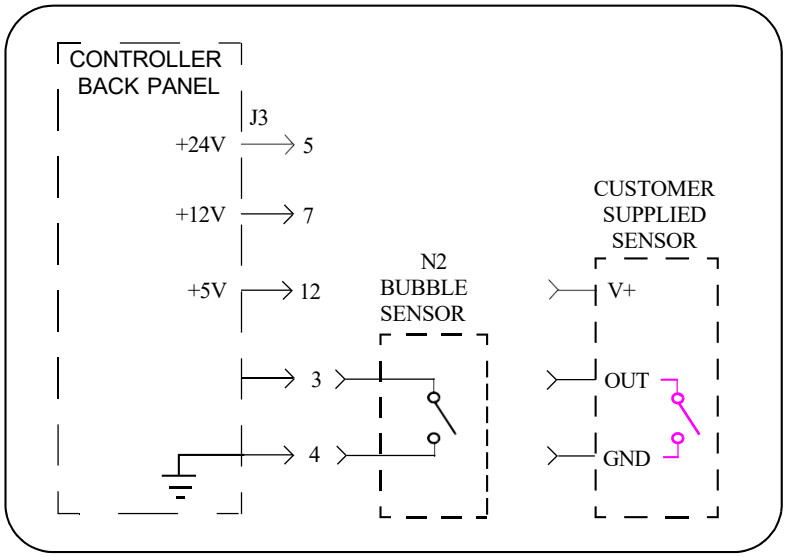


Level Sensor Program Setting

This system uses a switched output, bubble-type sensor. Optical or capacitive-type sensors may also be used. For these other types of sensors, wire them to the appropriate pin for selection of +24V, +12V or +5V.

Only programming values of zero (0) or one (1) may be used with the system.

Figure 3-2: Controller J3 Interface to Client Controls



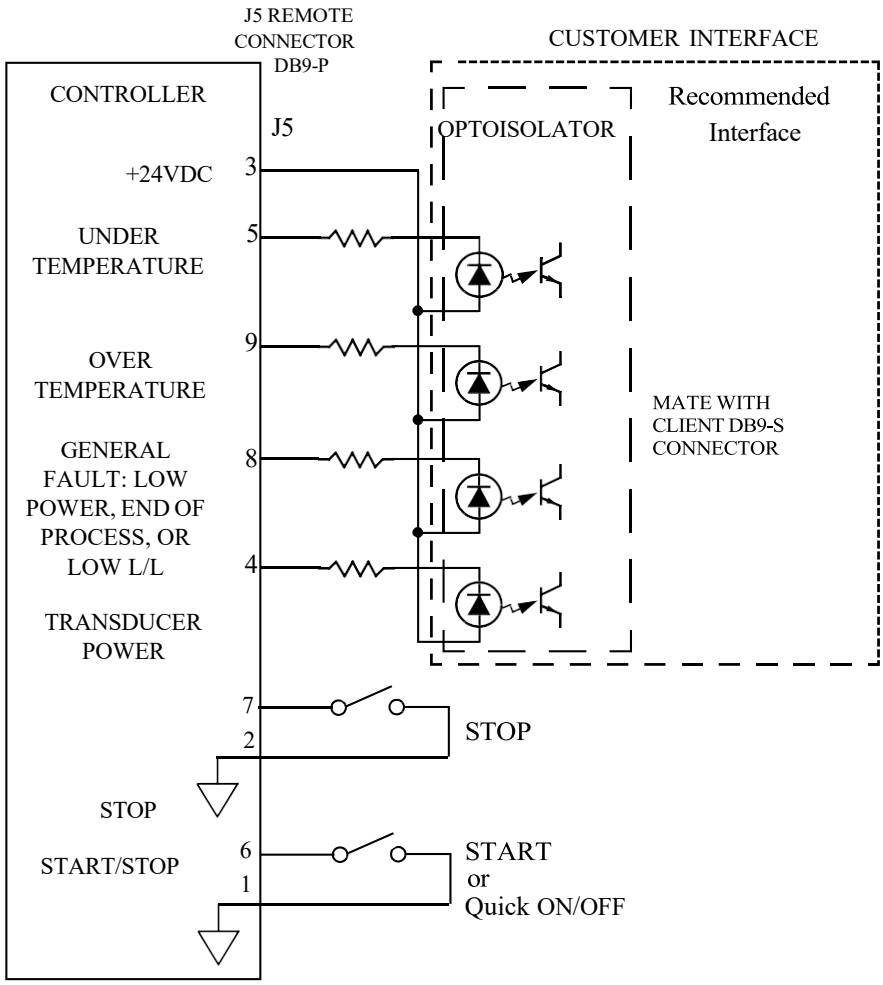
Liquid Level Set Point Switched Output Value 0	J3-4 to J3-3 OPEN indicates the liquid level is adequate to heat and run the Megasonic energy.
Liquid Level Set Point Switched Output Value 1	J3-4 and J3-3 CLOSED indicates the liquid level is adequate to heat and run the Megasonic energy.

PLC Controller Interface

Use the standard inputs and outputs on this system to interface the Generator to your PLC.

In addition to the system's standard set, 8 additional custom inputs and outputs can be configured as an option. Please contact PCT's Engineering Department for details.

Figure 3-3: 6000H Input/Output Pins



SECS II Interface Protocol

The Series 6000 software has a SECS II Interface. This interface allows remote control of the system, via an RS-232 communications port, to the host computer.

WARNING:

When using the RS-232 communications port, use only Pins 1, 2, and 3 of Connector J1.

Make sure the other pins are not connected for communications use.

Using other pins for communication will cause damage to the Generator.

The Series 6000 software is PC compatible using SECSism software from G.W. Associates. The SEMI SECS II handbook provides protocol information.

Supported Streams & Functions List

These streams and functions are supported by all versions PCT Systems' software:

- Stream 1: Function 1; Are You There
- Stream 1: Function 3; STATUS REQUEST
- Stream 2: Function 15; RECEIVED PROCESS
- Stream 2: Function 21; REMOTE COMMAND
- Stream 5: Function 1; ALARM REPORT SEND (AT POWER UP)
- Stream 6: Function 11; EVENT REPORT
- Stream 9: Function 1; INVALID ID CODE
- Stream 9: Function 3; INVALID STREAM
- Stream 9: Function 5; INVALID FUNCTION
- Stream 9: Function 7; INVALID FORMAT

Stream 1 Function 1; Are You There

Responds with Stream 1, Function 2 and uses this template:

L,2

1. <MSONIC>
2. <V8.00>

```
DB      27              ;LENGTH BYTE
DW      700H ; DEVICE ID TEMPLATE TO BE ORED WITH DEVICE ID
DB      1,2,70H,1
DB      0,0,0,0         ;SYSTEM BYTES
DB      1,2,41H,6       ;2 ITEM LIST. ASCII FORMAT 1 LENGTH BYTE
DB      ' MSONIC'       ;THE DEVICE ID
DB      41H,5           ;ASCII FORMAT 5 BYTES LONG
DB      'V8.00'         ;THE VERSION NUMBER
DW      0; CHECKSUM
```

Stream 1, Function 3; Status Request

Responds with Stream 1, Function 4 and uses this template:

L, 4

1. <PROGRAMMED TEMPERATURE>
2. <ACTUAL TEMPERATURE>
3. <TIME REMAINING THIS PROCESS>
4. <STATUS DUMMY>

The **STATUS DUMMY** is actually a binary encoded status and may be interpreted as follows:

```
BIT 0       :LOW LIQUID LEVEL
BIT 1       :LID OPEN (DOESN'T APPLY TO STANDARD MEGASONIC)
BIT 2       :BAD PARAMETERS (PROGRAMMED INVALID TEMPERATURE)
BIT 3       :MEGASONIC IN PROGRESS
BIT 4       :GENERAL HARDWARE FAILURE
BIT 5 to 7  :RESERVED
BIT 8 to 15 :RESERVED FOR FUTURE EXPANSION

DB          22
DW          7000H
DB          1,4,70H,1       ;STREAM 1 FUNCTION 4
```

```
DB      0,0,0,0
DB      1,1         ;LIST ONE ITEM
DB      0A9H,8      ;UNSIGNED INTEGER, 4 TOTAL
DW      0           ;DESIRED POWER 1
DW      0           ;ACTUAL POWER 1
DW      0           ;PROCESS TIME LEFT
DW      0           ;STATUS
DW      0           ;CHECKSUM
```

Stream 2, Function 15; Receive Process

Receives process temperature and time as unsigned integers.

L, 3

1. <PROGRAMMED TEMPERATURE>UNSIGNED INTEGER
2. <PROGRAMMED TIME>UNSIGNED INTEGER
3. <PROGRAMMED POWER>UNSIGNED INTEGER

Responds with Stream 2, Function 16:

L, 1

```
1,      <PARAMETER DOWNLOAD STATUS>, 0=OK, 3=BAD PARAMETER
DB      13
DW      7000H           ;DEVICE ID TEMPLATE CODE
DB      2, 16, 70H, 1   ;STREAM 2, FUNCTION 16, LAST BLOCK
DB      021H,1          ;UNSPECIFIED BINARY, ONE TO FOLLOW
DB      0               ;INTEGERS
DW      0               ;CHECKSUM
```

Stream 2, Function 21: Remote Command

Executes one of two commands, which either STARTS or STOPS the Megasonic.

```
<RCMD>
        ;TWO VALID COMMANDS ARE ACCEPTED
        ;1=START PROCESS
        ;1B HEX=CANCEL PROCESS
```

Responds with Stream 2, Function 22; THE SINGLE ITEM RETURNED IS AN UNASSIGNED BYTE.:

```
<CMDA>  ;COMMAND ACKNOWLEDGE 0=COMMAND DONE, 1=INVALID COMMAND
        ;2=UNABLE TO EXECUTE COMMAND, IE, LOW LIQUID LEVEL OR
        OTHER HARDWARE CONDITION IS NOT READY
DB      1 3             LENGTH BYTE
DW      7000H           ;DEVICE ID
DB      2, 22, 70H, 1 ;STREAM 2 FUNCTION 22, LAST BLOCK TEMPLATE
DB      0, 0, 0,0       ;SYSTEM BYTE
DB      0A5H, 1         ;UNSIGNED BYTE, ONE TO FOLLOW
DB      0               ;STATUS BYTE TO BE RETURNED
DB      0
```

Stream 5, Function 1: Alarm Report Send

Sent after every power-up or hardware set.

L, 3

1. <ALCD> ;SET TO 0
1. <ALID> ;SET TO 0
1. <ALTX> ;SET TO 0

```
DB      1 8             ;LENGTH BYTE
DW      7000H           ;
DB      5, 1, 70H, 1    ;EVENT REPORT STREAM 6, FUNCTION 11
DB      0, 0, 0, 0
DB      A9H, 6          ;UNSIGNED BYTE, ONE TO FOLLOW
DW      0               ;ALCD
DW      0               ;ALID
DW      0               ;ALTX
DW      0               ;CHECKSUM
```

Stream 6, Function 11: Event Report

Reports the end of the Megasonic cycle.

L, 1

1. <TIME REMAINING> ;UNSIGNED INTEGER

```
DB      1 4             ;LENGTH BYTE
DW      7000H           ;
DB      6, 11, 70H, 1   ;EVENT REPORT STREAM 6, FUNCTION 11
DB      0, 0, 0, 0
DB      A9H, 2          ;UNSIGNED INTEGER, ONE TO FOLLOW
DW      0               ;TIME REMAINING
DW      0               ;CHECKSUM
```

Stream 9, Function 1: Invalid Device ID Code

Reports in the standard format.

;INVALID DEVICE ID CODE:

```
DB      2 2                 ;LENGTH
DW      7000H               ;ID TEMPLATE
DB      9, 1, 70H, 1        ;STREAM 9, FUNCTION 1
DB      0, 0, 0, 0          ;SYSTEM BYTES
DB      21H, 10             ;UNSPECIFIED BINARY BYTE, 10 TO FOLLOW
DB      0,0,0,0,0,0,0,0,0,0 ;HEADER TO BE RETURNED
DW      0                   ;CHECKSUM
```

Stream 9, Function 3: Invalid Stream

Generates the following message when any stream except the one above is received.

Reports in the standard format.

```
DB      2 2                 ;LENGTH
DW      7000H               ;ID TEMPLATE
DB      9, 3, 70H, 1        ;STREAM 9, FUNCTION 3
DB      0, 0, 0, 0          ;SYSTEM BYTES
DB      21H, 10             ;UNSPECIFIED BINARY BYTE, 10 TO FOLLOW
DB      0,0,0,0,0,0,0,0,0,0 ;HEADER RETURN SPACE
DW      0                   ;CHECKSUM
```

Stream 9, Function 5: Invalid Function

Generates message when a non-supported function is received.

Reports in the standard format.

```
DB      2 2                 ;LENGTH
DW      7000H               ;ID TEMPLATE
DB      9, 5, 70H, 1        ;STREAM 9, FUNCTION 5
DB      0, 0, 0, 0          ;SYSTEM BYTES
DB      21H, 10             ;UNSPECIFIED BINARY BYTE, 10 TO FOLLOW
DB      0,0,0,0,0,0,0,0,0,0 ;HEADER RETURN SPACE
DW      0                   ;CHECKSUM
```

Stream 9, Function 7: Invalid Format

Generates message when one of the variable types in the list is of the wrong format (i.e., unsigned integer when ASCII is expected, etc.).

Reports in the standard format.

```
DB      2 2                 ;LENGTH
DB      7000H               ;ID TEMPLATE
DB      9, 7, 70H, 1        ;STREAM 9, FUNCTION 7
DB      0, 0, 0, 0          ;SYSTEM BYTES
DB      21H, 10             ;BINARY RETURN OF THE HEADER JUST
                            RECEIVED
DB      0,0,0,0,0,0,0,0,0,0
DW      0                   ;CHECKSUM
```

The SECSism file used to test the SECS II Interface with the G.W. Associates software is listed as follows:

```
*Are You There
S1F1 W.
*On Line Data
S1F2
<L>.
*Selected Equipment Status Request
S1F3
<L
        <U2 1>  *SVID
        >.
*Selected Equipment Status Data
S1F4
<L
        <I2 1>    *SV
        >.
*Formatted Status Request
*New Equipment Constant Send
S2F15 W
<L
        <L [2]
                <U2 1>          *PROGRAMMED TEMPERATURE
                <U2 65>         *
                >
                                <L [2]
                <U2 2>          *PROGRAMMED TIME
                <U2 310>        *
                                >
                                <L [2]
                                <U2 3>          *PROGRAMMED POWER
                                <U2 70>         *
>
>.
New Equipment Constant Acknowledge
S2F16
        <B 0>.
*Remote Command Send
S2F21 W
```

<U1 1>.

*Remote Command Acknowledge

S2F22

<U1 0>.

*Stream 9 Abort

S9F0.

*Unrecognized Device ID

S9F1

<B 0001 0000 7001 00000000>.

*Unrecognized Stream Type

S9F3

<B 0001 0000 7001 00000000>.

*Unrecognized Function Type

S9F5

<B 0001 0000 7001 00000000>.

*Illegal Data

S9F7

<B 0001 0000 7001 00000000>.

*Transaction Timer Time-Out

S9F9

<B 0001 0000 7001 00000000>.

RS-232 Software Protocol

Overview & Requirements

Due to an increased demand for more centralized control of wet deck processes, PCT Systems has devised a ASCII control language that allows the PLCs to communicate and control the Model 6000.

IMPORTANT:
Software revision of FTUNE1D or later is required.

