

# **Thermo** Forma

**Model:**

**Table Top Orbital Shaker\***

**Operating and Maintenance Manual**

**Manual No: 7014518 Rev. 0**

*\* Triple counter-balanced, single eccentric drive mechanism (U.S. Patent #5,558,437)*

**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.




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***CAUTION! All internal adjustments and maintenance must be performed by qualified service personnel.***

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**Refer to the serial tag on the back of this manual.**




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***The Model 4518 must be used to process non-flammable materials only!***

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

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**MANUAL NO. 7014518**

--	--	12/29/98	Removed P/N 300311 from Section 1.1, per A. Campbell	deg
-	17428 / OS-154	6/22/98	Added warning on ground to recorder outlet	heg
-	OS-136	7/31/97	Added pkg Sealview to packing list	heg
-	IN-2212	1/24/97	Patent notation added to cover	heg
0	IN-2212	12/19/96	Added RJ-11 connector information	heg
-	-	1/24/97	Patent notation on cover	deg
<b>REV</b>	<b>ECN</b>	<b>DATE</b>	<b>DESCRIPTION</b>	<b>By</b>



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

**Ce symbole attire l'attention de l'utilisateur sur des instructions importantes de fonctionnement et/ou d'entretien. Il peut être utilisé seul ou avec d'autres symboles de sécurité. Lire attentivement le texte d'accompagnement.**

**Wichtige Betriebs- und/oder Wartungshinweise. Lesen Sie den nachfolgenden Text sorgfältig.**

**Importante instrucciones de operacion y/o mantenimiento. Lea el texto acompanante cuidadosamente.**



---

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

**Ce symbole attire l'attention de l'utilisateur sur des risques électriques potentiels. Seules des personnes qualifiées doivent appliquer les instructions et les procédures associées à ce symbole.**

**Gefahr von Stromschlägen. Nur qualifizierte Personen sollten die Tätigkeiten ausführen, die mit diesem Symbol bezeichnet sind.**

**Potencial de riesgos electricos. Solo personas das capacitadas deben ejecutar los procedimientos asociadas con este simbolo.**



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

**Risques potentiels liés à l'énergie. L'équipement en entretien ou en maintenance doit être éteint et mis sous clé pour éviter des blessures possibles.**

**Geräte, an denen Wartungs- oder Servicearbeiten durchgeführt werden, müssen abgeschaltet und abgeschlossen werden, um Verletzungen zu vermeiden.**

**El equipo recibiendo servicio o mantenimiento debe ser apagado y asegurado para prevenir danos.**



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**Hot surface(s) present which may cause burns to unprotected skin, or to materials which may be damaged by elevated temperatures.**

**Présence de surface(s) chaude(s) pouvant causer des brûlures sur la peau non protégée, ou sur des matières pouvant être endommagées par des températures élevées.**

**Heiße Oberfläche(n) können ungeschützter Haut Verbrennungen zufügen oder Schäden an Materialien verursachen, die nicht hitzebeständig sind.**

**Superficies calientes que pueden causar quemaduras a piel sin proteccion o a materiales que pueden estar danados por elevadas temperaturas.**

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- √ 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.

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## Section 1 - Receiving

### 1.1 Preliminary Inspection

This item was thoroughly inspected and carefully packed prior to shipment and all necessary precautions were taken to ensure safe arrival. Immediately upon receipt, before the unit is moved from the receiving area, carefully examine the shipment for loss or damage. Unpack the shipment and inspect both interior and exterior for any in-transit damage.

### 1.2 Visible Loss or Damage

If any loss or damage is discovered, note any discrepancies on the delivery receipt and call the delivering carrier and request that their representative perform an inspection. Do not discard any of the packing material and do not move the shipment from the receiving area.

### 1.3 Responsibility for Shipping Damage

For products shipped F.O.B. Marietta, Ohio, the responsibility of Thermo Forma ends when the merchandise is loaded onto the carrier's vehicle.

On F.O.B. Destination shipments, Thermo Forma's and the carrier's responsibility ends when your Receiving Department personnel sign a free and clear delivery receipt.

Whenever possible, Thermo Forma will assist in settling claims for loss or in-transit damage.

### 1.4 Packing List

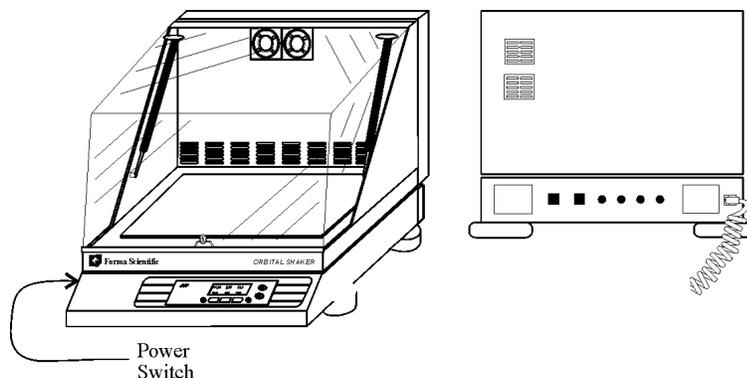
The Model 4518 Orbital Incubator Shaker is supplied with the following materials:

- 2 - Keys for the lid lock (packaged and attached to the outside of the 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 - Screwdriver for flask clip installation and removal
- 1 - Line cord
- 1 - Instruction manual

## Section 2 - Installation



***This Shaker is heavy! The net weight of Model 4518 is 153 lbs. (69.5kg) Place this unit on a support surfaces which will accommodate both the weight and operating motion of this shaker. Have assistance available when moving it.***



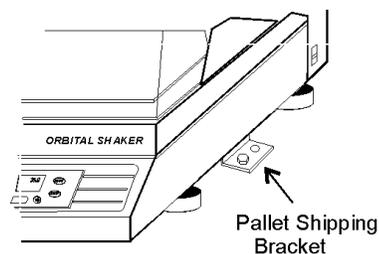
**Figure 2-1**  
Thermo Forma Model 4518 Table Top Laboratory Incubator/Shaker

### 2.1 Location

Install the shaker on a sturdy table or bench. The support structure must be able to accommodate both the weight and operating motion of the shaker. The shaker can also be placed under a bench or in a "knee well."

### 2.2 Removing the Pallet Shipping Brackets

The Orbital Shaker is secured to its shipping pallet with two brackets, one on each side of the frame. Remove these brackets when the unit is unpacked by unhooking them from the shaker frame.



**Figure 2-2**

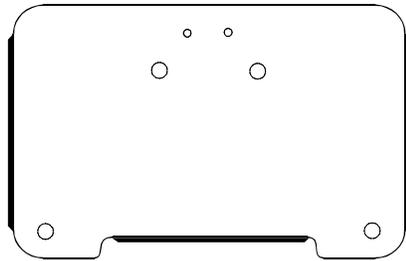
### 2.3 Installing the Shaker Platform



**Remove the drive mechanism shipping bracket and install the shaker platform before plugging in or attempting to operate the unit.**

#### a. Removing Drive Mechanism Shipping Bracket

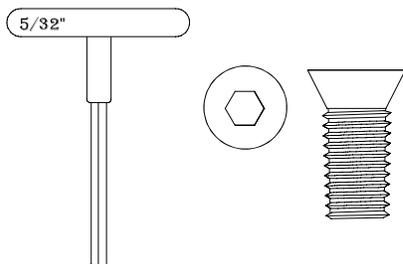
**Figure 2-3**  
Drive Mechanism Shipping Bracket



To protect the shaker's orbital mechanism during shipment, a sheet metal bracket is installed and must be removed before the unit can be operated. (Refer to Figure 2-3.) Using a 7/16" and 9/16" wrench, remove the three 1/4-20 and single 3/8-18 bolts.

#### b. Installing the platform

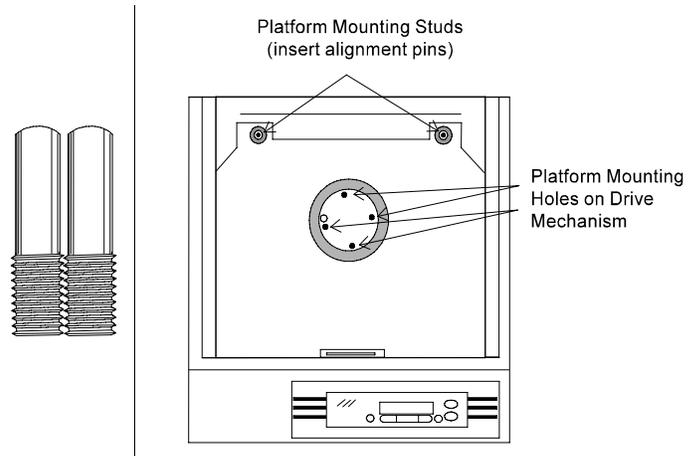
Standard on the Model 4518 Shaker/Incubator is a heavy-duty, 18" (wide) x 17-3/4" (front to back), 5/16" aluminum platform. The shaker platform is attached to the orbital mechanism with six 5/32" hex socket flat head screws, Grade 8. These screws are hardened and should not be exchanged with any other screw type. A 5/32" hex socket wrench is included with the shaker. This wrench must be used when attaching the platform. Figure 2-4 identifies the hex socket wrench and hex socket flat head screws.



**Figure 2-4**  
T-Handle Wrench and Hex Socket Head Screw

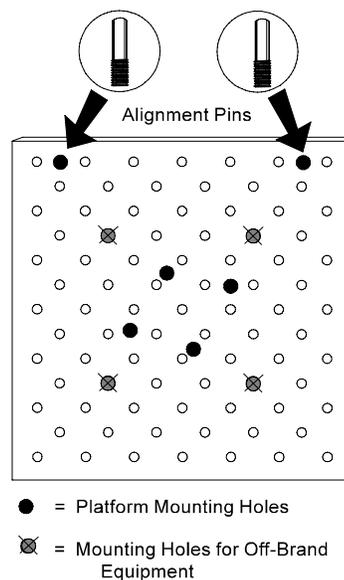
To install the shaker platform:

1. Insert the two 1/4-20 alignment pins into the two mounting holes identified in Figures 2-5 and 2-6.



**Figure 2-5**  
Platform Mounting Holes and Alignment Pins

2. Rotate the drive mechanism until the four mounting holes generally match the holes in the platform.
3. Place the platform onto the shaker and over the alignment pins.
4. Move the platform in an orbital motion until one or more of the center mounting holes are located.
5. Insert the hex socket head screws as the four holes are located. Do not tighten the screws.
6. Remove the 1/4-20 alignment pins and replace them with the remaining two hex socket screws.



**Figure 2-6**  
Platform Mounting Hole Locations

**Do not attempt to use a Phillips head screwdriver.**

- Tighten all screws as tight as possible using the T-handle wrench. If a torque wrench is available, tighten these screws at 120 in. lbs. Check these screws monthly if the unit is operated at or near maximum RPM.



