

Model 435 and 436

Forma Orbital Shaker *

Operating and Maintenance Manual 7010435 Rev. 1



- * Triple counter-balanced, single eccentric drive mechanism (U.S. Patent #5,558,437)
- * Horizontal, HEPA-filtered airflow design (U.S. Patent #5,577,837)
- * Test tube rack (U.S. Patent #5,632,388)

MANUAL NUMBER 7010435

1	22245/OS-284	3/26/04	Updated timer increments to 5 minutes	ccs
--	OS-279	2/19/04	Added unit specific electrical schematic, no Model 4500 Series	ccs
0	21382/OS-263	3/19/03	updated UL listing, unit to Release 11	ccs
REV	ECR/ECN	DATE	DESCRIPTION	By



Important Read this instruction manual. Failure to read, understand and follow the instructions in this manual may result in damage to the unit, injury to operating personnel, and poor equipment performance. ▲

Caution All internal adjustments and maintenance must be performed by qualified service personnel. ▲

Warning Model 435/436 Orbital Shaker may be used to process non-flammable materials only! ▲

Warning Grounding circuit continuity is vital for safe operation of this shaker. Never operate this unit with the grounding circuit disconnected. ▲

Material in this manual is for information purposes only. The contents and the product it describes are subject to change without notice. Thermo Scientific makes no representations or warranties with respect to this manual. In no event shall Thermo be held liable for any damages, direct or incidental, arising out of or related to the use of this manual.

©2003 Thermo Scientific. All rights reserved.



Important operating and/or maintenance instructions. Read the accompanying text carefully.



Potential electrical hazards. Only qualified persons should perform procedures associated with this symbol.



Equipment being maintained or serviced must be turned off and locked off to prevent possible injury.



Marking of electrical and electronic equipment, which applies to electrical and electronic equipment falling under the Directive 2002/96/EC (WEEE) and the equipment that has been put on the market after 13 August 2005.



This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the WEEE symbol. Thermo Scientific has contracted with one or more recycling/disposal companies in each EU Member State European Country, and this product should be disposed of or recycled through them. Further information on Thermo's compliance with this directive, the recyclers in your country and information on Thermo products will be available at www.thermofisher.com.

- ✓ Always use the proper protective equipment (clothing, gloves, goggles, etc.)
- ✓ Always dissipate extreme cold or heat and wear protective clothing.
- ✓ Always follow good hygiene practices.
- ✓ Each individual is responsible for his or her own safety.

Do You Need Information or Assistance on Thermo Scientific Products?

If you do, please contact us 8:00 a.m. to 6:00 p.m. (Eastern Time) at:

1-740-373-4763	Direct
1-888-213-1790	Toll Free, U.S. and Canada
1-740-373-4189	FAX
http://www.thermo.com	Internet Worldwide Web Home Page
service.led.marietta@thermofisher.com	Service E-Mail Address

Our **Sales Support** staff can provide information on pricing and give you quotations. We can take your order and provide delivery information on major equipment items or make arrangements to have your local sales representative contact you. Our products are listed on the Internet and we can be contacted through our Internet home page.

Our **Service Support** staff can supply technical information about proper setup, operation or troubleshooting of your equipment. We can fill your needs for spare or replacement parts or provide you with on-site service. We can also provide you with a quotation on our Extended Warranty for your Thermo Scientific products.

Whatever Thermo Scientific products you need or use, we will be happy to discuss your applications. If you are experiencing technical problems, working together, we will help you locate the problem and, chances are, correct it yourself...over the telephone without a service call.

When more extensive service is necessary, we will assist you with direct factory trained technicians or a qualified service organization for on-the-spot repair. If your service need is covered by the warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

Regardless of your needs, our professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 6:00 p.m. Eastern Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:

Thermo Scientific
Controlled Environment Equipment
401 Millcreek Road, Box 649
Marietta, OH 45750

International customers, please contact your local Thermo Scientific distributor.

Table of Contents

Section 1	Installation	1-1
	Pallet Hold-down Shipping Brackets	1-1
	Location	1-2
	Install Cabinet Stand-off Bolts	1-2
	Unit Drains	1-2
	Foot Pedal	1-3
	Assemble the Flask Clips	1-3
	Install the Flask Clips	1-4
	Install the Test Tube Holders	1-5
	RS-232 Interface Connector	1-6
	Connect the Remote Alarm	1-8
	Lid Security Lock	1-8
Section 2	Operation	2-1
	Control Panel Operation	2-2
	Quick Start-Up	2-2
	Factory (Default) Settings	2-3
	Change Temperature, Speed, Time Settings	2-3
	Change Temperature	2-4
	Change RPM	2-4
	Change Time	2-4
	Shaker Alarms	2-5
	Overtemp Shutdown	2-6
	Cycle Complete	2-6
	Power Failure	2-7
	RPM Tracking	2-7
	Check Belt	2-8
	Sensor Fault	2-8
	Temperature High or Low	2-8
	Platform Stalled	2-9
	Check Fuse	2-9
	Change Shaker Configuration	2-9
	Turn Audible Alarm On/Off	2-10
	Set Alarm Limits	2-11
	Calibrate Speed (RPM)	2-14
	Calibrate Temperature	2-14

Section 2 (continued)	Remote Alarm System	2-15
	Cycle Complete	2-15
	Power Failure	2-16
	RPM Tracking	2-16
	Check Belt	2-16
	Sensor Fault	2-17
	Temperature High or Low	2-17
	View Total Operating Hours	2-17
	Heat %	2-18
	Software Version	2-19
	Temperature Sensor Readings	2-19
Section 3	Maintenance	3-1
	Platform and Cabinet	3-1
	Control Panel	3-1
	Clean or Replacing Air Filter	3-1
	Menu Map	3-2
	Alarm Messages	3-8
	Preventive Maintenance	3-10
Section 4	Service	4-1
	Alarms and Alarm Conditions	4-1
	Change HEPA Filter	4-2
	If Shaker Will Not Operate	4-2
	Spare Fuses	4-2
	Circuit Boards	4-4
	Temperature Sensors	4-5
	Blower Fan Motors and Heating Elements	4-5
	Heater Element Circuit Breaker	4-6
	Tune the Cabinet	4-6
	Service the Drive Belt	4-6
Section 5	Specifications	5-1
Section 6	Parts List	6-1
Section 7	Electrical Schematics	7-1
Section 8	Warranty Information	8-1

Section 1 Installation

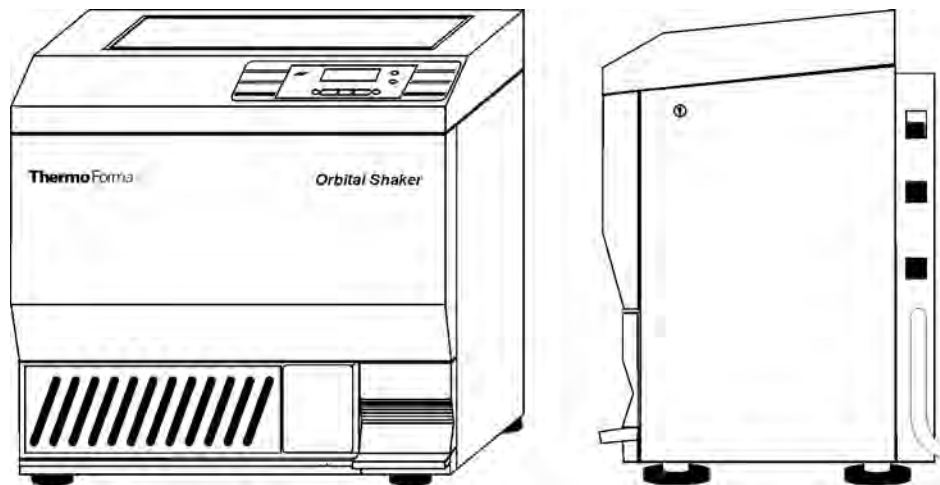


Figure 1-1. Model 435/436 Console Incubator Orbital Shaker

The Model 435/436 Orbital Shaker ships with the following materials:

- 2 - Keys for the lid lock (packaged and attached to outside of unit)
- 1 - T-handle 5/32" hex socket wrench
- 2 - Platform alignment studs 1/4 -20
- 1 - Shaker platform
- 6 - Grade 8, 5/32" hex socket flat head screws (provided with platform)
- 1 - 3/4" Open end wrench
- 2 - 1/4-20x7" Stand-off bolts with rubber caps
- 1 - Screwdriver for flask clip installation and removal

Pallet Hold-down Shipping Brackets

To secure the console shaker to the shipping pallet, hold-down brackets are attached to slots in both sides of the cabinet. The brackets are fastened to the wood pallet with lag screws (Figure 1-2).

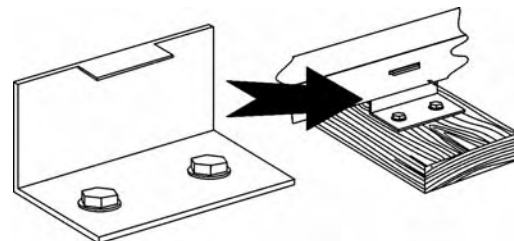


Figure 1-2. Bracket

Location

Install the shaker on a firm, level surface in an area free of dust and dirt. To allow for lid opening, the back of the shaker must be at least 4 ½ inches from the wall. As the electrical plug is the “ mains disconnect” for the unit, the electrical wall outlet must remain accessible at all times.

Install the Cabinet Stand-off Bolts

The Model 435/436 console shaker features front-to-back air circulation for cooler compressor temperatures, increased performance and reliability, and longer compressor life. Therefore, the fan area on the back of the cabinet must be at least 4 inches from the back wall or other obstruction. To maintain this distance, two 1/4-20x7” bolts are included in the parts bag.

Screw the bolts into the threaded holes on the back of the shaker cabinet (Figure 1-3). The bolts should be screwed in by hand to the limit of the threads. Further tightening is unnecessary. Put the protective rubber caps, also supplied in the parts bag, over the heads of the bolts.

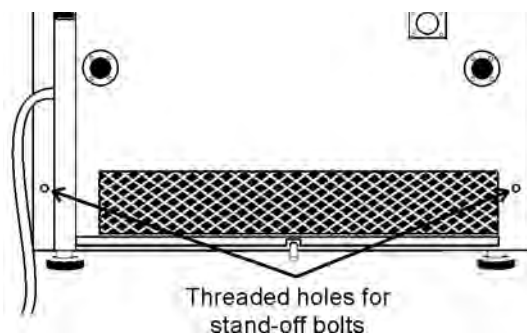


Figure 1-3. Rear View

Unit Drains

Two drains are provided in this unit; a internal chamber drain and a condensate drain on the back.

Chamber Drain

One drain is provided in the bottom of the chamber for convenience when cleaning or removing spills (Figure 1-4). A clear vinyl hose and plastic valve is connected to the drain and accessed by removing the front grille assembly and the lower front panel. The grille is removed by gently pulling it off. It is held in place by six push-in type retainers.

To remove the cabinet panel located in back of the grille, remove the six Phillips screws; three on the top and three on the bottom. It may also be necessary to loosen the two left side Phillips screws which hold the foot pedal assembly to the shaker frame.

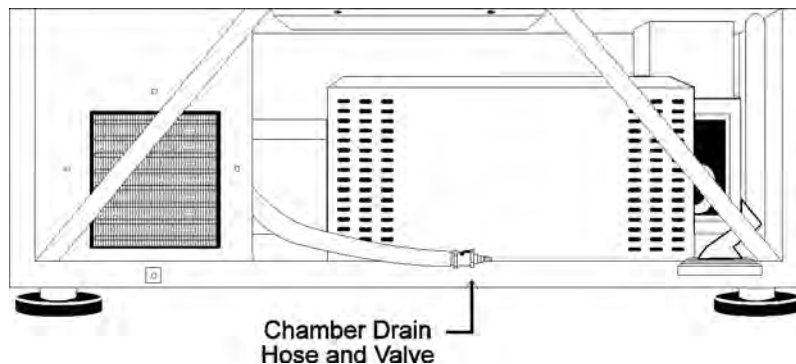


Figure 1-4. Hose from Chamber Drain

Condensate Drain

A 1/4" stainless steel condensate drain is located on the back of the shaker to remove any water that may collect in the air ductwork. Refer to the illustration in Figure 1-4.

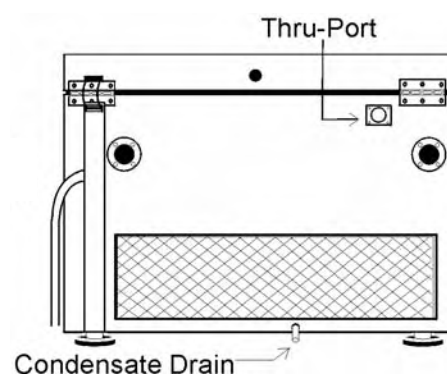


Figure 1-5. Drain Location

Foot Pedal

The lid of the console shaker is counterbalanced for ease of opening and closing. A foot pedal on the lower right of the front of the cabinet is also provided for operator convenience and ready access to the chamber.

Assemble Flask Clips

Each Flask Clip up to 6.0 liters in size comes with a metal spring that must be installed onto the clip. For flask clips through 500 ml, insert the end of each spring into the holes on the top of the clip leg as shown in Figure 1-6.

The 2 liter, 2.8 liter, 4 liter, 5 liter, and 6 liter Flask Clips use two metal springs and rubber spring tubes. On these larger clips, the springs are installed by hooking their ends together as illustrated in Figure 1-7. The upper spring and spring tubes should be installed prior to mounting the clip to the platform.

The lower spring and spring tubes, however, are placed around the bottom of the clip legs after the flask clip is fastened to the platform.

Note that the rubber spring tubes are placed between the clip legs.

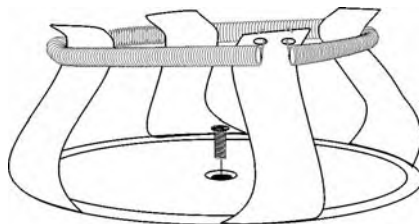


Figure 1-6. Clip Mounting Screw

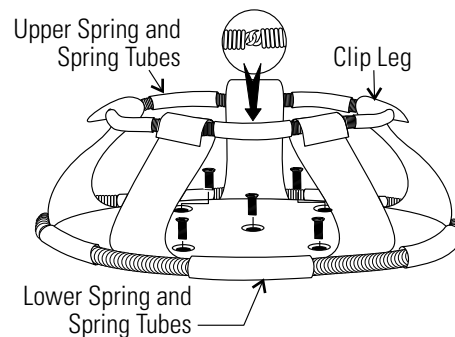


Figure 1-7. Clip Components

Install Flask Clips

The Model 435/436 accommodates glassware in numbers and sizes from ninety-one 25 ml flasks to four 6 liter flasks. All platforms have mounting holes for flask clips and test tube racks made by other manufacturers. Table 1-1 lists the flask clip assemblies and kits available.

Flask clips can be attached anywhere on the shaker platform. The counter-balanced design of these shakers accommodates the worst unbalanced load.

The flask clips are supplied with the proper screws and can be attached to the platform with a standard Phillips screwdriver or the screwdriver provided with the unit.

Figures 1-6 and 1-7 illustrate the installation of the flask clips. Note that clips for 1 liter and 2 liter flasks use five screws. The 250/300 flask clip has an adhesive-backed flask cushion pad, which is installed on the flat base of the clip body. A hole is provided in the pad for the mounting screw (see Figure 1-6.)

Table 1-1. Platform Clip Capacity

Dedicated Platform Number	No. of Clips	Flask Size (ml)	Springs per Clip	Screws per Clip
238017	91	25	1	1
238018	91	50	1	1
238019	39	125	1	1
238051	30	250/300	1 (w/ 1 lg. pad)	1
238021	24	500	1	1
238022	15	1 L	1	5
238023	12	2 L	2 (w/ 10 tubes)	5
236024	6	4 L	2 (w/ 10 tubes)	5
238054	6	5L (2(w/ 10 tubes)	5	
236025	4	6 L 2 (w/ 10 tubes)	5	
236026	6	2.8 L 2 (w/ 10 tubes)	5	

Install Test Tube Holders

Accessory Test Tube Racks and Test Tube Rack Holders are available in four sizes and are listed in Table 1-2. All the Test Tube Rack Holders are adjustable into seven positions, swinging and locking at 15°, 30° and 45° in either direction. Figure 1-8 illustrates the Test Tube Rack Holder with rack in place. To remove the rack, spread the metal tabs on either end of the holder and lift out the plastic Test Tube Rack.