Programming Information

START ARRAY #1

Command: Ax(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START ARRAY #2

Command: Bx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START BOTH ARRAYS

Command: Cx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

DOWNLOAD PROCESS INFORMATION

Command:Dxprocesstime,processpower,processtemp,mintemp,maxtemp,
cs,(cr)
(x = 1-9 only)

Response: none

DOWNLOAD FREQUENCY INFORMATION

Command: Ex1freq1,1freq2,1freq3,1freq4,1freq5,1freq6,1freq7,1freq8,
2freq1,2freq2,2freq3,2freq4,2freq5,2freq6,2freq7,2freq8,cs,(cr)
(x = 1-9 only)

Response: none

DOWNLOAD TUNING INFORMATION

Command: Fx#of xtals,speed,minfreq1,maxfreq1,minfreq2,maxfreq2,
wobble1,wobble2,tunetype,cs,(cr)
(x = 1-9 only)

Response: none

IDENTIFY UNITS

Command: I0(zero)(cr)

Response: Ix(cr) x = number of units found

START AUTO LOGGING

Command: Lx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

STOP AUTO LOGGING

Command: lx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START UNIT(S)

Command: Ox(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

STOP UNIT(S)

Command: ox(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

QUERY UNIT(S)

Command: Qx(cr) x = 1-9 (0 = All)

Response: Qx,mux,freq1,acoustic power,freq2,power1,power2,temp,(cr)

QUERY STATUS

Command: qx(cr) x = 1-9 (0 = All)

Response: qx,status(cr)

START TUNING ARRAY #1

Command: Rx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START SCANNING ARRAY #1

Command: rx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START TUNING ARRAY #2

Command: Sx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START SCANNING ARRAY #2

Command: sx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START TUNING BOTH ARRAYS

Command: Tx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

START SCANNING BOTH ARRAYS

Command: tx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

UPLOAD PROCESS INFORMATION

Command: Ux(cr) x = 1-9 (0 = All)

Response:Ux,processtime,processpower,processtemp,mintemp,maxtemp,(cr)

UPLOAD FREQUENCY INFORMATION

Command: Vx(cr) x = 1-9 (0 = All)

Response: Vx,1freq1,1freq2,1freq3,1freq4,1freq5,1freq6,1freq7,1freq8,
2freq1,2freq2,2freq3,2freq4,2freq5,2freq6,2freq7,2freq8,(cr)

UPLOAD TUNING INFORMATION

Command: Wx(cr) x = 1-9 (0 = All)

Response: Wx,#of xtals,speed,minfreq1,maxfreq1,minfreq2,maxfreq2,
wobble1, wobble2,tunetype,cs,(cr)

CANCEL ALL

(Like pressing the “STOP” button on the unit to cancel alarms)

Command: Xx(cr) x = 1-9 (0 = All)

Response: x = 1-9, none. x = 0 , command echoed

Programming Notes

(cr) = 0Dh

(cs)= Checksum. Add the values of all the fields (except unit #)

Example:

Fx#of xtals,speed,minfreq1,maxfreq1,minfreq2,maxfreq2,
wobble1,wobble2,tunetype,cs,(cr)

(cs) = # of xtals+speed+minfreq1+maxfreq1+minfreq2+maxfreq2+
wobble1+wobble2+tunetype

All values are in Binary Coded Decimal (***BCD***) with a range of 00000-99999, except where noted.

Communications are set at: 9600 baud, no parity, 8 data bits, 2 stop bits

When "Auto Logging" is ON, the unit will generate a "Query Unit" message every second.

When downloading information to the Generator, do not insert a comma after the unit number.

Example:

Dxprocesstime,processpower,processtemp,mintemp,maxtemp,cs,(cr)

When uploading information from the Generator, a comma will be present after the unit number.

Example:

Response:
Ux,processtime,processpower,processtemp,mintemp,maxtemp,(cr)

QUERY STATUS VALUES

0 = Ready to run process
1 = Running process
2 = Liquid level low (before running process)
3 = Liquid level low (process aborted)
4 = Process complete
5 = Overtemp (process aborted)
6 = Heater disabled
7 = Tuning Array #1
8 = Tuning Array #2
9 = Tuning both
10 = Low power (process aborted)

CABLING REQUIREMENTS FOR A SINGLE UNIT

- DB25 Female (to Generator J1, Auxiliary)

  Pin 3 = Tx

  Pin 2 = Rx

  Pin 1 = GND

CABLING REQUIREMENTS FOR MULTIPLE UNITS

- The Ground loops to all units.
- The Tx of the Computer (Pin 3) connects to the first Generator Rx (Pin 2)
- The Tx of the first Generator (Pin 3) connects to the next Generator Rx (Pin 2)
- The Tx of the next Generator (Pin 3) connects to another Generator Rx (Pin 2)
- and so on.
- The Tx (Pin 3) of the last Generator connects to the Computer Rx (Pin 2)

CHAPTER 4
THE CONTROLLER

Purpose

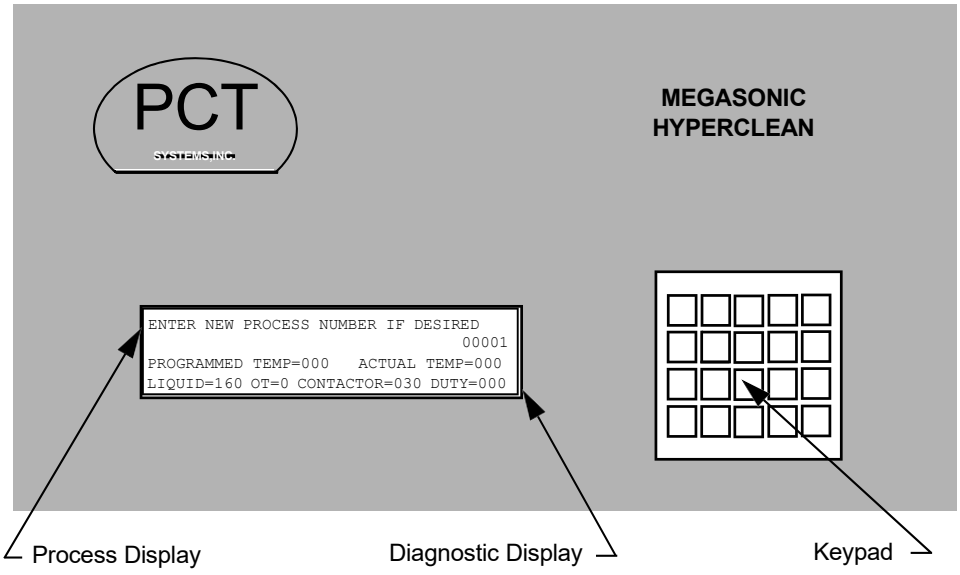
This chapter discusses the Key Components of the Controller & how they work:

- Liquid Crystal Display (Display)
- Keypad and the Control Keys:
  - Process Control Keys
  - Diagnostic Keys
  - Operation Control Keys
- The Program and Programming the Controller: To Access the Program & Enter a Value

Key Components of the Controller

To monitor and control the cleaning process, the **DISPLAY** and **KEYPAD** are used. The cleaning process, itself, is controlled by values input for various operating parameters, via the Keypad, into the **PROGRAM**.

Figure 4-1: A Typical Front Panel of a PCT Systems' Controller

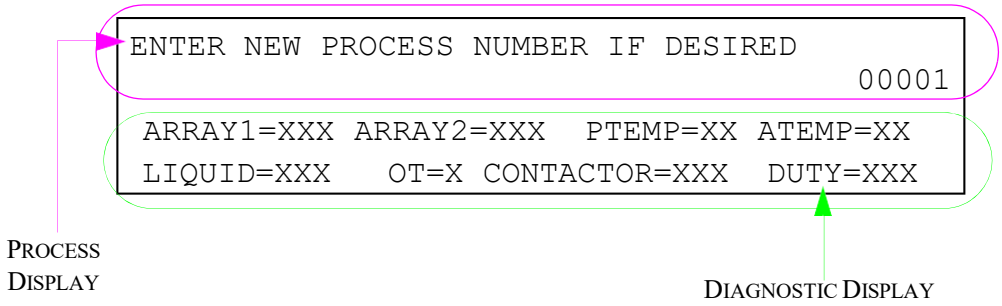


Display

The Controller's LCD (**DISPLAY**) shows various screens correlating to the state of the process (normal and abnormal conditions), and its programming status.

Located on the left front panel, the Display shows **PROCESS DATA** (the top 2 lines), followed by 2 lines of **DIAGNOSTIC DATA**.

Figure 4-2: Close-Up: A Typical Controller's Display



Keypad

The Keypad is the main interface to the system and serves multiple functions:

- Allows the Operator to control the cleaning process (enter new values for various parameters) via the **PROCESS CONTROL KEYS**
- Enables the Operator to troubleshoot the system via the **DIAGNOSTIC KEYS**
- Allows the Operator the ability to control operation of the cleaning process (for example, stop, start, clear alarms) via the **OPERATION CONTROL KEYS**

Process Control Keys

By using the **PROCESS CONTROL KEYS**, located on the Keypad on the front of the Controller or on the Remote Panel, the Operator can enter the system's operating parameters and control the process.

Figure 4-3: Location of the Process Control Keys

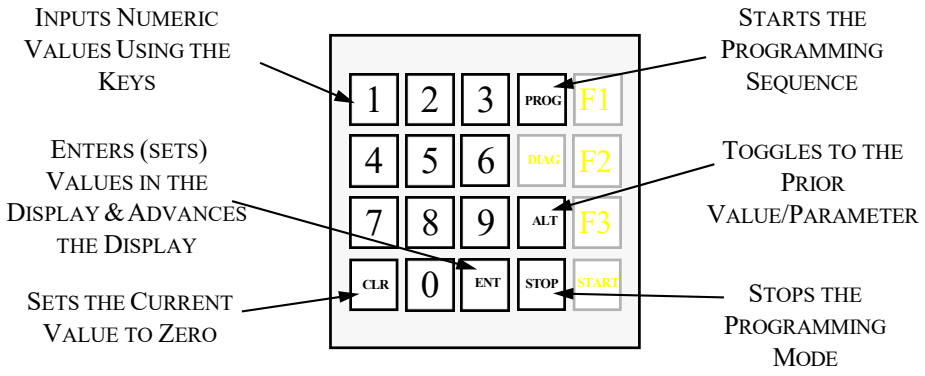


Table 4-1: Summary of the Process Control Key Functions

PROG	Initiates the programming sequence.
CLR	Sets the current Display value to 0.
ENT	Enters the Display value. Advances to the next Display.
ALT	Changes to the previous parameter.
STOP	Stops the programming mode.
0–9	Enables numeric value input.

Diagnostic Keys

As stated, the **DIAGNOSTIC KEYS** allow the Operator to troubleshoot the cleaning process.

Figure 4-4: Location of the Diagnostic Keys

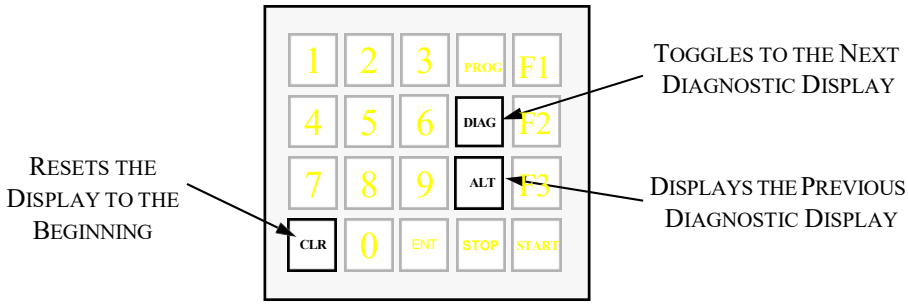


Table 4-2: Summary of the Diagnostic Key Functions

DIAG	Toggles to the next Diagnostic informational Display in the sequence.
ALT	Shows the previous Diagnostic Display.
CLR	Sets the Diagnostic Display to first Display in the sequence.

Operation Control Keys

The **OPERATION CONTROL KEYS** allow the Operator to do just that, control the cleaning process' operation. The Operator can stop the process, start the process, clear alarms, and so on.

Figure 4-5: Location of the Operation Control Keys

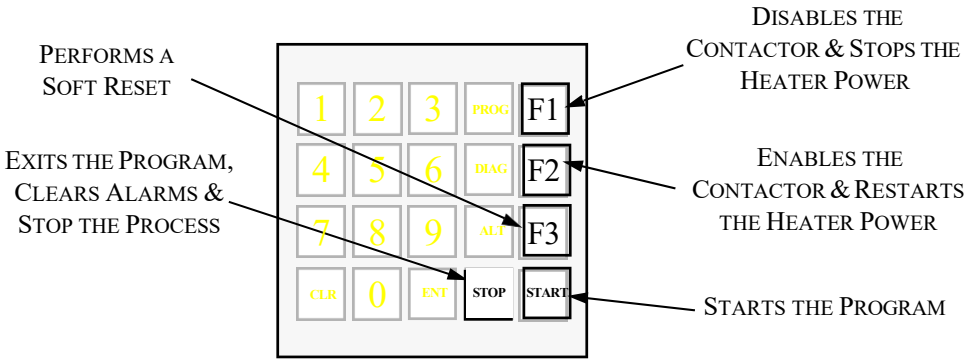


Table 4-3: Summary of the Operation Control Key Functions

F1	Disables the Contactor and stops power to the Heaters.
F2	Enables the Contactor and resumes power to the Heaters.
F3	Performs a Soft Program reset.
STOP	Exits the programming mode. Clears the alarms. Stops the current process.
START	Starts the Megasonic Cleaning Process.

The Program

The **PROGRAM** controls the cleaning process. The appropriate values are entered for the various process parameters via the Keypad or the Remote Operator Control Panel.

Other features of this system include:

- Transducer frequencies are programmed at the factory.
- Interval time of each Transducer is factory set to this Program.
- The Controller stores/accesses up to 9 processes.
- The last process set remains the programmed process until a different process is programmed.
- The Power level is set by the Operator.
- The Temperature is set by the Operator.
- The Heater/Power factor is set in the Program.

IMPORTANT:
Maximum operating temperature is factory set at 70ºC.

Programming the Controller: To Access the Program & Enter a Value

1. Press the PROG key on the Keypad.
2. Enter the value using the numeric keys (0–9).
3. Press the ENT key to accept the value.
   - The Programming screen appears after Step 3 is completed.
4. Verify the new value has been accepted by the system by checking the Display's second message line.
   - Press the ALT key to display the message line.
   - The change is reflected immediately on the Display.

IMPORTANT:
Using unauthorized values may cause system problems which will not be covered by the warranty.

REMINDER:
The first 2 lines of the Display state the *Process Data* and the next lines state the *Diagnostic Data*.

CHAPTER 6
FTUNE PROGRAMMING

Purpose

This chapter provides programming information for the 6000 Series Program **F-SERIES** (FTune1JC), which operates the Megasonics.

This chapter discusses the:

- Various Programming Displays
  - System Programming Displays
  - Level Sensor Programming
  - SECS Interface Programming
  - Frequency Programming
  - Programming Transducer Parameters
- Process Displays
- Diagnostic Displays

> **IMPORTANT:**
> When programming the system, use only the parameter values listed in the this chapter unless otherwise told by PCT personnel.

Programming the Controller

TO ACCESS THE PROGRAM & ENTER A VALUE

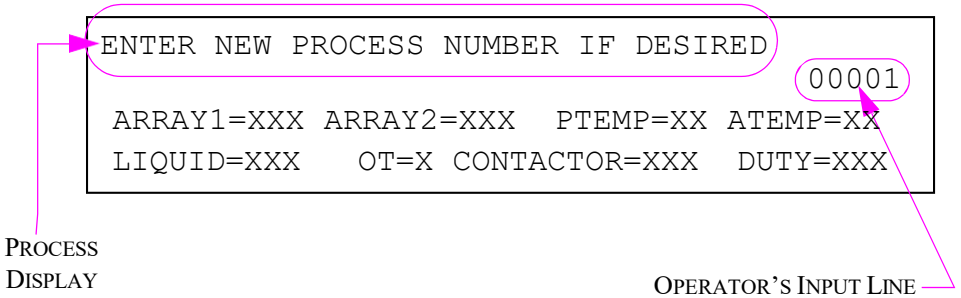
1. Press the PROG key on the Keypad.
2. Enter the value using the numeric keys (0–9).
3. Press the ENT key to accept the value.
   - The Programming screen appears after Step 3 is completed.
4. Verify the new value has been accepted by the system by checking the Display's second message line.
   - Press the ALT key to display the message line.
   - The change is reflected immediately on the Display.

> **IMPORTANT:**
> Using unauthorized values may cause system problems which will not be covered by the warranty.

REMINDER:

The first 2 lines of the Display state the *Process Data* and the next lines state the *Diagnostic Data*.

Figure 6-1: Input Location on the Process Display



For more information regarding the Controller, the Keypad and the Display, please see Chapter 4: The Controller.

