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Guide to Operations

C-24KC Classic Benchtop Incubator Shaker

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CAUTION!

This equipment *must* be operated as described in this manual. If operational guidelines are not followed, equipment damage and personal injury *can* occur. Please read the entire User's Guide before attempting to use this unit.

Do not use this equipment in a hazardous atmosphere or with hazardous materials for which the equipment was not designed.

New Brunswick Scientific Co., Inc. (NBS) is not responsible for any damage to this equipment that may result from the use of an accessory not manufactured by NBS.

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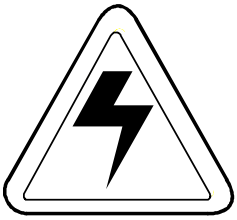
NOTE:

Notes contain essential information that deserves special attention.



CAUTION !

***Caution* messages appear before procedures which, if caution is not observed, could result in damage to the equipment.**



WARNING !

***Warning* messages alert you to specific procedures or practices which, if not followed correctly, could result in serious personal injury.**

Bold

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1 OVERVIEW

The C-24KC Classic Benchtop Incubator Shaker is a portable shaker utilizing a triple eccentric counterbalanced drive to provide horizontal plane rotary motion in a ¾ inch (1.9 cm) or 1 inch (2.54 cm) circular orbit. A Proportional/Integral (PI) Microprocessor controller with instantaneous digital feedback controls the speed over a range of 50-400 rpm. It also provides temperature control over a range of 15°C below ambient (minimum setpoint 5°C) to 60°C.

The shaker may be operated either continuously or in a timed mode via a programmable timer for shaking periods of 0.1 hour to 99.9 hours.

For safe operation, the C-24KC is provided with a safety switch which automatically stops the shaker mechanism, when the lid is lifted. Additionally, the lid can be operated with one hand and latches when fully opened and an upward motion deactivates the latch for closing the lid.

In addition, the C-24KC is equipped with audible and visual alarms that alert the user to the following conditions:

- The end of a timed run
- Deviations of shaking speed
- Deviations of temperature setpoint
- Power failure
- Lid open

A wide variety of platforms can be used with the C-24KC. Dedicated platforms are available for a variety of flask sizes. Universal platforms, utility trays, utility carriers and test tube racks are also available.

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1.1 Specifications



NOTE:

This product meets the standards for CENELEC EN 61325-1 Class A specifications.

C-24KC Classic Benchtop Incubator Shaker		
Shaking Speed	**Range**	50-400 rpm
	Control Accuracy	+/- 2 rpm
	Indication	3-digit LED
	Stroke	¾ inch (1.9 cm) or 1 inch (2.54 cm)
Temperature	**Range**	15°C below ambient temperature to 60°C
	Control Accuracy	± 0.25°C
	Indication	Digital LED display in 0.1°C increments
	Heaters	Low-watt density resistance type
	Refrigeration	1/5 HP, CFC-free (R134A) refrigerant
Ambient Operating Environment		5 - 35°C 20 to 90% relative humidity, non-condensing
Alarms		Audible and visible warning indications when speed deviates more than 5 rpm or temperature more than 1°C from setpoint, and when timer has expired.
Timer		0.1 hour to 99.9 hours. Shuts off agitation at end of period. Can be deactivated for continuous operation.
Automatic Restart		Automatic restart after power is restored. Setpoints and operating status are retained in memory during power interruption.
Drive Interrupt		Automatic drive-interrupt when cover is opened.
Electrical Requirements		115/230V AC 50/60 Hz, 1500 VA
Platform		18 x 18 in 46 x 46 cm
Overall Dimensions Width x Depth x Height		22 x 28 x 26 in 56 x 71 x 66 cm
Overall Height with Lid Open		41 inches 104 cm
Chamber Dimensions Width x Depth x Height		20.5 x 22 x 13 in 52 x 56 x 33 cm
Weight	**Net**	180 lbs 82 kg
	Gross	200 lbs 91 kg

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2 INSPECTION, VERIFICATION & UNPACKING OF EQUIPMENT



WARNING!
The unit is heavy.
Do not attempt to lift or move it by yourself.

2.1 Inspection of Boxes

After you receive your order from New Brunswick Scientific, inspect the boxes carefully for any damage that may have occurred during shipping. Report any damage to the carrier and to your local NBS Sales Order Department immediately.