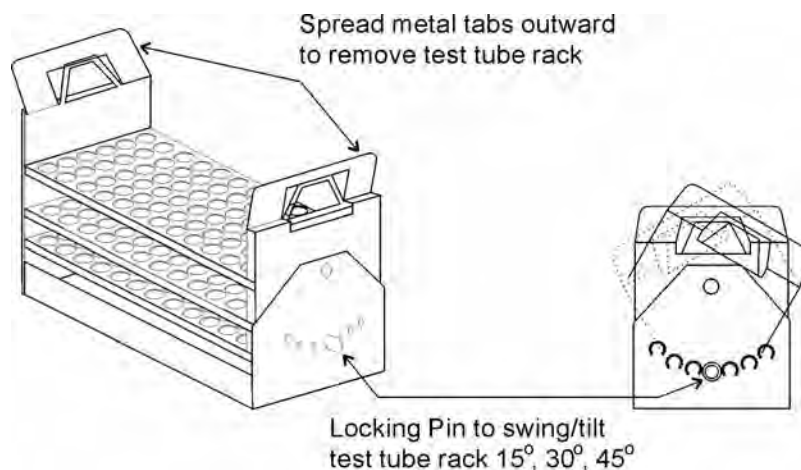


Figure 1-8. Test Tube Rack Holder

To install the Test Tube Rack Holder onto the shaker platform, remove the rack and rotate the swing-bed of the holder 90° by pulling the knobs of the locking pins on either end of the holder outward. The pins are locked outward by turning the knob 1/4-turn (Figure 1-9). Attach the tray to the platform with the screws provided.

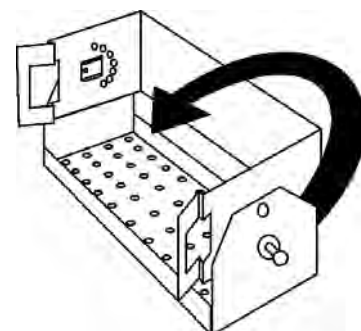


Figure 1-9. Rotate Rack

Table 1-2. Racks and Holders

Part No.	Description
950040	Test Tube Rack, 10-13 mm size
950060	Test Tube Rack, 16-20 mm size
600074	Test Tube Rack, 21-25 mm size
600075	Test Tube Rack, 26-30 mm size
600076	Adjustable-Angle Test Tube Holder w/ Rack, 10-13mm
600077	Adjustable-Angle Test Tube Holder w/ Rack, 16-20mm
600078	Adjustable-Angle Test Tube Holder w/ Rack, 21-25mm
600079	Adjustable-Angle Test Tube Holder w/ Rack, 26-30mm
600088	Universal Adjustable-Angle Test Tube Holder, 10-25mm
600089	2 Tier Micro-Plate Rack
600090	3 Tier Micro-Plate Rack
194024	#10-24 pan head Phillips screws for mounting holders to platforms

RS-232 Interface Connector

The Model 435/436 Orbital Shaker is equipped with an RS-232 Serial Communication Interface for the remote transmission of data. A RJ-11 telephone style connector is located on the left side of the incubator. A cable with RJ-11 plugs and an RJ-11 to DB-25 adapter are required. Refer to Figure 1-11 for connector locations on the shaker back panel. Figure 1-10 identifies the pin connections.

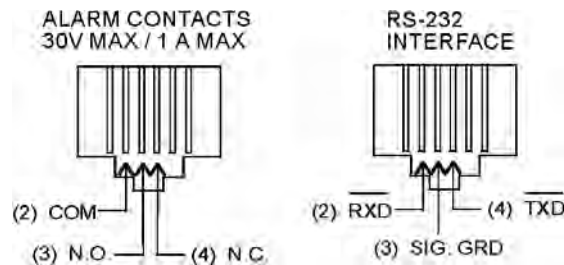


Figure 1-10. RS-232 and Remote Alarm Connectors

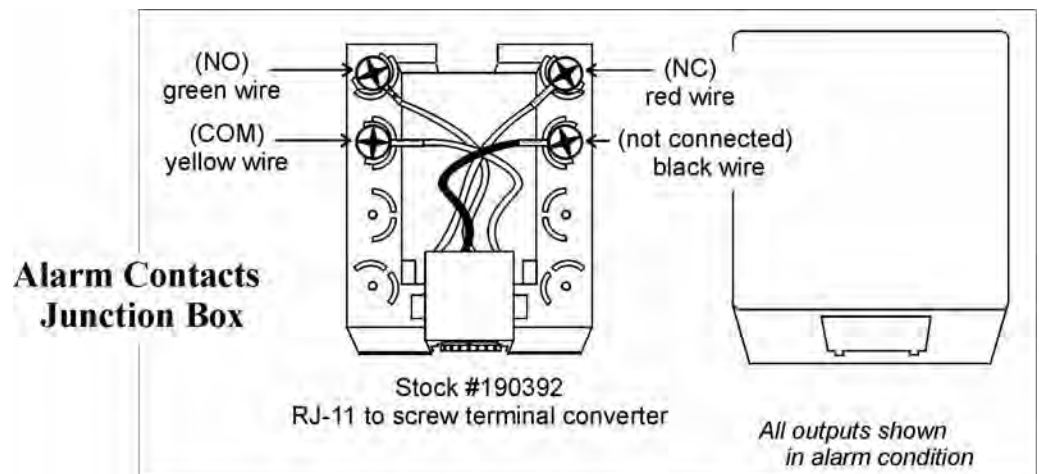


Figure 1-11. Pin Connections

The data is “dumb terminal” formatted, which permits interfacing with either a computer or a serial printer.

Three wires are used for the RS-232 interface:

1. Transmit data (/TXD) - pin 2 DB-25 connections
2. Receive data (/RXD) - pin 3 DB-25 connections
3. Signal ground (GND) - pin 7 DB-25 connections

RS-232 Interface Connector (cont.)

The data format is:

Baud . . 1200 (9600 baud with jumper at J2, on the Main Control Board)
 Data bits8 (7 bit ASCII with leading zero)
 Start bits1
 Stop bits1
 Paritynone

The data transfer sequence is transmitted in the following format. X refers to the numerical time, RPM and temperature.

(NUL)XX:XX(H)(SP)(SP)XXXRPM(SP)(SP)XX.XC(SP)(LF)(CR)(EOT)

NULNull character (0)
 SPSpace
 LFLine feed
 CRCarriage return
 EOTEnd of text (4)
 HHold Mode

The Model 435/436 transmits time, RPM and temperature information one minute after power is first applied to the unit, then every 60 minutes.

The shaker's microprocessor responds to two ASCII commands from the remote: DC1 (XON), and DC3 (XOFF)

DC1 (17, 11 Hexadecimal)

The shaker will transmit Time, Temperature and RPM data upon receiving "DC1" (XON) and will restart 60 minute interval transmissions if they have been inhibited by a "DC3" (XOFF).

DC3 (19, 13 Hexadecimal)

Receiving a "DC3" (XOFF) from the remote inhibits the shaker from sending serial data indefinitely until a "DC1" (XON) is received.

Connect the Remote Alarm

IMPORTANT USER INFORMATION

Caution! Stored product should be protected by a redundant 24 hour/day monitoring system with alarm capability. An interconnect jack and thermocouple are installed for centralized monitoring, should on-board system fail.

An internal SPDT relay is provided to monitor alarms and is connected by a RJ-11 (telephone style) jack on the rear of the cabinet. The remote alarm provides NO (normally open) and NC (normally closed) output. Figure 1-10 identifies the pin contacts. Figure 1-13 shows the location of the Remote Alarm Connector.

A modular to modular cable (Stock No. 190388) and an RJ-11 telephone style terminal converter (Stock No. 190392) or equivalent may be used to convert the remote alarm output to a screw terminal connection. Refer to Figure 1-12 below.

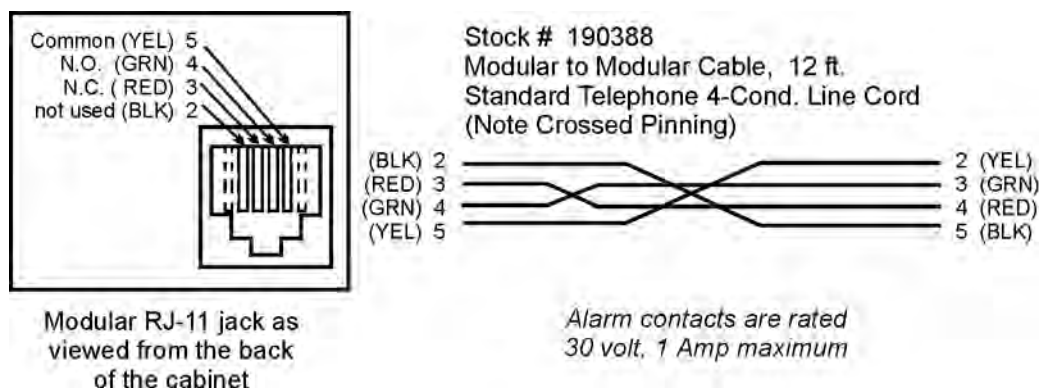


Figure 1-12. Remote Alarm Output to Screw Terminal Connection

Lid Security Lock

To protect the contents of the shaker or prevent tampering or unauthorized access, a security lock is located on the right side of the lid (Figure 1-13). Two keys for this lock are in the parts package attached to the outside of this unit when shipped.

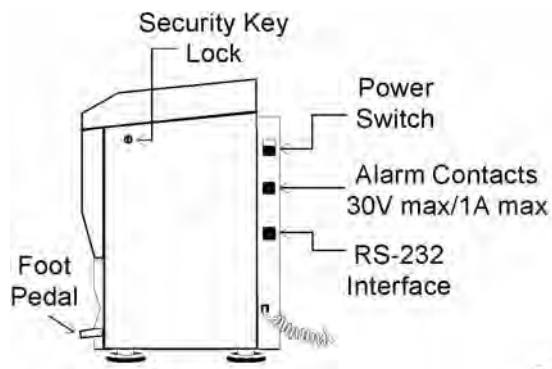


Figure 1-13. Side View

Section 2 Operation

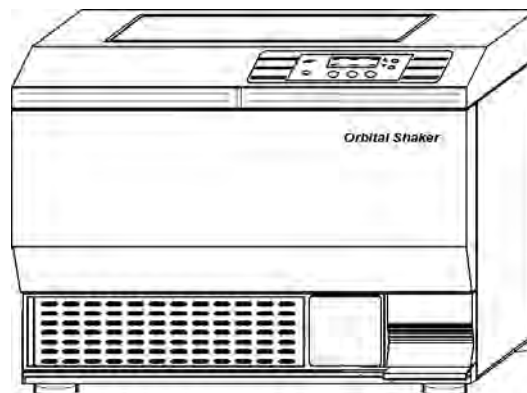


Figure 2-1. Front View

Model 435/436 is a microprocessor-controlled incubator orbital console shaker designed to accommodate a wide variety of flasks, test tubes and other glassware. The control system is easily programmed and stores the user-defined time, temperature and speed setting which remain in memory even when the shaker is turned off and unplugged.

The computer-based speed controller continuously adjusts for line voltage fluctuations and provides smooth start-ups and consistent RPM control. The circuitry is designed to slowly bring the platform up to speed and down to a stop to prevent liquid splashing from flasks or test tubes.

An insulated lid with viewing port is counter-balanced for easy opening by hand or foot pedal. A convenience interlock requires that the lid be closed for the drive motor, circulating fans and heating elements to operate.

Caution The microprocessor speed control system may take up to one minute to bring the platform up to speed.

Never leave the shaker unattended when starting it. Make sure all flasks and test tube racks are firmly seated in the clips and check the security of the flask clip and platform attachment screws monthly.

Air circulating fans will only operate with the lid closed.

Do not operate the shaker at maximum RPM without a load. ▲

Control Panel Operation

The Model 435/436 control panel has a liquid crystal display and eight operating keys or buttons which are identified by word and symbol. During programming activities, the up and down arrows increase and decrease the numerical values of time, platform speed, or temperature. Pressing and holding either arrow will cause the values to scroll in that direction. Pressing and holding for about five seconds will increase the scrolling speed.

When programming the system configuration, the Up arrow returns the display to the system's Operating Screen showing the Time, RPM and Temperature, while the Down arrow advances the display to the next programming screen.

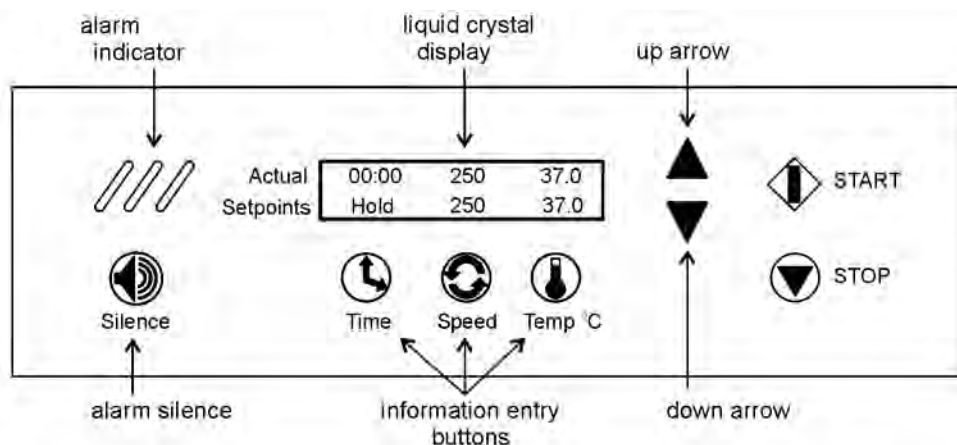


Figure 2-2. Control Panel

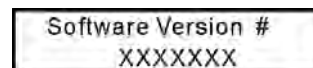
The alarm indicator and alarm silence button complete the shaker control panel. When in alarm, the unit sounds an audible warning and flashes the three red indicators. Pressing the Silence button turns off the audible portion of the alarm. However, the three flashing indicators continue to flash until the alarm condition is corrected. The audible warning will sound again in about fifteen minutes if the condition continues.

The alarm features are discussed in more detail in the “Shaker Alarms” section of this manual.

Quick Start-Up

The Model 435/436 Orbital Shaker may be operated as soon as the platform is installed, the unit is plugged in, and turned on.

Note At power up, the screen at right briefly appears. ▲



Quick Start-Up (cont.)

Pressing Start and Stop will operate the shaker at the factory settings shown in Figure 2-2. When starting, the Actual numbers along the top of the display will differ from the Setpoint values shown along the bottom. These numbers will change as the unit begins to operate.

Time - With the time set at Hold, the time display in the upper left portion of the screen begins to count upward, showing the total operating hours and minutes. The system resets to 00:00 whenever the unit is stopped and restarted, using the Stop and Start buttons. The unit will not reset if the unit is turned off and on using the power switch, or if the cover is repeatedly opened and closed.

Speed - The Actual speed will display zero RPM's and will gradually rise as the platform begins its motion.

Temperature - The temperature, shown in the upper right portion of the liquid crystal display, will indicate the actual ambient temperature inside the cabinet and will slowly move toward the 37° setpoint.

Factory (Default) Settings

The values shown in Figure 2-2 are set at the factory and are considered default values. Other factory settings are shown in the table following.

Table 2-1. Defaults

Function	Default
Audible Alarm	ON
RPM Tracking Limit (fixed)	5
Temperature Tracking Limit	10°C
Over Temperature Shut-down	83°C - 85°C
All Remote Alarms	ON

To get the most from the shaker's microprocessor-based technology, the Model 435/436 can be easily programmed to meet the most demanding laboratory requirements. The following sections outline the procedures for changing the settings and for programming the shaker control system.

Change Temperature, Speed, Time Settings


When first turned on or during shaker operation, Temperature, Time and RPM values are displayed on the LCD. A typical screen is illustrated in Figure 2-2. For convenience, this is called the Operating Screen throughout these instructions. All programming or setting changes start from this screen.

Change Temp, Speed, Time Settings (cont.)


The instructions to program the Model 435/436 are written in a step-by-step format. For convenience, the instructions begin and end at the Operating Screen.

Note At any time during programming or changing settings, if no control panel buttons are pressed for about fifteen seconds, the display automatically returns to the Operating Screen, storing any settings made. New settings are also stored immediately when an arrow key is pressed. ▲


Change Temperature

1. Press the button beneath the temperature setpoint (Temp °C).  The temperature value will begin to flash.
2. Press the up or down arrows to set the new temperature in 0.1°C increments. Hold either button to scroll.
3. Press the temperature button again to return to the Operating Screen.

Change RPM

1. Press the button beneath the Speed setpoint.  The RPM value will begin to flash.
2. Press the up or down arrows to set the new speed in 1 RPM increments. Hold either button to scroll.
3. Press the Speed button again to return to the Operating Screen.

Change Time

The Model 435/436 manages operating time in two ways: 

Hold - When Time is set to Hold, the value shown in the Actual portion of the display represents total operating time and may be reset at the operator's convenience. The shaker will continue to count upwards even if the console lid has been repeatedly opened and closed, or turned off and on with the power switch. The Time will, however, reset to 00:00 when the Stop button is pressed and the unit then restarted by pressing the Start button.