Programming Displays

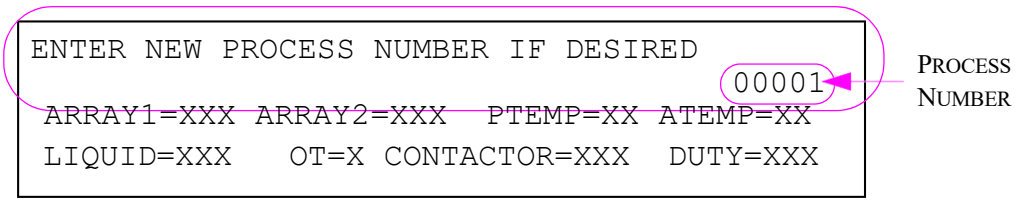
This section summarizes the various Programming Displays:

- Process Number
- Password
- Process Temperature
- Minimum Temperature to Start a Process
- Maximum Temperature to Start a Process
- Process Time
- Power Level
- Minimum Qualifying Power-Array 1
- Minimum Qualifying Power-Array 2
- Transducer Type
- Remote Interface Type: Quick On/Off
- Heater Power Factor

Process Number

The **PROCESS NUMBER** value defaults to last process parameter used.

Press the ENT key to accept the process number displayed.



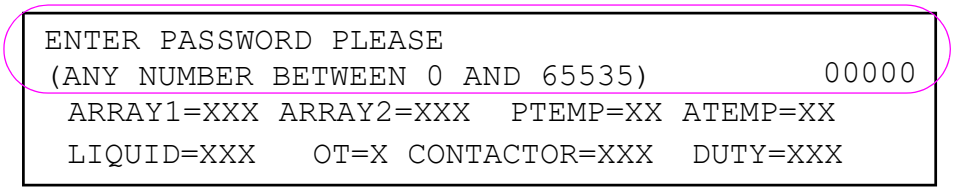
Range	00001 to 00009
Normal	00001
Value	00001 to 00009 (Default is 00000 for setup.)

Password

TO ENTER THE PASSWORD

You must enter a password before you can start programming.

Enter the password (set previously), then press the ENT key.



Range	00000 to 65535
Normal	00000 (00000 is the Default)
Values	00000 to 00250 (User-defined value. We recommend using this range. Values higher than 00250 are reserved for factory use only.)

Process Temperature

```
PROCESS TEMPERATURE (IN DEGREES C)
                                                    00065
 ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
 LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00000 to 00070
Normal	00015 to 00070

IMPORTANT:
Maximum operating temperature is factory set at 70°C.

Minimum Temperature to Start a Process

The Process will not start until the temperature reaches the value set in the Program.

```
MINIMUM TEMPERATURE TO START A PROCESS
(IN DEGREES C)                                  00060
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00000 to 00070
Normal	00000 to 00060
Value	00070 (process maximum)

TO DISABLE THIS FUNCTION

Set the value to 00000.

Press the ENT key.

Maximum Temperature to Start a Process

```
MAXIMUM TEMPERATURE TO START A PROCESS
(IN DEGREES C)                              00070
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00000 to 00070
Normal	00001 to 00060 (00060 recommended)

IMPORTANT:

If the Bath Temperature exceeds the programmed maximum temperature, the process will not start. Also, as a safety feature, if the Bath Temperature exceeds the maximum setpoint, the Heater will shut off and the meg cycle will not start. If this condition occurs, the Operator **MUST** restart the process.

TO RESTART THE CLEANING PROCESS

1. Wait until the Bath Temperature cools to within the programmed range.
2. Press the STOP key.
3. Press the START key to continue the current process.

TO DISABLE THIS FUNCTION

Set the value to 00000.

Process Time

The **PROCESS TIME** function sets the duration of the cleaning, in seconds.

A value of 00060 = 1 minute. A value 00360 = 6 minutes.

```
ENTER PROCESS TIME IN SECONDS
IE 10 MINUTES = 600 SECONDS                00600
 ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
 LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 65535
Normal	00300, 00600 or 00900 for 5, 10 or 15 minute processes

Power Level

Power is programmed in 1% increments.

For example:

100% = 45 watts per square-inch = 7.75 w/sq.cm. of Crystal surface area
1% = 0.45 w/sq.in. = 0.0775 w/sq.cm.

```
ENTER POWER IN PERCENT (IE 1 TO 100%)
(ANYTHING OVER 100 IS SAME AS 100)         00100
 ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
 LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00100
Normal	00100

Minimum Qualifying Forward Power - Array 1

The system's microprocessor compares this minimum power value to the Forward Power Sensors' reading. (Note: The value shown is NOT calibrated to indicate actual watts. It gives an indication of relative power levels coming off each array at any point in time.)

The process shuts down if low power is detected. Typically, this situation indicates hardware failure.

See the Chapter 8: Troubleshooting Guide *for more details.*

```
ENTER MINIMUM POWER VALUE TO QUALIFY
ARRAY1 PROCESS (100 TO 500 TYPICAL)      00050
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00500
Normal	00050

Minimum Qualifying Forward Power - Array 2

The system's microprocessor compares this minimum power value to the Forward Power Sensors' reading. (Note: The value shown is NOT calibrated to indicate actual watts. It gives an indication of relative power levels coming off each array at any point in time.)

The process shuts down if low power is detected. Typically, this situation indicates hardware failure.

See the Chapter 8: Troubleshooting Guide *for more details.*

```
ENTER MINIMUM POWER VALUE TO QUALIFY
ARRAY2 PROCESS (100 TO 500 TYPICAL)      00050
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00500
Normal	00050

Transducer Type

```
TYPE OF TRANSDUCER FOR SENSING HEAT
0=RTD 1=(TC EMBEDDED IN BATH)              00000
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00001
Normal	00000
Value	00000 = RTD; accurate sensing during the process. 00001 = Embedded thermocouple; non-intrusive temperature measurement.

NOTE:
The change in temperature value lags because the quartz thermal insulation characteristics slow cooling and heating of the Bath liquid.

Remote Interface Type: Quick On/Off

The **REMOTE TYPE, QUICK ON AND OFF** function sets the machine for quick starting and stopping—using only one input.

One signal from a single relay turns the complete Megasonic system ON and OFF.

```
TYPE OF REMOTE ON/OFF SIGNAL 0=NORMAL
1=QUICK OFF                                  00000
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00001
Normal	00000
Value	00000 = Normal 00001 = Quick Off

Heater Power Factor

This variable correlates the system's Tank size to the Duty Cycle in order to provide optimum heating time.

- To **DECREASE** the Tank heat-up time, **INCREASE** the value.
- To **INCREASE** the Tank heat-up time, **DECREASE** the value.

```
HEATER POWER FACTOR (USUALLY 200 TO 900)
                                        00900
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00200 to 00900
Normal	00900 (recommended)

Level Sensor Programming

Program the level sensors for the type of sensor and external interface used.

The wiring diagram and information for these senor types are located in the "Level Sensor Program Setting" section in Chapter 3 on page 4.

Liquid Level Set Point

```
LL SWITCH POLARITY FOR NORMAL OPERATION
(0 = N.O. SWITCH  1 = N.C. SWITCH)        00000
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00001
Default	00000
Value	00000 = Normally Open State ▪ An open contact indicates a liquid level is present. 00001 = Normally Closed State ▪ A closed contact indicates a liquid level is present.

SECS Interface Programming

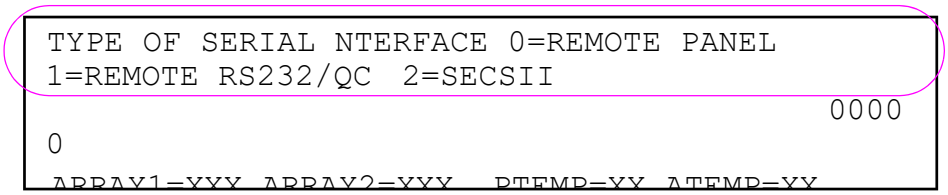
This section is used with a SECS II Interface.

The streams and functions for the SECS II Interface are in Chapter 3: System Interfaces.

The functions for the SECS Interface programming sequence are as follows:

- Serial Interface
- Data Log Flag
- Baud Rate
- Device ID
- Transmission Character Pause
- Transmission Message Pause
- Retry Send
- Dupe Block

Serial Interface



Range	00000, 00001, or 00002
Normal	00000

For more information regarding the RS-232 interface, please see Chapter 3: System Interfaces, "RS-232 Software Protocol" *section.*

For more information regarding SECSII Interface, please see Chapter 3: System Interfaces, "SECS II Interface Protocol" *section.*

Data Log Flag

> **IMPORTANT:**
> The Data Log Flag display only occurs if the Type of Serial Interface value >0 (zero).

```
AUTOMATIC DATA LOGGING DURING PROCESS
0=OFF  1=ON  (ONCE PER SECOND)            00000
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 or 00001
Normal	00000

Baud Rate

The Baud Rate sets the communication rate of the SECS Interface.

```
ENTER DESIRED BAUD RATE 300, 600, 1200
2400, 4800, 9600                          09600
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00300, 00600, 01200, 02400, 04800, 09600 (Use only these values.)
Normal	09600

Device ID

Entering the SECS Interface Device ID is a SECS protocol cross-check for ensuring the packet is sent to the correct equipment port.

> **IMPORTANT:**
> The Device ID display only occurs if the Type of Serial Interface value=2.

```
ENTER MEGASONIC SECS 1 DEVICE ID
(0 TO 32767)                                  00000
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00000 to 32767
Normal	00000 to 32767
Value	00000 (typically used)

Transmission Character Pause

This value sets the maximum time between character transmissions.

If the transmission exceeds this time, the system interprets the delay as a communication failure.

```
ENTER T1 FOR SECS 1 (1 TO 100 IN .1 SEC)
(INTER CHARACTER TIME-OUT)                    00003
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00000 to 00500
Normal	00003 (default setting)

Transmission Message Pause

This value sets the maximum time between message transmission.

If the transmission exceeds this time, the system interprets the delay as a communication failure.

```
ENTER T2 FOR SECS 1 (2 TO 250 IN .1 SEC)
(REPLY TIME-OUT)                          00010
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00500
Normal	00005 to 00100 00100 (default setting)

Retry Send

This value is the number of times the SECS Interface will attempt re-sending the information packet.

```
ENTER NUMBER OF RETRIES WHILE SENDING A
SECS 2 MESSAGE (0 TO 31)                  00005
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00031
Normal	00005

Dupe Block

```
DUPE BLOCK CHECKING
0=NO 1=YES                                        00000
 ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
 LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00000 to 00001
Normal	00000
Value	1 = Enables checking of incoming system byte values to validate the message.

Frequency Programming

IMPORTANT:

The frequencies are factory set and must never be changed.

Incorrect frequencies cause malfunction or damage to the system.

Repair due to incorrect use is not covered by the warranty.

The correct frequencies for this system are listed in Appendix B.

- Use these values to reset this system if the values are deleted from the Controller's memory of if a new Generator has been installed.

All frequencies will default to 07000 if a value is (less than) <6250 or (greater than) >10500 is entered.

- If this occurs, immediately enter the correct frequencies listed in Appendix B.

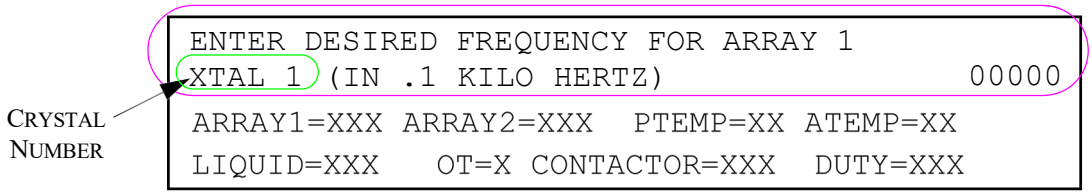
Frequencies are programmed in 0.1kHz increments.

For example, the frequency 700.0 kHz has the input value 07000 which is the integers and the first decimal place value after the point (700 times 0.1 equals 7,000 increments). The decimal point does not display.

The Frequency Programming Displays are shown in the following sequence:

- Array 1 Frequency Crystals 1–8
- Array 2 Frequency Crystals 1–8
- Change Password
- Array 1 W-Factor
- Array 2 W-Factor

Array 1 Frequency Crystals 1–8



Range	06250 to 10500
Normal	See Appendix B for this specific Array and Crystal.

As previously mentioned, based on the number of Crystals programmed during the Crystal Count screen, only the number of corresponding screens will be displayed.

FOR EXAMPLE, if your system has 4 Crystals per Array, and you have programmed it as such, you will only see the screens for Crystals 1 through 4. You will not see the screens for Crystals 5 through 8.

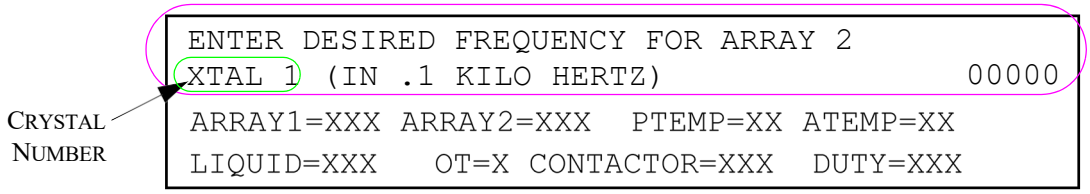
For more information about autotuning the arrays, please see Appendix D: Autotuning Procedure.

WARNING:

Do not perform the autotuning procedure unless instructed by PCT Systems, Inc.

Performing this procedure without prior authorization may permanently damage the equipment or void your warranty.

Array 2 Frequency Crystals 1–8



Range	06250 to 10500
Normal	See Appendix B for this specific Array and Crystal.

As previously mentioned, based on the number of Crystals programmed during the Crystal Count screen, only the number of corresponding screens will be displayed.

FOR EXAMPLE, if your system has 4 Crystals per Array, and you have programmed it as such, you will only see the screens for Crystals 1 through 4. You will not see the screens for Crystals 5 through 8.

For more information about autotuning the arrays, please see Appendix D: Autotuning Procedure.

WARNING:

Do not perform the autotuning procedure unless instructed by PCT Systems, Inc.

Performing this procedure without prior authorization may permanently damage the equipment or void your warranty.

Change Password

```
ENTER NEW PASSWORD NOW, IF DESIRED
(ANY NUMBER BETWEEN 0 AND 65534)          00000
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 65535
Normal	00000 (00000 is the Default)
Values	00000 to 00250 (User-defined value. We recommend using this range. Values higher than 00250 are reserved for factory use only.)

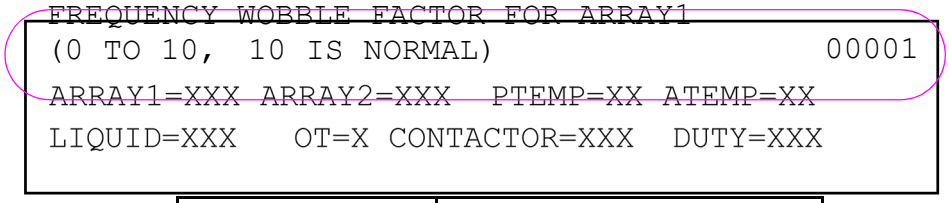
TO SET THE PASSWORD

Enter the new value.

Press the ENT key.

Array 1 W-Factor

IMPORTANT:
PASSWORD PROTECTED SCREEN!
In order to access this screen, you must enter 255 as the password on the Password screen.



Range	00000 to 00010
Normal	00001

Array 2 W-Factor

IMPORTANT:
PASSWORD PROTECTED SCREEN!
In order to access this screen, you must enter 255 as the password on the Password screen.

```
FREQUENCY WOBBLE FACTOR FOR ARRAY2
(0 TO 10,  10 IS NORMAL)                    00001
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	00000 to 00010
Normal	00001

Programming Transducer Parameters

IMPORTANT:
This section is used ONLY by **FACTORY SERVICE TECHNICIANS** for system setup and requires a password for access.

The Frequency Parameter Program Displays are shown in the following order:

- Multiplexer Dwell Time
- Crystal Count
- Minimum Frequency for Array 1
- Maximum Frequency for Array 1
- Minimum Frequency for Array 2
- Maximum Frequency for Array 2
- Tuning Speed

Multiplexer Dwell Time

This value states the individual Crystal active time, in seconds.