2.2 Packing List Verification

Verify against your NBS packing list that you have received the correct materials. Report any missing or incorrect items to your local NBS Sales Order Department.

2.3 Unpacking of Equipment

Save all packing materials and the User's Guide. If any part of your order was damaged during shipping, missing pieces, or fails to operate properly, please fill out the *Customer Satisfaction Form 6300* and return it by fax.

There are two small plastic straps holding the bearing housing in place during shipping. Remove the straps from the bearing housing once the unit is unpacked and inspected.

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3 PREPARING THE LOCATION

3.1 Physical Location

The surface where you place the C-24KC should be smooth, level and sturdy, and must be able to accommodate 200 pounds. The feet can be adjusted for leveling, if necessary: loosen the locking nuts on the threaded studs attached to the feet of the shaker, then retighten when you have achieved the correct level for your shaker.

3.2 Environment

The C-24KC operates properly under the following conditions:

- ambient operating temperature range: 5 - 35°C
- relative humidity 20 to 90% non-condensing
- main voltage fluctuation not to exceed 10 %
- indoor use only



CAUTION! **The C-24KC is very heavy and may require special equipment to transport. *Never* try to lift or move it by yourself.**

3.3 Unpacking of Equipment

Save all packing materials and the User's Guide.

If any part of your order was damaged during shipping, is missing pieces, or fails to operate properly, please fill out the *Customer Service Form 6300* and return it by fax. This form can be found in the envelope that contains the warranty card.

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3.4 Inspection of Equipment

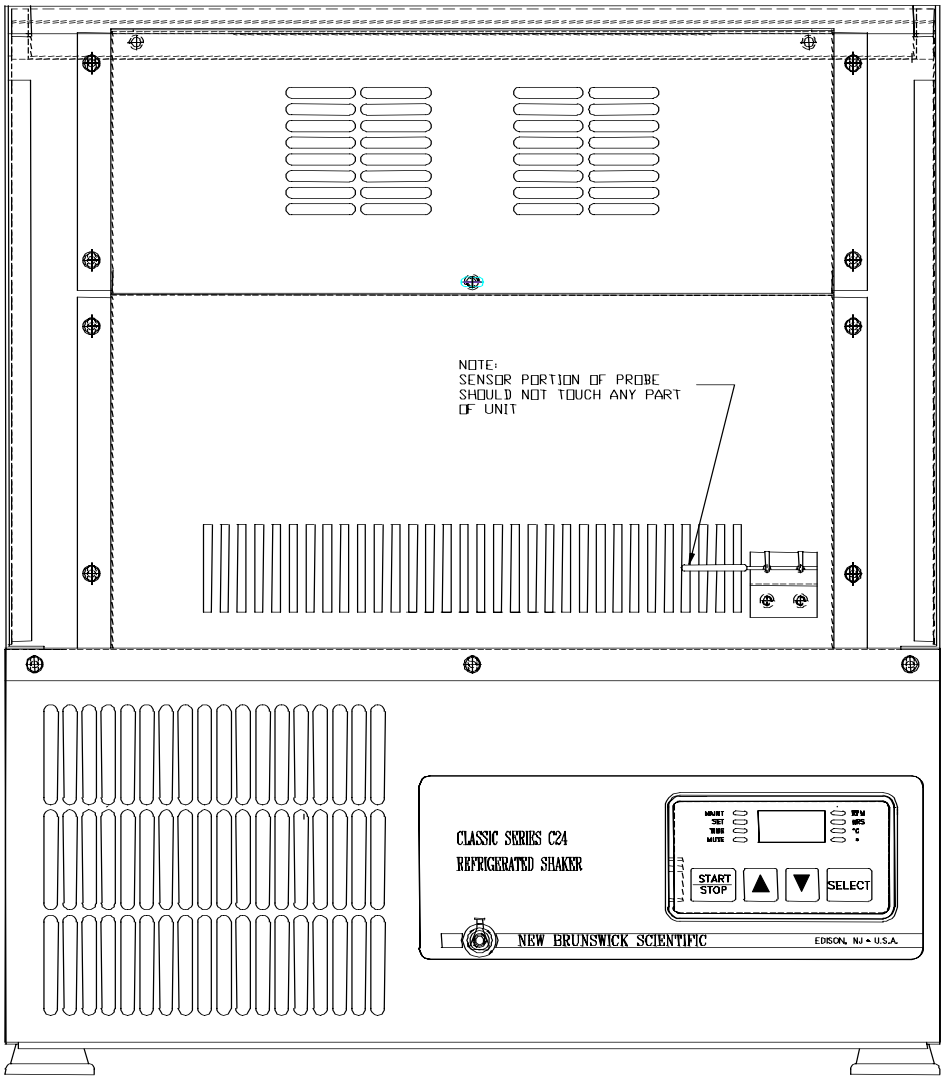
Verify against the packing list that you have received everything you ordered. If anything is missing, contact your NBS sales representative.