Countdown - When the Hold setpoint is changed to Countdown entering a time value in hours and minutes, the shaker will operate for that period and automatically shut down. The display will show the total time in the Setpoint segment and the operating time remaining in the Actual part of the display, as the microprocessor counts down to zero.

Change from Hold to Countdown

1. Press the button beneath the Time setpoint. Hold will begin to flash.

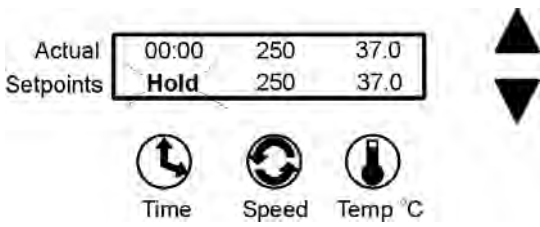


Figure 2-3. Flashing Hold

2. Press either arrow to access the Countdown Time setpoint. The preset time setpoint will begin to flash.
3. Press the up or down arrows to set the desired operating time in five minute increments. Hold either arrow to scroll in that direction.
4. When the desired elapsed time is set (8 hours, 30 minutes in this example), press the Time button to return to the Operating Screen. Pressing the Start button will start the shaker and begin the countdown sequence. When 00:00 is reached, the shaker will automatically shut off and the Cycle Complete alarm will sound.

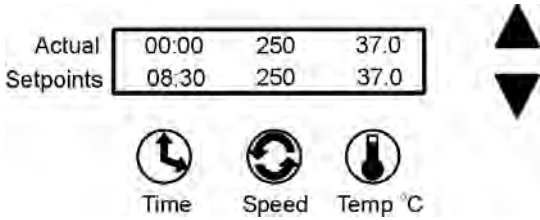


Figure 2-4. Time Set

Shaker Alarms

The Model 435/436 Orbital Shaker control system monitors and provides alarms for nine operating parameters.

Parameter	Alarm Message
Overtemp Setpoint Status	Overtemp Shutdown
Cycle Status	Cycle Complete
Loss of Input Power	Power Failure
RPM versus Setpoint	RPM Tracking
Drive Belt Integrity	Check Belt
Temp Sensor Integrity	Sensor Fault
Temp Control Status	Temperature High/Low
Platform Movement Status	Platform Stalled
Motor Fuse Integrity	Check Fuse

Shaker Alarms (continued)

Both audible and visual alarm warnings for these nine parameters are provided by the shaker. Visual flashing of the three diagonal indicator lights on the control panel, a progression of text messages on the display, and an audible tone alerts the operator that an alarm condition has occurred, or currently exists.

For convenience, the audible tone is silenced by pressing the Silence button, but rings back in about 15 minutes. However, the alarm warning indicator lights and alarm messages continue until the alarm condition is corrected by the operator. Then, pressing the Silence button clears the message from the display ('Check Belt' and 'Check Fuse' alarms require the unit to be turned off, then on again to remove the message from the display). The audible alarm feature may be turned off to suit operator or laboratory needs. See "Turn Audible Alarm ON/Off" section.

Refer also to the alarms and corrective actions chart at the end of this section.

Overtemp Shutdown

Overtemp Shutdown alerts the operator that the overtemp setpoint has been exceeded by a few tenths of a degree.

Actual	08:41	250	37.0
Setpoints	Overtemp Shutdown		

The Overtemp Shutdown message displays and the heaters are turned off, but the platform and the blowers continue to operate.

In the alarm state, the audible alarm is silenced by pressing the Silence button, but rings back in about 15 minutes. The screen message and warning lights, however, continue until the fault is corrected. Then, press the Silence button to clear the alarm message.

Cycle Complete

Cycle Complete alerts the operator that the end of the count-down running time has been reached.

Actual	00:00	0	37.0
Setpoints	Cycle Complete		

The Cycle Complete message shown displays and the shaker stops.

Press the Silence button to clear the message from the display screen.

Power Failure

Power Failure alerts the operator that electrical power to the shaker was interrupted, then restored while it was shaking.

Actual	00:00	0	37.0
Setpoints	Power Failure		

While the system returns to normal operation when power is restored, the alarm message remains and the audible tone continues to sound to alert the operator. Both the display message and the audible tone are cleared by pressing the Silence button.

Note The alarm will not occur if the power failure is less than 15 seconds in duration. ▲

Note If power is interrupted for two hours or more while the Shaker is turned on but not shaking, a Power Fail alarm will occur. The purpose of the alarm in this case is to alert the user that an extended duration power failure occurred during the Hold interval after a timed shaking operation, or during a period of incubation only. This alarm will also occur any time the Shaker is turned on after an extended off period greater than 2 hours (such as when the unit is shipped from the factory, or when it is returned to use after a period of storage). ▲

RPM Tracking

RPM Tracking alerts the operator by either alarm message shown below that the platform speed has varied ± 5 RPM.

Actual	08:41	255	37.0
Setpoints	RPM is High		

Actual	08:41	245	37.0
Setpoints	RPM is Low		

Note A two-minute alarm delay is built into the software. ▲

In the alarm state, the audible alarm is silenced by pressing the Silence button, but rings back in about 15 minutes. The screen message and warning lights, however, continue until the fault is corrected. Then, the alarm message is cleared by pressing the Silence button.

Check Belt

Check Belt alerts the operator that the drive belt may have broken or something is slowing or preventing platform movement.

Actual	08:41	0	37.0
Setpoints	Check Belt		

In the alarm state, the audible alarm is silenced by pressing the Silence button, but will ring back in about 30 minutes. The screen message and warning lights, however, will continue until the fault is corrected. Then, the alarm message is cleared by cycling power to the unit OFF, then ON.

Sensor Fault

Sensor Fault alerts the operator that either of the shaker's two temperature sensors have failed. An alarm message similar to those shown below will show which sensor has failed.

Actual	08:41	250	37.0
Setpoints	Main Temp Sensor		

Actual	08:41	250	37.0
Setpoints	Over Temp Sensor		

When in the alarm state, the audible alarm is silenced by pressing the Silence button, but rings back in about 15 minutes if the fault condition persists. The screen message and warning lights continues until the fault is corrected.

When the sensor problem is corrected, the alarm message is cleared by pressing the Silence button.

Temperature High or Low

Temperature High or Temperature Low alerts the operator that the operating temperature of the shaker has risen above or fallen below the programmed temperature tracking limit control point. One of the alarm messages shown below will be displayed.

Actual	08:41	250	47.0
Setpoints	Temperature is High		

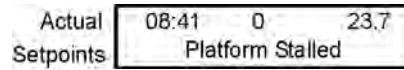
Actual	08:41	250	27.0
Setpoints	Temperature is Low		

In the alarm state, the audible alarm is silenced by pressing the Silence button, but rings back in about 15 minutes if the fault condition persists. The screen message and warning lights continues until fault is corrected.

After the temperature problem is corrected, press the Silence button to clear the alarm message.

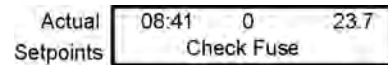
Platform Stalled

Platform Stalled alerts the operator that something is preventing free platform movement. The motor automatically shuts off and the audible alarm, screen message and warning lights are initiated. The motor will attempt restart after approximately 15-20 seconds. The motor will continue to cycle on and off until the obstruction is removed, or the unit is turned off. On motor restart, the audible alarm and warning lights are automatically cleared. The screen message will remain until cleared by the operator.



Check Fuse

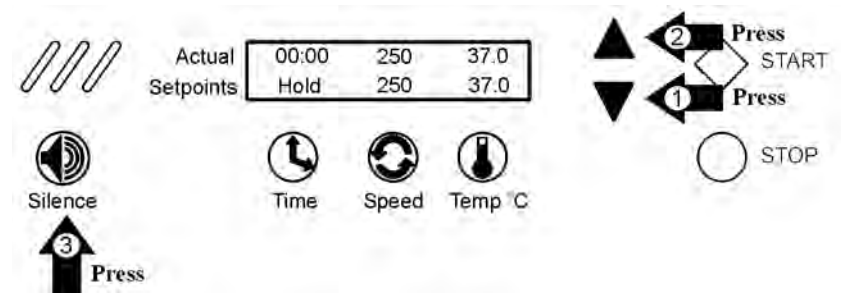
Check Fuse alerts the operator that primary drive motor fuse has blown. The audible alarm, screen message and warning lights are initiated. When the unit is turned on after fuse replacement, all alarm indicators are automatically cleared.



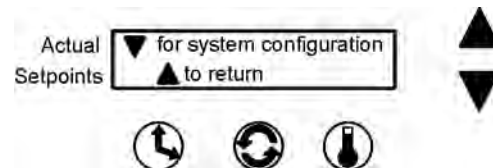
Warning Fuse replacement must be performed by qualified service personnel. See Service section. ▲

Change Shaker Configuration

To access the system Configuration menu, press the down arrow, the up arrow and the Silence button in that sequence.



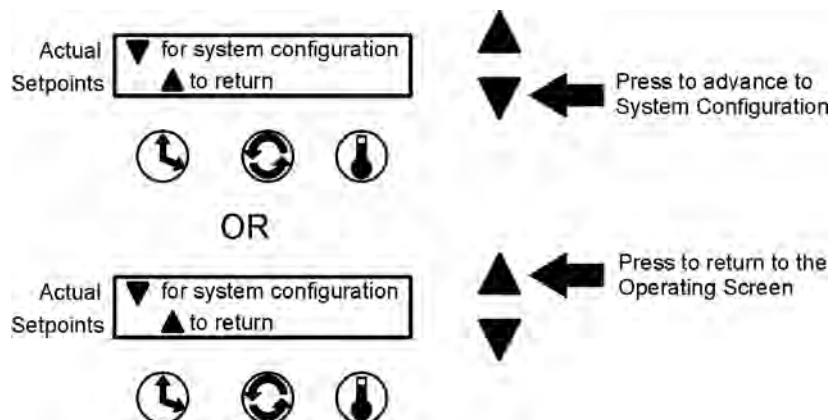
This screen will appear on the display.



Change Shaker Configuration (cont.)

Pressing the down arrow continues with system configuration.

Pressing the up arrow returns to the Operating Screen.

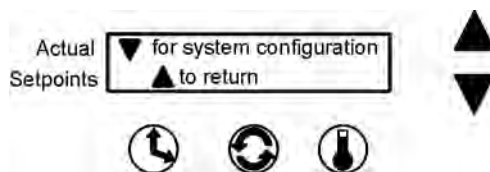
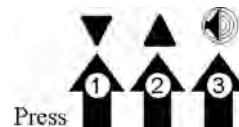


During the following configuration procedures, menu options are given to either modify a setting as it appears in sequence, or scroll past to the next item. If no selection is made by pressing a button or arrow, the display will revert to the Operating Screen in about 15 seconds. The complete Configuration menu is shown in the chart at the end of this section.

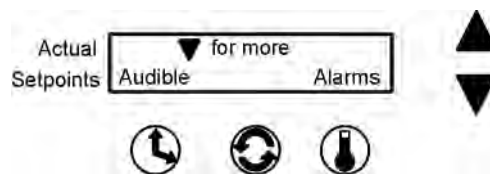
In these procedures, values and settings for time, temperature, speeds, alarms, and so forth are shown on the display screens. These numbers are for example only and may not be the values encountered when programming your shaker.

Turn Audible Alarm On/Off

Begin by pressing the down arrow, the up arrow, and the Silence button. The screen shown below will appear on the display:

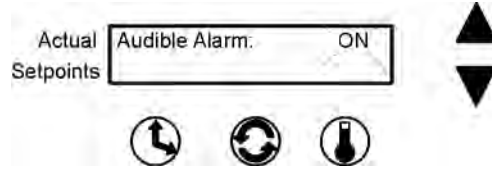


When this screen opens, press the down arrow once.



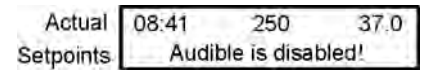
At this screen, press the Time button beneath Audible. The following screen will appear and the current setting will flash.

Turn Audible Alarm On/Off (continued)



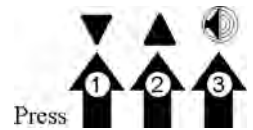
Press the up or down arrow to turn the audible alarm function on or off. Pressing any of the three buttons (Time, Speed, or Temp) will return the display to the previous screen. Not pressing anything for about 15 seconds returns the display to the Operating Screen.

When the audible alarm is disabled, a warning message is placed in the Setpoint portion of the Operating Screen display as illustrated at the right.

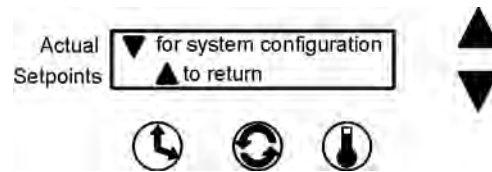


Set Alarm Limits

Two temperature alarms are programmed into the Model 435/436 orbital shaker: Overtemperature and Tracking limits. To change these values, open the Configuration menu by pressing the down arrow, up arrow, and the Silence button in the sequence shown at the right.

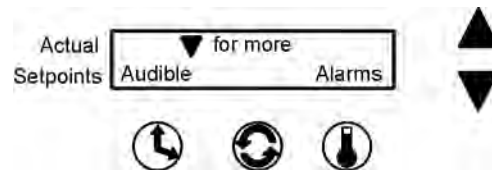


When this screen (below) opens....



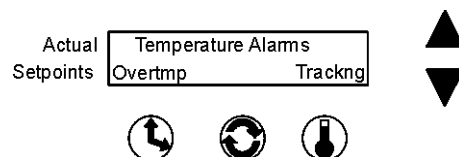
Press the down arrow once

Then press the temperature button beneath Alarms.



Set Overtemperature Alarm

To change the overtemperature alarm setting, press the Time button beneath Overtemp. The following screen appears and the current overtemperature alarm setting flashes.

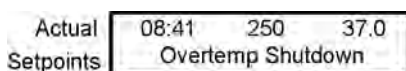


Set Overtemperature Alarm (continued)

Change the temperature setting by pressing the up or down arrow. When set, press the Temperature button to return to the previous screen or press nothing for about 15 seconds. The display will change to the Operating Screen, saving the new settings into memory.



When the overtemperature setpoint is exceeded by a few tenths of a degree, the control system will shut the shaker down by turning off the heaters.



The Overtemp Shutdown warning shown above will be displayed, the warning lights will flash and the audible warning (if not turned off) will sound.

Pressing the Silence button turns off the audible alarm. However, the warning lights continues to flash and the alarm message continues to be displayed until the overtemperature condition is corrected. The audible warning also sounds again in about 15 minutes if the overtemperature condition persists.

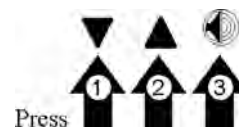
When the fault is corrected, press the Silence button to clear the alarm message from the display.

Set Temperature Alarm Tracking Limit

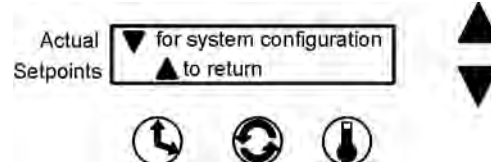
The Temperature Tracking alarm activates whenever the operating temperature goes above or below the setpoint temperature by a predetermined value. This adjustable limit is set at the factory as 10° above and below the temperature setpoint.

Note The above and below limits will always be the same value. ▲

To change this limit, open the configuration menu as in the previous alarm procedures, by pressing the buttons in the sequence at right.

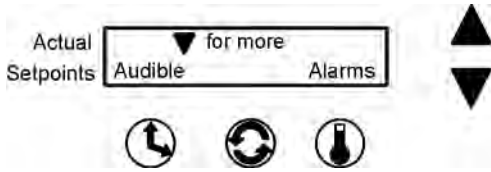


The following screen appears. Press the Down arrow once.

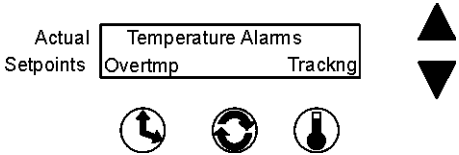


Set Temperature Alarm Tracking Limit (continued)

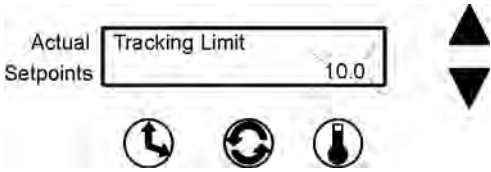
Then press the Temperature button beneath Alarms.



Then, from the screen below, press the temperature button beneath Tracking.



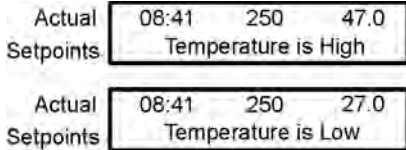
The following screen will appear and the present temperature tracking alarm limit setting will flash.



Change the temperature tracking limit by pressing the up or down arrow. When set, press the Temperature button to save the setting and return to the previous screen.