WARNING:
USE ONLY VALUES OF 1 OR 2.

Higher values do not improve cleaning capabilities and will reduce the lifetime of the Transducers.

```
ENTER TIME IN SECONDS FOR THE AMP TO BE
ON BEFORE MUXING (1 NORMAL 3 MAX)          00001
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00001 to 00003
Normal	00001 or 00002 (00001 is default)

Crystal Count

This value is the number of Transducers per Array in the Tank for this system.

This critical value affects the Controller programming.

Set the number of Crystals in each Array for this system using the value in Appendix B (multiple Arrays have identical numbers of Crystals).

> **IMPORTANT:**
> If the data is not available, contact PCT Systems' Customer Service.

```
ENTER NUMBER OF CRYSTALS PER ARRAY
CAUTION!!! MAKE SURE YOU KNOW              00008
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00003 to 00008
Normal	See Appendix B

Minimum Frequency for Array 1

This value is the minimum frequency at which the autotuning begins the sweep while computing the optimum frequency for each Transducer in this Array.

```
MINIMUM FREQUENCY FOR TUNING ARRAY1
IN .1 KHZ (05000 TYPICAL)                  05000
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	05000 to 10000
Normal	06850, 08750, 09750

Maximum Frequency for Array 1

This value is the maximum frequency at which the autotuning ends the sweep while computing the optimum frequency for each Transducer in this Array.

```
MAXIMUM FREQUENCY FOR TUNING ARRAY1
IN .1 KHZ (07500 TYPICAL)                    07500
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	05750 to 10500
Normal	07500, 09500, 10500

Minimum Frequency for Array 2

This value is the minimum frequency at which the autotuning begins the sweep while computing the optimum frequency for each Transducer in this Array.

```
MINIMUM FREQUENCY FOR TUNING ARRAY2
IN .1 KHZ (05000 TYPICAL)                    05000
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Range	05000 to 10000
Normal	06850, 08750, 09750

Maximum Frequency for Array 2

This value is the maximum frequency at which the autotuning ends the sweep while computing the optimum frequency for each Transducer in this Array.

```
MAXIMUM FREQUENCY FOR TUNING ARRAY2
IN .1 KHZ (07500 TYPICAL)                    07500
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	05750 to 10500
Normal	07500, 09500, 10500

Tuning Speed

```
SPEED WHEN AUTO TUNING THE XTALS
1 TO 50.  35 NORMAL    50 IS  SLOW          00035
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Range	00001 to 00050
Normal	00035
Value	00001 = Fastest Speed 00050 = Slowest Speed

Process Displays

The In-Process Displays show the system's status, alarms, and process notices.

The Displays appear as required by the system's Program:

- Ready Display
- Running Display
- Liquid Level Alarm
- Abort Alarm
- Process Complete
- Overtemp Alarm
- Heater Disabled
- Array 1 Autotuning
- Array 2 Autotuning
- Autotuning Message
- Low Power Warning for Array 1
- Low Power Warning for Array 2
- Memory Reset
- System Initialization

Ready Display

The **READY** display indicates that the system is idle, and that it is ready to start the process designated by the integer following the #-sign.

This screen also shows reference data for time, power, and power percent used.

Press the START key to start the system.

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX  POWER=XXX PERCENT
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Running Display

The **RUNNING** display indicates that cleaning is in process and indicates the percent of operating power.

The **SECONDS** value indicates the REMAINING time in the process.

The **MUX** value identifies the Transducer that is currently active.

```
PROCESSING AT XXX PERCENT POWER
XXXX SECONDS REMAINING IN PROCESS MUX=X
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Liquid Level Alarm

The **LIQUID LEVEL ALARM** display indicates that the liquid level in the Tank needs to be adjusted to the correct level.

This Display shows until the liquid level is corrected.

```
TANK LIQUID LEVEL LOW, PLEASE FILL
BEFORE STARTING PROCESS
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Abort Alarm

The **ABORT ALARM** display indicates that the process is aborted.

The Operator must press the STOP key to clear this alarm, which then allows the system to resume processing.

```
HYPER CLEAN PROCESS ABORTED, CHECK LIQUID
LEVEL, (PRESS STOP TO CLEAR ALARM)
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Process Complete

The **PROCESS COMPLETE** display indicates that the process is finished.

Press the STOP key to clear this notice.

```
HYPER CLEAN PROCESS COMPLETE WAFERS ARE
CLEAN, PRESS "STOP" TO STOP ALARM
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Overtemp Alarm

The **OVERTEMP ALARM** display indicates that the system detects a temperature that exceeds the programmed temperature maximum and has aborted the process.

Use the diagnostic functions to verify the programmed parameters, then restart the process.

This alarm may also indicate a problem with the Heater Controller.

```
HYPER CLEAN SYSTEM DETECTED OVERTEMP
CONDITION,     !!! PROCESS ABORTED !!!
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Heater Disabled

The **HEATER DISABLED** display indicates that the Heater has been disabled.

Press the F2 key to turn the Heater ON.

Press F1 to DISABLE the Heater prior to changing the Tank's solution. This allows the Tank to drain safely.

> **IMPORTANT:**
> Verify the correct liquid level is in the Tank before pressing the F2 key. The F2 key resumes the process.

```
HEATER DISABLED PRESS "F2" TO RE_ENABLE

ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Array 1 Autotuning

The **ARRAY 1 AUTOTUNING** display indicates that the system's computer is automatically tuning the Crystals in Array 1.

This Display shows the Crystal that is currently being calibrated.

INDICATES THE CRYSTAL & ARRAY BEING TUNED

```
TUNING XTAL X ARRAY1, PWR=XXXX FREQ=XXXXX
PEAK FREQ=XXXXX PEAK POWER=XXXX TIME=XXX
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Array 2 Autotuning

The **ARRAY 2 AUTOTUNING** display indicates that the system's computer is automatically tuning the Crystals in Array 2.

This Display shows the Crystal that is currently being calibrated.

```
TUNING XTAL X ARRAY2, PWR=XXXX FREQ=XXXXX
PEAK FREQ=XXXXX PEAK POWER=XXXX TIME=XXX
ARRAY1=XXX ARRAY2=XXX   PTEMP=XX ATEMP=XX
LIQUID=XXX    OT=X CONTACTOR=XXX   DUTY=XXX
```

Autotuning Message

The **AUTOTUNING MESSAGE** display indicates that the system's computer has completed the tuning procedure and processing can resume.

Press the STOP key to clear this message.

```
HYPERCLEAN FINISHED TUNING TRANSDUCERS
PRESS "STOP"
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Low Power Warning for Array 1

The **LOW POWER WARNING** display indicates that the system has aborted processing because it detected a low power condition in Array 1.

Press the STOP key to clear this warning.

Verify the power values are correct or determine the source of the power failure. Next, when safe, perform the appropriate power diagnostics, then restart the process when the situation is resolved.

Instructions for performing the diagnostics are Chapter 8: Troubleshooting Guide.

```
HYPER CLEAN SYSTEM DETECTED LOW POWER
CONDITION, ON ARRAY1  ! !  PROCESS ABORTED ! !
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Low Power Warning for Array 2

The **LOW POWER WARNING** display indicates that the system has aborted processing because it detected a low power condition in Array 2.

Press the STOP key to clear this warning.

Verify the power values are correct or determine the source of the power failure. Next, when safe, perform the appropriate power diagnostics, then restart the process when the situation is resolved.

Instructions for performing the diagnostics are Chapter 8: Troubleshooting Guide.

```
HYPER CLEAN SYSTEM DETECTED LOW POWER
CONDITION, FOR ARRAY2 ! ! PROCESS ABORTED ! !
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Memory Reset

To clear this message, the Operator must press the STOP key—**OTHERWISE, THE NEW VARIABLES WILL NOT BE SAVED!**

IMPORTANT:
If this situation occurs, call Maintenance immediately!

During this condition, all the program variables are reset to the factory defaults. Specifically, the frequency information for the Tank will be changed. The appropriate values MUST BE reloaded/reprogrammed.

```
CAUTION! SYSTEM DETECTED MEMORY LOSS!
NOW USING FACTORY DEFAULT SETTINGS
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

IMPORTANT:
When a system memory loss occurs, recheck the following program variables because they will be reset to zero (0):

* Process Temperature
* Minimum Temperature to Start a Process
* Maximum Temperature to Start a Process
* Process Time
* Power Level
* Crystal Frequencies
* Minimum Qualifying Power for Array 1
* Minimum Qualifying Power for Array 2

System Initialization

The **SYSTEM INITIALIZATION** display indicates that the system is in the initialization process, and the system **CANNOT** be started until this process is complete.

```
SYSTEM  INITIALIZATION  IN  PROGRESS
PLEASE  WAIT .   .   . XX  SECONDS  REMAINING
ARRAY1=XXX ARRAY2=XXX  PTEMP=XX ATEMP=XX
LIQUID=XXX   OT=X CONTACTOR=XXX  DUTY=XXX
```

Diagnostic Displays

The Diagnostic Displays can be accessed at any time.

Press the DIAG key to sequence through the series of Diagnostic Displays.

> **REMINDER:**
> The Diagnostic Displays are the bottom 2 lines of text in the Controller display window.

TO CHANGE THE DISPLAY

Press the ALT key to change the Display to show the previous Diagnostic Display.

TO RETURN TO THE DEFAULT DISPLAY

Press the CLR key to return to the Default Display (beginning of series).

LIST OF DIAGNOSTIC DISPLAY SCREENS

The Diagnostic Displays include:

- Temperature Diagnostic
- Frequency Synthesizers
- Power Sensors
- Array 1 Frequencies
- Array 2 Frequencies
- Forward Power Array 1
- Forward Power Array 2
- RTD/TC/LL Status (RTD/Thermocouple/Liquid Level Status)
- Heater Status
- Liquid Level Status
- MUX Status
- ID Display

Temperature Diagnostic

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
ARRAY1=XXX   ARRAY2=XXX   PTEMP=XX   ATEMP=XX
LIQUID=XXX   OT=X    CONTACTOR=XXX   DUTY=XXX
```

The temperature values are displayed in °C.

ARRAY1	The Forward Power value for this Array.
ARRAY2	The Forward Power value for this Array.
PTEMP	The programmed temperature value.
ATEMP	The actual temperature.
LIQUID	The Liquid Level value.
CONTACTOR	The time countdown to disable the Heater Contactor. 000 = disabled. The computer checks and resets this value continuously during operation.
DUTY	The value's percent varies during the Tank's heat-up. 000 = disabled. The value is the percent of the time that the Heater's solid-state relay (SSR) is closed (operating), e.g. a value of 050 indicates that the SSR is ON one-half (1/2) of the time.

Frequency Synthesizers

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
FRQ1 PRG=XXXXX  ACT=XXXXX    DAC=XXXX  LOCK=X
FRQ2 PRG=XXXXX  ACT=XXXXX    DAC=XXXX  LOCK=X
```

PRG	The programmed frequency for the active Transducer in the Arrays.
ACT	The actual frequency of the active Transducer in Arrays.
DAC	The value used by the D/A converter to maintain the current frequency.
LOCK	A zero (0) value disables the microprocessor's control of the frequencies.

Power Sensors

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
ARAY1 POWER=XXXX  THRESHOLD=XXXX  TIM=XXX
ARAY2 POWER=XXXX  THRESHOLD=XXXX  TIM=XXX
```

POWER	This represents the Forward Power amplitude being applied to the Transducers.

Array 1 Frequencies

This screen displays the programmed frequency for each of the 8 Crystals in Array 1.

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
XT1A=XXXX    XT2A=XXXX   XT3A=XXXX  XT4A=XXXX
XT5A=XXXX    XT6A=XXXX   XT7A=XXXX  XT8A=XXXX
```

Array 2 Frequencies

This screen displays the programmed frequency for each of the 8 Crystals in Array 2.

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
XT1B=XXXX   XT2B=XXXX   XT3B=XXXX   XT4B=XXXX
XT5B=XXXX   XT6B=XXXX   XT7B=XXXX   XT8B=XXXX
```

Forward Power Array 1

This Display shows the autotune values for the Forward Power in Array 1.

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
PWR1=XXXX   PWR2=XXXX   PWR3=XXXX   PWR4=XXXX
PWR5=XXXX   PWR6=XXXX   PWR7=XXXX   PWR8=XXXX
```

Forward Power Array 2

This Display shows the autotune values for the Forward Power in Array 2.

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
PWR1=XXXX   PWR2=XXXX   PWR3=XXXX   PWR4=XXXX
PWR5=XXXX   PWR6=XXXX   PWR7=XXXX   PWR8=XXXX
```

RTD/TC/LL Status (RTD/Thermocouple/Liquid Level Status)

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
OVERTEMP SET=XXXX    OT-TC=XXXX    OT-SENSE=X
LIQUID LEVEL=X    RTD=XXXX    TEMP=XXX    CF=X
```

OVERTEMP SET	Factory set. High Limit Temperature.
OT-TC	The actual TC-temperature reading.
OT-SENSE	The status of the overtemp TC. 0 = Okay 1 = Overtemp
LIQUID LEVEL	The status of the Liquid Level sensor.
RTD	The raw analog value of the RTD before scaling.
TEMP	The vessel temperature.
CF	The internal calibration flag that locks out all the analog-to-digital conversions during the power-up.

Heater Status

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
PTEMP=XXX    ATEMP=XXX    PFACT=XXXXX  DUTY=XXX
ADJUSTED  FACTOR=XXXXX    DELTA  FACTOR=XXXXX
```

PTEMP	The programmed temperature, in °C.
ATEMP	The actual temperature, in °C.
PFACT	The programmed Power Factor.
DUTY	The actual Duty Cycle of the solid state relay.
ADJUSTED FACTOR	The internal calculation factor.
DELTA FACTOR	The internal calculation factor.

Liquid Level Status

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
ALARM=X      LL INTERLOCK=XX    LLSENSE=XXXX
RAW LIQUID LEVEL INPUT XXXX
```

ALARM	Alarm Output Timer 0 = OFF
LL INTERLOCK	The Liquid Level Interlock Timer status.
LL SENSE	Status of the liquid level sensor: 0000 = Low Liquid Level 0001 = Liquid Level Okay
RAW LIQUID LEVEL INPUT	For factory use only.

MUX Status

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
MUXTIMER=XX    MUX=X   DAC3=XXXX   DAC4=XXXX
POWER=X         FREQ=XXXXX      MUXTIME=XXXXX
```

MUXTIMER	For factory use only.
MUX	This identifies which Transducer is ON.
DAC3	The indicates the DAC frequency controlling the frequency of Array 2.
DAC4	This indicates the DAC frequency controlling the frequency of Array 1.
POWER	For factory use only.
FREQ	This indicates the frequency in Array 1.
MUXTIME	This is the programmed value of the individual Transducer on-cycle before the system switches to next Transducer.

ID Display

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
HYPERSONIC SOFTWARE  FTUNE1JC      05-04-01
PCT SYSTEMS    TEL#510-657-4412       FAX-0112
```

This screen identifies the system's Software information.

If you have any questions or need help, call the telephone number (TEL #) listed: (510) 657-4412.

Notes

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CHAPTER 7
OPERATING & MAINTAINING THE SYSTEM

Purpose

This chapter explains how to:

- Start the System & Initiate a Cleaning Process
- Properly Load the Tank
- Perform Preventative Maintenance
  - Daily Maintenance
  - Weekly Maintenance

NOTE:
The orientation of the parts/carrier to the length direction of the Transducers is critical to the process result.

See instructions and the diagram located in the "Load the Tank" section of this chapter.

Start the System

1. **BEFORE STARTING THE CONTROLLER OR THE SYSTEM**, review the information listed in Table 7-1: Operating Precautions and the "Operator Safety Notes" located in this section.

Table 7-1: Operating Precautions

Process Bath	Liquid in the Vessel must **NOT** cascade over the outer flange of the Process Tank. The RTV seals used are adequate to seal out occasional spills and vapor. Continuous exposure will cause premature failure of the seals.
Liquid Level	Maintain the minimum liquid level in the Vessel.
Liquid Temperature	The maximum temperature is 70°C. **DO NOT** exceed this temperature.

Heating Solvents 	 **IMPORTANT**	**NEVER EXCEED THE FLASH POINT FOR THE CHEMICAL USED IN THE VESSEL.** Some chemicals will burn BELOW 70°C. It is your responsibility to safely use all chemicals.