**Use only the hex socket flat screws to fasten the platform. And, use only the T-handle wrench to tighten the screws. If a torque wrench is available, torque the screws at 120 in. lbs. The platform screws should be checked monthly if the unit is operated at or near maximum RPM.**

## 2.4 Electrical Requirements

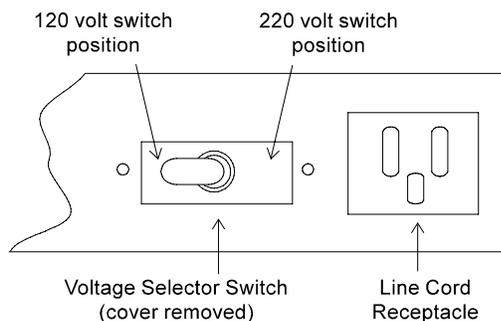
The electrical power requirements of the Model 4518 Shaker are:

**Model 4518**     90-125 VAC, 50/60 Hz, 1 PH, 5.6 FLA  
 180-250 VAC, 50/60 Hz, 1 PH, 2.9 FLA

Because Thermo Forma Orbital Shakers operate at a wide range of voltages, the electrical line cord is not permanently wired to the unit. Instead, a line cord receptacle is provided which accepts power cords for 110 or 220 volts. A voltage selector switch is located behind a cover on the rear panel of the shaker adjacent to the line cord receptacle. This switch must be set for the voltage in use at the laboratory site. Refer to Figures 2-7 and 2-13. (The power switch is located on the right side panel of the shaker cabinet.)



**Before plugging in the shaker, remove the metal plate covering the electric power selector switch and verify that it is set for the electrical service available. Figure 2-7 illustrates the switch and switch positions. Refer to Figure 2-13 for the location of the selector switch.**



**Figure 2-7**  
**Voltage Selector Switch, cover removed**

## 2.5 Assembling the Flask Clips

Each Flask Clip up to 1 liter in size is supplied with a metal spring which must be installed onto the clip. Two liter flask clips are supplied with two springs.

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 2-8. One liter flask clips require the spring ends to be hooked together as shown in Figure 2-9.

The spring ends on the two liter flask clip are also hooked together, but require the rubber spring tubes to be installed between the clip legs. (Figure 2-9) The second spring and spring tubes are placed around the base of the clip after it has been installed onto the platform.

## 2.6 Installing the Flask Clips

The Model 4518 will accommodate glassware in numbers and sizes from forty-nine 25 ml flasks to five 2 liter flasks. All Forma platforms have mounting holes for flask clips and test tube racks made by other manufacturers (Refer to the Platform illustration, Figure 2-6).

Table 2-1 lists the flask clip assemblies and kits available for Forma Shakers.

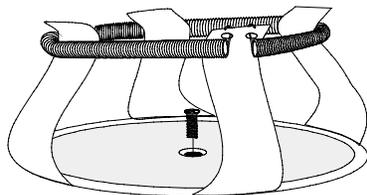
Flask clips can be attached anywhere on the shaker platform. The counter-balanced design of Forma shakers accommodates the worst unbalanced load. The flask clips are supplied with the proper screws and are attached to the platform with a standard Phillips screwdriver or with the screwdriver provided with the unit.

**Table 2-1**  
**Thermo Forma Model 4518 Shaker Platform Flask Clip Capacity and Kit Assembly Part Numbers**

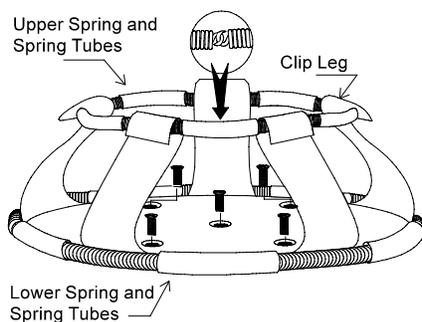
Dedicated Platform No.	No. of Clips	Flask Size	Springs per Clip	Screws per Clip
238010	49	25 ml	1	1
238011	49	50 ml	1	1
238012	25	125 ml	1	1
238013	18	250/300 ml	1 (w/large pad)	1
238014	16	500 ml	1	1
238015	8	1 L	1	5
238016	5	2 L	2 (w/10 tubes)	5

Figures 2-8 and 2-9 illustrate the installation of the flask clips. Note that 1 liter and 2 liter flask clips 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 2-8.)

**Figure 2-8**  
Installing the flask clip assembly with a single screw. (250/300 ml flask shown with cushion pad installed.)



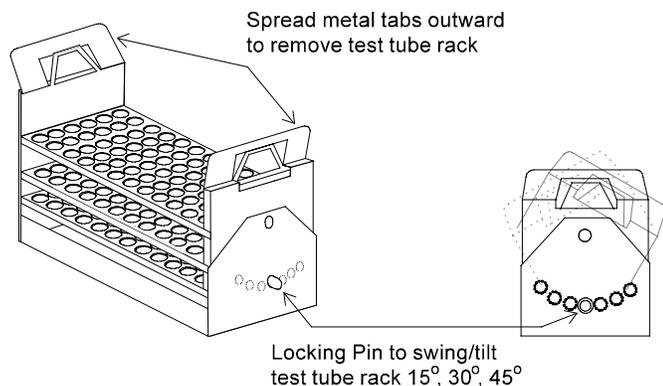
**Figure 2-9**  
Installing 2 liter flask clips. Note that two sets of springs and rubber tubes are used. The lower set is installed after the clip is attached to the platform.



**2.7 Installing the Test Tube Holders**

Thermo Forma Accessory Test Tube Racks and Test Tube Rack Holders are available in four sizes and are listed in Table 2-2. All the Thermo Forma Test Tube Rack Holders are adjustable in seven positions, swinging and locking at 15°, 30° and 45° in either direction. Figure 2-10 illustrates the Test Tube Rack Holder with rack in place.

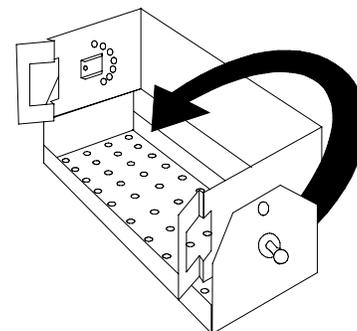
To remove the rack, spread the metal tabs on either end of the holder and lift out the plastic Test Tube Rack.



**Figure 2-10**  
Test Tube Rack showing the swing/tilt mechanism

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 2-11) Attach the tray to the platform with the screws provided.

**Figure 2-11**  
Test Tube Rack Holder with the Test Tube Rack Removed



**2.8 Accessory Test Tube Racks and Adjustable-Angle Test Tube Rack Holder**

Part Number	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 with Rack, 10-13 mm
600077	Adjustable-Angle Test Tube Holder with Rack, 16-20 mm
600078	Adjustable-Angle Test Tube Holder with Rack, 21-25 mm
600079	Adjustable-Angle Test Tube Holder with Rack, 26-30 mm
194024	#10-24 Pan head Phillips screws for mounting test tube holders to Orbital Shaker platforms
185062	Pan head Phillips screws, washers and nuts for mounting test tube holders to Models 2568 and 2569 Shaker Baths

## 2.9 The RS-232 Interface Connector

The Model 4518 Orbital Shaker is equipped with an RS-232 Serial Communication Interface for the remote transmission of data. An RJ-11 telephone style connector is located on the rear of the incubator. A cable with RJ-11 plugs, and an RJ-11 to DB-25 adapter are required. Refer to Figure 2-13 for connector locations on the shaker back panel.

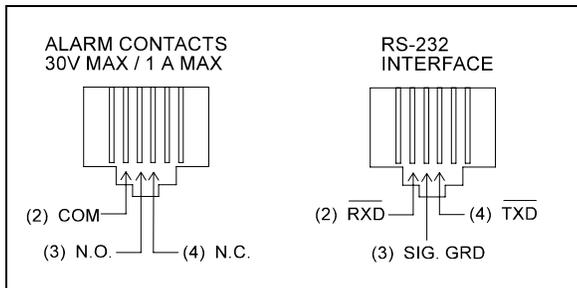
The data is “dumb terminal” formatted, which permits interfacing with either a computer or a serial printer.

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

The data format is:

Baud	1200 (9600 baud with jumper at J2 on the Main Control Board)
Data bits	8 (7 bit ASCII with leading zero)
Start bits	1
Stop bits	1
Parity	none



**Figure 2-12**  
**RS-232 and Remote Alarm Connectors**

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)

- NUL - Null character (0)
- SP - Space
- LF - Line feed
- CR - Carriage return
- EOT - End of text (4)
- H - Hold Mode

The Model 4518 transmits time, RPM and temperature information one minute after power is first applied to the unit and 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 unless 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.

## 2.10 Connecting the Remote Alarm

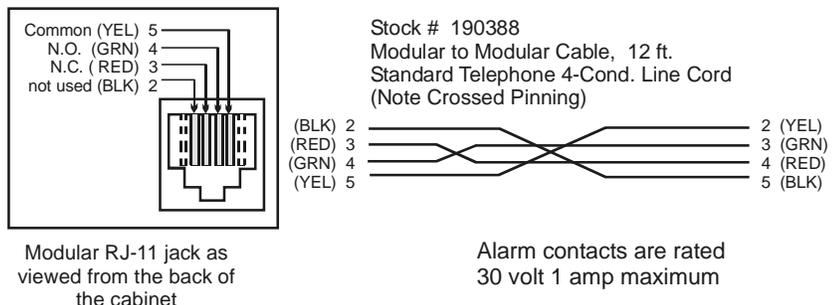
### IMPORTANT USER INFORMATION

Caution! Stored product should be protected by an activated alarm system capable of initiating a timely response 24 hours/day. Thermo Forma Alarms provide interconnect for centralized monitoring.

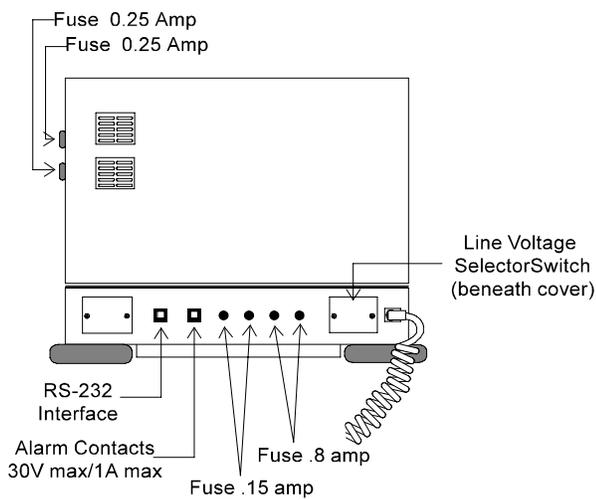
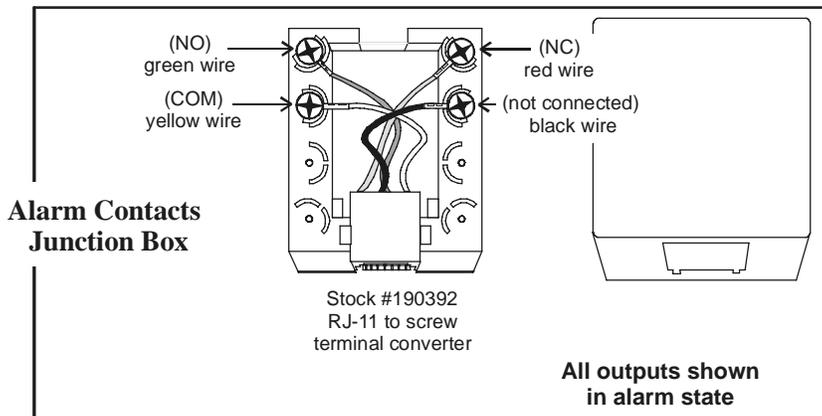
An internal, remote alarm SPDT relay is provided to monitor alarms and is connected by an RJ-11 (telephone style) jack located on the rear of the cabinet. The relay provides NO (normally open) and NC (normally closed) output and may be wired to a central remote alarm location or to an independent alarm system.