If no buttons are pressed for about 15 seconds, the display reverts to the Operating Screen, saving the new setting to memory.

When the chamber temperature rises above or falls below the temperature tracking limit, the appropriate message is displayed, the warning lights flash and the audible warning (if not turned off) sounds.

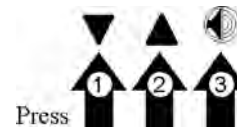


Pressing the Silence button turns off the audible alarm. However, the warning lights continue to flash and the alarm message continues to be displayed until the high or low temperature condition is corrected. The audible warning also sounds again in about 15 minutes if the over or under temperature tracking condition persists.

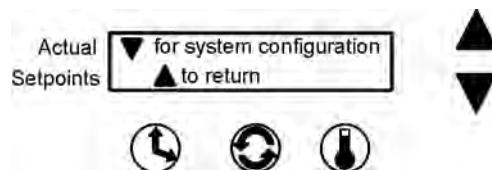
When the fault is corrected, press the Silence button to clear the alarm message from the display.

Calibrate Shaker Speed (RPM)

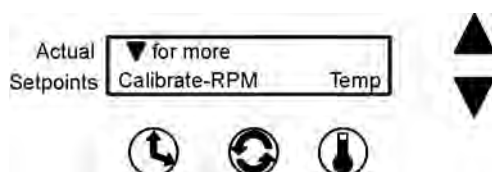
From the Operating screen, press the down arrow, up arrow and Silence button in that sequence (shown at the right) to open the Configuration menu.



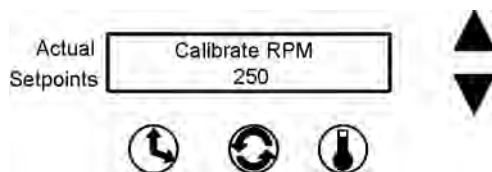
From the screen below, press the down arrow twice to bring up the following screen.



Press the Speed button beneath RPM.



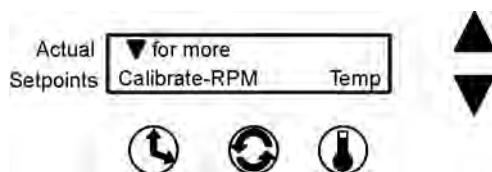
The value shown on this screen is the present speed setpoint. Using the up and down arrows, increase or decrease the platform speed until the reading on an independent, accurate speed measuring device matches the shaker speed setpoint.



When finished, press the Speed button to save the setting. The display will return to the Calibrate - RPM Temp screen. Or, if nothing is pressed for about 15 seconds, the display will revert to the Operating Screen and the setting will be automatically saved to memory.

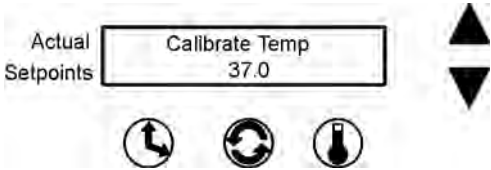
Calibrate Shaker Temperature

After accessing the Configuration menu (right), the screen below will appear on the display. Press the Temperature button beneath Temp.



Calibrate Shaker Temperature (cont.)

Using the up and down arrows, increase or decrease the temperature value to match an independent, accurate temperature measuring device placed near the level of the platform. When selected, press the Time, Speed, or Temp button to save the setting. The display will return to the Calibrate - RPM Temp screen. Or, if nothing is pressed for about 15 seconds, the display reverts to the Operating Screen and the setting is automatically saved to memory.

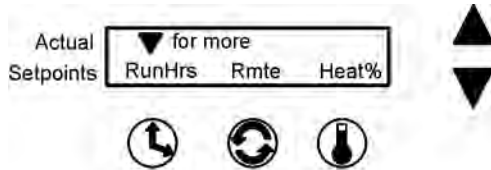
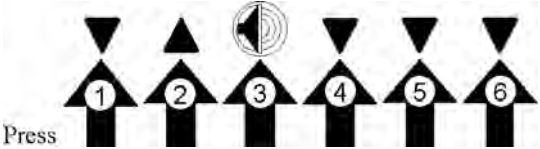


Remote Alarm System

Any of the alarm states described can alert a remote alarm monitoring system through an internal SPDT relay connected to an RJ-11 jack on the rear of the shaker cabinet. Refer also to 'Connect the Remote Alarm' in Section 1. For the convenience of the laboratory, these remote alarms can be individually turned on or off. Any or all of the remote alarms set to On will activate the internal relay.

Note The Remote Overtemp Shutdown, Platform Stalled and Check Fuse alarms cannot be deactivated. ▲

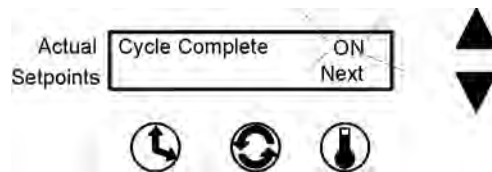
To set the remote alarms to On or Off, open the Remote Alarm Configuration menu by pressing the down arrow, up arrow, and silence buttons in that sequence. Then, press the down arrow three times until the screen below is showing.



Press Rmte (remote). The alarms will be shown in the following sequence.

Cycle Complete

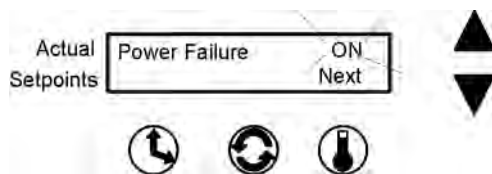
Toggle the Cycle Complete alarm with either the up (On) arrow or the down (Off) arrow. Pressing the Next (temperature) button advances the display to the next alarm, saving the shown Cycle Complete setting to memory.



If no buttons are pressed, the display automatically returns to the Operating Screen after about 15 seconds, saving the selection to memory.

Power Failure

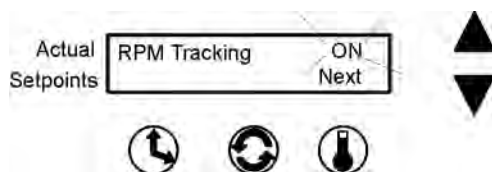
Toggle the Power Failure alarm with either the up (on) arrow or the down (off) arrow. Pressing the Next (temperature) button advances the display to the next alarm, saving the Power Failure setting to memory.



If no buttons are pressed, the display automatically returns to the Operating Screen after about fifteen seconds, saving the selection to memory.

RPM Tracking

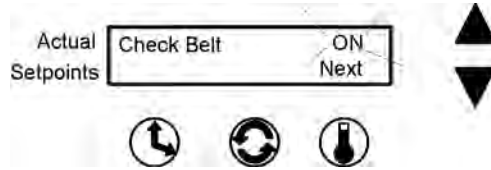
Toggle the RPM Tracking alarm with either the up (On) arrow or the down (Off) arrow. Pressing the Next (temperature) button advances the display to the next alarm, saving the RPM Tracking setting to memory.



If no buttons are pressed, the display automatically returns to the Operating Screen after about 15 seconds, saving the selection to memory.

Check Belt

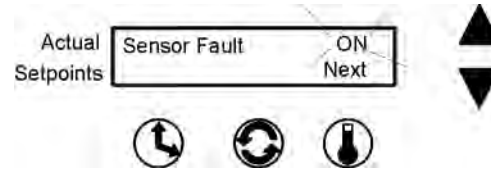
Toggle the Check Belt alarm with either the up (on) arrow or the down (off) arrow. Pressing the Next (temperature) button advances the display to the next alarm, saving the Check Belt setting to memory.



If no buttons are pressed, the display automatically returns to the Operating Screen after about 15 seconds, saving the selection to memory.

Sensor Fault

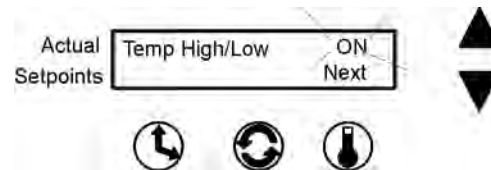
Toggle the Sensor Fault alarm with either the up (On) arrow or the down (Off) arrow. Pressing the Next (temperature) button advances the display to the next alarm, saving the on/off setting to memory.



If no buttons are pressed, the display automatically returns to the Operating Screen after about 15 seconds, saving the selection to memory.

Temperature High or Low

Toggle the Temperature High/Low alarm with either the up (On) arrow or the down (Off) arrow. Pressing the Return (temperature) button advances the display to the display shown below.



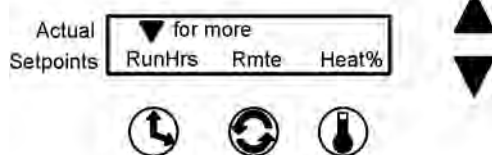
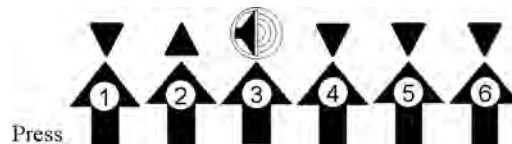
If no buttons are pressed, the display automatically returns to the Operating Screen after about fifteen seconds, saving the selection to memory.

View Total Operating Hours

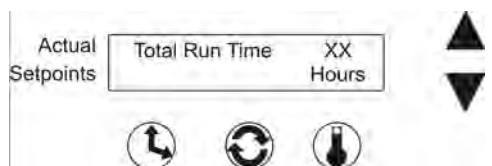
Whether the shaker has been operated in hold or countdown modes, and/or has been turned off and unplugged many times, the microprocessor control system maintains a running total operating hours.

View Total Operating Hours (continued)

To view this information, access the Configuration menu by pressing the down arrow, up arrow and Silence button in sequence, then press the down arrow three times.



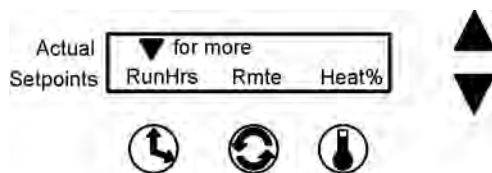
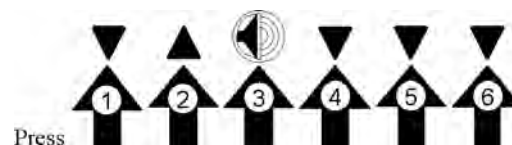
Pressing RunHrs shows the total accumulated run hours as displayed in the illustration below. In about fifteen seconds, the display returns to the Operating Screen.



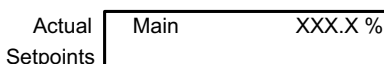
Heat %

Heat percent is intended for factory use only, but can be helpful in troubleshooting the heat control system.

To view this information, access the Configuration menu by pressing the down arrow, up arrow and Silence button in that sequence, then press the down arrow three times.



Press Heat %.



Main Heat % is the percentage of time that the heater is turned on during a five second period. Example: If the heater is being cycled on for two seconds and off for three seconds, the Heat % value is 40 percent.

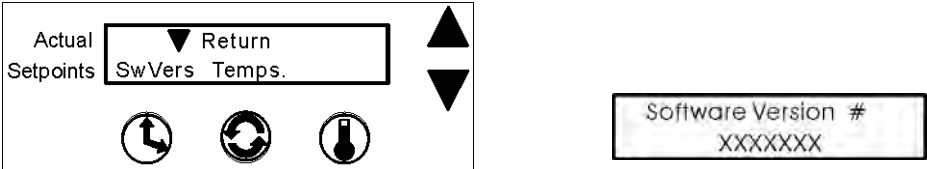
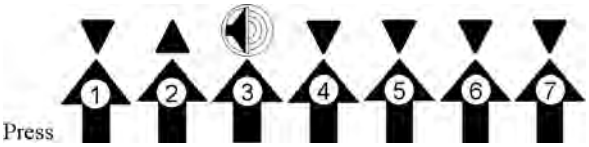
Heat % (continued)

Return to RunHrs Rmte Heat% screen by pressing any of the three buttons beneath the display. If no buttons are pressed, the display automatically returns to the Operating Screen in about fifteen seconds.

Software Version

Software Version is for factory use only and will be important if troubleshooting the microprocessor programming is ever necessary.

To access this screen, press the down arrow, up arrow, Silence button, then the down arrow button four more times. The screen below will appear on the display:



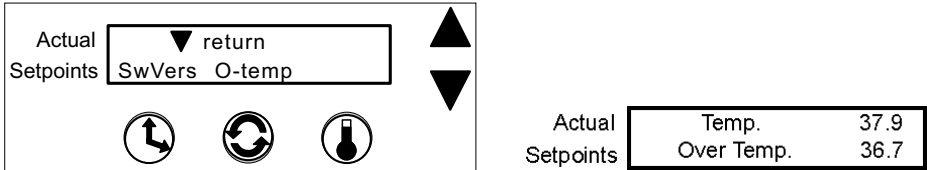
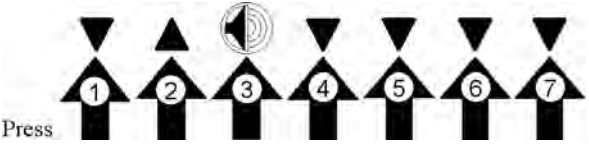
Press the Time button beneath SwVers and the screen at above right will appear, showing the Model 435/436 software version in the control system memory.

To return to the previous screen, press the Time button. To return to the Operating Screen, wait about 15 seconds.

Overtemp Sensor Readings

Overtemp Sensor Readings is for factory use only and will be important if troubleshooting the microprocessor programming is ever necessary.

To access this screen, press the down arrow, up arrow, Silence button, then the down arrow button four more times. The screen shown below will appear on the display.



Press the Speed button beneath Temps. and the following screen will appear, showing the temperatures being measured or read by the Main Temperature and the Overtemperature sensors as shown (above).

To return to the previous screen, press the Time, Speed or Temperature button. To return to the Operating Screen, wait about fifteen seconds.

Section 3 Maintenance

Model 435/436 Orbital Shaker uses a brushless DC motor and oversized, permanently-lubricated bearings that require no maintenance.

Platform and Cabinet

The anodized brushed aluminum platform and powder-coated steel cabinet surfaces can be cleaned with common laboratory materials. However, liquids should not be allowed to enter the shaker cabinet from under the platform. All spills should be cleaned up immediately. If necessary, remove the platform.

Control Panel

The microprocessor control panel has sealed push buttons and a liquid crystal display. It may be cleaned by wiping with laboratory detergents and drying with a soft cloth.

Cleaning or Replacing Air Filter

The air filter (9.5" x 23.6") is located behind the grille on the front of the cabinet. The grille is held in place by six press-in type retainers and is easily removed by grasping it by the edges and pulling it off.

The air filter is held in place by four retaining springs (Figure 3-1) and is easily removed. It may be washed in water with a mild detergent and dried between two lint-free towels.