Operator Safety Notes

DANGER:

Operators must not put their hand or any body part into the Process Tank during an operating cycle.

The energy generated during an operating cycle can cause deep tissue or bone marrow damage.

There is no danger to the Operators from being near the Tank or leaning over the Tank during operation. The energy does not transmit well through air.

2. System start-up should be performed in this sequence:
    a. Verify the liquid level in Tank.
    b. Turn the system ON.
    c. Start a process program in memory or start a new process program.
    d. **IF THE SYSTEM HAS A HEATED TANK:** Test the Bath Temperature with a thermometer to determine if process Bath Temperature matches programmed value.

e. Verify the energy is performing smoothly.

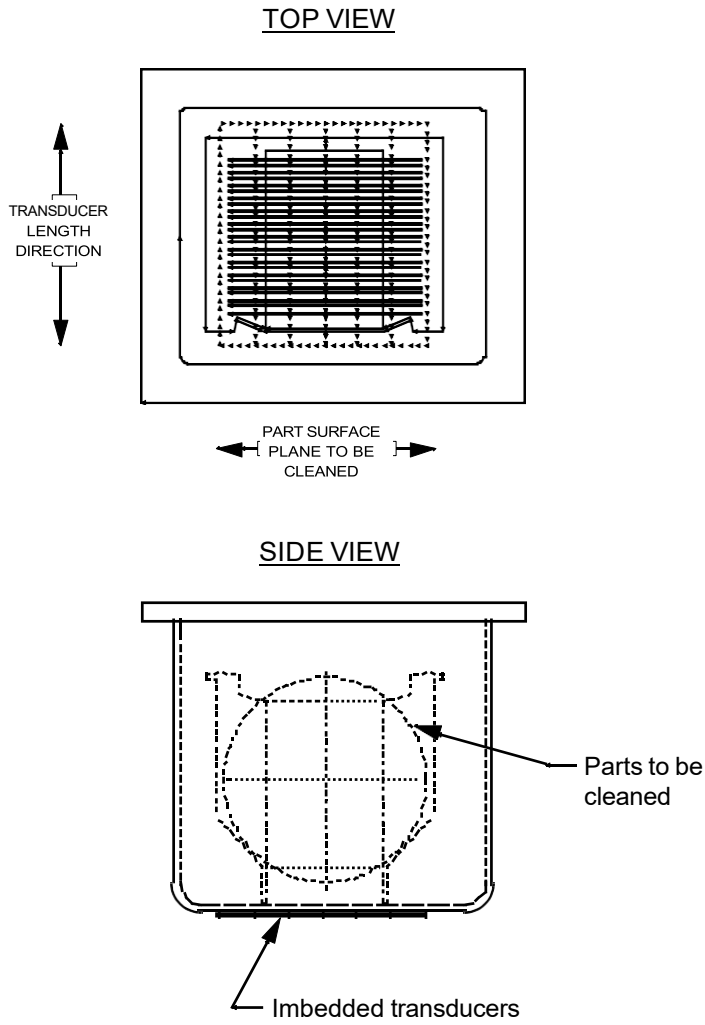
For more information, please see the procedure appropriate to your system: "Energy Inspection Procedure" *or* "FPOWER Verification Procedure".

Load the Tank

The surfaces on items to be cleaned must be placed perpendicular to the length-wise direction of the Transducers.

Place the cassette into the Bath, centered over the Array, and in the correct orientation to Transducer length. This orientation is shown in the following figure.

Figure 7-1: Part Orientation to Transducers



Preventative Maintenance

Daily and weekly maintenance must be done.

Regular maintenance ensures the optimum benefits from this equipment.

The Tank has a longer life when it is flushed daily.

Daily Maintenance

Daily maintenance is ***simple***: Flush the Tank Flange Area with DI water at the end of each shift and before starting a different process.

Tank Flushing Procedure

- Turn the power OFF before flushing the Tank Flange Area.
- Use DI water to flush away liquid residue from the top Flange of the Tank.

REMINDER:

Be sure to dispose of the flushed liquid in accordance to your companies policies and all regulations.

Be sure wear the proper personal protective equipment when flushing the Tank Flange Area.

Weekly Maintenance

Verifying the energy pattern/FPOWER settings, and the program parameters is necessary in ensuring the system's performance.

The procedure takes approximately 5 minutes to perform:

1. Verify the program values are correct. (See the "Program Verification Procedure".)
2. Verify the energy according to the Transducers location in the Tank:
   - **TRANSDUCERS LOCATED ON TANK'S FLOOR/BOTTOM**: Inspect the Energy Pattern. (See the "Energy Inspection Procedure".)
   - **TRANSDUCERS LOCATED ON TANK'S SIDES/WALLS:** Verify the FPOWER values. (See the"FPOWER Verification Procedure".)

Program Verification Procedure

1. Check to make sure all cables are hooked-up correctly (the correct array into the correct output of the correct generator).

   On each cable near the connector, there should be a cable identification tag. If the cables are hooked-up incorrectly, the individual piezoelectric crystals will be operated at incorrect frequency values. This incorrect hookup could lead to poor system performance and uniformity. Under severe conditions, damage to the crystals may result.

   See the "Pin Out Information" *note for the correct pin outs.*

2. Verify correct input voltage to the generator:
   - U.S.: Typically 208V-220V
   - International: 230V
3. Perform the following checks with the generator unit power switch ON (back of generator), and without starting the generator firing (START button on front of generator).
   - **CHECK/RECORD SOFTWARE VERSION.**
     (Diagnostic screens are displayed in the bottom half of the display screen on the front of the generator.)
     - Press the CLR button, then Diagnostic (DIAG) key to display the first screen.
     - Keep pressing the DIAG key to advance one screen at a time, until the software version is shown.
     - Pressing the ALT key during either programming or diagnostic review moves you back one screen.
     - Also, depending on your software version, pressing the ALT key during programming can display some previously hidden screens.
   - **CHECK/VERIFY ALL CRYSTAL FREQUENCIES.**
     Verify the Programmed versus the Actual frequency values for each crystal in each array. (Diagnostic screen)
     - Compare values in the Documentation that came with the system initially and/or those values listed directly on each cable near the connector.
     - If a wild “actual frequency value” comes up (greatly different from the programmed value, for example., 09943 versus the programmed value of 07048), then

there likely is an internal problem/damage with/to the generator. Consult PCT Systems.

- On the pertinent screen, make sure that lock ≠ 0, it must read lock = 1

PIN OUT INFORMATION

Sometimes connectors are removed in the field in order to feed the array cables through bulkheads, etc. Care must be exercised to make sure that the pin outs are correct when re-attaching the connectors.

- Pin 1 is Crystal 1
- Pin 2 is Crystal 2
- Pins 11/12 is Ground

Pins 14/15 jumped so that the Generator output cannot be energized unless the crystal/array is installed (hooked up).

If there is some concern about damage to the crystal(s), they can be partially tested with a Volt/Ohm meter.

Unhook cables:

- Pin xx to grd should read open circuit
- Pin xx to grd capacitance = 12–25 nF

A lower capacitance (for example, 5 nF) may suggest a cracked or broken crystal.

NOTE:
These tests will not tell you if a crystal has delaminated from the tank. A visual inspection inside the tank may show a different "glue" line or interface between the crystal and the tank wall.

4. Check programmed values
   - **NEVER RUN IN PROCESS = 0,** run process 1, 2, etc. (Process = 0 can give strange and unstable values/performance.)
   - Make sure that the **CORRECT NUMBER OF CRYSTALS PER ARRAY** is entered.
     - Choosing the wrong number can cause the Generator to fail.
       For example, if there are only 4 Crystals and you entered 6 Crystals, the two open outputs on the Generator will be energized causing generator damage.

- For example, if the generator won't start:
  - **MIN/MAX TEMPERATURES**
    Set values to 0 to disable the function.

    Choosing incorrect values may prevent the generator from starting.
  - **PROCESS TEMPERATURE**
    Enter appropriate values (whether the process tank is heated/controlled by the generator or not).
- Correct the **wobble factor**.
  - Values other than 1 should only be entered if directed to do so after consultation with PCT Systems.
- Correct the **frequency ranges** (min/max values).
  - The frequency range chosen should bracket the range of operating frequencies programmed for the crystals in each array. These values are used for the autotuning range if autotuning is necessary.

IMPORTANT:
PCT does not recommend that customers perform autotuning unless specifically directed to do so by PCT.

Energy Inspection Procedure

(PERFORM IF THE TRANSDUCERS ARE ON THE BOTTOM/FLOOR OF THE TANK)

Perform this inspection with the Tank full of liquid to the required level, and the system energized.

The Tank must contain only liquid, without part/wafer or boat/carrier in the Tank.

1. Turn the Heater OFF if this system is heated.
2. Start a process.
3. Observe the energy pattern visible on the surface of the liquid in the Tank, over each Crystal (Transducer).

The energy created by the Transducers should form a smoothly rippling, uniformly distributed effervescent area on the liquid surface above the full width of each activated Crystal. The energy pattern should be similar for all Crystals.

- If any energy pattern is shorter, dissimilar, or not as active, record the Crystal location and immediately contact PCT Systems Customer Support for assistance.

FPOWER (Forward Power) Verification Procedure

(PERFORM IF TRANSDUCERS ARE ON THE SIDES/WALLS OF THE TANK)

Perform this inspection with the Tank full of liquid to the required level, and the system energized.

1. Look at the FPOWER (Forward Power) value for each array.
    - The value shown **is not calibrated to indicate actual watts**. It does give an indication of relative power levels actually coming off each array at any point in time as the Generator fires each Crystal in each array in turn.
        - Some discrepancy between Array 1 and Array 2 readings is common and not unexpected. Large differences between the two (for example, 50–100%) may indicate a problem with the system. Consult PCT Systems.
        - Values below 25 are very uncommon and PCT should be consulted.
2. Look at the activity/disruption of the liquid's surface (the speed bump).
    - Run at 100% power and look at height of the localized "ridge" (or speed bump) on the surface of the tank.
    - Run at 50% power and see if ridge height is reduced.
    - Run at 10% power and see if ridge height (or general rippling) is reduced even further.

Periodic Preventive Maintenance

Solenoid and Overtemp Verification

PCT Systems recommends to periodically check the solenoids and the overtemp devices in the Electrical Cabinet to ensure they are functioning properly. If not, replace the components as needed.

Notes

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CHAPTER 8
TROUBLESHOOTING GUIDE

Purpose

This chapter explains the actions an Operator may perform to resolve minor problems.

These minor problems are usually caused by incomplete input of process values or a value is out of range.

Common Problems Resolved in this Chapter

Some common problems to troubleshoot are the:

- Remote Panel Screen Display Is Not Showing/Does Not Display
- Keypad on the Remote Panel Is Not Working
- Process Bath Is Not Heating Up
- Alarm: HyperClean System Detected Low Power, Process Aborted
- Transducers Do Not Fire

If the solutions in this chapter do not resolve the problem, contact Customer Service, at (510) 657-4412, so we can advise you.

IMPORTANT:
If you experience a problem not covered in this chapter, please contact your Customer Service representative at PCT Systems before attempting other methods of resolution.

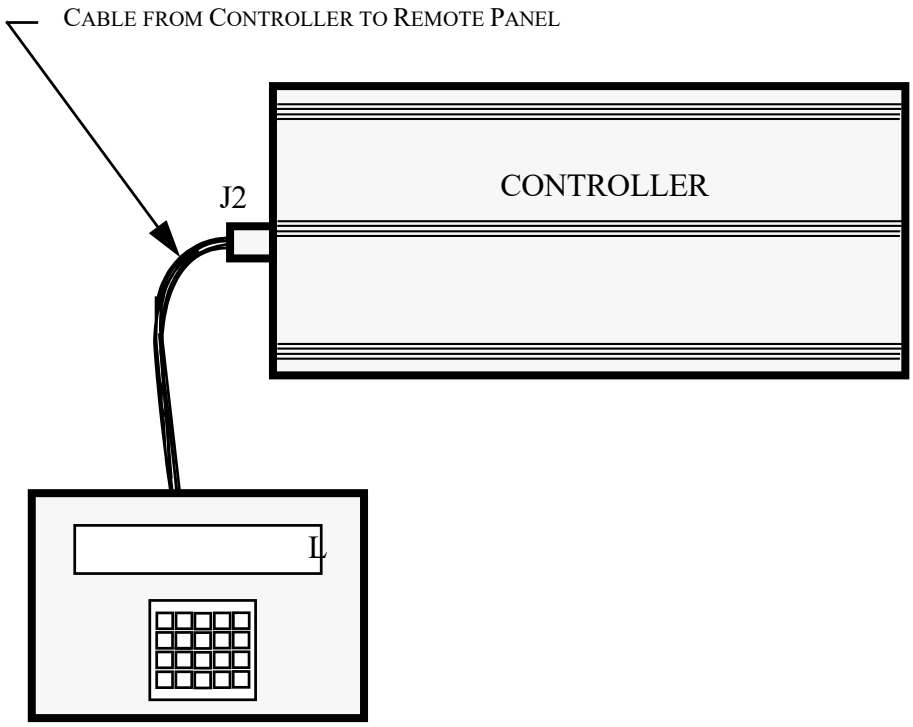
WARNING:
This system equipment is depot repair only.

You must contact PCT Systems Customer Service for repair service. Any attempt to modify, repair or open the equipment Controller will void the warranty.

REMINDER:
A damaged Unit may be repairable. Please contact PCT Systems' Customer Service for assistance.

PROBLEM	SOLUTION
Remote Panel Screen Display Is Not Showing/Does Not Display	1. Verify the Controller's power cable is plugged into a grounded outlet. 2. Verify that the power switch is turned ON. 3. Verify that the Remote Operator Panel is plugged into J2 on back of Controller unit. 4. Press F3 button on Keypad (soft reboot). 5. If Step 4 did not restore Display, cycle the power OFF then ON again.
Keypad on the Remote Panel Is Not Working	To prevent electrical damage, **turn the Power OFF** before disconnecting or reconnecting the J2 cable. Verify that the cable from the Remote Operator Panel is securely connected to the J2 receptacle on the back panel of the System Controller.