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4 SHAKER FEATURES

The Keypad and LED Display are located on the front panel:

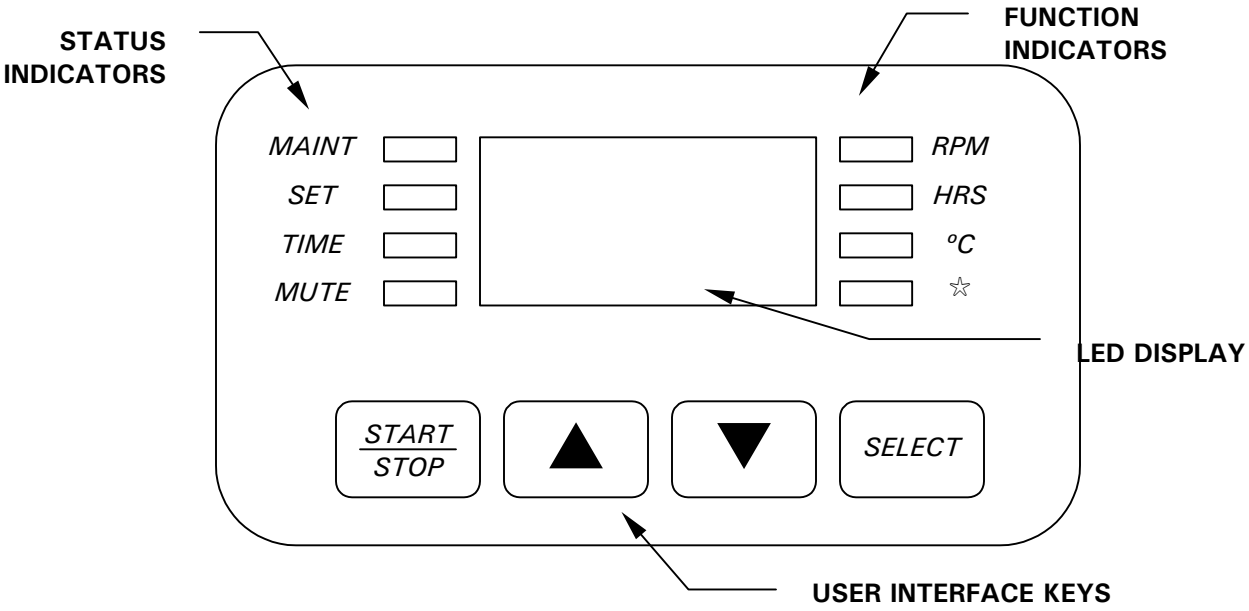
Figure 1: Front View



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4.1 Keypad

Figure 1a: Keypad & LED Display



4.1.1 LED Display

The digital display on the control panel is a three-digit **LED DISPLAY**. During normal shaker operation, the display will indicate:

- Shaker status (On/Off)
- Shaking speed
- Chamber temperature
- Setpoints
- Hours remaining (timed run)
- Lid open

4.1.2 User Interface Keys

- **START/STOP** — This key is used to start or stop the shaker. It will also activate or stop the timer when a timed run is desired.

- **SELECT** — This key is used to enter the SET mode, to make setpoint changes.

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- **▲(UP), ▼(DOWN)** These keys are used to adjust the setpoint of a displayed parameter up or down.

4.1.3 Status Indicators

Four status indicator lights are located to the left of the **LED DISPLAY**. They are:

- **MAINT** Remains lit after 10,000 hours of use. Accumulated running time is internally monitored and may be displayed as a guideline.
- **SET** Indicates that the shaker is in the **SET MODE**. Setpoints are displayed and can be altered.
- **TIME** Indicates that the timer is in operation. The shaker can be programmed to run for a preset time from 0.1 hour to 99.9 hours without stopping an ongoing run. The timer can be disengaged or reset..
- **MUTE** Indicates the status of the audible alarm—when the **MUTE** indicator is illuminated, the audible alarm device is disabled.