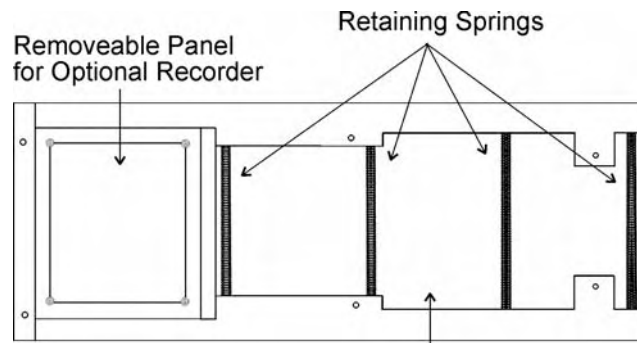
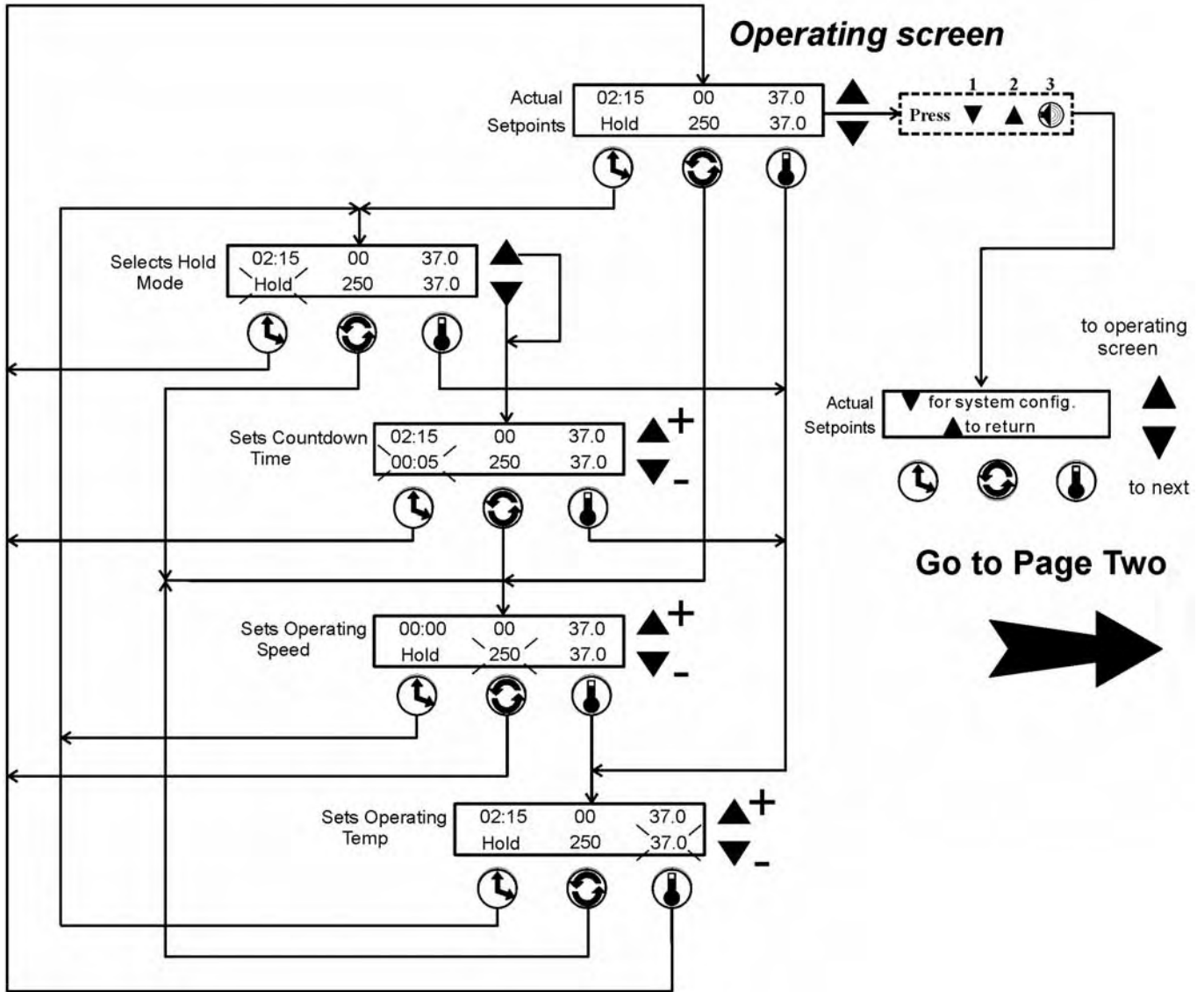


Figure 3-1. Air Filter

Selecting Hold or Countdown Time
 Setting Operating Speed
 Setting Operating Temperature

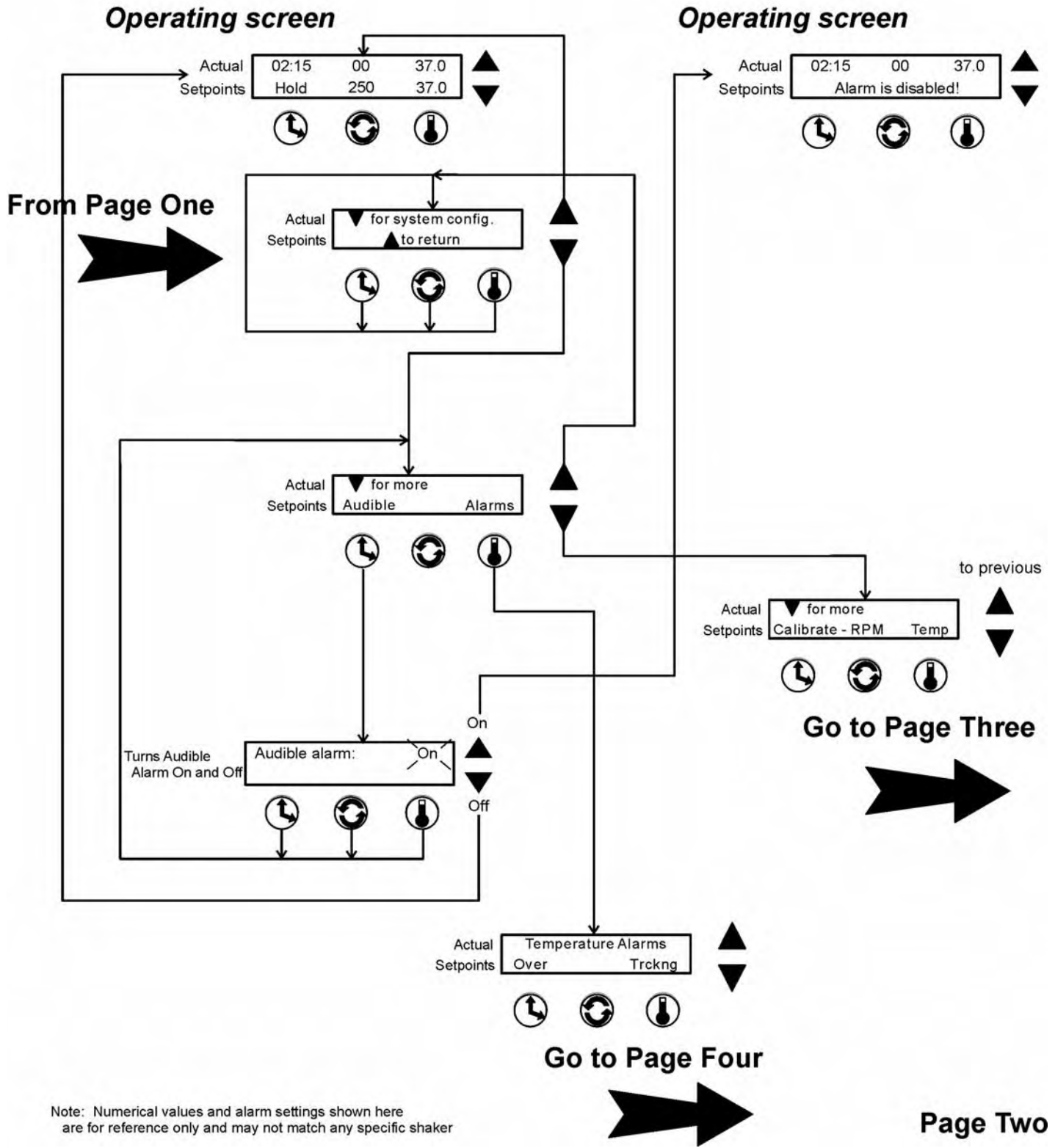
Models 435 and 436 Orbital Shaker Menu Map



Note: Numerical values and alarm settings shown here are for reference only and may not match any specific shaker

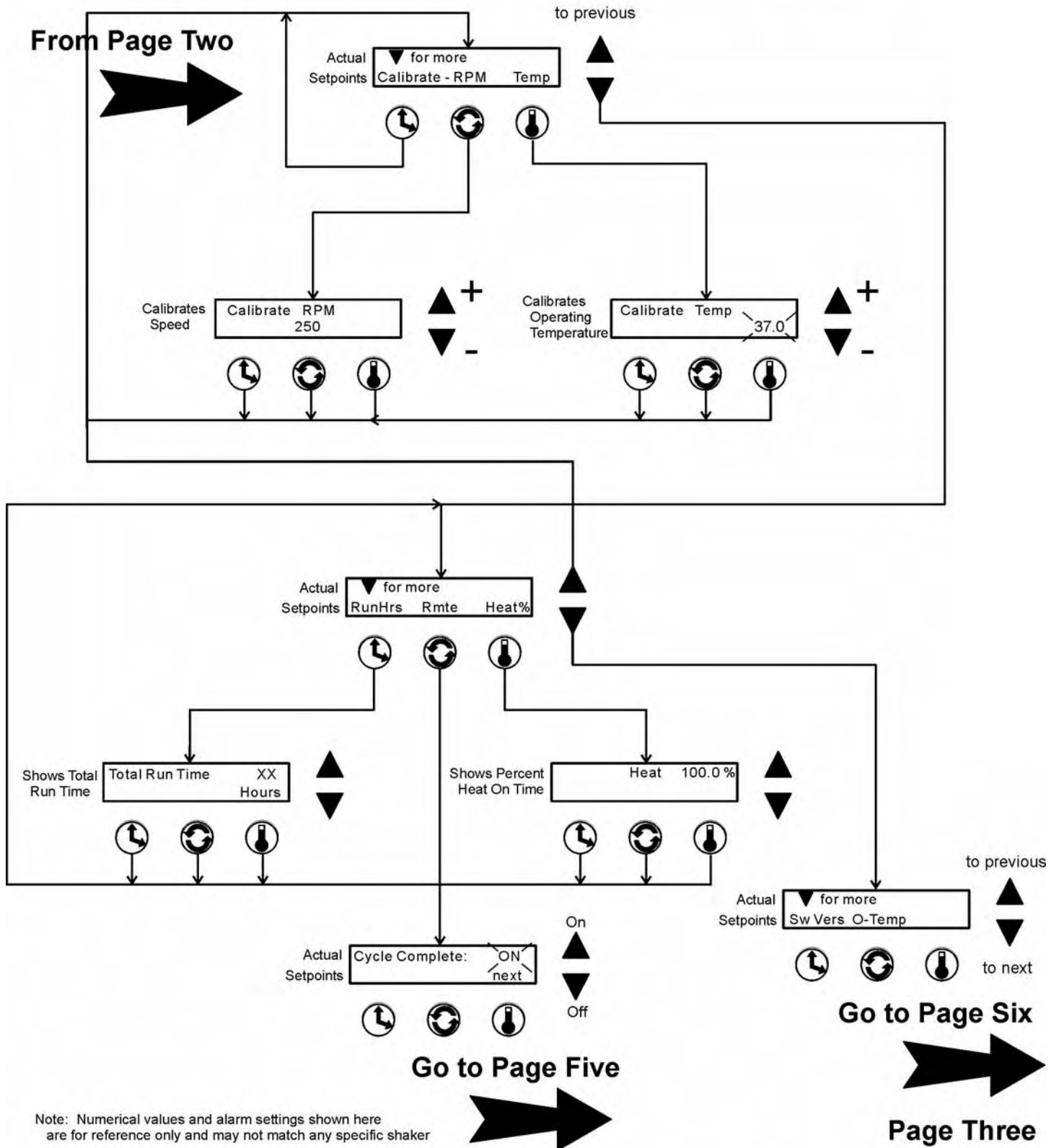
Models 435 and 436 Orbital Shaker Menu Map

Turning the Audible Alarm On and Off



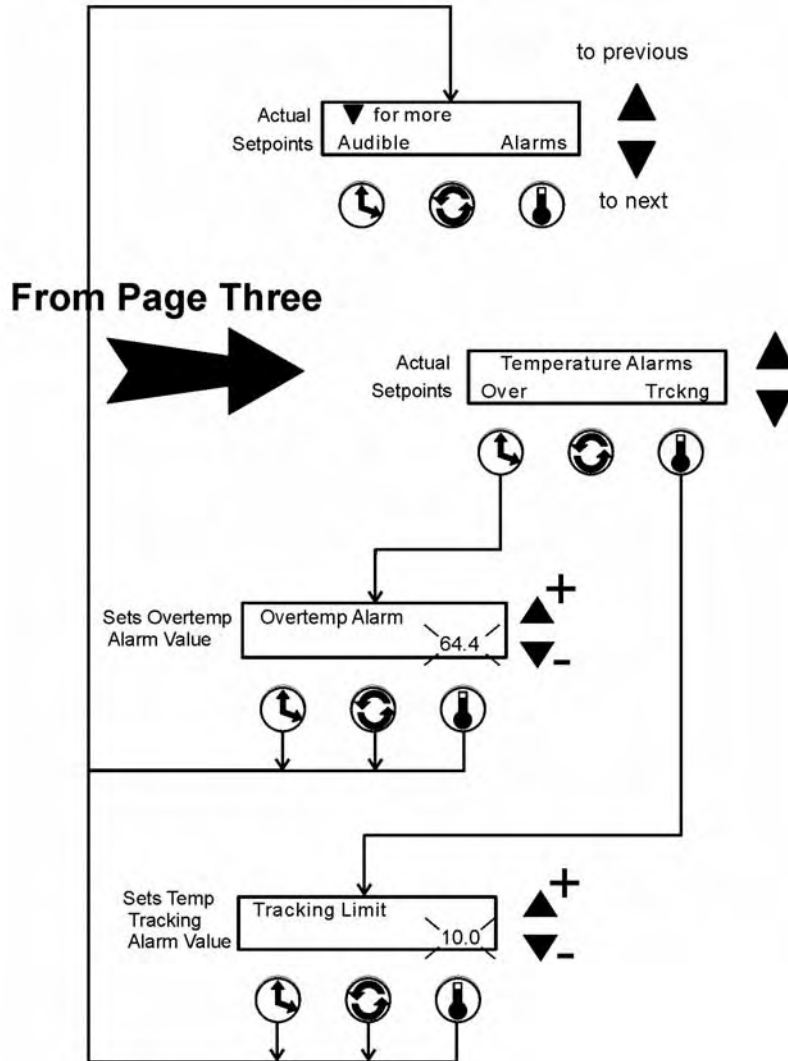
Calibrating Speed
 Calibrating Temperature
 Viewing Total Unit's Running Time
 Viewing Percent Heat

Models 435 and 436 Orbital Shaker Menu Map



Models 435 and 436 Orbital Shaker Menu Map

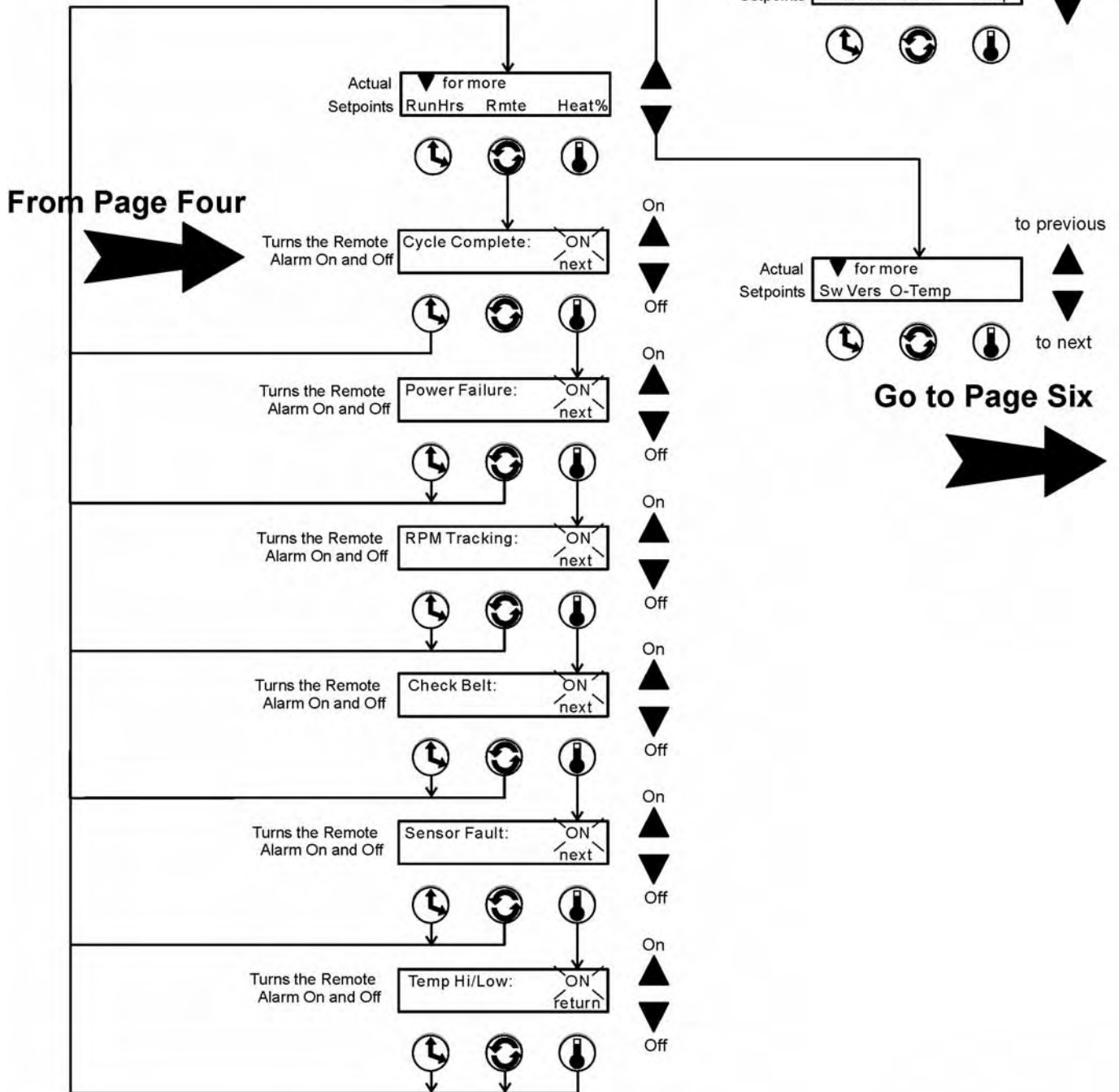
Setting Overtemperature Alarm Value
Setting Temperature Tracking Limit Value