Figure 8-1: Remote Panel to Controller

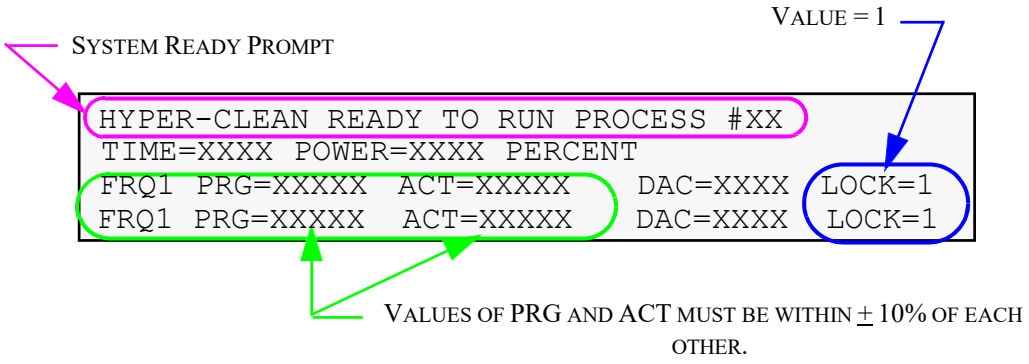


PROBLEM	SOLUTION
Process Bath Is Not Heating Up	1. Verify READY TO RUN PROCESS is displayed. *See the appropriate Ready display for your system.* *For TuneH, see* Chapter 5: TuneH Programming, Ready Display. *For FTune, see* Chapter 6: FTune Programming, Ready Display. 2. Verify that the Controller Fans are operating. 3. Verify all cable plugs are securely connected. 4. Verify the programmed temperature value is correct. 5. Check the Heater Power Factor programming. 6. Verify the actual Bath Temperature with a thermometer & compare it to the ACTUAL TEMP on the Display. *(See the figure below.)* 7. Verify the Bath liquid is at the correct level. 8. Verify the SSR LED on the front panel blinks & the CONTACTOR LED is steady ON when the programmed temperature is higher than actual temperate (normal condition). 9. Verify the DUTY and CONTACTOR values are greater than zero (>0). 10. Cycle the Power OFF then ON again. 11. If Steps 1–9 do not correct the problem: ▪ Turn OFF the Power. ▪ Unplug the 2-pole plug on the Heater Power Cable. ▪ Measure the resistance across the 2 blades of the plug with an ohmmeter. ▪ The measurement should read between 10–40 ohms. ▪ If the measurement is a different value, the Unit needs repair (this may indicate an open connection). ▪ *Contact PCT Systems for service.*

PROBLEM	SOLUTION
Alarm: HyperClean System Detected Low Power, Process Aborted	1. Press the STOP key to clear the alarm. 2. Perform the setup again (see the figure below). Improper setup can cause this error message. 3. Check the program parameter "Minimum Power to Qualify Process". Input of a value too high can cause this alarm. 4. If the Array Forward Power drops below the programmed Minimum Power Value for a duration longer than 30 seconds, the Low Power Alarm activates and shuts off the power from the Generator to Array. 5. The Amplifier Board may be malfunctioning. Shut OFF the Power and contact PCT Customer Service.
Transducers Do Not Fire	1. Check all the cable connections to verify they are securely connected. 2. Verify the Fans on the back of Controller are running. 3. Verify the program values are set correctly for the Sensors. Use DIAG key to see the: ▪ Time value ▪ Temperature value ▪ Power Level ▪ Number of Transducers ▪ Minimum Temperature to Start Process ▪ Maximum Temperature to Start Process ▪ Process Time, in seconds 4. Verify that the frequency value of the PRG equals the ACT value ± 10%. 5. Verify that the value of LOCK=1. A zero (0) value disables the frequency control. 6. Verify READY TO RUN PROCESS # is displayed 7. Cycle the power OFF then ON again & initiate a process. ▪ *If the process is not functioning correctly, contact PCT Systems Service Department.*

PROBLEM	SOLUTION

Figure 8-2: Frequency Synthesizer Diagnostic Screen



Notes

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CHAPTER 9
RECEIPT, WARRANTY, & REPAIR INFORMATION

Purpose

This chapter describes:

- The Product Warranty Information
- Receiving, Unpacking & Inspection Instructions
- How to Report Damage
- Arranging Repair to the Equipment
- The Return Shipping Procedure

In General

PCT Systems ships the tested equipment in special packaging which protects the system during transport. Carefully read the information contained in this chapter.

IMPORTANT:
This equipment becomes your property when the contracted shipper picks up the equipment at PCT Systems factory. It is important that you inspect the equipment immediately and note any damage, whether obvious or hidden (internal breakage, crushed cord, etc.).

Report damaged containers or equipment to the transportation company immediately.

Product Warranty Information

When using the correct operating conditions defined in this Manual, PCT Systems, Inc. warrants this system free from manufacturing defects in material or workmanship for 12 months from the date of original factory shipment.

Coverage

The coverage for this system, excluding the Quartz Tank, is pro-rated:

- **FULL COVERAGE:** 6 months or 1,040 hours, whichever comes first
- **50% COVERAGE:** Next 3-month period or 520 hours, whichever comes first

- **25% COVERAGE:** Last 3-month period or 520 hours, whichever comes first

These percentages apply to the value defined by PCT Systems, Inc. at the time of repair. The decision to repair or replace warranted systems is reserved by PCT Systems, Inc.

If operated within the scope detailed in this Manual, the Megasonic systems will operate correctly for the maximum lifetime.

Exclusions

As previously stated, the Quartz Tank is excluded from warranty. It does not develop damage from normal use.

The Quartz Tank is inspected prior to assembly and again before shipment from the factory.

System damage from the following causes is not covered by warranty:

1. A cracked Quartz Tank
2. Improper installation
3. Improper operation
4. Unapproved modification to the system.
5. Modification or replacement of factory installed sensors, unless approved in writing by PCT Systems or performed by PCT Systems.

Non-Warranty Repairs

Repairs are quoted using one 8-hour shift per day for 5 days each week.

contact White Knight Fluid Handling Customer Support for repair quotes.

Receiving, Unpacking & Inspection Instructions

Step 1: Inspect the Container Upon Receipt & Before Opening

Visually inspect the outside of the shipping crates/containers for damage.

- **IF THERE IS NO DAMAGE**, continue with Step 2.
- **IF THERE IS DAMAGE**, follow the "How to Report Damage" section contained in this chapter.

Step 2: Open the Container.

WARNING:

For Quartz Tanks, the Quartz can shatter if subjected to abrupt impact.

Handle the shipping crate carefully and protect it from impact.

- Open the container carefully.
- Use a sharp blade to cut the packing tape—do not cut deeply into the shipping carton. Try to avoid scoring the Vessel or equipment with the cutter.
- Inspect the contents for damage.
- Report any damage to the shipper immediately.

Step 3: Remove the Unit from the Container.

- Use care when removing the contents of the Container—especially if the system has a Quartz Tank.

IMPORTANT:

Avoid tearing the clear plastic seal placed over the Vessel.

Do not remove or tear the protective cover on the Tank until it is fully installed into the Wet Process Area

Step 4: Inspect the Contents for Damage.

- After unpacking the equipment, inspect the contents immediately for any damage.
    - Prior to shipment, the Vessel has been tested and examined to ensure proper performance and to be free from scratches, dents, and external cosmetic defects.
- Should you find any scratches, dents, or cosmetic defects on these items, preserve the shipping container and contact the carrier to file a damage claim.
    - You may be requested to take photographs to document your claim.

How to Report Damage

Follow these steps if the shipment is damaged:

1. Notify the shipper immediately to pick up the damaged equipment in its original shipping container. Leave it in the condition in which you received it.

IMPORTANT:

If the carton is opened before detecting damage and the carton is not damaged, repackage the equipment in original packaging, or else use suitable packaging which provides the same protection as the original packaging. Damaged packaging will not give adequate protection to equipment.

2. The shipper will give you a receipt when the damaged equipment is picked up. List all damages you find and give a copy to the shipper with the damaged equipment. The shipper will send an acknowledging copy of their damage report.
3. Contact White Knight Customer Support Department to request an Returned Materials Authorization (**RMA**) number. Include a copy of the shippers damage report and your purchase order number.

WARNING:

The Quartz Tank can shatter if subjected to abrupt impact.

Handle the shipping container carefully and protect it from impact.

Arranging Repair to the Equipment

This section contains instructions for obtaining a Return Material Authorization (**RMA**) from White Knight and shipping the equipment to White Knight Service.

The Return Procedure in this section is required in order for White Knight execute repairs efficiently and restore your system in minimum time. Federal and State laws governing safety for people, require flushing chemicals from parts prior to transport.

For more information regarding shipping preparation, please see the "Return Shipping Procedure" section of this chapter.

Systems in repair must be accompanied by the User/Installer Usage Logs.

Installation sign-off dates must be supplied to White Knight upon request.

Call Customer Service at 888.796.2476 for repair quotes.

Return Material Authorization

A Return Material Authorization (**RMA**) from White Knight is required prior to shipping equipment to White Knight.

For RMA numbers, either:

- Call Customer Support at 888.796.2476
- E-mail at customer.support@wkfluidhandling.com

Inspection Fee

An **INSPECTION FEE** applies to all equipment sent to White Knight for repair/diagnosis. This Fee is quoted when the RMA request is processed. This Fee is charged against the Purchase Order authorizing repair or replacement of the equipment. This Fee is not refunded or waived for equipment which does not need repair or for equipment with no Purchase Order to repair or replace parts.

IMPORTANT:
If the problem with the system may be caused by incorrect program usage, ask for assistance with setting the program before shipping system for repair.

Repairs covered by warranty is exempt from the Inspection Fee.

Credit, allowance, or adjustment to the outstanding invoice will be issued after inspection and evaluation by White Knight Service department.

Repair Charge

Repair time is calculated using one 8-hour shift per day for 5 days each week.

Faster service is available on request. An **EXPEDITE FEE** applies to rush service and is quoted at the time of order.

The **REPAIR CHARGE** is calculated with the number of hours required to repair the equipment multiplied by the Service Hour Rate. The Service Hour Rate is quoted at the time of order.

An option, which may be available for some repairs, is **FIELD TECHNICIAN SERVICE**. Your equipment will be diagnosed and repaired in place. Ask for details regarding this service option.

Disposal Fee

White Knight will dispose of equipment that cannot be repaired for a $1000 **DISPOSAL FEE**.

Prepare a Purchase Order if you want White Knight to dispose of this equipment.

Return Shipping Procedure

Shipment Preparation

Federal and State laws governing safety for people, require flushing chemicals from parts prior to transport.

The equipment must be neutralized and chemical-free prior to packaging for shipment.

Rinse the equipment, including the insulation if equipment has internal leakage, with DI water then drain until dry.

IMPORTANT:

White Knight will only work on a system which are:
1. Free of chemical residue (cleaned as described above).
2. Free of phenol solvents (no contamination).

Packaging Equipment for Shipping

1. Flush and neutralize the equipment of all chemicals.
   For more information, please see the "Shipment Preparation" *section of this chapter.*

2. Wrap the ***clean***, ***dry equipment*** in heavy plastic (10 mil or thicker) bags. Tightly secure these bags so as to contain any seepage from insulation during transit.

> **WARNING:**
>
> The shipping company will declare the shipment undeliverable if the packaging leaks. If the shipper determines the leaking solution is hazardous, your company is liable for damages.

3. Pack the bagged equipment into the original or equivalent shipping carton and fill the spaces in the box with bubble pack or other cushion material that provides substantial protection.

4. Either pack in the same container or send separately the User/Installer Usage Logs. These logs are required for systems in repair. Also, if requested by White Knight, send the Installation sign-off information.

5. Place a notification/declaration tag on the bagged Unit before closing box. This tag must state the chemicals used in the Tank. If the notification/declaration tag is missing, the shipment will be refused service and returned to the shipper freight collect.

6. Mark each box with caution labels indicating **THIS SIDE UP** at the top edge of the box. It is important that the Tank remains upright.

7. Mark each box with caution labels reading **FRAGILE** on each surface of the box. This labeling helps ensure careful handling during transit.

8. Insuring the full value of the equipment is strongly recommended.

Notes

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CHAPTER 1
MEGASONICS: THEORY & BENEFITS

Purpose

This chapter:

- Provides a Brief Developmental History of the PCT Systems' HyperClean Megasonic System.
- Explains the The Theory Behind the Cleaning Process.
- States the Benefits of PCT Systems' Megasonic Cleaning System.
- Discusses Forward Power Versus Reflected Power.
- Defines Power Output.

Brief Developmental History of the PCT Systems' HyperClean Megasonic System

The Megasonic process was first developed over 20 years ago at the David Sarnoff Institute, then owned by the RCA Corporation. It was developed with the idea that non-contact cleaning of wafers could be accomplished using sound waves propagated through a cleaning solution.

In early Megasonic days, sonic energy was introduced into the cleaning solution by using a signal generator, RF amplifier, and a piezo electric crystal covered with Tantalum. The crystal, referred to as a Transducer, was coated with a conductive surface, usually gold or silver. Because most semiconductor processes can not tolerate contamination from either gold or silver, a Tantalum skin was epoxy coated over one side of the Transducer. The Tantalum Transducer was then placed in a mounting apparatus and sealed against an opening in the Process Tank.

Improving on this design, the PCT Systems team evaluated the shortcomings of previous systems and the demands of future semiconductor processing requirements, and, from this, designed and produced the most advanced Megasonic cleaning system in the world.

PCT Systems uses all natural polypropylene tanks with Tefzel® coated aluminum Transducer plates. PCT Systems has also developed new type of electronic signal generator specifically for driving the piezo electric Transducers at output frequency levels.

The transducing Array is bonded to a substrate, such as the bottom of a Quartz Tank or a metal plate. This tank or plate provides the base for the transducing

Array and the means by which the acoustic energy is transferred to the cleaning liquid.

One of the most common failures of older Megasonic designs was Transducer failure as a result of the cracking of the epoxy bond between the transducing Array and the substrate material. This failure delaminated the Array and inhibited the transmission of the energy. The cause of this was thermal-mechanical fatigue. This transfer of acoustic energy is a simple principle on simple models. However, on large, high-powered surfaces such as those used in most Megasonic systems the physics becomes complicated. The major problem is the generation of heat in the Transducer assembly sufficient to cause epoxy failure.

PCT Systems decided that an Array—a Multiplexed Array—of Transducers would have a much longer life span because the duty cycle of each Transducer could be lowered. This design allowed the Transducer time to cool while the other was firing. This principle worked extremely well and had an additional advantage in that there were no moving parts in the system.

The selection of the optimum ultrasonic acoustic cleaning frequency has been hampered by the fact that no adequate theoretical model has been presented to the industry, as to the physical chemistry of the Megasonic cleaning process. PCT Systems' Megasonic Systems are capable of generating frequencies from 300 kHz to over 2 MHz. However, extensive empirical testing has found that a process using frequencies between 700 to 750 kHz provides unsurpassed cleaning results.

Because of minor variations in the manufacturing of each Transducer, PCT Systems discovered that a specific Transducer has its own optimum working frequency falling within a 10 kHz range. Thus, PCT Systems fine tunes each transducing crystal prior to shipping.

The Theory Behind the Cleaning Process

There is no general agreement as to the exact reason why the Megasonic cleaning process works.

To completely model all of the phenomena that cause excellent particle removal with a Megasonic System is beyond the scope of this section. However, there is a direct relationship between surface energy, surface tension, wetability, chemistry, and acoustic energy. The following discussion briefly addresses the surface chemistry of particulate contamination and cleaning.

Theory

A particle is on a substrate. A force of attraction holds it there. This force may be ionic, Van Der Wals, or chemical (actual bonding takes place). Whatever the force is, as the particle becomes smaller, the force becomes stronger. This is because the intensity of the force is proportional to 1/radius of the particle, R, and in some cases $1/R^2$. Thus, the smaller the particle, the stronger the force holding it to the surface of the substrate.

A cleaning action takes place when a substrate, such as a semiconductor wafer, is immersed in a cleaning solution. The particles adhering to the substrate become wet, which means that water, or a cleaning solution, has flowed around the particle and has come between it and the substrate. Water competes with the particle for space on the substrate. The radius of the water molecule is much smaller than the particle. The natural forces of attraction will thus favor the adhesion of the water molecule over the particle. This reduces particle adhesion and inhibits redepositing the particle. However, an air gap remains around the particle where it makes contact with the wafer. This is due to the surface tension of the water that resists bending around the particle. This gap interferes with the wetting action and reduces particle wetting. This surface tension must be overcome in order for the particle to be removed.

In addition to the effect of surface tension of the cleaning liquid, hydrophobic surfaces, such as those found on the particle or the substrate, actually repel water and force it away from the substrate surface.

One of the more popular cleaning solutions contains Hydrogen Peroxide, Ammonium Hydroxide, and water. This solution is known as SC1 or Wang A. When bare silicon is exposed to this chemistry, an oxide layer is formed that reduces the hydrophobic qualities of the substrate and allows the particles above 1 micron to wet efficiently. For the years, an SC1 clean has been used effectively in the industry without using Megasonic frequencies. However, as the geometry of the semiconductor has become smaller, the removal of smaller particles has become more important. This is why Megasonics is now important to the semiconductor process engineer.

Acoustic Streaming

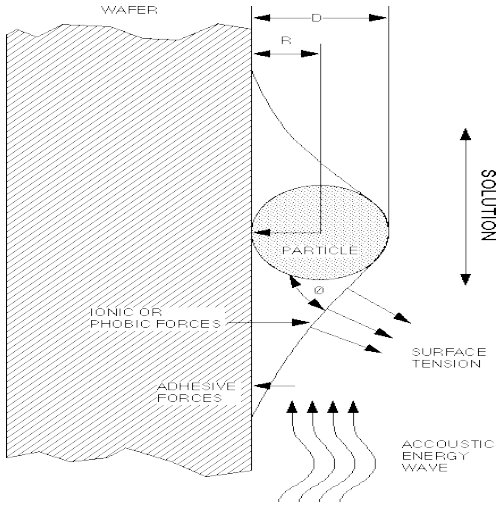
When acoustic energy is transmitted through a liquid, the liquid begins to move in the same direction as the traveling sound wave. This phenomena is known as **ACOUSTIC STREAMING** (Figure 10-1). This streaming is the result of the following conditions:

- The fluidity of the liquid in response to the force of the acoustic wave
- The acoustic impedance of the liquid
- Any additional impedance caused by diffused gaseous bubbles

Higher acoustic energy results in higher streaming velocity. This velocity begins to play a significant role in particle removal as both the drag and the lift increase with the liquid velocity.