4.1.4 Function Indicators

Four function indicator lights are located to the right of the **LED DISPLAY**. They identify the current parameter being displayed:

- **RPM** Revolutions per minute
- **HOURS** Time remaining in cycle
- **°C** Interior chamber temperature
- ***** Not used at this time

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4.2 Platform Assemblies

The C-24KC can be used with a wide variety of NBS 18 x 18 inches (46 x 46 cm), platforms which will accept a variety of clamps for flasks test tubes, etc.

A platform is a separate item that is required for operation. Refer to the Replacement Parts and Accessory Information section of this manual for details.

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5 GETTING STARTED

5.1 Installation of Platform

A platform is required for operation. To install a platform on the unit, do the following:

NOTE:

There are two small plastic straps holding the bearing housing in place during shipping. These straps must be removed from the unit.

1. Using the 5/32 inch hex wrench provided, remove the four Allen head platform screws from the **UPPER BEARING HOUSING**.
2. Place the platform on the **UPPER BEARING HOUSING**. Align the mounting holes of the platform with the platform screw locations in the **UPPER BEARING HOUSING**.
3. Insert the platform screws and tighten them down with the 5/32 inch hex wrench to secure the platform.

5.2 Installing Flask Clamps

Flask clamps purchased for use with universal platforms (*see Section 10.2*) require installation. Clamps are installed by securing the base of the clamp to the platform with the correct type and number of screws. All clamps are shipped complete with hardware.

Clamps for 2-, 2.8- and 4-liter flasks are shipped with an additional girdle to keep the flasks in place. The girdle is an assembly of springs and sections of rubber tubing. One girdle is already in place on the clamp, the other is packed separately. To install these double girdle clamps:

1. Place the clamp on the platform, aligning its mounting holes with holes on the platform. Secure the clamp in place using the flat Phillips head screws provided (#S2116-3051, 10-24 x 5/16-inch). *Use Figure 2b on the following page to help you identify the proper screws, as three different types of screws are shipped with the clamps*.
2. With the first girdle in place, as delivered, on the upper part of the clamp body (*see Figure 2a on the following page*), insert an empty flask into the clamp.
3. After making sure the sections of tubing are located between the clamp legs, roll the first girdle down the legs of the clamp as far as it can go. The tubing sections will rest against the platform, and the springs will be under the clamp base.

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4. Place the second girdle around the upper portion of clamp body (just as the first girdle was initially). Make sure that its spring sections rest against the clamp legs, while its rubber tubing sections sit against the flask, in between the clamp legs.

Figure 2a: Double Girdle Clamp Installation

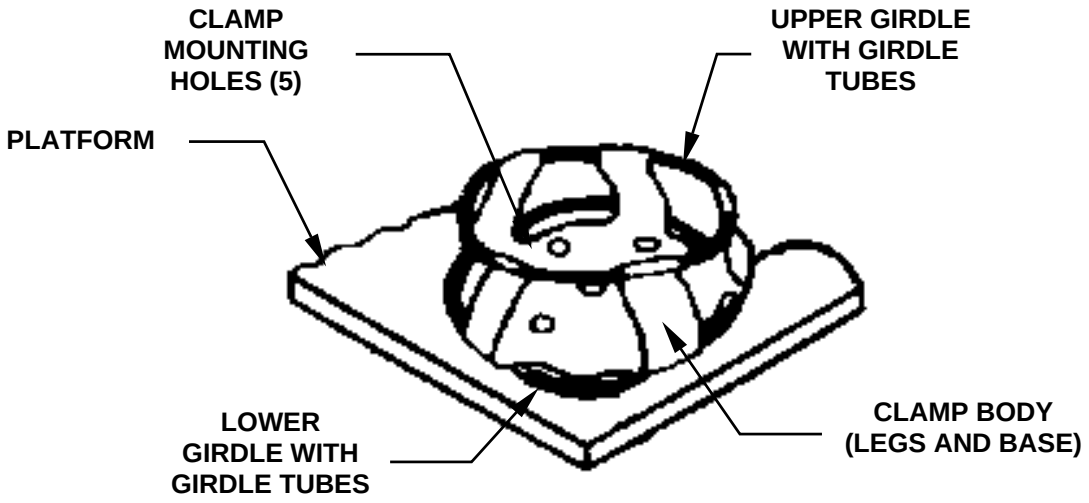
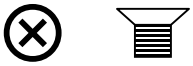


Figure 2b: Clamp Fastener



NOTE:

The upper girdle secures the flask within the clamp, and the bottom girdle keeps the flask from spinning.