Figure 2-12 identifies the pin contacts. Figure 2-15 shows the location of the Remote Alarm Connector.

A modular to modular cable (Thermo Forma 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 Figures 2-13 and 2-14.



**Figure 2-13**



**Figure 2-14**

**Figure 2-15**

**Rear Panel of the Model 4518 Tabletop Shaker**

**2.11 Lid Security Lock**

To protect the contents of the shaker or prevent tampering or unauthorized access, a security lock is located on the front of the acrylic lid. Two keys for this lock are in the parts package attached to the outside of this unit when shipped.

**2.12 Quick Reference Guide**

A Quick Reference Guide and a self-adhering vinyl pouch is included in the manual bag. Adhere the vinyl pouch in a convenient location on, or near, the shaker and insert the Quick Reference Guide for easy user reference.



**Caution! Do not adhere the pouch to the side panels of the Model 4518.**

## Section 3 - Operation

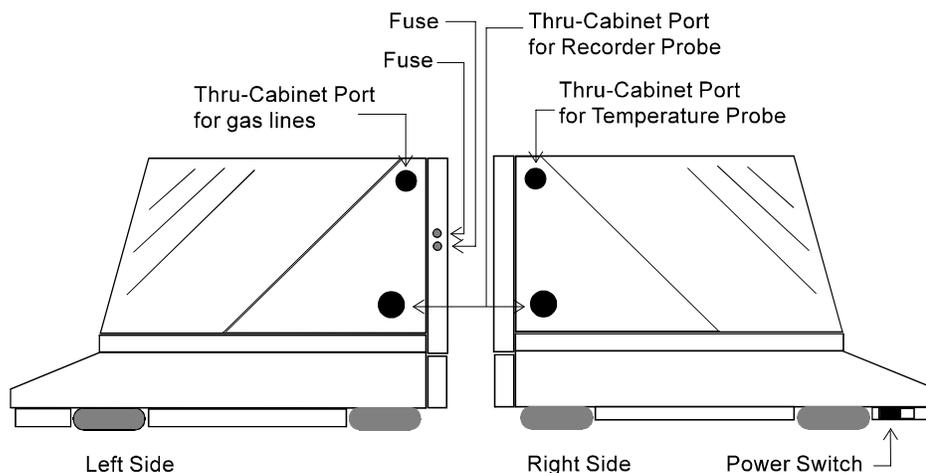


Figure 3-1

Right and Left Sides of the Model 4518 Incubator Shaker

### 3.1 Introduction

The Thermo Forma Model 4518 is a microprocessor controlled table top orbital shaker designed to accommodate a wide variety of flasks, test tubes and other glassware. The control system is easily programmed and stores up to three user-defined time, temperature and speed combinations. These pre-set programs 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. A safety interlock requires that the lid be closed for the drive motor, circulating fans and heating elements to operate.

### 3.2 Factory Settings

#### a. At Initial Start-Up

The Model 4518 has been shipped from the factory with the following settings which will appear on the display screen when the shaker is powered up for the first time. These are also the default settings of pre-set program P3.

1. **Time:** The display will show 00:00H. Any changes in the Time settings will be made in increments of 5 minutes. If the Up or Down buttons are held for two seconds, the display will scroll in that direction.
2. **RPM:** Display will show 100. Changes in the RPM are made in increments of 1 RPM. However, if the Up or Down buttons are held for two seconds, the display will scroll in that direction.
3. **Temperature:** Display will show 35.0°C. Changes to the Temperature setting are made in increments of 0.1°C.
4. **Access Code:** Although not shown on the Start-Up screen, the Access Code from the factory is 0 0 0 0. The Access Code may be changed to any four digit combination of numbers 0-9. When the Access Code is set at 0000, the system will not pause for entry of the Access Code when programming or changing any setting. (Refer to Chart 3-5 for setting or changing the Access Code.)

### b. Pre-set Programs

Three pre-set programs are stored into the shaker’s computer memory and may be used or edited at the operator’s discretion. The operating parameters of Pre-set program P3 are active (default) when the unit is turned on for the first time “out of the shipping box.” The values set by the factory for pre-set programs P1, P2 and P3 are listed on the following page.

Instructions on operating the shaker using these pre-set programs are found in Section 3.6. Instructions to edit these programs are in Section 3.7.



**The microprocessor speed control system may take up to one minute to bring platform up to speed. Never leave the shaker unattended when starting. Make sure all flasks and test tube racks are firmly seated in the clips and check the security of flask clips and platform attachment screws monthly. The lid must be closed to operate the shaker. Do not operate the shaker at maximum RPM without a load.**

**P1**

Time: 720 minutes (12 hours) Countdown Mode  
 RPM: 250  
 Temp: 35°C

**P2**

Time: 1200 minutes (20 hours) Countdown Mode  
 RPM: 300  
 Temp: 28°C

**P3**

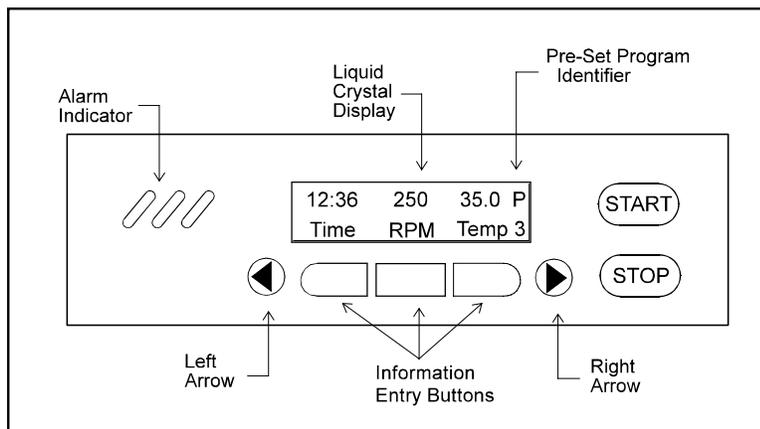
Time: 00:00H Hold Time (accumulated) Mode  
 RPM: 100  
 Temp: 35°C

### c. Other factory default settings

Function	Default	Reference Manual Section
Audible Alarm	ON	3.8
Access Code	0 0 0 0	3.10
RPM		
Tracking Limit	5	3.11
Temperature		
Tracking Limit	10°C	3.14
Over Temperature Shut-down	63°C - 65°C	3.12.c
All Remote Alarms	ON	3.11

### 3.3 Operating the Control Panel

The Model 4518 Shaker control panel uses micro switches which respond with a “click” when pressed. The Liquid Crystal Display (LCD) shows the information being entered into the system. Figure 3-2 illustrates the Control Panel and identifies its elements.



**Figure 3-2**  
**The Model 4518 Control Panel**

The Model 4518 Control Panel has seven operating keys or buttons. The Start and Stop buttons are marked and the left and right arrow buttons are identified by their symbols. During most programming activities, pressing the Left Arrow button returns the display to the system’s Operating Screen showing the Time, RPM and Temperature. Pressing the Right Arrow button changes the display to the previous screen.

The functions of the three unmarked buttons below the LCD vary with the particular screen and the information being entered into the system. As information is entered or the operating programs modified, the functions of the buttons will change. Their new function will be identified on the portion of the LCD above the button.

Figures 3-3 and 3-4 illustrate how the functions of these three buttons are identified.

### 3.4 Quick Start Up

The Thermo Forma Model 4518 Orbital Shaker may be operated as soon as the platform is installed, the unit is plugged in, turned on and a Time value entered. Pressing Start and Stop will operate the shaker at the factory settings. However, to get the most from the shaker’s microprocessor-based technology, the unit can be programmed to meet the most demanding laboratory requirements.

Example: The three buttons are used to change the operating setpoints. Pressing Time, RPM or Temp changes the screen to that parameter.

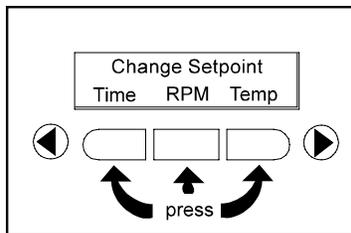


Figure 3-3

Example: To change the shaker RPM, pressing the button below Up increases the speed, pressing the button below Down decreases the speed. Speed changes are made in increments of 1 RPM.

Holding the Up or Down button for two or more seconds will scroll the display in that direction. Pressing the button beneath RPM saves the new setting to computer memory.

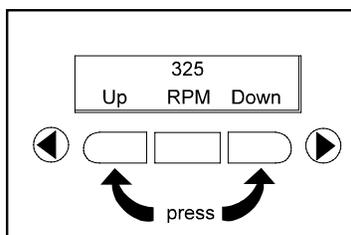
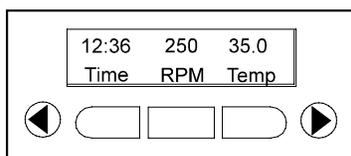


Figure 3-4

Figure 3-5

#### Typical Start-Up or Operating Screen

Any programming or setting changes are made starting from this screen.



The following sections outline the procedures for changing the settings and for programming the shaker control system.

### 3.5 Changing the Shaker Time, Speed and Temperature Settings

When first turned on or when the shaker is operating, the Time, RPM and Temperature values are displayed on the LCD. A typical screen is illustrated in Figure 3-5. For convenience, this will be called the Operating Screen throughout the instruction series. All programming or setting changes start from this screen.

#### a. Changing the Time setting

Refer to Chart 3-1. The instructions to program the Model 4518 are written in a step-by-step format. For convenience, these instructions begin and end at the Operating Screen.

#### b. Changing the RPM setting

1. Refer to Chart 3-1.
2. Press Up or Down to set the new speed in 1 RPM increments or press and hold either button to scroll.
3. Pressing RPM stores the new entry into computer memory and returns the display to the Change Setpoint screen.
4. The operator may then program changes to Temperature or Time or press the Left Arrow to return to the Operating Screen.

---

*At any time during programming or changing settings, if no control panel buttons are pressed during a five minute period, the display will automatically return to the Operating Screen.*

---

#### c. Changing the Temperature Setting

1. Refer to Chart 3-1.
2. Press Up or Down to set the new temperature in 0.1°C increments. Hold either button to scroll.
3. Pressing Temp stores the new entry into computer memory and returns the display to the Change Setpoint screen.