PCT Systems has developed proprietary technology to maximize acoustic energy with acoustic streaming to clean safely semiconductor wafers using an energy wave that maintains even penetration across the substrate.

Figure 10-1: Megasonic Hydrodynamics



Chemical reactions that take place in an active acoustic field are accelerated significantly. This action promotes surface chemistry activity and aids the conversion of a hydrophobic surface to a hydrophilic surface.

This increased reaction rate accounts for decreased process times, but does not explain how cleaning efficiencies can increase, especially on smaller particles. The smaller particles benefit greatly from a reduced surface tension caused by the acoustic field acting upon the surface of the solution. Factors that directly influence cleaning are surface energy, surface tension, wetability, chemistry and acoustic energy. Thus, the more energy delivered to the substrate-particle interface area, the more chemical usage can be reduced, while maintaining optimum cleaning. However, at higher frequencies, effects deleterious to the wafer and to the transducing Array begin to take effect.

General Positive & Negative Effects of Megasonic Cleaning

The general principles of Megasonics can be summarized as follows:

1. Positive effects of increasing frequency (sonic energy):
   - *Improves Wetting Efficiency.* Increasing frequency reduces the surface tension of the cleaning solution.

- *Decreases Process Time.* Increasing frequency increases the reaction rate of the cleaning chemistry.
- *Reduces Associated Material and Waste Management Requirements.* Increasing frequency reduces the required cleaning solution concentration.
- *Aids in Wetting the Particles.* Increasing frequency increases surface motion.
- *Reduces the Risk of Wafer Damage Common to Some Lower Frequency Ultrasonic Systems.* Increasing frequency increases the cavitation threshold, so more watts per square inch are required to cause cavitation.

2. Negative effects of increasing frequency (sonic energy):
   - *Reduces Transmission Efficiency.* This limits the use of significantly higher frequencies.
   - *Increases Heat.*

Benefits of PCT Systems' Megasonic Cleaning System

General Summary

The PCT Systems' HyperClean Megasonic System, an advanced cleaning system for ultimate performance and reliability, provides economical and efficient contaminant cleaning—**BEYOND THOSE OF STANDARD RF-BASED CLEANING SYSTEMS.**

This cost-effective cleaning system:

- **GIVES SUPERIOR, REPEATABLE RESULTS.**
- **HAS NO MOVING PARTS AND NO MOTION OF PARTS/CARRIERS** during the process, which prevents further contamination.
- **IS EASY TO MAINTAIN**—simply rinse the flange area with DI water daily.
- **HAS A LONGER RUNNING TIME** than other cleaning systems **AND HAS NOISE-FREE OPERATION** in heated-type systems.
- **ELIMINATES THE NEED FOR ADJUSTING FORWARD (*FPOWER*) AND REFLECTED POWER (*RPOWER*) WITH A MATCHING NETWORK** by using a broadband Generator that continuously adjusts to the very narrow resonate frequencies of the finely tuned Arrays of Crystals.
- **UTILIZES THE MECHANICAL AND ELECTRICAL PROPERTIES OF PIEZOELECTRIC CRYSTALS.**
- **REQUIRES LESS MAINTENANCE AND ADJUSTMENT TO MAINTAIN CONSISTENT RESULTS.**

Backed by our Engineering Team, with over 30 years of semiconductor processing equipment experience and over 25 years of experience in the Megasonic field, our systems evolve with the latest technology.

Production Benefits

Cleaning with PCT Systems Megasonic system also provides the following benefits important to your process:

- **INCREASED WETTING EFFICIENCY** through decreased surface tension
- **REDUCED PROCESS TIME**
- **IMPROVED SUPERWETTING** of small particles for removal
- **RAISED CAVITATION THRESHOLD**, with no cavitation damage to parts being cleaned when system is operated at specified frequencies
- **ACCELERATED CHEMICAL REACTIONS**, increasing the number of clean batches per shift and reduce chemical use

Cost Savings

Costs savings from higher yield, longer equipment operation time, low maintenance, and lower chemical cost make this system a excellent value.

Chemical Use

Lower chemical concentration of the process bath is more efficient for Megasonic processing than a bath with a higher chemical to water ratio.

Forward Power Versus Reflected Power

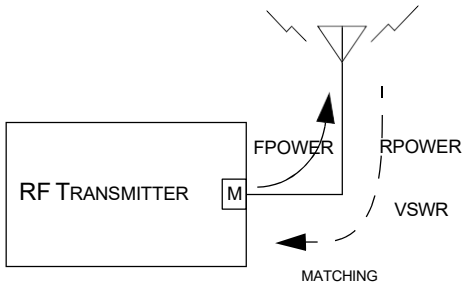
Standard-Design Systems

The standard RF transmitter has a matching network with a coaxial cable and an antenna.

In these systems, it is necessary to get the ***VSWR*** ratio (the adjustment ratio) as low as possible in order to balance, or "zero out", the RPower.

The idea is to have as much of the transmitted power radiate from the antenna as possible while having as little as possible power reflected back to the Transmitter.

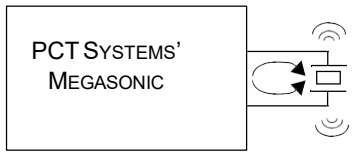
Figure 10-2: Standard RF Transmitter



PCT Systems Design

The PCT Systems design has finely tuned Crystals in each Array. There is no need to use a matching network to cancel the effects of the FPOWER and RPOWER.

Figure 10-3: PCT Systems' Megasonic Cleaning System Configuration



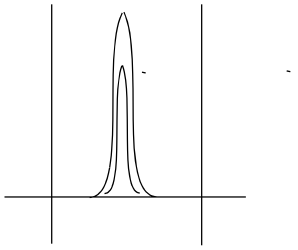
In fact, the energy generated by the Crystals is used by the system to increase its efficiency.

The PCT Systems' Generator is a broadband amplifier and the Crystals have a very narrow resonant frequency. The PCT Systems' Generator continuously shifts its frequency to match the frequencies of each Crystal.

Standard Systems

In standard, or conventional, systems, the amplifier and the Crystal need to have their impedance matched very carefully.

Figure 10-4: Individual Adjustments



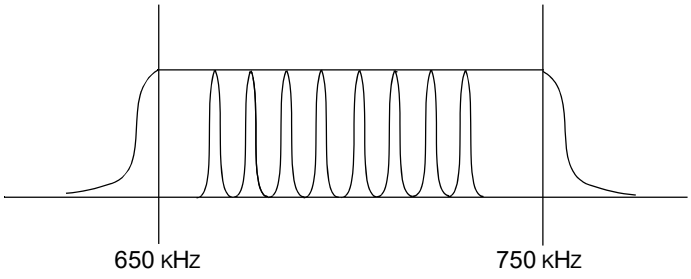
PCT Systems Design

In the PCT Systems design, the impedance of the Crystals and the amplifier are handled differently.

The Generator is matched for a minimum and maximum frequency bandwidth that we know will cover the range for the Transducers used and the type of material the Bath is made of.

Because the Transducers have a unique resonate frequency, the Generator continuously switches its frequency to match that of the Transducers.

Figure 10-5: Frequency of the 8 Crystals in the Array



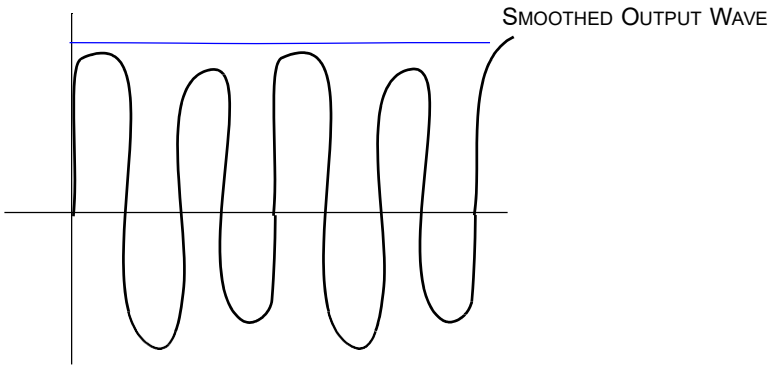
Power Output

The smoothed output wave represents the conditioned output voltage that is sampled by the CPU, is used to generate the Power reading displayed in the Generator, and to determine if the minimum power to qualify the process has been met.

PLEASE NOTE: The following representation is not drawn to scale. The drawings are for illustrative purposes only.

This output should only be used as a diagnostic tool—**NOT** a quantifiable power reading in watts.

Figure 10-6: Representation of a Smoothed Output Wave Form



Benefits Summary of PCT Systems Design

Because the PCT Systems design handles Forward and Reflected Power, and the power output in a superior and efficient manner, the equipment:

- **ELIMINATES THE NEED FOR ADJUSTING FORWARD AND REFLECTED POWER WITH A MATCHING NETWORK** by using a broadband Generator that continuously adjusts to the very narrow resonate frequencies of the finely tuned Arrays of Crystals.
- **UTILIZES THE MECHANICAL AND ELECTRICAL PROPERTIES OF PIEZOELECTRIC CRYSTALS.**
- **REQUIRES LESS MAINTENANCE AND ADJUSTMENT TO MAINTAIN CONSISTENT RESULTS.**

Notes

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APPENDIX A
INSTALLATION DRAWINGS

Purpose

The Installation Drawing(s) for this system is/are inserted after this page or may be sent as separate documents (in electronic or hard-copy format).

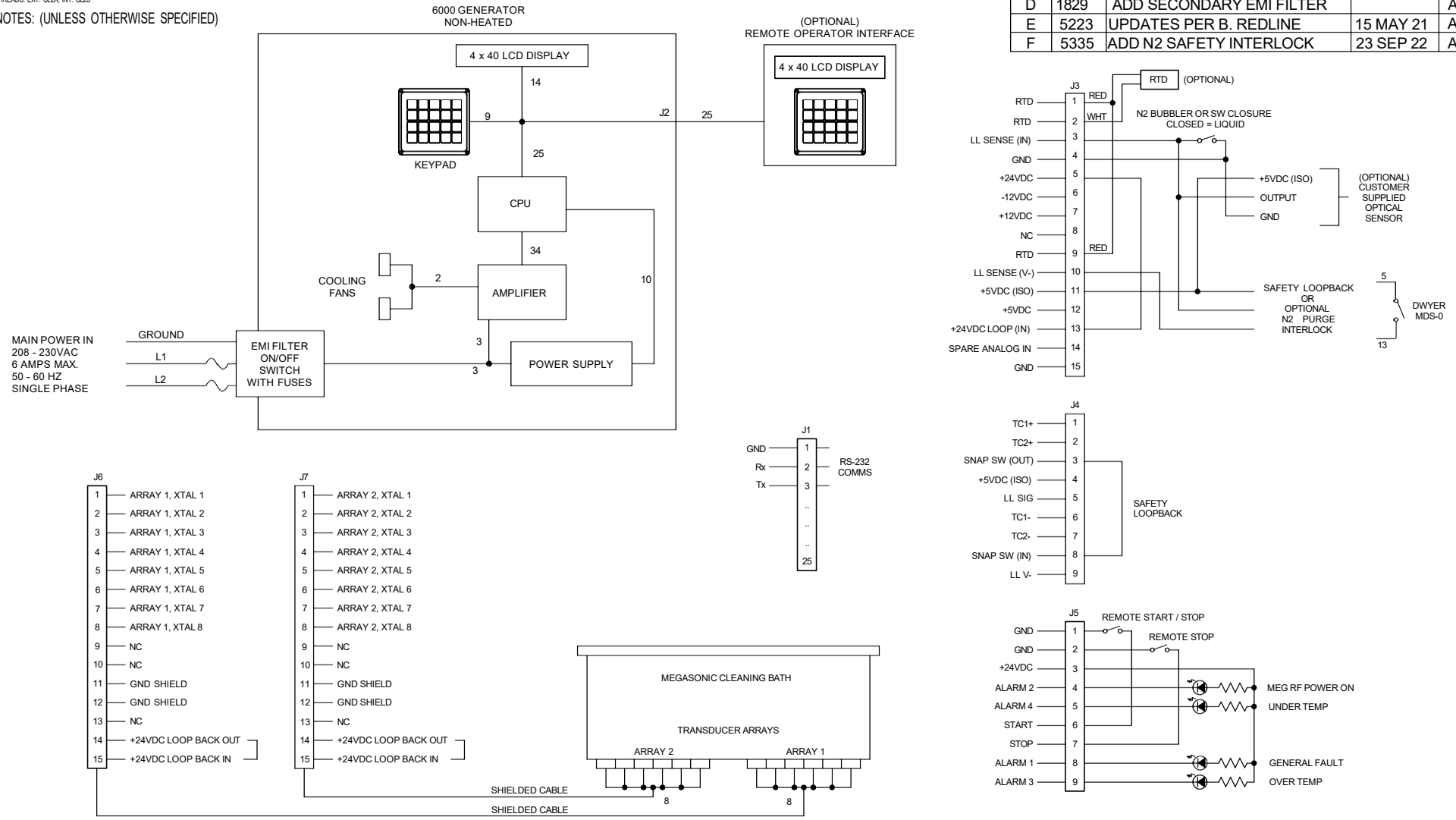
Location of plumbing connections, electrical connections, and clearances are on the Installation Drawings.

IMPORTANT:
If you do not have copies of these drawings, whether in electronic or hard copy form, please contact PCT Systems' Customer Service.

. INTERPRET THIS DRAWING PER ASME Y 14.5M-1994]
. ALL DIMENSIONS ARE IN INCHES. (REF)
. REMOVE ALL BURRS AND SHARP EDGES
.THREADS: EXT. CL2A, INT. CL2B

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS				
REV	ECO	DESCRIPTION OF CHANGE	DATE	APPROVAL
D	1829	ADD SECONDARY EMI FILTER		AMOROSO
E	5223	UPDATES PER B. REDLINE	15 MAY 21	AMOROSO
F	5335	ADD N2 SAFETY INTERLOCK	23 SEP 22	AMOROSO