Note: Numerical values and alarm settings shown here are for reference only and may not match any specific shaker

Models 435 and 436 Orbital Shaker Menu Map

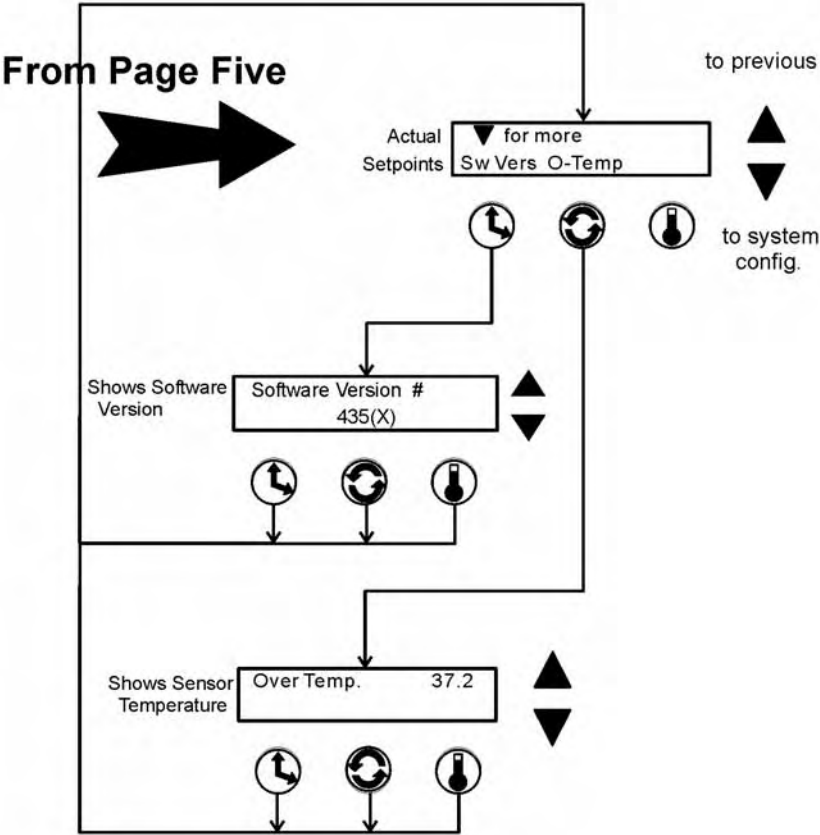
Turning the Individual Remote Alarms
On and Off



Note: Numerical values and alarm settings shown here are for reference only and may not match any specific shaker

Models 435 and 436 Orbital Shaker Menu Map

Viewing Software Version
Viewing Overtemperature Sensor Reading



Note: Numerical values and alarm settings shown here are for reference only and may not match any specific shaker

Alarm Message	Alarm Criteria	Alarm Delay*	Alarm Ringback*	System State	Corrective Action
Over Temp Shutdown	Temperature at the over temp sensor is about 1° over shut down set point	None	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters off	Press SILENCE to silence audible alarm Check for air intake blockage Over temperature probe malfunction Sensor connector unplugged Heater circuit not cycling Main circuit board failure Call Forma's Service Department
Main Temp Sensor	Sensor circuit is open or shorted beyond the expected resistance range in either direction	30 sec.	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters off	Press SILENCE to silence audible alarm Check board connector Check sensor circuit Replace sensor Call Forma's Service Department
Over Temp Sensor	Sensor circuit is open or shorted beyond the expected resistance range in either direction.	30 sec.	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters on	Press SILENCE to silence audible alarm Check board connector Check sensor circuit Replace sensor Call Forma's Service Department
Temperature is High	Temperature is above control set point by temperature tracking limit	None	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters on	Press SILENCE to silence audible alarm Check temperature tracking limit Check sensor circuit Replace main temperature sensor Call Forma's Service Department
Temperature is Low	Temperature is below control set point by temperature tracking limit	30 min.	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters on	Press SILENCE to silence audible alarm Check if lid is completely closed Check temperature tracking limit Check sensor circuit Replace main temperature sensor Call Forma's Service Department
	Electrical power has been disrupted	Upon power up	None	Not affected	Warning notice only Press SILENCE to silence audible alarm

* Alarm Delay and Ringback times are approximate

Alarm Message	Alarm Criteria	Alarm Delay*	Alarm Ringback*	System State	Corrective Action
Cycle Complete	Count-down time has reached zero	None	None	Alarm light on Audible alarm on Blower fans on Shaker motor off Heaters on	Advisory notice only Press SILENCE to silence alarm
RPM High	RPM is above control set point by tracking limit	2 min.	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters on	Press SILENCE to silence audible alarm Check platform loading Check RPM tracking limit setting Shut the unit off and call Forma's Service Department
RPM Low	RPM is below control set point by tracking limit	2 min.	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters on	Press SILENCE to silence audible alarm Check for overloaded platform Check for obstruction to edges of platform Check for low input AC mains voltage. Shut the unit off and call Forma's Service Department
Check Belt	Rotation sensor circuit sees no mechanical rotation or excessive belt slippage	None	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on Heaters on	Press SILENCE to silence audible alarm Shut the unit off and check the belt If alarm persists, call Forma's Service Department
Audible is disabled!	Operator has turned off the audible alarm	None	None	Normal operation	Lower half of the LCD display will show this warning as long as the audible alarm remains turned off
Platform Stalled	Motor tries to start but platform is obstructed	15 sec.	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor on/off/on Heaters on	Press SILENCE to silence audible alarm Check for overloaded platform Check for platform edge obstruction Shut the unit off and check the belt If alarm persists, call Forma's Service Department
Check Fuse Power Failure	Primary drive motor fuse blown	15 sec.	15 min.	Alarm light on Audible alarm on Blower fans on Shaker motor off Heaters on	Press SILENCE to silence audible alarm Check/replace drive motor fuse If alarm persists, call Forma's Service Department

* Alarm Delay and Ringback times are approximate

PREVENTIVE MAINTENANCE

Shakers

Your equipment has been thoroughly tested and calibrated before shipment. Regular preventive maintenance is important to keep your unit functioning properly. The operator should perform routine cleaning and maintenance on a regular basis. For maximum performance and efficiency, it is recommended the unit be checked and calibrated periodically by a qualified service technician.

The following is a condensed list of preventive maintenance requirements. See the specified section of the operating manual for further details.

We have qualified service technicians, using NIST traceable instruments, available in many areas. For more information on Preventive Maintenance or Extended Warranties, please contact us at the number below.

Cleaning and calibration adjustment intervals are dependent upon use, environmental conditions and accuracy required.

Tips for all shakers:

- Use only our standard flat-head screws for flask clips.
- Use only our standard round-head screws for test tube racks, holders and utility trays.

Preventive Maintenance for 435 Series Shakers

Refer to Manual Section	Action	Daily	Monthly	Yearly
--	Clean the unit with mild detergent and wipe dry as needed		✓	
--	Clean the window with a mild detergent and wipe dry		✓	
--	Check under the platform for broken glass or other debris.		✓	
4	Inspect air filter. Clean as needed		✓	
3	* Check and document calibration of temperature, alarms, speed and time, as applicable			✓
--	* Verify operation of circulation fan motor			✓
5	Change the HEPA filter, as needed			✓

* Qualified service technicians only

Section 4 Service

Caution The procedures outlined in this section must be performed by persons experienced in servicing and maintaining laboratory equipment. Lockout and tagout electrical power connections whenever removing cabinet panels or working on electrical or motor control components. To avoid damage to solid state electrical components, proper grounding techniques must be observed whenever working on this shaker. ▲

With the exception of the HEPA filter, the Model 435/436 Orbital Shaker contains no user-serviceable components. The following table lists display messages which may help diagnose abnormal conditions.

Alarms and Alarm Conditions

If the microprocessor control system senses a fault, malfunction or abnormal operating condition, alarm messages appear on the display. These messages will be helpful should service or repair assistance be necessary.

Table 4-1. Alarm Indications

Alarm Message	Fault Condition
Overtemp Shutdown	System shutdown due to overtemperature condition
Main Temp Sensor	Temperature sensor has failed
Over Temp Sensor	Temperature sensor has failed
Temperature is High	Temperature tracking has sensed higher temperature than setting
Temperature is Low	Temperature tracking has sensed lower temperature than setting
Power Failure	Power has failed during shaker operation
Cycle Complete	Countdown to zero time has been reached. Unit stops.
Check Belt	Motor V-belt has broken or slipped
Audible is Disabled!	Continuously notifies operator that audible alarm has been disabled
Platform Stalled	Free movement of the platform has been obstructed
Check Fuse	Primary drive motor fuse has blown

Change HEPA Filter

The HEPA filter is located on the left side of the chamber and is accessed by pulling up the four black press-in fasteners and sliding the cover off. Refer to Figure 4-1.

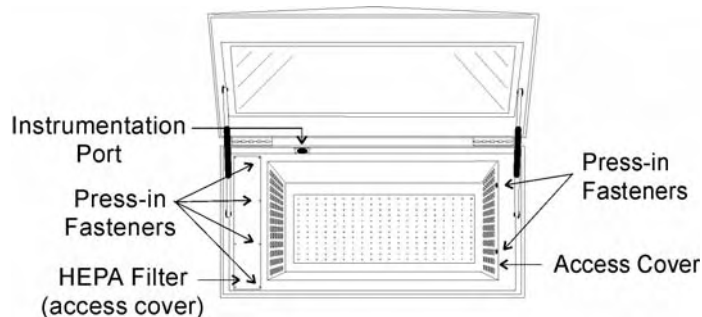


Figure 4-1. HEPA Filter Location

If the Shaker Will Not Operate

If the shaker platform won't operate with the unit plugged in and the power switch turned on, the following conditions may be present:

- The lid is open - lower the lid to the closed position.
- Time countdown has been reached - reset the time.

Spare Fuses

Three spare fuses are provided with this shaker and are taped to the underside of the control panel plastic frame. The plastic frame is attached to the cabinet by Velcro strips. Grasp the frame by the corners and pull to remove. There are also small indents located along the edges of the panel to accommodate a flat screwdriver blade. Figure 4-2 illustrates the underside of the frame.



Figure 4-2. Spare Fuse Location

Spare Fuses (continued)

Three fuse holders are located on the left side of the relay tray located in the lower part of the console cabinet. Figure 4-3 shows the location of the fuses. A list of their electrical ratings, part numbers, and applications follow.

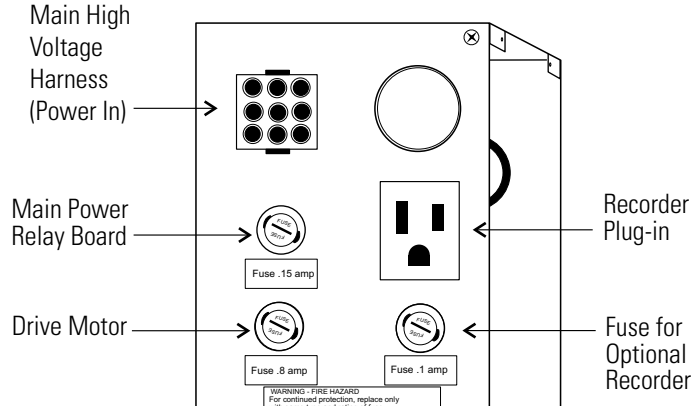


Figure 4-3. Fuse Holders and Connector Locations

Access to the relay tray is made by removing the grille from the front of the cabinet. It is held in place by six press-in type retainers and is easily removed by grasping the edges of the grille and pulling it off.

To remove the panel beneath the grille, remove six Phillips screws; three on the bottom of the panel and three on the top. The two Phillips screws on the left side of the foot pedal will need to be loosened to allow the panel to slide outward. The fuses are:

Model 435

- 0.25 amp (P/N 230144) - Main power relay board
- 1.6 amp (P/N 230145) - Drive motor
- 0.1 amp (P/N 230107) - Optional recorder

Model 436

- 0.15 amp (P/N 230142) - Main power relay board
- 0.8 amp (P/N 230141) - Drive motor
- 0.1 amp (P/N 230107) - Optional recorder

Caution Do not substitute! Replace these fuses with fuses of identical electrical ratings only. ▲

Circuit Boards

Warning Only qualified service personnel should perform this procedure. ▲

Five circuit boards control the Orbital Console Shaker. Four boards are located in the relay tray compartment, the fifth is behind the LCD display. Figure 4-4 identifies the circuit boards and other major components in the relay tray.

To access the panel, unplug the shaker and move it to a sturdy location that will allow the back of the cabinet to swing down and lie flat. Remove the screws indicated by the arrows in Figure 4-2 and lower the back panel.

Components in the electronics panel are identified in Figure 4-4. Refer to the parts list and the electrical schematics in the back of this manual for part numbers.

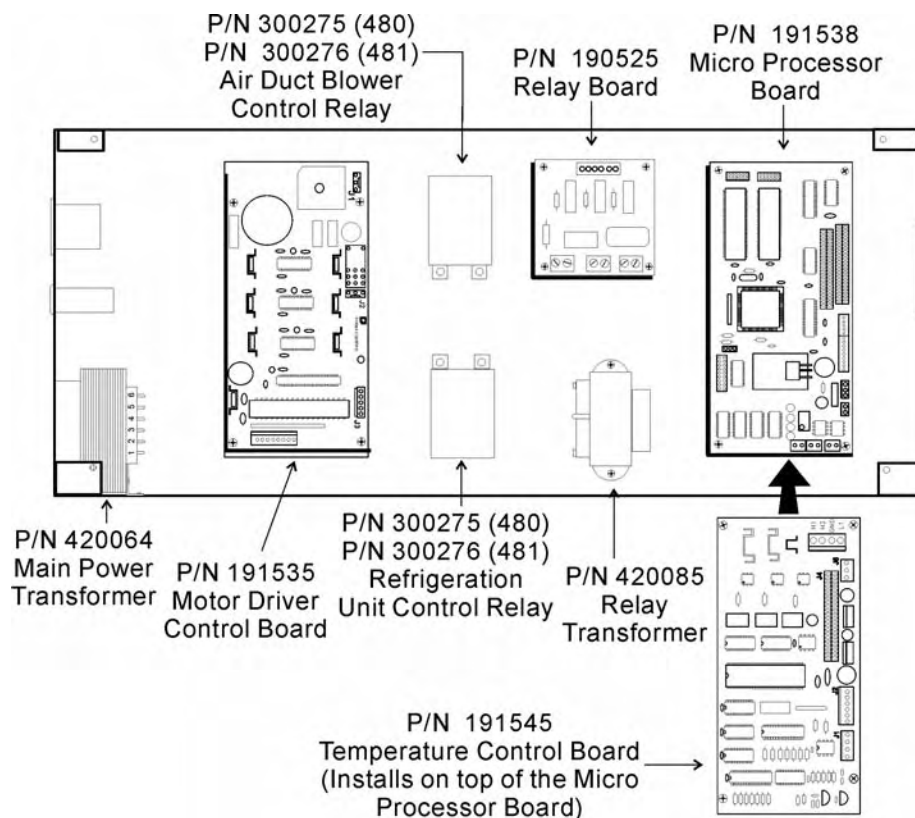


Figure 4-4. Circuit Board Locations

Temperature Sensors

Two temperature sensors are located behind a perforated cover plate on the right side of the chamber. Refer to Figure 4-5. To access these sensors, pull outward on the two black press-in fasteners on the top edge of the cover and lift the cover upward. The cover is held in place with four metal clips.

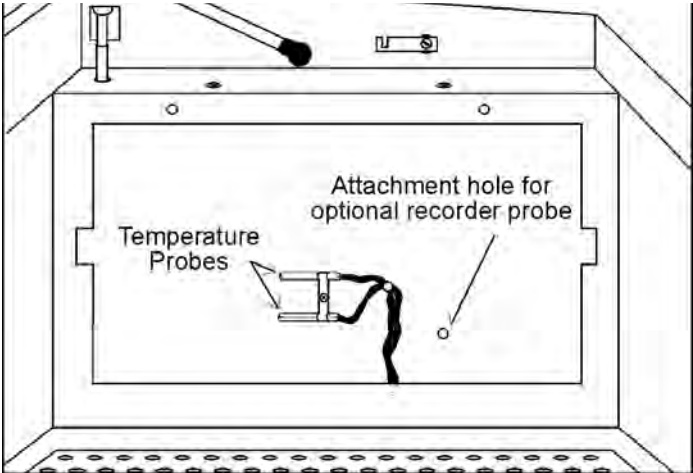


Figure 4-5. Chamber Right Side with Perforated Cover Plate Removed

To replace the cover, make sure all four clips engage the metal edges of the chamber and the two fasteners are firmly seated in their holes. Press the top of the fastener in until a “click” is heard. See Figure 4-6.