---

*When an alarm occurs, the Temp button is used to silence the audible alarm when the Operating Screen is visible. If no alarm exists, pressing Temp will bring up the Change Setpoint screen.*

---

#### d. Hold Function - Setting the System to Count Elapsed Time

The Hold function allows the total shaker operating time to be recorded regardless of the number of times the unit is started and stopped. Selecting Hold when programming Time sets the elapsed time to zero. Counting upward begins when the Start button is pressed. Despite the number of times that the shaker is stopped and started, the upward counting continues until the Reset command is given.

To set the Hold time to zero, Refer to Chart 3-2.

When the display returns to the Operating Screen, the Time value on the display is 00:00H. The H denotes that the time reading is accumulated elapsed time.

Pressing the shaker's Start button begins the count upward.

The accumulated Hold time can be cleared at any time by pressing Time from the Operating Screen and pressing (Reset) from the (Reset) Setpoints screen.

### 3.6 Operating the Shaker using Pre-Set Programs

Three different pre-set programs may be stored in the microprocessor’s memory. To operate the shaker using these programs, Refer to Chart 3-3.

The program selected will be displayed with the Time, RPM and Temp settings. A number 1, 2 or 3 in the lower right corner of the display shows which pre-set program is in use.

### 3.7 Making or Editing the Pre-Set Programs

To create a new set of operating parameters for Pre-Set Program P1, P2 or P3, Refer to Chart 3-4.

### 3.8 Changing/Setting the Access Code (Refer to Chart 3-5)

Record and file the new Access Code in a safe place. If the new code is lost or forgotten, contact the Thermo Forma Service Department.

### 3.9 Setting the Remote Alarms (Refer to Chart 3-5)

The Thermo Forma 4518 Orbital Shaker control system monitors and provides alarms for six operating parameters :

- Cycle Complete      Power Failure
- RPM Tracking        Drive Belt Integrity
- Sensor Fault        Temperature High/Low

Each of these alarms may be independently turned on and off to suit the operator or laboratory needs.

### 3.10 Audible and Visual Alarms

Both audible and visual alarm warnings are provided by the Forma Orbital Shaker. Visual flashing of the three diagonal indicator lights on the Control Panel and a progression of text messages on the display (See Figure 3-7) alert the operator that an alarm condition has occurred. An electronic “beep” is also heard if the audible alarm function is active. The Audible alarm feature may be turned off. Refer to Section 3.13.

The alarm condition and resulting alarm message sequence shown in Figure 3-7 are:

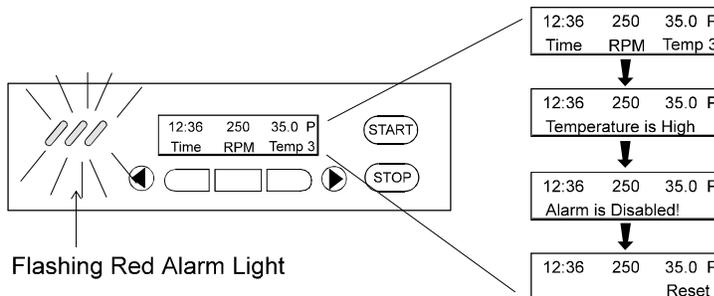
- Operating time remaining - 12 hours, 36 minutes
- Operating speed - 250 RPM
- Operating temperature (actual) - 35.0°C
- Pre-set program in use - P3
- Alarm condition - Temp has exceeded high alarm set point.
- The audible alarm has been disabled.
- Press Reset to acknowledge the alarm.

#### a. Silencing the Audible Alarm

The audible alarm is silenced by pressing the Reset (Temp) button on the operating screen. However, it will sound again (ring back) in 15 minutes if the alarm condition has not been corrected by the operator.

#### b. Clearing the alarm display

The warning lights will continue to flash and the display will alternate with the warning message and the reset screen until acknowledged by the operator. The message will continue even if the alarm condition is no longer present. This is to alert the operator that an alarm did exist.



**Figure 3-7**

#### Interpreting Alarm warnings and message sequence

When (Reset) is pressed, the display may take 10-15 seconds to return to the Operating Screen.

#### c. Over Temp Alarm and Over Temp Shutdown

When the chamber temperature exceeds the alarm set point, both audible and visual warnings are initiated and the shaker heaters are shut down. The platform will continue to operate, however, and the system will reset once the temperature has lowered past the alarm point, although the warning message will continue to be displayed.

#### **d. Raising and Lowering the Temperature Alarms Setpoints (Refer to Chart 3-6)**

The temperatures at which the alarms activate are raised or lowered by following the instructions in Chart 3-6. The temperatures are set or changed in 0.1°C increments. Pressing and holding the Up and Down buttons will cause the display to scroll in that direction.

#### **3.11 Turning the Audible Alarm Feature On or Off (Refer to Chart 3-7)**

At the operator's discretion, the audible alarm warning feature may be shut off. Refer to the instructions in Chart 3-7.

Turning off the audible alarm will not affect the flashing warning light or the alarm messages presented on the display screen.

#### **3.12 Reading the Accumulated Run Time (Refer to Chart 3-8)**

Accumulated running time may be read or viewed any time the shaker is operating. The button-press sequence is listed in Chart 3-8. The chart page also contains a date and time entry record box for convenience.

#### **3.13 Temperature Calibration**

The Model 4518 temperature monitoring system may be calibrated  $\pm 4^{\circ}\text{C}$  from the factory setting. A thermometer of known accuracy must be used and the system allowed to stabilize before calibrating.

The programming sequence is shown below.

From the Operating Screen:

1. Press the Right Arrow twice.
2. Press Program Functions
3. Press the Left Arrow twice.
4. Press Temp Calib.
5. Using the Up and Down buttons, match the system temperature with the temperature shown on the thermometer. Changes are made in 0.1°C increments.
6. When set, press Temp to return to the Over-Temp, Calibrate and Alarms screen.
7. Press the Right Arrow.
8. Press Exit to return to the Operating Screen.

#### **3.14 Reading the Over Temperature Probe**

To compare the temperature being sensed by the over temperature probe with the actual temperature reading of the system, follow the procedures in the top half of Chart 3-6. Pressing "O-Temp" at the prompt will provide the Over Temperature probe information.

This function is mainly diagnostic and should be used for information only. Making any changes to the over temperature system based on this reading should be made only by persons trained in servicing the Model 4518 Orbital Shaker.

#### **3.15 Setting the Temperature Tracking Limit**

From the Operating Screen:

1. Press Right Arrow twice.
2. Press Program Function.
3. Press Right Arrow twice.
4. Press Alarms.
5. Press Trackg to set the Tracking Limit using the Up and Down buttons. When set, press Temp.
6. Press Right Arrow twice.
7. Press Exit to return to the Operating Screen.

# Edit a Program

Actual Condition Display

XX:XX	XXX	XX.X
TIME	RPM	TEMP



Press right arrow twice

Program Functions
----------------------



Press Program Functions

Edit Programs		
P1	P2	P3



Select one (ex. P1)

XX:XX	XXX	XX.X	P
Time	RPM	Temp	1



Change Setpoints (see p. 2),  
then press left arrow twice

Maintenance Functions		Exit
--------------------------	--	------



Press Exit

You must Load and Start a program to run it (see p. 3)

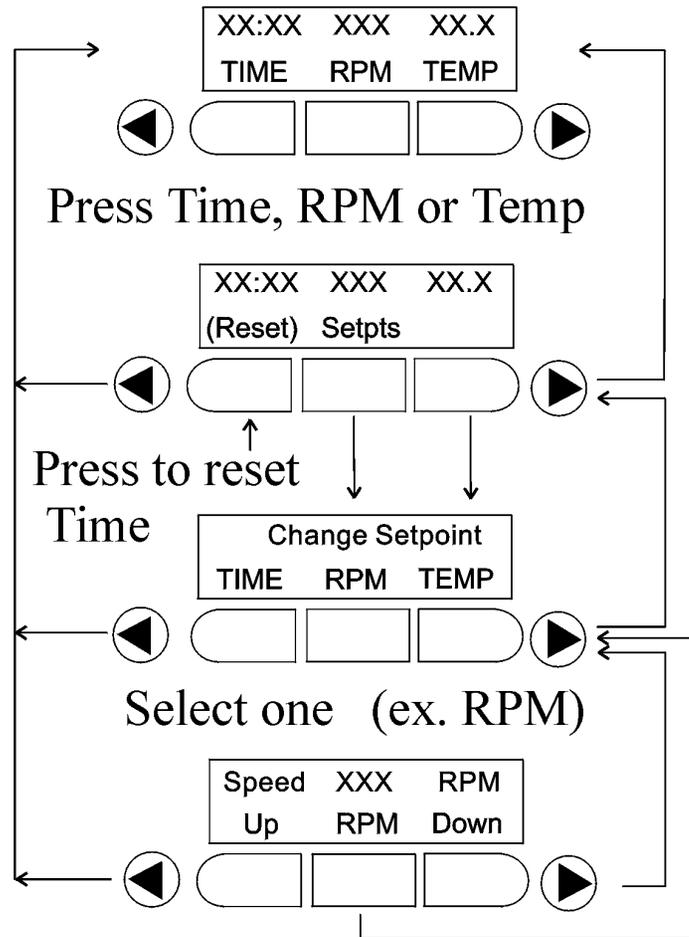
# Thermo Forma

## Orbital Shaker

### Quick Reference Guide

# Setpoint Change

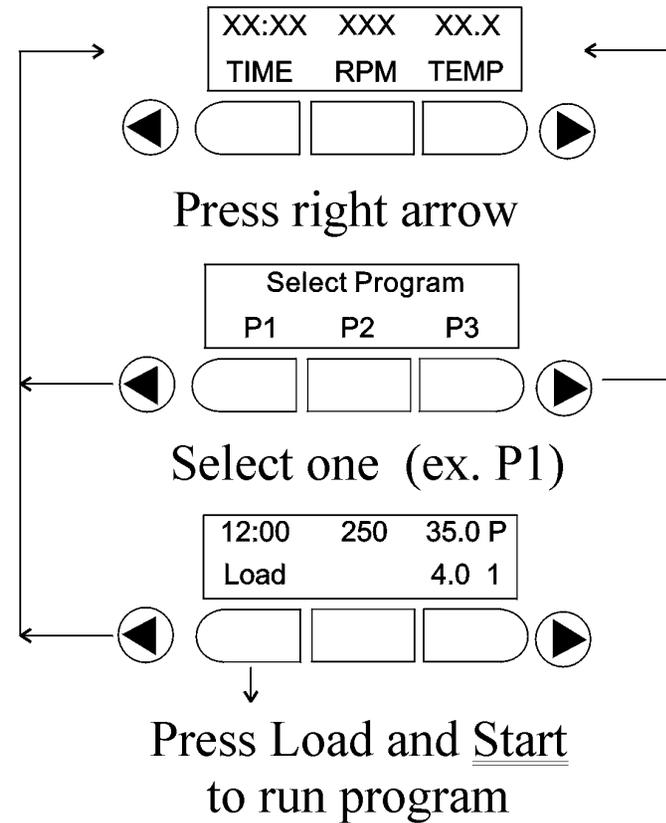
Actual Condition Display



Adjust RPM, press RPM to store change  
Press left arrow  
Press Start

# Load a Program

Actual Condition Display

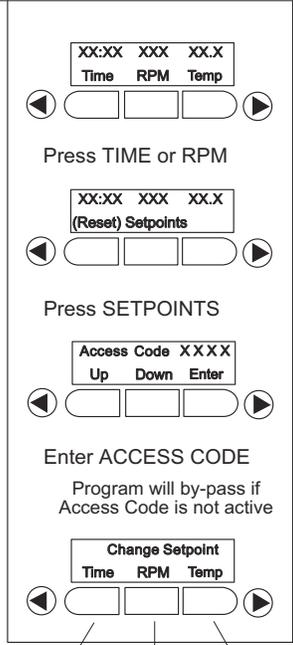


To Change Operating Time, RPM or Temperature Settings

Operating Screen (start) →

Press Time or RPM to begin program changes to:  
Time  
RPM  
Temperature

If the Access Code is 0 0 0 0 (factory default) the program will not ask that the code be entered