MATERIAL:
FINISH:
THIRD ANGLE PROJECTION

TOLERANCES	HOLES
DECIMALS	.0 - 250 +.007 +.003
	.251-.500 +.010 -.005
ANGLES ± .5°	.501 & UP +.015 -.008

PCT SYSTEMS, INC.
2182 PARAGON DR.
SAN JOSE, CA 95131
SOLID-EDGE

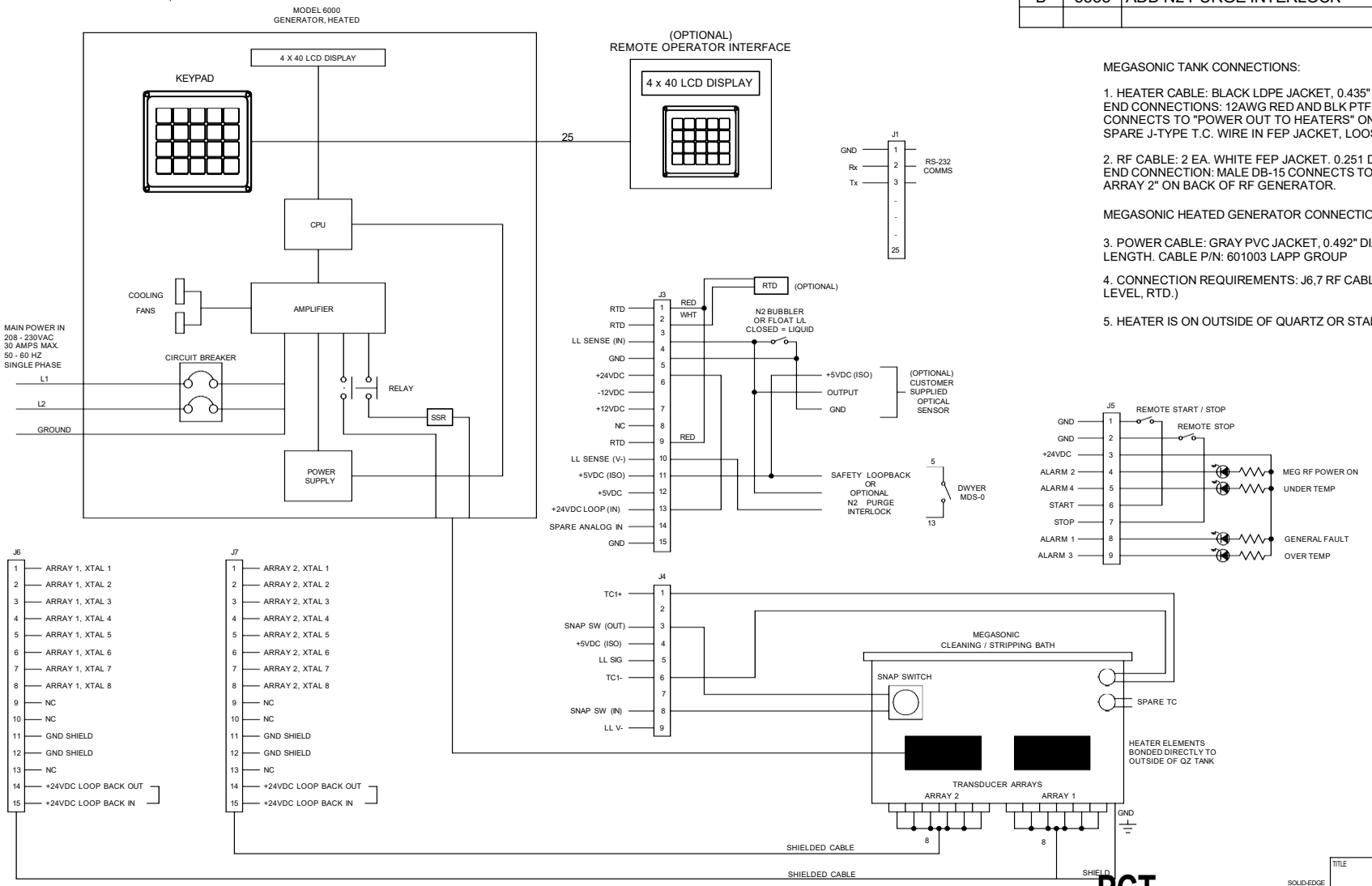
DRAWN H. AMOROSO DATE 28 MAY 09
PART NO. 29-005-0050

TITLE: SYSTEM DIAGRAM, 6000 GENERATOR NON-HEATED
DRW NO. PCT-2426-1
REV. F
SHEET 1 OF 1

. INTERPRET THIS DRAWING PER ASME Y 14.5M-1994]
. ALL DIMENSIONS ARE IN INCHES. (REF)
. REMOVE ALL BURRS AND SHARP EDGES
.THREADS: EXT. CL2A, INT. CL2B

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS				
REV	ECO	DESCRIPTION OF CHANGE	DATE	APPROVAL
A	5223	INITIAL RELEASE	10 MAY 21	AMOROSO
B	5335	ADD N2 PURGE INTERLOCK	23 SEP 22	AMOROSO



MEGASONIC TANK CONNECTIONS:

1. HEATER CABLE: BLACK LDPE JACKET, 0.435" DIA. RATED: 1000V/200C
END CONNECTIONS: 12AWG RED AND BLK PTFE WIRE IN A NEMA L2-20P PLUG
CONNECTS TO "POWER OUT TO HEATERS" ON BACK OF RF GENERATOR.
SPARE J-TYPE T.C. WIRE IN FEP JACKET, LOOSE

2. RF CABLE: 2 EA. WHITE FEP JACKET. 0.251 DIA. RATED: 600V/200C
END CONNECTION: MALE DB-15 CONNECTS TO "J6 - ARRAY 1" AND "J7 - ARRAY 2" ON BACK OF RF GENERATOR.

MEGASONIC HEATED GENERATOR CONNECTIONS:

3. POWER CABLE: GRAY PVC JACKET, 0.492" DIA. 3-CONDUCTOR 10AWG 6' LENGTH. CABLE P/N: 601003 LAPP GROUP

4. CONNECTION REQUIREMENTS: J6,7 RF CABLES, J4 (FROM TANK), J3 (LIQUID LEVEL, RTD.)

5. HEATER IS ON OUTSIDE OF QUARTZ OR STAINLESS TANK.

MATERIAL:
FINISH:
THIRD ANGLE PROJECTION

TOLERANCES
DECIMALS
ANGLES ± .5°

HOLES
.0 - .250 + .007 + .003
.251 - .500 + .010 - .005
.501 & UP + .015 - .008

PCT SYSTEMS, INC.
PCT SYSTEMS, INC.
2182 PARAGON DR.
SAN JOSE, CA 95131
SOLID-EDGE

DRAWN H. AMOROSO
DATE 22 SEP 20
PART NO. 29-005-0051

TITLE
SYSTEM DIAGRAM, HEATED MEGASONIC BATH

DRW NO. PCT-2426-2
REV. B
SHEET 1 OF 1

Notes

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APPENDIX B
PROGRAMMING PARAMETERS

Purpose

The parameter values for this tuned system are contained in this section.

IMPORTANT:
The values provided must be used for this system.

Using other values voids your warranty.

Contact PCT Engineering to discuss using different values for your system.

NOTE:
As a backup copy, a copy of the parameter values list is taped on the inside bottom panel of the Controller.

Quick Set-Up of the Programmable Parameters

Displayed Message		FTune version	
		DEFAULT	PROGRAMMED
Programming Displays *For more information about these screens, please see Chapter 6: FTune Programming.*			
ENTER NEW PROCESS NUMBER IF DESIRED		00001	00001
ENTER PASSWORD PLEASE (ANY NUMBER BETWEEN 0 AND 65535)		00000	00000
PROCESS TEMPERATURE (IN DEGREES C)		00000	00000
MINIMUM TEMPERATURE TO START A PROCESS (IN DEGREES C)		00000	00000
MAXIMUM TEMPERATURE TO START A PROCESS (IN DEGREES C)		00000	00000
ENTER PROCESS TIME IN SECONDS IE 10 MINUTES = 600 SECONDS		00600	00600
ENTER POWER IN PERCENT (IE 1 TO 100%) (ANYTHING OVER 100 IS THE SAME AS 100)		00100	00100
ENTER MINIMUM POWER VALUE TO QUALIFY ARRAY PROCESS (100 TO 500 TYPICAL)		00000	00000
TYPE OF TRANSDUCER FOR SENSING HEAT 0=RTD 1=(TC EMBEDDED IN BATH)		00000	00000
TYPE OF REMOTE ON/OFF SIGNAL 0=NORMAL 1=QUICK OFF		00000	00000
HEATER POWER FACTOR (USUALLY 200 TO 900)		00000	
Level Sensor Programming *For more information about these screens, please see Chapter 6: FTune Programming.*			
LIQUID LEVEL SET POINT (0 FOR ALL NON ULTRASONIC TYPE SENSORS)		00000	00000

Displayed Message		FTune version	
		DEFAULT	PROGRAMMED
SECS Interface Programming Displays *For more information about these screens, please see Chapter 6: FTune Programming.*			
TYPE OF SERIAL INTERFACE 0=REMOTE PANEL 1=REMOTE RS232/QC 2=SECSII		00000	00000
ENTER DESIRED BAUD RATE 300, 600,1200 2400, 4800, 9600		09600	09600
ENTER MEGASONIC SECS 1 DEVICE ID (0 TO 32767)			
ENTER T1 FOR SECS 1 (1 TO 100 IN .1 SEC) (INTER CHARACTER TIME-OUT)			
ENTER T2 FOR SECS 1 (2 TO 250 IN .1 SEC) (REPLY TIME-OUT)			
ENTER NUMBER OF RETRIES WHILE SENDING A SECS 2 MESSAGE (0 TO 31)			
DUPE BLOCK CHECKING 0=NO 1=YES			
Programming Transducers Parameters Displays *For more information about these screens, please see Chapter 6: FTune Programming.*			
ENTER TIME IN SECONDS FOR THE AMP TO BE ON BEFORE MUXING (1 NORMAL 3 MAX)		00001	00001
ENTER NUMBER OF CRYSTALS PER ARRAY CAUTION!!! MAKE SURE YOU KNOW		00004	00004
ENTER MINIMUM FREQUENCY FOR TUNING IN .1 KHZ (05000 TYPICAL)		06850	06850
ENTER MAXIMUM FREQUENCY FOR TUNING IN .1 KHZ (07500 TYPICAL)		07500	07500

Displayed Message			FTune version	
			AMBIENT	50 DEGREES C
SPEED WHEN AUTO TUNING THE XTALS 1 TO 50. 10 NORMAL 50 IS SLOW			00035	00035
Frequency Programming Displays *For more information about these screens, please see Chapter 6: FTune Programming.*				
ENTER FREQ CONTROL VALUE (0=HIGH & LOW 1= HIGH FREQ ONLY 2=LOW FREQ ONLY)			00000	00000
ENTER DESIRED FREQUENCY FOR ARRAY 1 XTAL 1 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 1 XTAL 2 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 1 XTAL 3 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 1 XTAL 4 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREUQENCY FOR ARRAY 1 XTAL 5 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 1 XTAL 6 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 1 XTAL 7 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 1 XTAL 8 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 1 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 2 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 3 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 4 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 5 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 6 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 7 (IN .1 KILO HERTZ)			07000	07000
ENTER DESIRED FREQUENCY FOR ARRAY 2 XTAL 8 (IN .1 KILO HERTZ)			07000	07000

Displayed Message		FTune version	
		DEFAULT	PROGRAMMED
ENTER NEW PASSWORD NOW, IF DESIRED (ANY NUMBER BETWEEN O AND 65534)		00000	00000
ENTER TYPE OF TRANSUCER FOR TUNING 0=ELECTRICAL 1=ACOUSTICAL		00000	00000
FREQUENCY WOBBLE FACTOR FOR ARRAY 1 (0 TO 100, 10 IS NORMAL)		00001	00001
FREQUENCY WOBBLE FACTOR FOR ARRAY 2 (0 TO 100, 10 IS NORMAL)		00001	00001

Notes

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APPENDIX C

SAMPLE RECIPES

Process Recipes

PCT Systems can recommend a variety of cleaning applications. Please call PCT Engineering at (510) 657-4412 for assistance.

Included in this section, are reference examples of 2 standard process recipes:

- Pre-Diffusion Clean Procedure
- Mask Clean Procedure

Using the PCT Megasonic Cleaning Process reduces process time for NMP-based stripping applications.

Pre-Diffusion Clean "Recipe"

1. HF Dip
   - Ratio: 100:1
   - Time: 60 to 120 seconds
2. Rinse to resistivity.
3. Megasonic Clean Procedure:
   - Program the system Controller:
     - Enter the Process Temperature value=65.
     - Enter the Minimum & Maximum Process Temperatures, if required.
     - Enter the Process Time value=10 minutes.
     - Enter the Power Level value=100%.
   - Megasonic clean for 10 minutes in 65°C bath solution of:
     - DI water: 7 parts
     - Ammonium Hydroxide: 1 part
4. Rinse to resistivity.
5. Spin or vapor dry.

As the bath chemical concentrations decrease, maintain the Peroxide level at a 1-part ratio to prevent etching of parts by the Ammonium Hydroxide.

The life of this bath is typically 4 hours.

Bath life may be extended up to 24 hours by refreshing the bath every 2-3 hours with 5% Peroxide by volume.

Good cleaning results are achieved with a weak solution of:

- DI water: 100 parts
- Hydrogen Peroxide: 2 parts
- Ammonium Hydroxide: 1 part

NOTE:
Reducing the bath temperature increases the bath lifetime, but cleaning efficiency is reduced and longer process time is required.

Mask Clean "Recipe"

1. Sulfuric Peroxide bath:
   - Time: 10-15 minutes
   - Temperature: 100–130ºC
2. Rinse to resistivity.
3. Megasonic Clean Procedure:
   - Program the system Controller:
     - Enter the Process Temperature value=65.
     - Enter the Minimum & Maximum Process Temperatures, if required.
     - Enter the Process Time value=10 minutes.
     - Enter the Power Level value=100%.
   - Megasonic Clean for 10 minutes in 65°C bath solution of:
     - DI water: 7 parts
     - Hydrogen Peroxide: 1 part
     - Ammonium Hydroxide: 1 part
4. Rinse to resistivity.
5. Spin or vapor dry.

Peroxide may attack thin metal coatings used in masking.

AUTOTUNING PROCEDURE

IMPORTANT:
Only use this procedure when you are instructed by PCT Systems.

If you perform this procedure without permission from PCT Systems, you may void your warranty or irreparably damage the unit.

Autotuning Procedure

1. Determine the Arrays to be autotuned (both Arrays, Array 1, or Array 2).
2. Press the PROG key on the Keypad to enter the programming mode.
3. Press the ENT key.
4. Press the CLR key to clear the entry on the display.
5. At the Password screen, use the Keypad to enter the appropriate passwords.

```
ENTER PASSWORD PLEASE
(ANY NUMBER BETWEEN 0 AND 65535)          00000
PROGRAMMED TEMP=XXX       ACTUAL TEMP=XXX
LIQUID=XXX    OT=X     CONTACTOR=XXX    DUTY=XXX
```

Table D-1:Tuning Type and Associated Password

Tuning	Password
Both Arrays	44000
Array 1 only	44001
Array 2 only	44002

6. Press the ENT key to start the autotuning process.

   A display will appear stating

   - The autotuning process is occurring
   - The Array number
   - The Transducer number

- The peak power of the Transducer being autotuned

The autotuning process *starts with the last Crystal* on the Array *and works forward*.

For example, if there are 8 Crystals, the process will start with Crystal 8 and work forward to Crystal 1.

NOTE:

DURING THE AUTOTUNING PROCESS, *Crystal 1 is displayed as Crystal 0*, Crystal 2 is displayed as Crystal 1,..., *Crystal 8 is displayed as Crystal 7*.

7. During the autotune process, visually inspect each Crystal to ensure the proper energy pattern is generated.

   Look for these 2 characteristics:

   - A continuous, domed line spanning the length of the Crystal (a *speedbump*-like shape)
   - With *small fountain-like spurts*

IMPORTANT:

If you see smoke at any time during the process, **press the STOP key** and call PCT Systems, Inc. **IMMEDIATELY**.

DO NOT continue the autotuning process.

DO NOT exceed the values stated in *Table D-2*.

Table D-2: Minimum and Maximum Frequency Ranges for Various Tank Types

Tank Type	Frequency Range
Quartz Tank	6750–7500
Stainless Steel Plate	8500–9500
Tefzel-coated Aluminum	6750–7500

8. When the process is complete, a display will indicate this. Press the STOP key.

```
HYPERCLEAN FINISHED TUNING TRANSDUCERS
PRESS "STOP"                                  00000
PROGRAMMED TEMP=XXX        ACTUAL TEMP=XXX
LIQUID=XXX    OT=X     CONTACTOR=XXX    DUTY=XXX
```

9. Compare the new frequencies with the documented frequencies by pressing the DIAG key. Press the ALT key to change the screen.

> **REMINDER:**
> Check the frequencies of **both** Arrays if your system has 2 Arrays.

POWER-TRANS ARRAY 1

This Display shows the autotune values for the Forward Power in Array 1.

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
PWR1=XXXX    PWR2=XXXX    PWR3=XXXX    PWR4=XXXX
PWR5=XXXX    PWR6=XXXX    PWR7=XXXX    PWR8=XXXX
```

POWER-TRANS ARRAY 2

This Display shows the autotune values for the Forward Power in Array 2.

```
HYPER-CLEAN READY TO RUN PROCESS #XX
TIME=XXXX POWER=XXXX PERCENT
PWR1=XXXX    PWR2=XXXX    PWR3=XXXX    PWR4=XXXX
PWR5=XXXX    PWR6=XXXX    PWR7=XXXX    PWR8=XXXX
```

10. Document the new frequencies, where appropriate.

Notes

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APPENDIX E
OTHER INFORMATION

Purpose

Occasionally, other information, not contained in this Manual, will be sent to you as an addendum to this Manual.

This Appendix provides a place to store this information.

This information may also be provided electronically on this disk or through other media (e-mail, etc.).

Notes

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