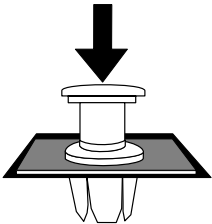


Figure 4-6. Fastener

Blower Fan Motors and Heating Elements

Locations of the Blower Motor and Ambient Fan Motor are shown in Figure 4-7. Removal of the relay tray is necessary to service the Blower Motor or the Heating Elements. Access to the heaters is through an access port on the front of the air plenum.

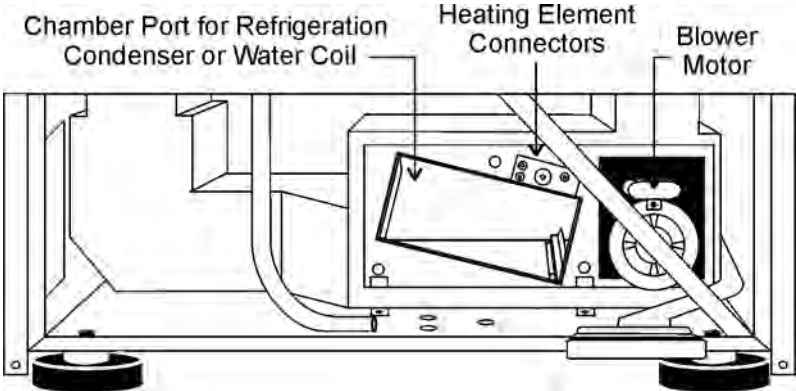


Figure 4-7. Air Plenum with Heating and Air Moving Components

Heater Element Circuit Breaker

Warning Only qualified service personnel should perform this procedure. ▲

A manual reset circuit breaker is located between the heating element electrical connectors on the side of the air plenum. (Figures 4-7 and 4-8) The breaker can be reset by removing the front grille and reaching over the relay tray.

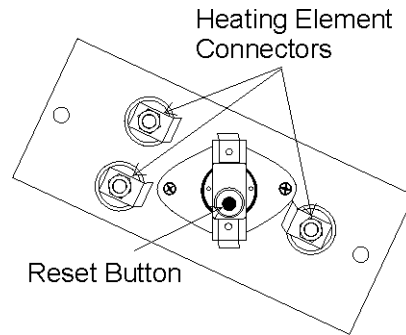


Figure 4-8. Connectors and Reset

Caution Remove and lock-out electrical power when working on or near the relay control tray and heating element connectors. Allow sufficient time for the heating elements to cool before reaching into that area. ▲

Tune the Cabinet

After the console cabinet is in place and leveled, with the platform installed, turn the unit on and set the RPM to 300. Kneeling in front of the console, lightly touch the lower left and right corners of the cabinet. If one side seems to vibrate more than the other, raise or lower the corner support leg using a 3/4" open end wrench. Continue this "fine tuning" until the vibrations are lessened as much as possible.

Service the Drive Belt

After removing the grille, the motor drive pulley, large mechanism pulley, belt and motor mounting bolts are visible (Figure 4-9).

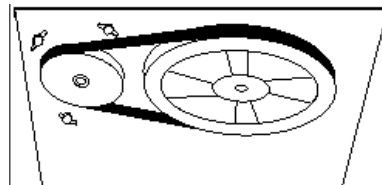


Figure 4-9. Drive Belt

Loosening the three 7/16" bolts at the base of the drive motor allows the belt to be changed or tension applied to the belt. Tighten the three bolts and torque to 10 ft. lbs.

Service the Drive Belt (continued)

To remove the pulleys from their shafts, use a 1/8" Allen wrench to remove two set screws from the belt groove of the larger pulley; use a 5/16" Allen wrench to remove the single set screw from the belt groove of the smaller pulley.

When replacing the pulleys, seat the larger pulley completely against its baseplate. The smaller pulley, however, is installed with 0.300" space between it and the baseplate.

Section 5 Specifications

Shaking

Range	.....25-525 RPM
Accuracy	.....±1 RPM
Motion	.....One inch/orbital
Indicator	.....LCD in 1 RPM increments

Temperature

Range	.....5°C above ambient to 60°C (140°F)
Control	.....±0.1°C
Uniformity	.....±0.2°C (in flask)
Indicator	.....LCD, in 0.1°C increments

Timer

Periods	.. Programmable from 5 minutes to 200 hours, or continuous operation
Indicator	.....LCD in 5 minute increments
Run Time	.. Display counts down for a timed run or counts up in a “hold” function

Alarms

Temperature	.. Adjustable tracking high/low temp
RPM	.....Adjustable tracking high/low RPM
Time	.....Run complete
Power	.... Fail Message displayed on LCD screen

Safety

Temperature	.....Independent over temperature
RPM	.....Independent platform motion

LCD Display

Run Time, RPM, Temperature, User Program, Alarm Conditions and Power Failure indicated by messages

Drive

Triple counterbalanced. Handles unbalanced platform loads regardless of flask placement

Drive Motor

1/3 HP brushless DC, permanently-lubricated ball bearing

Lid

Counterbalanced, hand or foot operated, with tempered thermal pane window and key lock.

Automatic Restart

Microprocessor retains all programming in non-volatile memory. In the event a power outage, the shaker restarts automatically.

Construction

InteriorStainless steel with coved corners

ExteriorCold rolled steel

Finish Powder coated for a durable, easily maintained surface

PlatformAnodized brushed aluminum

Dimensions

Exterior45.0" W x 39.0" H x 30.0" F-B
.(114.3cm x 99.1cm x 76.2cm)

Exterior45.0" W x 39.0" H x 30.5" F-B
(lid open)(114.3cm x 99.1cm x 77.5cm)

Interior34.3" W x 18.8" H x 21.1" F-B
.(87.1cm x 47.8cm x 53.6cm)

Electrical

435

Nominal: 120 VAC, 60Hz, 1 PH, 8.6 FLA

Operating Range: 108-125 VAC

436

Nominal: 230 VAC, 50/60 Hz, 1 PH, 3.5 FLA

Operating Range: 207-253 VAC

Data OutputRS-232 standard

Remote Alarm Contacts . . Time, RPM, Temperature and Loss of Power Alarms

Certification

UL Standard No. 61010A-1 (Model 435)

CSA Standard C22.2 No. 1010.1 (Model 435)

CSA Standard C22.2 No. 1010.1 (Model 436)

CE Mark - Electromagnetic and Low Voltage Directives

Ambient Operating Conditions - for indoor use

Temperature 18°C (64°F) to 40°C (104°F)

Humidity 80% RH at or below 31°C, decreasing linearly to 50% RH at 40°C

Sound Level

Not to exceed 85db

Safety Specifications

Altitude 2,000 meters

Temperature 5°C to 40°C

Humidity . . 80% RH at or below 31°C, decreasing linearly to 50% RH at 40°C

Mains Supply Fluctuations . . Operating Voltage Range

Installation Category II ¹

Pollution Degree 2 ²

Class of Equipment I

Capacity

Flasks From (91) 25ml up to (4) 6L

Weights

Net 518 lbs. (235.2kg)

Optional Platforms

Size 29.5" x 18" (74.9cm x 45.7cm)

Clips 25ml, 50ml, 125ml, 250/300ml, 500ml

1L, 2L, 4L, 6L and 2800ml Fernbach sizes available

Racks . . Adjustable angle test tube holder with rack, 13-30mm

Filter

HEPA: Rated efficient at 0.3 microns

Size: 18" x 16" x 2" (45.7cm x 40.6cm x 5.1cm)

1 Installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II which is the category used for instruments in installations supplied from a supply comparable to public mains such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 2500V for a 230V supply and 1500V for a 120V supply.

2 Pollution Degree describes the amount of conductive pollution present in the operating environment. Pollution Degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

Section 6 Parts List

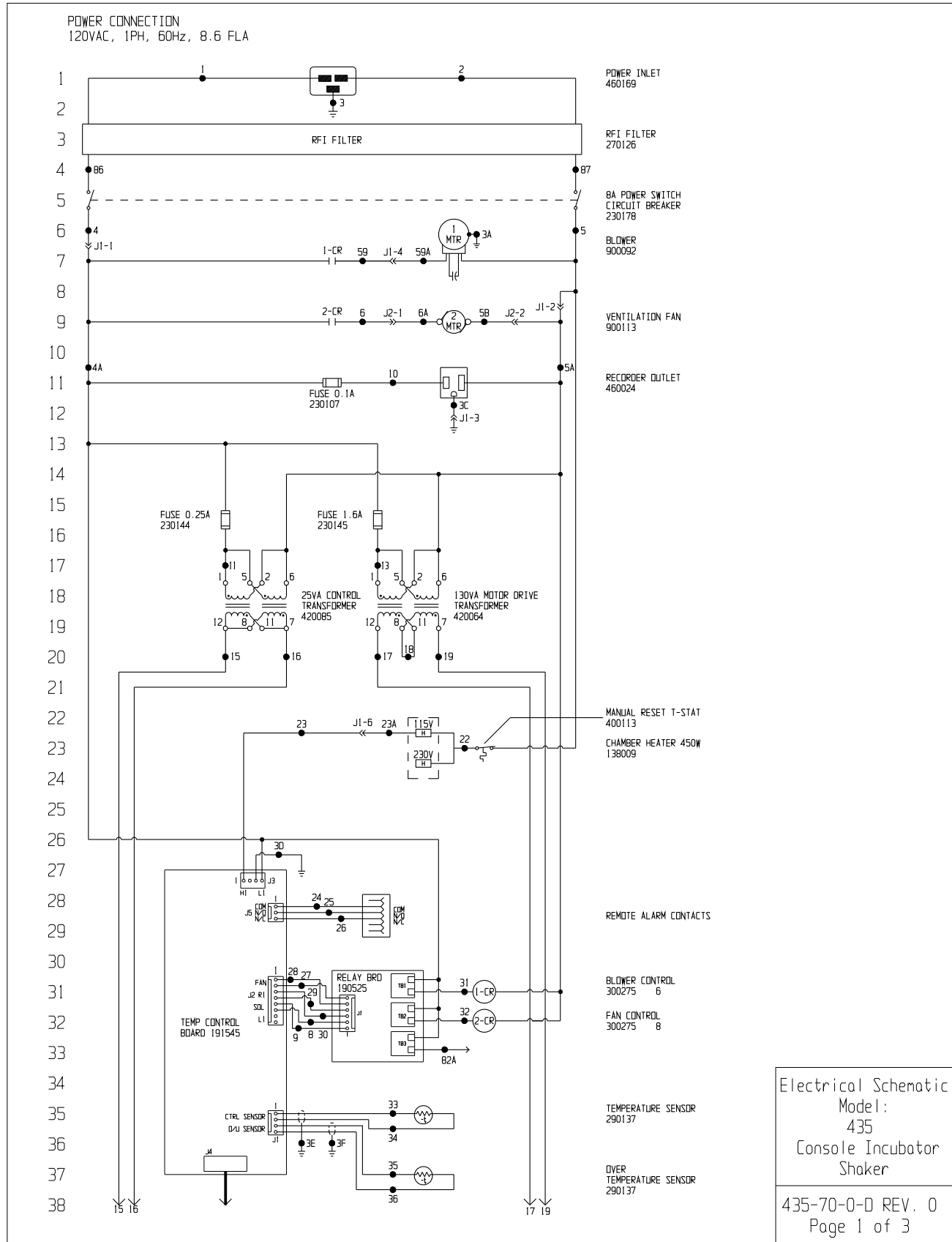
**Refer to Section 4 for electrical fuse information.*

Model 435

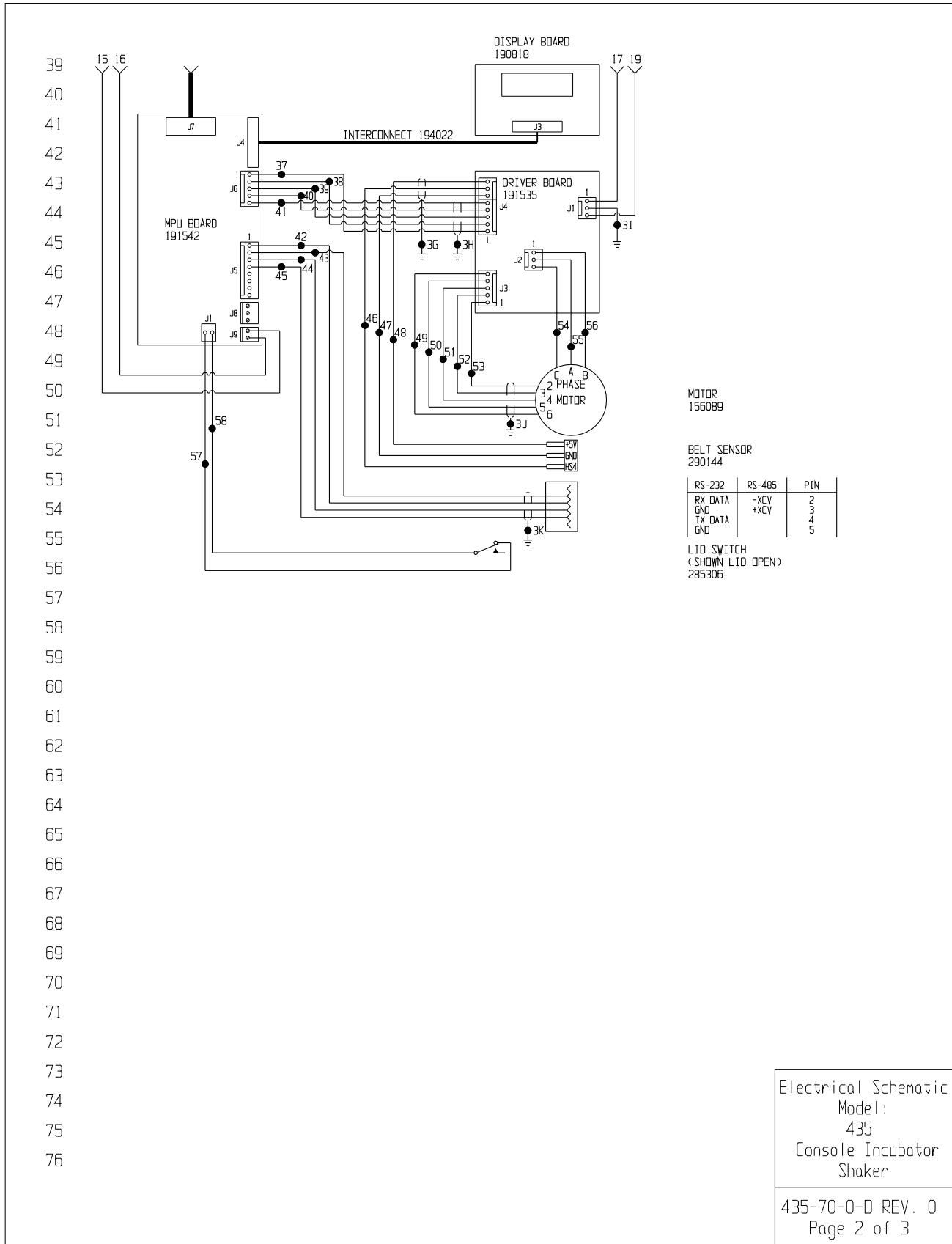
Part No	Description
129024	Pneumatic Spring, 80 lbs.
138009	Heater, Wirewound 450W 115V/230V
156089	Motor, Brushless 24V
191535	Motor Drive Board
191545	Temp Control Board
190562	LCD Display Panel
190525	Relay Board
191542	Micro Board
290137	Probe, 2252 Ohm/25°C, 1/8 x 2 (2)
300275	DPDTRelay 120V
400113	Thermostat
420064	Transformer, 130VA
420085	Transformer, 25VA
800040	V-Belt, A x 43 1/2" x 45"
435051	Screwdriver, Phillips 8-3/4"
443020	Wrench, 5/32" Hex with T-handle
194046	Spare Part Screw Bag, (for platform and clips)
900113	Tubeaxial Fan, 560 CFM 115V
900092	.230 CFM Blower 115V
760164	HEPAFilter
760167	Air Filter 9.5" x 23.625"

Model 436

Part No	Description
129024	Pneumatic Spring, 80 lbs.
138009	Heater, Wirewound 450W 115V/230V
156089	Motor, Brushless 24V
191535	Motor Drive Board
190525	Relay Board
191545	Temp Control Board
190562	LCD Display Panel
191542	Micro Board
290137	Probe, 2252 Ohm/25°C, 1/8 x 2 (2)
300276	DPDT Relay 240V
400113	Thermostat
420064	Transformer, 130VA
420085	Transformer, 25VA
800040	V-Belt, A x 43 1/2" x 45"
435051	Screwdriver, Phillips 8-3/4"
443020	Wrench, 5/32" Hex with T-handle
194046	Spare Part Screw Bag, (for platform and clips)
900111	Tubeaxial Fan, 560 CFM 220V
900093	.230 CFM Blower 220V
760164	HEPA Filter
760167	Air Filter 9.5" x 23.625"