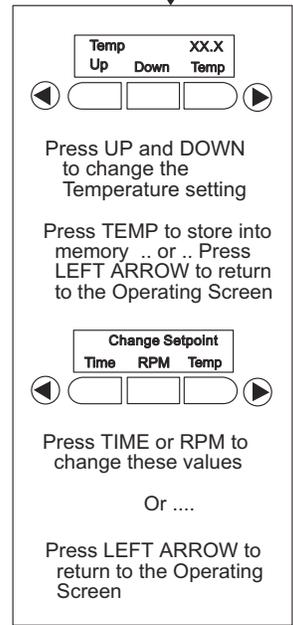
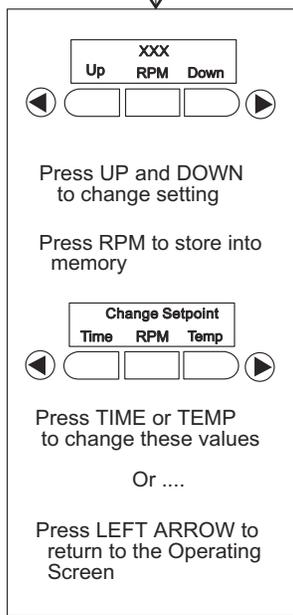
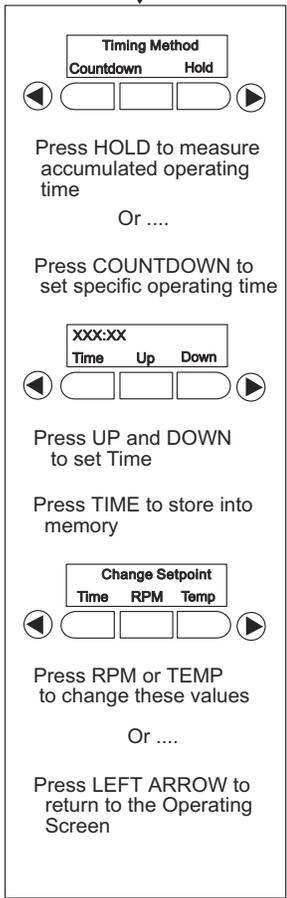
← Press Temp to silence the audible alarm

← "Reset" will appear in the Operating Screen display when an alarm condition exists

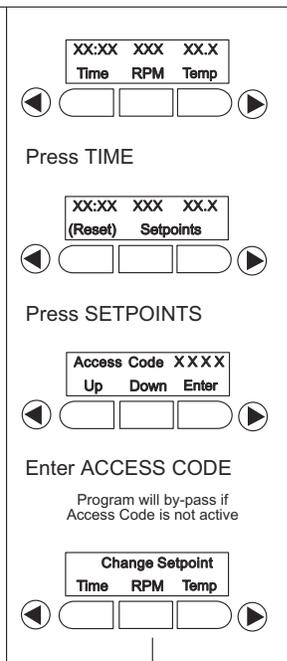
← Press Up or Down to select the first number of the Access Code and press Enter. Cursor will move to the next digit.

← Display will advance to the next screen when the fourth digit is selected and Enter is pressed.

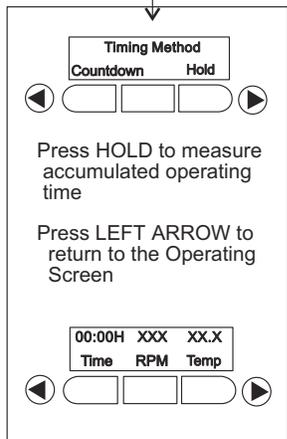
Press TIME      Press RPM      Press TEMP



To Set Hold Time to Zero



Press TIME

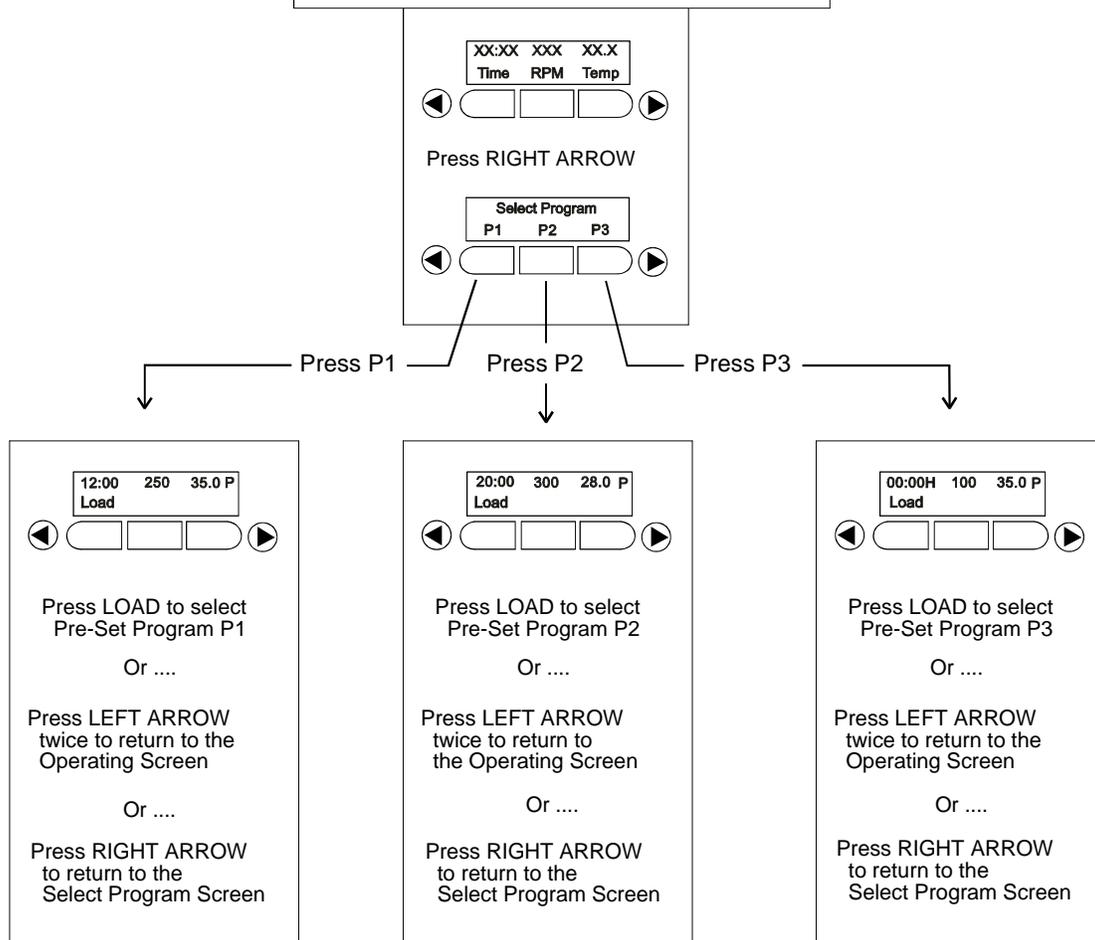


Time value is set to zero

H denotes the time reading  
is accumulated elapsed  
time

Accumulated HOLD time can be  
cleared at any time by pressing  
TIME from the Operating Screen  
and pressing (RESET) from the  
(RESET) SETPOINTS screen

## Loading the Pre-Set Programs



Values shown are factory default settings and may be edited.  
Refer to Section 3.7 and Chart 3-4.

When a Pre-Set Program is in use, a "P" appears in the upper right corner of the liquid crystal display and the program number is in the lower right corner.

Pre-Set Program P3 is made the active program at the time of manufacture and is the default program when the unit is turned on the first time.

# To Edit the Pre-Set Programs

XX:XX XXX XX.X  
Time RPM Temp

Press RIGHT ARROW twice

Program Functions

Press PROGRAM FUNCTIONS

Access Code XXXX  
Up Down Enter

Enter ACCESS CODE

Program will by-pass if Access Code is not active

Edit Programs  
P1 P2 P3

Press P1

XX:XX XXX XX.X P  
Time RPM Temp 1

Press P2

XX:XX XXX XX.X P  
Time RPM Temp 2

Press P3

XX:XX XXX XX.X P  
Time RPM Temp 3

Press TIME Press RPM Press TEMP  
... to change any of these values, then ...

Press TIME Press RPM Press TEMP

... to store the new values into computer memory

XX:XX XXX XX.X P  
Time RPM Temp 1

Press LEFT ARROW twice

Maintenance Functions exit

Press EXIT to return to the Operating Screen

Press TIME Press RPM Press TEMP  
... to change any of these values, then ...

Press TIME Press RPM Press TEMP

... to store the new values into computer memory

XX:XX XXX XX.X P  
Time RPM Temp 2

Press LEFT ARROW twice

Maintenance Functions exit

Press EXIT to return to the Operating Screen

Press TIME Press RPM Press TEMP  
... to change any of these values, then ...

Press TIME Press RPM Press TEMP

... to store the new values into computer memory

XX:XX XXX XX.X P  
Time RPM Temp 3

Press LEFT ARROW twice

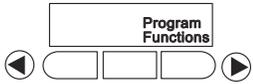
Maintenance Functions exit

Press EXIT to return to the Operating Screen

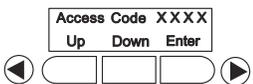
# Setting or Changing Access Code, Remote Alarms, Unit Configuration



Press RIGHT ARROW twice

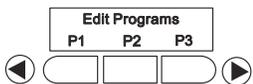


Press PROGRAM FUNCTIONS

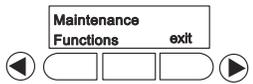


Enter ACCESS CODE

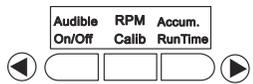
Program will by-pass this screen if the Access Code is not active



Press LEFT ARROW

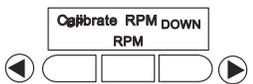


Press MAINTENANCE FUNCTIONS



Press RIGHT ARROW

Press RPM Calib.\*

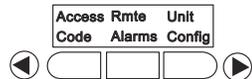


Press UP or DOWN to calibrate

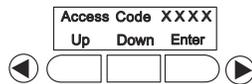
Press RPM to store the value into computer memory

Display will return to the previous screen

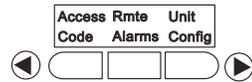
## Access Code



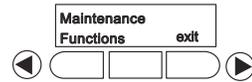
Press ACCESS CODE



Press UP and DOWN to change the code. Press ENTER as each digit is set.

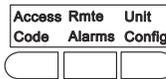


Press RIGHT ARROW



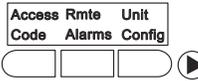
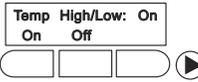
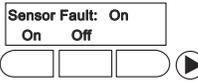
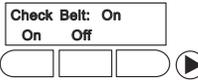
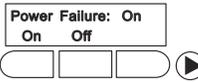
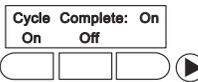
Press EXIT to return to the Operating Screen

## Remote Alarms

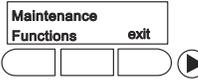


Press REMOTE ALARMS

Change or not change the setting, press RIGHT ARROW to advance to the next screen.

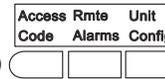


Press RIGHT ARROW

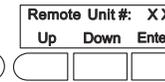


Press EXIT to return to the Operating Screen

## Unit Configuration

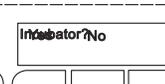


Press UNIT CONFIGURE (To program unit for RS-485 interface, Forma 1535)



Press UP and DOWN to set unit number. Press ENTER to store into computer memory.

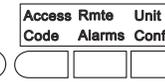
or... Press RIGHT ARROW to advance to next screen.



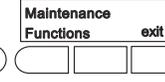
Press Yes to select 4518. Press No to select 4530. or... Right Arrow to advance to the next screen.



Press RIGHT ARROW



Press RIGHT ARROW



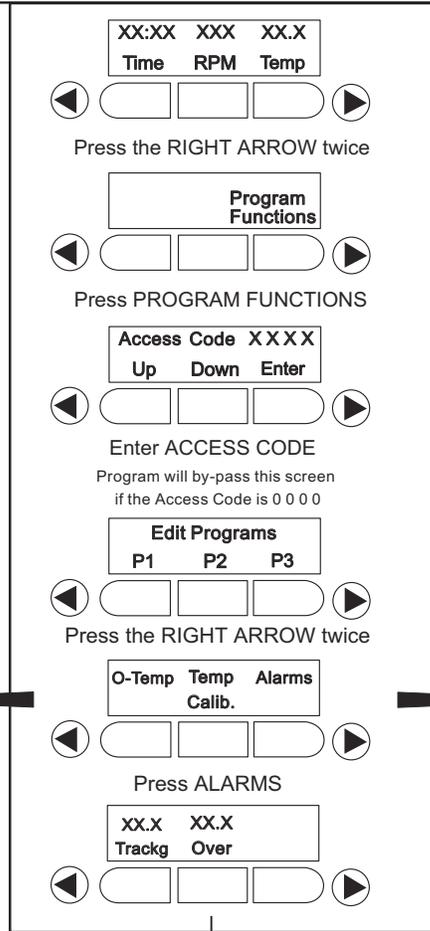
Press EXIT to return to the Operating Screen

\*For Factory and Service use only

For Factory and Service use only

## Raising and Lowering the Temperature Alarms Setpoints

Start from the Operating Screen



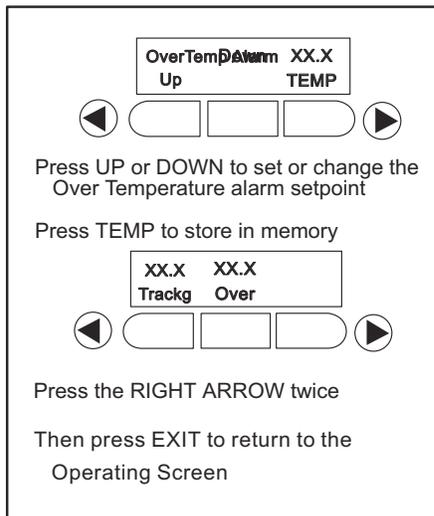
Press O-TEMP to read the temperature being sensed by the Over Temperature Probe.

See Section 3.17.

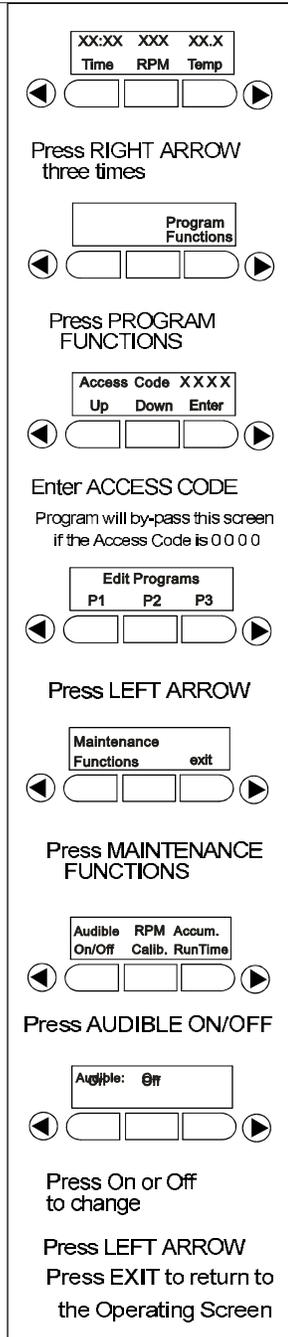
Press TEMP CALIB. to calibrate the temperature monitoring system.

See Section 3.15.

Press OVER to set the over temperature alarm setpoint



## Turning the Audible Alarm Feature On and Off





## Section 4 - Maintenance

### 4.1 General Cleaning and Lubrication

The Thermo Forma Model 4518 Orbital Shaker uses a brushless DC motor and oversized, permanently lubricated bearings which require no maintenance.

#### a. Shaker 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. Follow the procedures in Section 2.2.b when re-installing the platform.

#### b. Control Panel

The microprocessor control panel uses sealed push buttons and liquid crystal display and may be cleaned with laboratory detergents and dried with a soft cloth.

## Section 5 - Service



*The procedures outlined in this section should 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.*

With the exception of replacing the drive v-belt and the six electrical fuses, the Model 4518 Orbital Shaker contains no user-serviceable components. The following table lists display messages which may help diagnose abnormal conditions.

### 5.1 Alarms and Alarm Conditions

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

<b>Alarm Message</b>	<b>Fault Condition</b>
Overtemp Shutdown	System shutdown due to overtemp 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	
Check Belt	Motor V-belt has broken
Reset	
Audible is Disabled!	

### 5.2. General Fault Conditions

Symptom	What to Check & Where to Look
Display is dark, shaker will not operate	Power at the wall outlet Fuses on the back of the unit are blown Power switch not turned on
Display is lit, motor will not operate	Voltage selector switch at wrong position Drive motor fuses on back of cabinet are blown Acrylic lid is not closed No time value entered into the system (see Section 3.5) Time countdown has been reached (see Section 3.5)
Display is on, motor operates, display shows 7.5°C or over temp state	Faulty temperature sensor Faulty over temperature sensor
Display is on, motor operates, fan(s) do not run	Blower motor fuses are blown Connections or wires to fan relay board interrupted Lid switch faulty or lid ajar
Display is on, heat is on but fans and motor do not operate	Voltage selector switch Over temperature safety reset tripped
Display on, unit will not operate (Time reads zero)	Countdown time reached, reset TIME Section 3.5a
Forgot the Access Code	Call Thermo Forma Service Department

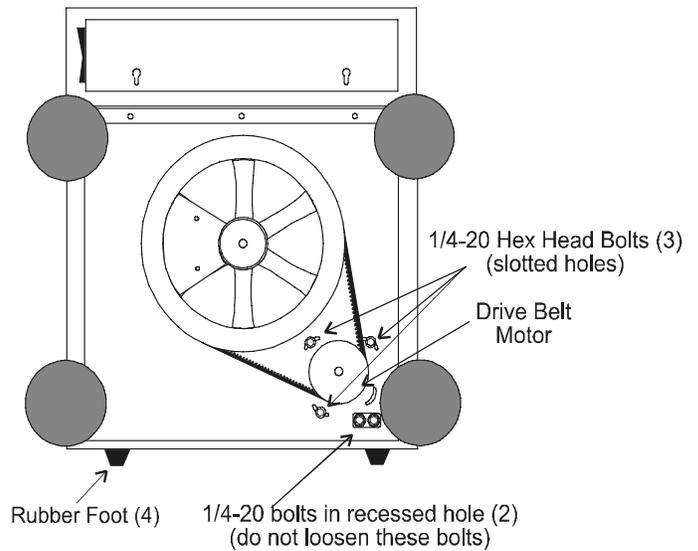


Figure 5-1

- Remove the bottom cabinet cover (4 Phillips screws).
- Loosen but do not remove the two 7/16" screws located in the slotted holes adjacent to the shaker drive motor (Refer to Figure 5-1).
- Loosen but do not remove the 7/16" screw adjacent to the drive motor which is not in a slotted hole. The drive motor pivots around this screw. Loosening all three screws allows internal springs to apply proper tension to the v-belt.
- Tighten both screws in the slotted holes.
- Tighten the remaining drive motor pivot screw. The v-belt is now under proper operating tension.



***Tighten all screws. Do not allow the shaker to operate against the spring tension.***

### 5.3 Adjusting the Drive V-Belt Tension

Tools needed: Phillips screwdriver  
3/8" drive socket wrench with 7/16" socket

- Remove all connectors and the line cord from the back of the shaker.
- Lift the front of the shaker and rest it on the back of the cabinet. Remember, the weight of the shaker is 153 pounds.



***The shaker is not stable when set on its back. A second person may be necessary to support the shaker when in this position.***

### 5.4 Installing a new Drive V-Belt (P/N 800040 - Ax43 V-belt 1/2" x 45")

Follow the procedures 1 through 5 in Section 5.2 to loosen all three 7/16" screws. Remember, the drive motor is under spring tension and may suddenly move when the third pivot screw is loosened.



***The drive motor is under spring tension and may suddenly move when the pivot screw is loosened. When the new belt is installed, tighten all screws. Do not allow the shaker to operate against spring tension.***

1. Place the new v-belt around the bottom of both the motor and the large drive wheel.
2. Force the drive motor inward toward the drive wheel and rotate the drive wheel counterclockwise, forcing the v-belt into the wheel groove. It may be necessary to use a lever (large screwdriver or pry bar) to move the drive motor inward against the spring tension. The large rubber foot can be used to pry against. Once the belt is properly seated in the motor and drive wheels, the internal springs apply proper tension.
3. Tighten the two screws in the slotted holes then tighten the drive motor pivot screw.
4. Replace the bottom cover and return the shaker to service.