Section 7
Electrical Schematics



Electrical Schematic
Model:
435
Console Incubator
Shaker

435-70-0-D REV. 0
Page 2 of 3

77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR	WIRE #	GAUGE	COLOR
1	14	BROWN	32	18	BROWN
2	14	BLUE	33	24	RED
3	14	GREEN	34	24	BLACK
3A-3D	18	GRN/YEL	35	24	RED
3E-3K		SHIELDS	36	24	BLACK
4	14	BLACK	37	24	BLACK
4A	14	BLACK	38	24	RED
5	14	WHITE	39	24	GREEN
5A	14	WHITE	40	24	WHITE
5B	14	WHITE	41	24	BROWN
6	14	BROWN	42	24	BLACK
6A	14	BROWN	43	24	RED
8	24	BLACK	44	24	GREEN
9	24	PURPLE	45	24	WHITE
10	18	BROWN	46	24	GREEN
11	18	RED	47	24	BLACK
13	18	YELLOW	48	24	RED
15	18	BROWN	49	24	BLACK
16	18	BLUE	50	24	RED
17	18	RED	51	24	GREEN
18	18	ORANGE	52	24	WHITE
19	18	RED	53	24	BROWN
22	18	YELLOW	54	18	RED
23	18	BROWN	55	18	WHITE
23A	18	BROWN	56	18	BLACK
24	24	GREEN	57	24	BLACK
25	24	RED	58	24	BLACK
26	24	BLACK	59	18	BROWN
27	24	BLACK	59A	18	BROWN
28	24	RED	82A	18	PURPLE
29	24	BLACK	86	14	BROWN
30	24	ORANGE	87	14	BLUE
31	18	YELLOW			

0	05-279	02-11-04	BOB	pdk	CCS	RELEASED FOR PRODUCTION
REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION

Electrical Schematic
Model:
435
Console Incubator
Shaker



ATTENTION
OBSERVE PRECAUTIONS
ELECTROSTATIC
SENSITIVE DEVICES

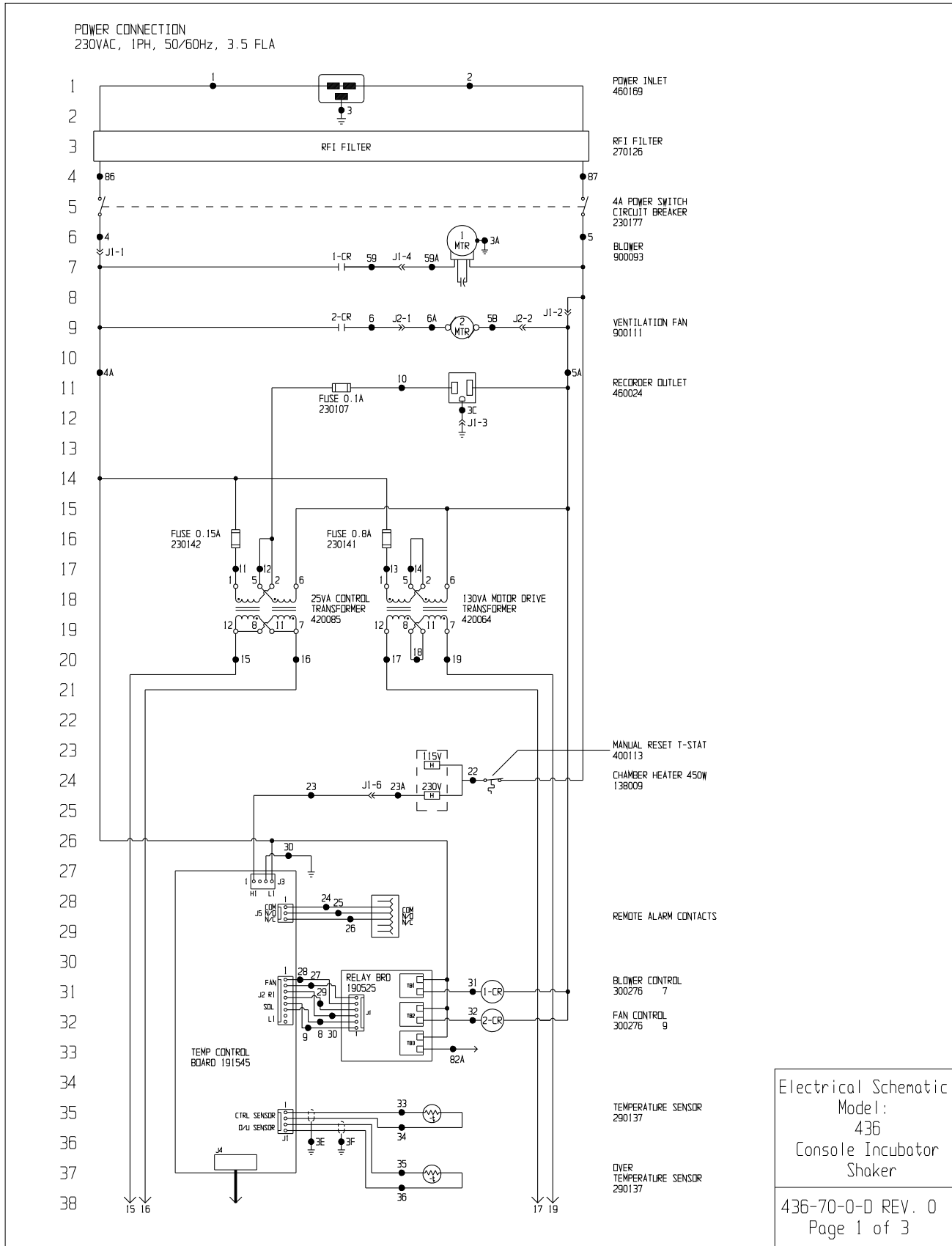
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM THERMO ELECTRON

Thermo
ELECTRON CORPORATION
Controlled Environment Equipment
Box 649, Morristown, Oh 45750

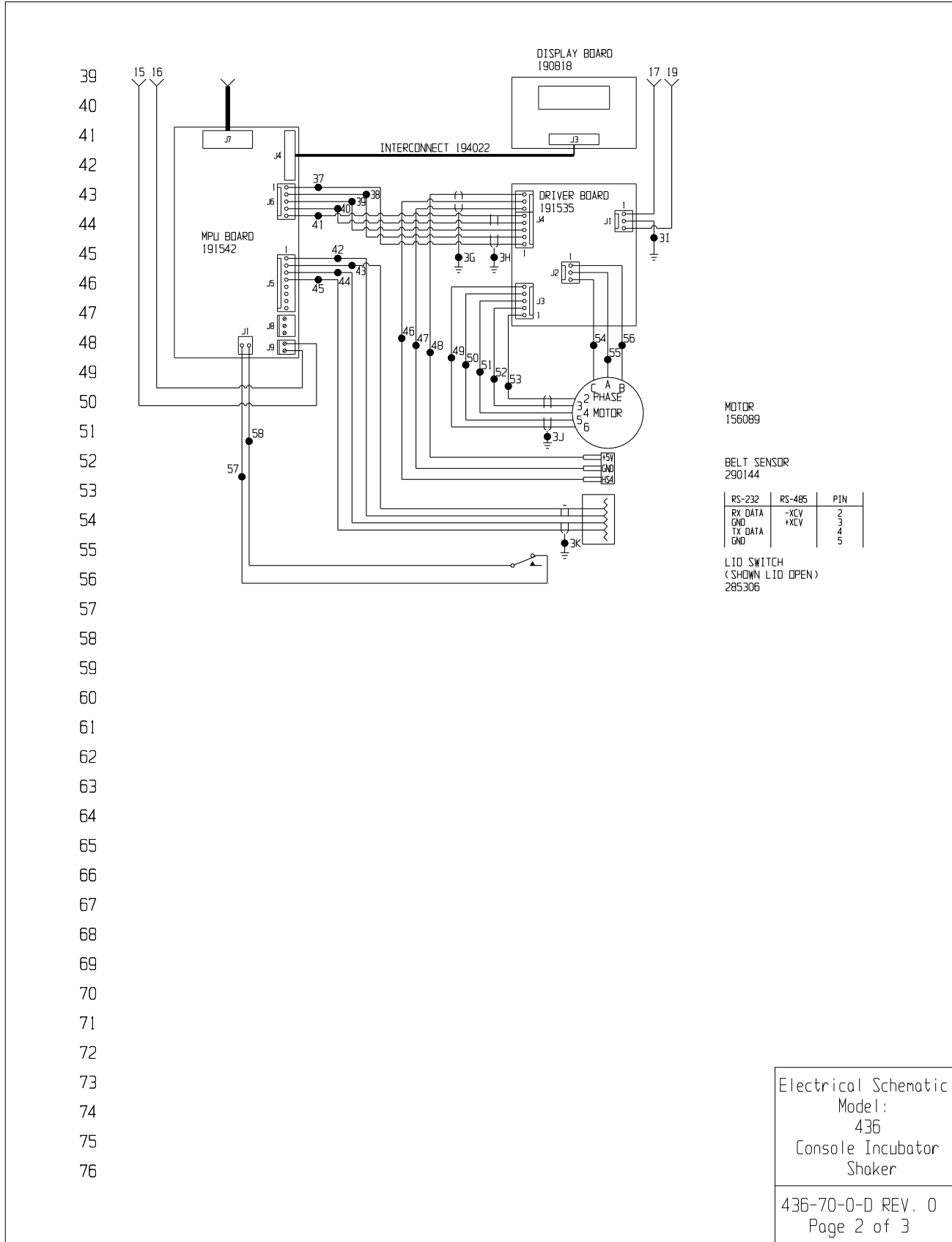
MODEL/PART NAME: 435 CONSOLE INCUBATOR SHAKER						
DWG TITLE: ELECTRICAL SCHEMATIC						
DWN:	pdk	CAD:	pdk	APPD:	DATE: 02-11-04	SCALE: NONE
MATERIAL: N/A						
PAINT COLOR: N/A						
TOLERANCE UNLESS OTHERWISE SPECIFIED				DRAWING NUMBER	SIZE	
ANGLES: .XX±				435-70-0	D	
DECIMAL: .XXX±						

435-70-0-D REV. 0
Page 3 of 3

Section 7
Electrical Schematics



Electrical Schematic
Model:
436
Console Incubator
Shaker
436-70-0-D REV. 0
Page 1 of 3



77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107

WIRE REFERENCE CHART

WIRE #	GAUGE	COLOR	WIRE #	GAUGE	COLOR
1	14	BROWN	31	18	YELLOW
2	14	BLUE	32	18	BROWN
3	14	GRN/YEL	33	24	RED
3A-3D	18	GRN/YEL	34	24	BLACK
3E-3K		SHIELDS	35	24	RED
4	14	BLACK	36	24	BLACK
4A	14	BLACK	37	24	BLACK
5	14	WHITE	38	24	RED
5A	14	WHITE	39	24	GREEN
5B	14	WHITE	40	24	WHITE
6	14	BROWN	41	24	BROWN
6A	14	BROWN	42	24	BLACK
8	24	BLACK	43	24	RED
9	24	PURPLE	44	24	GREEN
10	18	BROWN	45	24	WHITE
11	18	RED	46	24	GREEN
12	18	ORANGE	47	24	BLACK
13	18	YELLOW	48	24	RED
14	18	BROWN	49	24	BLACK
15	18	BROWN	50	24	RED
16	18	BLUE	51	24	GREEN
17	18	RED	52	24	WHITE
18	18	ORANGE	53	24	BROWN
19	18	RED	54	18	RED
22	18	YELLOW	55	18	WHITE
23	18	BROWN	56	18	BLACK
23A	18	BROWN	57	24	BLACK
24	24	GREEN	58	24	BLACK
25	24	RED	59	18	BROWN
26	24	BLACK	59A	18	BROWN
27	24	BLACK	82A	18	PURPLE
28	24	RED	86	14	BROWN
29	24	BLACK	87	14	BLUE
30	24	ORANGE			

0	DS-279	02-11-04	BOB	pdk	CCS	RELEASED FOR PRODUCTION
REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION

Electrical Schematic
Model:
436
Console Incubator
Shaker



ATTENTION
OBSERVE PRECAUTIONS
ELECTROSTATIC
SENSITIVE DEVICES

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM THERMO ELECTRON

Thermo
ELECTRON CORPORATION
Controlled Environment Equipment
Box 649, Marietta, Oh 45750

MODEL/PART NAME: 436 CONSOLE INCUBATOR SHAKER						
DWG TITLE: ELECTRICAL SCHEMATIC						
DWN:	pdk	CAD:	pdk	APPD:	DATE:	02-11-04
MATERIAL:				SCALE: NONE		
PAINT COLOR: N/A						
TOLERANCE UNLESS OTHERWISE SPECIFIED			DRAWING NUMBER		SIZE	
ANGLES: DECIMAL: .XX±			436-70-0		D	
DECIMAL: .XXX±						

436-70-0-D REV. 0
Page 3 of 3

THERMO FISHER SCIENTIFIC ORBITAL SHAKER WARRANTY USA

The Warranty Period starts two weeks from the date your equipment is shipped from our facility. This allows shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the warranty period.

During the first two years or 12,000 hours of use, whichever comes later, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor included. In addition, after the initial warranty period of two years or 12,000 hours, the Orbital Shaker mechanism is warranted for Unit Production Life, parts only, F.O.B. factory. The mechanism is defined as the bearing assemblies. Unit Production Life is defined as the period of time the current mechanism design is in production, plus seven years. The warranty will be void if the equipment is altered without written authorization from Thermo. The 12,000 hours use must be validated by the internal timer and/or objective documentation. If validation or documentation of run hours are not available, unit warranty defaults to 3 years, parts and labor. Installation and calibration is not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, i.e., glass, filters, light bulbs and lid gas-kets are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not exceed the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, OR IMPLIED. NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

Your local Thermo Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation, and preventive maintenance.

If equipment service is required, please call your Technical Services Department at 1-888-213-1790 (USA and Canada) or 1-740-373-4763. We're ready to answer any questions on equipment warranty, operation, maintenance, service and special applications. Outside the USA, contact your local distributor for warranty information.



Rev. 2 2/07

THERMO FISHER SCIENTIFIC INTERNATIONAL ORBITAL SHAKER WARRANTY

The Warranty Period starts two months from the date your equipment is shipped from our facility. This allows shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the warranty period.

During the first two years or 12,000 hours of use, whichever comes later, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, excluding labor. The orbital shaker mechanism is warranted for life, parts only, F.O.B. factory. The mechanism is defined as the bearing assemblies. Life is defined as the period of time the current mechanism design is in production, plus seven years. The warranty will be void if the equipment is altered without the written authorization from Thermo. The 12,000 hour use must be validated by the internal timer and/or objective documentation. If validation or documentation of run hours are not available, unit warranty defaults to 3 years, parts only. Installation and calibration is not covered by this warranty agreement. Expendable items, i.e., glass, filters, light bulbs and lid gaskets are excluded from this warranty.

Replacement or repair of component parts or equipment under this warranty shall not exceed the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, OR IMPLIED. NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. Thermo shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

Thermo International Sales Office is ready to help with comprehensive site preparation information before your equipment arrives. Printed instruction manuals carefully detail equipment installation, operation, and preventative maintenance.

If equipment service is required, please call your Technical Services Department at 740-373-4763, or Fax 740-373-4189. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special applications. Outside the USA, contact your local distributor for warranty information.



Rev. 2 2/07

Declaration of Conformity

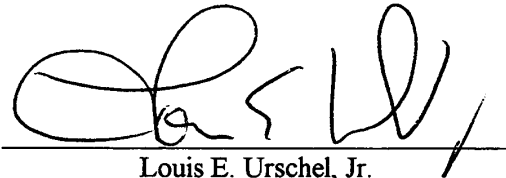
Manufacturer's Name: Thermo Forma, Inc.
Manufacturer's Address: Millcreek Road
Marietta, Ohio 45750
U.S.A.
Product Description: Orbital Shaker
Product Designations: 436
Year of Initial Marking (CE): 1998
Affected Serial Numbers: Release Level 6
Release Level (REL#) shown on Serial Tag

This product conforms to the following European Union Directive(s):

EMC: 89/336/EEC
LVD: 73/23/EEC

This product conforms to the following Harmonized, International and National Standards:

EMC:	LVD:
EN 61326-1:1997	EN 61010-1:1993
EN 50081-1:92	IEC 1010-1 Amendment 2
EN 50082-1:97	CSA C22.2 No. 1010.1-92



Louis E. Urschel, Jr.
V. P. of Quality & Service

Thermo Forma

20 September 2001

Rev. 1

Thermo Scientific
Controlled Environment Equipment
401 Millcreek Road
Marietta, Ohio 45750
United States

www.thermofisher.com