**b. The Main Circuit Board and Power Supply Tray**

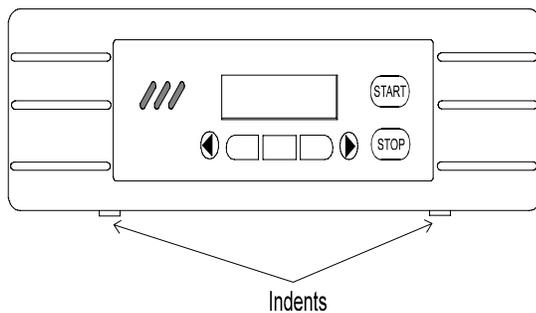
The Main Circuit Board and Power Supply tray is located inside the cabinet directly beneath the control panel. To access the tray:

1. Remove the control panel and disconnect the ribbon cable as outlined in Section 5.5.a above.
2. Remove the seven Phillips screws underneath the front section of the unit and allow the electronics tray to drop down. Note that the main power wires and connecting cables will prevent the tray from being removed from the shaker.

**5.5 Troubleshooting and replacing the Circuit Boards**

**a. Removing the Control Panel**

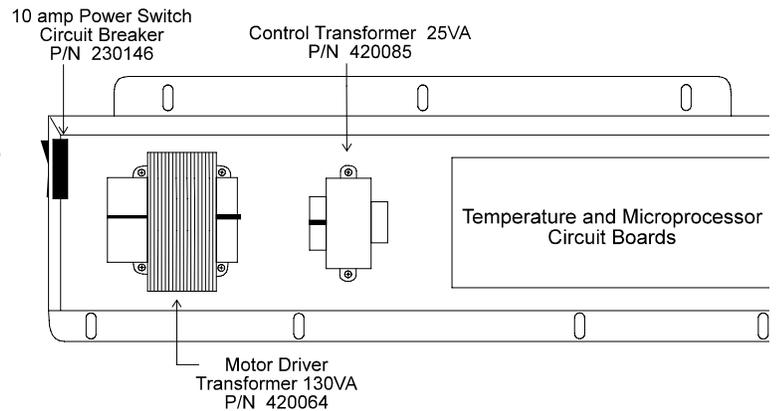
The Control Panel is attached to the cabinet by press-in fasteners. Two indents are located along the bottom edge of the panel which accommodate a flat screwdriver blade. (See Figure 5-2) Carefully pry the panel outward to release the fasteners. The display circuit board is attached to the pack of the control panel, P/N 190438.



**Figure 5-2**  
**Removing the Control Panel**

The Control Panel is connected to the Microprocessor Board by a ribbon cable. Two locking clips on the Control Panel connector must be released before the cable is removed.

When replacing the Control Panel, do not crimp the blue ribbon cable on the left side of the circuit board. The cable must be completely inside the sheet metal front panel before the Control Panel is pressed into place.

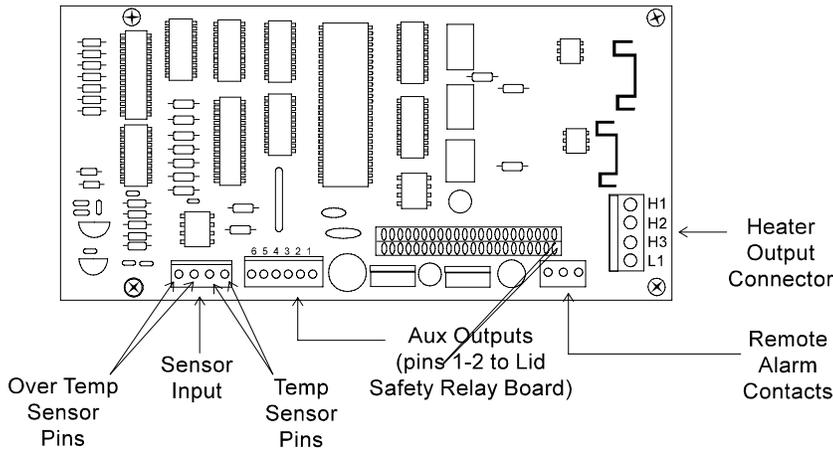


**Figure 5-3**

This tray contains the power transformers, temperature and microprocessor circuit boards and other components. (Figure 5-3)

The Temperature Board is mounted on top of the Microprocessor Board on the right side of the tray.

**c. The Temperature Control Circuit Board P/N 190524**

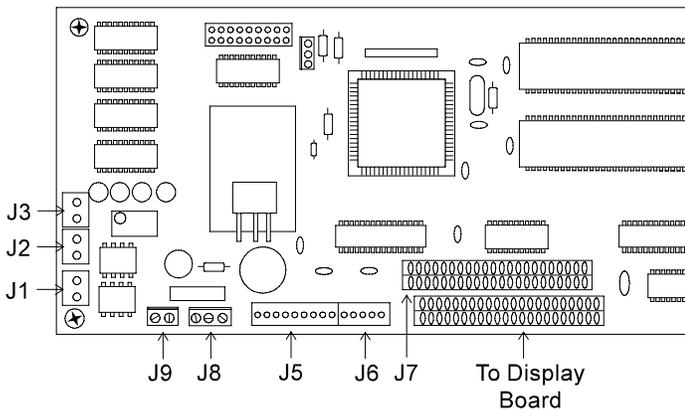


**Figure 5-4**

1. Carefully remove the wires and connectors from the circuit board, noting their locations. Figure 5-4 identifies the connections.
2. Unscrew the four Phillips screws from the corners of the board and remove the board from the assembly

**d. The Microprocessor Circuit Board P/N 190455**

Remove the Temperature Board as outlined in Section 5.5.c (above). Remove the wires and connectors from the Microprocessor Board, noting their locations. Unscrew the four Phillips screws and remove the board from the tray. Refer to Figure 5-5.



**Figure 5-5**

Table 5-1 identifies the microprocessor circuit board connectors

**Table 5-1  
Microprocessor Board Pin Connectors**

Connector	Description
J1	Lid safety Switch
J2	Baud rate 1200 default, 9600 with pins shorted
J3	Not used
J5	RS-232 port (right pins) RS485 Port (left pins)
J6	To Motor Driver Circuit Board
J7	Connector to stack with Temperature Board
J8	Not used
J9	20VAC in

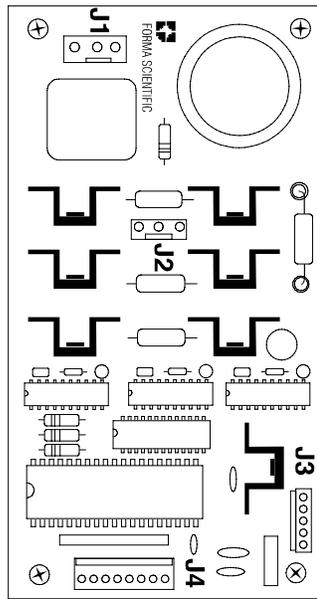
**e. The Motor Driver Circuit Board, P/N 190430**

The Motor Driver Circuit Board illustrated at the right, is located inside the shaker cabinet beneath the platform. To access the board, remove the platform and then remove the eight phillips screws which fasten the sheet metal top to the cabinet base. (Figure 5-7)

Also, remove the three screws along the back of the cabinet beneath the cover hinge. It will be necessary to remove the cable cover on the left side of the rear base.

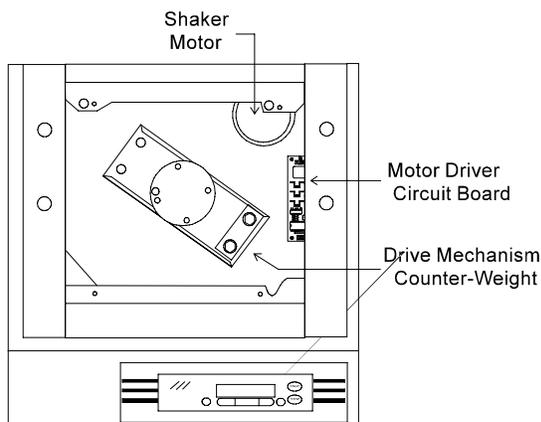
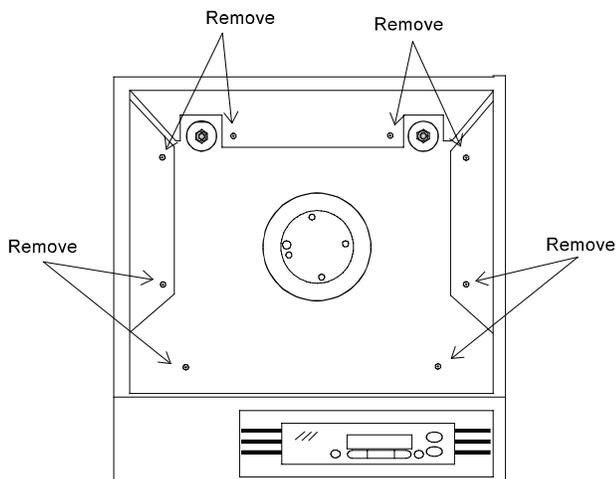
The entire acrylic top and upper metal portion of the cabinet may then be lifted off.

Table 5-2 identifies the connectors and pins on the Motor Driver Circuit Board, Figure 5-9 shows the locations of the major components. **Figure 5-6**



**Table 5-2  
Connector Pin Description, Motor Driver Board**

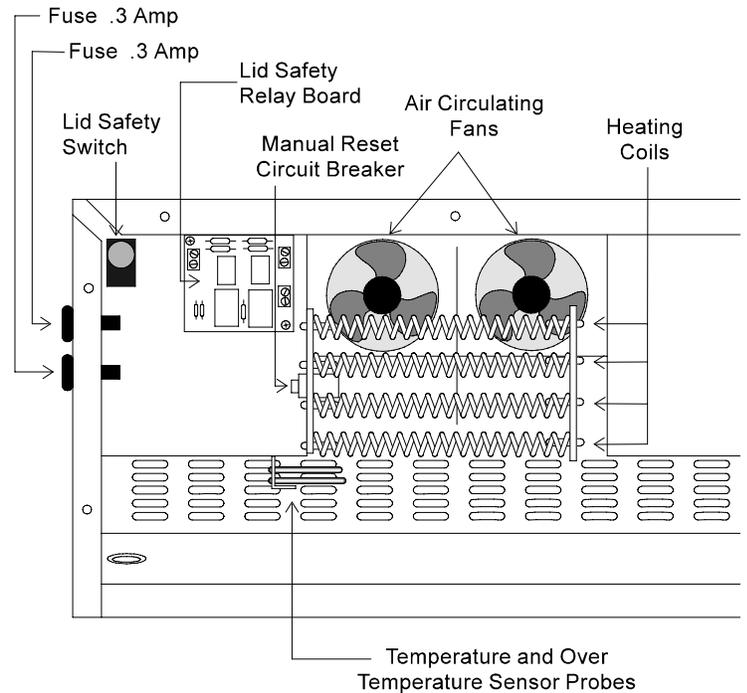
Connector	Pin #	Description
J1	1	AC in
	2	Ground
	3	AC in
J2	1	Phase A out
	2	Phase B out
	3	Phase C out
J3	1	+5 volts
	2	HS3
	3	HS2
	4	HS1
	5	Ground
J4	1	PA5
	2	MISO
	3	MOSI
	4	SCK
	5	Ground
	6	Ground
	7	HS4
	8	+5 volts



**Figure 5-7**

**f. The Manual Reset Safety Circuit Breaker P/N 400113**

To prevent excessively high temperatures inside the shaker cabinet if the air circulating fans should fail, a safety circuit breaker is located adjacent to the heating elements. (Figure 5-8) This thermal device will shut off the heaters and must be manually reset. Remove the back panel of the shaker to access this circuit breaker



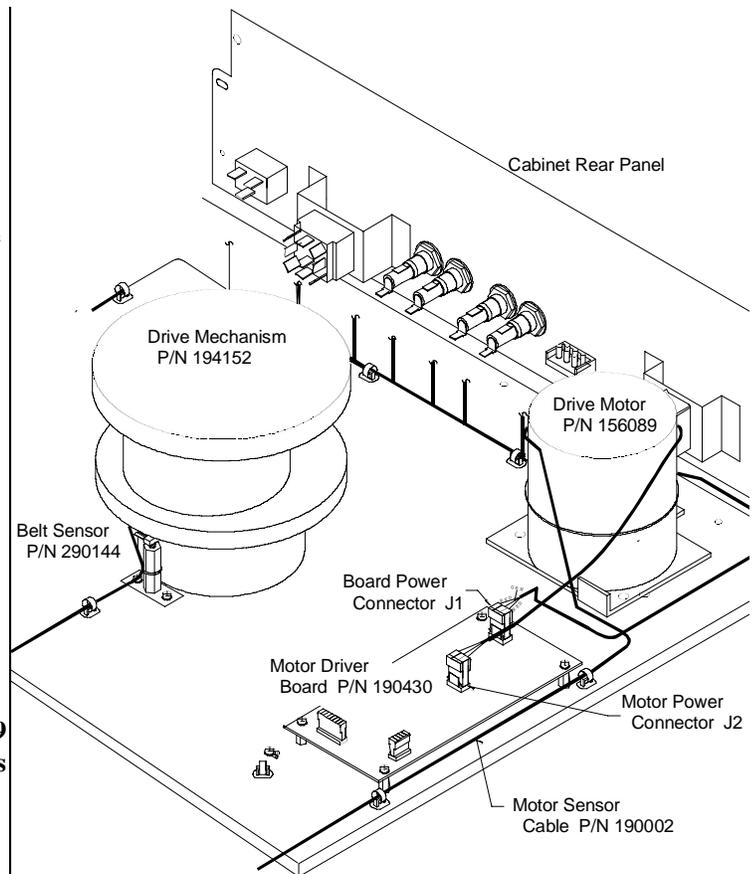
**Figure 5-8**  
**Model 4518 cabinet with rear panel removed**

**g. The Temperature Sensors**

Two sensors are located inside the back of the shaker which are part of the temperature regulating and temperature alarm systems. The location of these sensors is shown in Figure 5-8. Both sensors are wired to a single connector on the Temperature Circuit Board. Refer to Figure 5-4.

If either of these sensors should fail, a Pi symbol will appear on the left side of the temperature display.  
Example: II 32°C.

Install new sensors by splicing the replacements onto the wires presently connected to the faulty sensor.



**Figure 5-9**  
**Drive Motor and operating components**

## Section 6 - Specifications

### a. Shaking

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

### b. Temperature

Range	5°C above ambient to 60°C (140°F)
Control	0.1°C
Indicator	LCD, in 0.1°C increments

### c. Timer

Periods	Programmable from 1 min. to 199 hours 59 minutes or for continuous operation
Indicator	LCD in 1 minute increments
Run Time	Display counts down for a timed run or counts up when in "hold" function

### d. Alarms

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

### e. Safetys

Temperature	Independent over and under temp
RPM	Independent platform motion

### f. LCD Display

Run Time	Failure indicated by message
RPM	Failure indicated by message
Temperature	Failure indicated by message
User Program	Failure indicated by message
Alarm Condition	Failure indicated by message
Power	Failure indicated by message

### g. Drive

Triple counterbalanced.

Handles unbalanced platform loads regardless of flask placement

### h. Drive Motor

1/3 HP brushless DC, permanently lubricated ball bearing

### i. Cover

Hardened acrylic, dual gas spring cylinder assisted, with security lock

### j. Automatic Restart

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

### k. Construction

Interior	Cold rolled steel
Exterior	Cold rolled steel
Finish	Powder coated for a durable, easily maintained surface
Platform	Anodized brushed aluminum

### l. Dimensions

Exterior	24.3" W x 20.6" H x 29.0" F-B (61.7cm x 52.3cm x 73.7cm)
Exterior (lid open)	24.3" W x 37.5" H x 29.0" F-B (61.7cm x 95.3cm x 73.7cm)
Interior	21.4" W x 13.3" H x 21.4" F-B (54.4cm x 33.8cm x 54.4cm)

### m. Electrical

4518	90-125VAC, 50/60Hz, 1 PH, 5.6 FLA 180-250 VAC, 50/60Hz, 1 PH, 2.9 FLA
Data Output	RS-232 standard
Remote Alarm Contacts	Time, RPM, Temperature and Power Alarms

### n. Certification

UL	Standard No. UL1262
CSA	Standard C22.2 No. 151

**o. Capacity**

Flasks From (49) 25ml up to (5) 2L

**p. Weights**

Net 153 lbs. (69.5kg)

Shipping 191 lbs. (86.7kg)

**q. Optional Platforms**

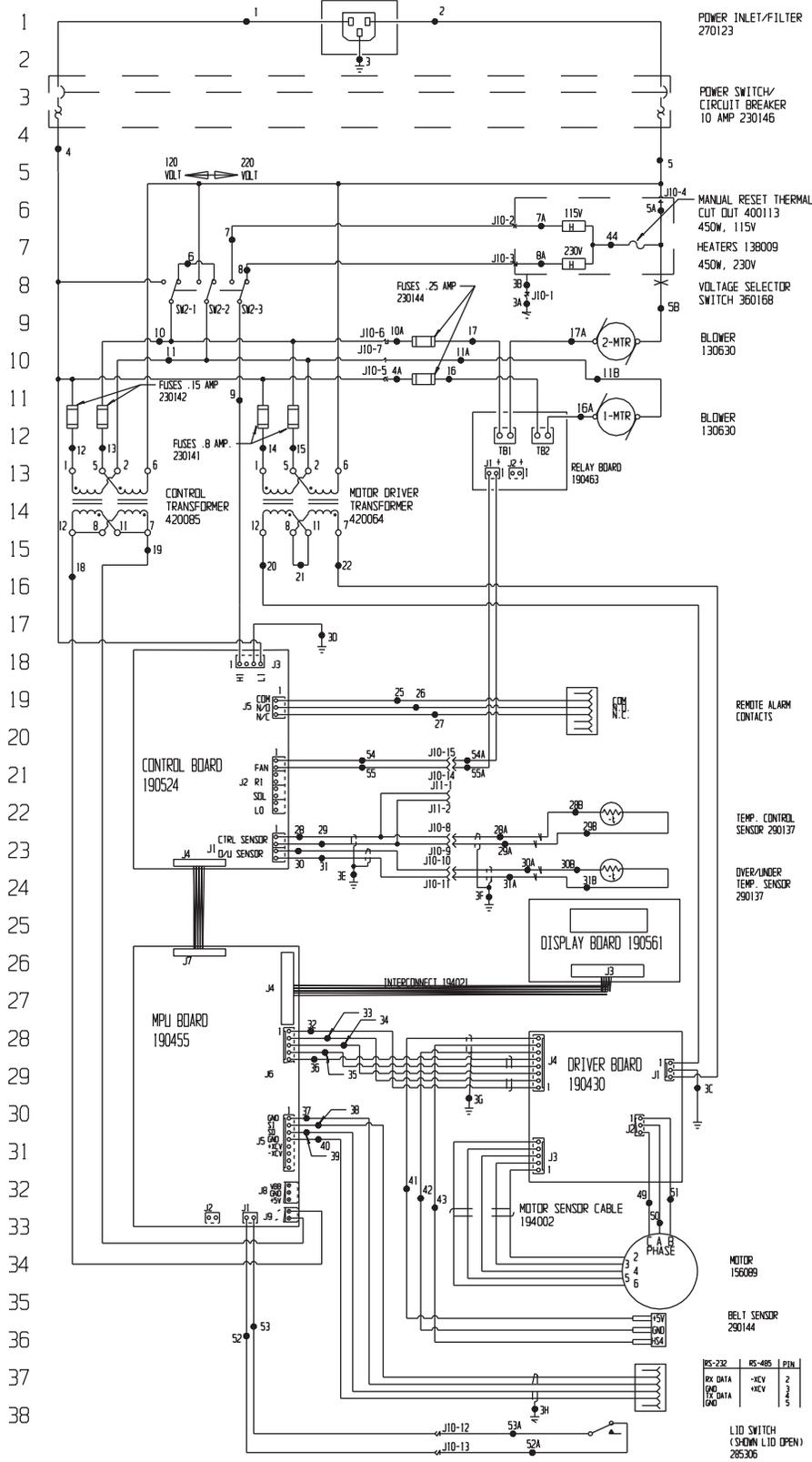
Size 18" x 18" (45.7cm x 45.7cm)

Clips 25ml, 50ml, 125ml

**Section 7 - Parts List**

<b>Part No.</b>	<b>Description</b>
129034	Pneumatic Spring, 30 lbs.
130630	Fan, 115 CFM, 115 V
138009	Heater, Wirewound 450 W 115V/230V
156089	Motor, Brushless 24V
190430	Motor Drive Board
190524	Temp Control Board
190438	LCD Display Panel
190455	Shaker Micro Board
190463	Relay Board
230141	Fuse, 800MA, T.D. 5 x 20 mm
230142	Fuse, 150MA, T.D. 5 x 20 mm
230146	Switch/Circuit Breaker 10 Amp
285306	Push-Button Switch, SPDT
290137	Probe, 2252 OHM/25C, 1/8 x 2
290144	Sensor, 5VDC 4MA
360168	Switch, 3PDT Toggle 15 Amp
400113	Thermostat
420064	Transformer, 130VA
420085	Transformer, 25VA
800040	V-Belt, 1/2" x 45"
435051	Screwdriver, Phillips 8-3/4"
443020	Wrench, Hex with T-handle
194046	Spare Part Screw Bag, (platform and clips)

POWER CONNECTION  
 120V, 1PHASE, 50/60HZ, 5.6A  
 OR 220V, 1 PHASE, 50/60 HZ, 2.9A



Electrical Schematic  
 Forma Model:  
 4518 Table Top  
 Shaker/Incubator

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4518-70-0-D Rev. 4  
 Page 1 of 2



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