NBS flask clamps are used on a variety of shaker platforms. Flat head screws of different lengths and thread pitch are used to secure the clamp. To identify the proper screw for your shaker application by reference to the head style, consult Table 1 below, find the proper screws and set the others aside:

Table 1: Clamp Hardware Application Chart

No matter what size the clamp, use these screws to fasten them to your platform:

Description	*Part Number*	*Qty.*	*Application*
10-24 x 5/16 (7.9 mm) flat Phillips (+) head screw	S2116-3051	1	5/16" (7.9 mm) thick aluminum, phenolic and stainless steel platforms.

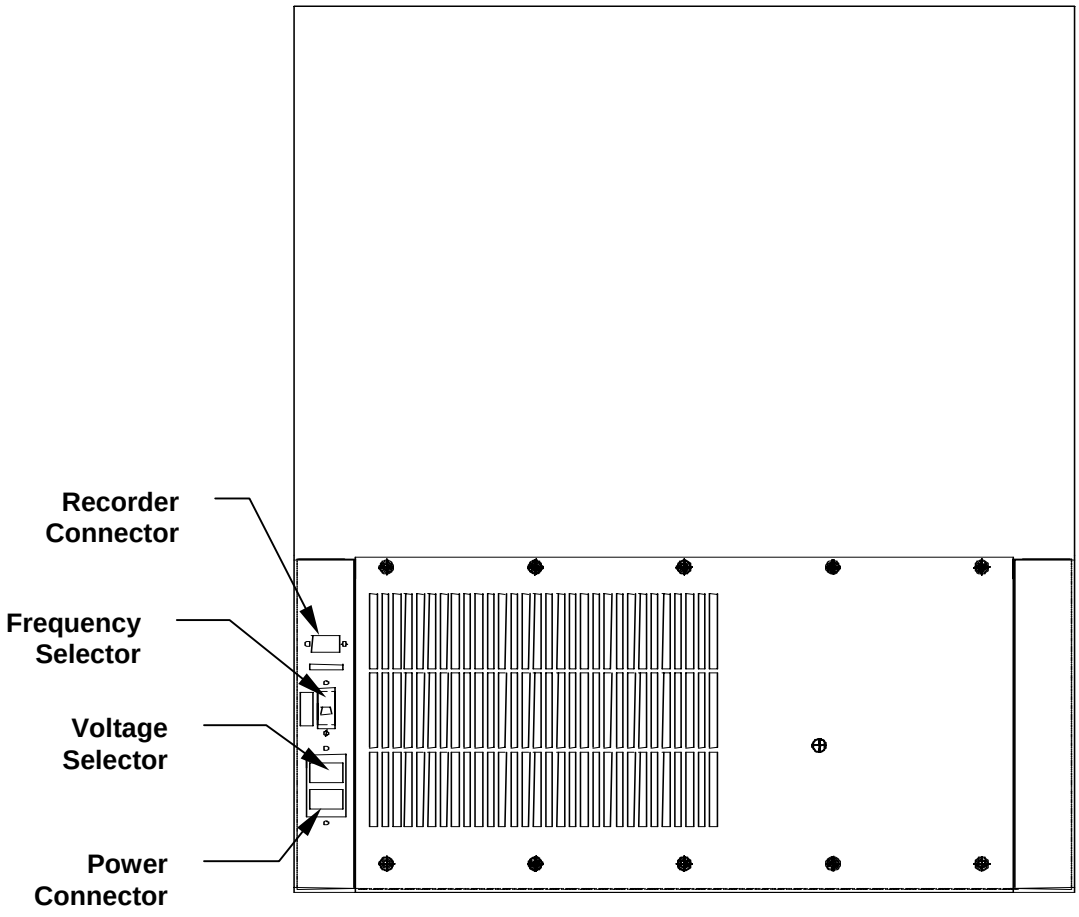
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5.3 Electrical Connections

Before making electrical connections, verify that the power source voltage matches the voltage on the **ELECTRICAL SPECIFICATION PLATE** and that the **ON/OFF SWITCH** is in the **OFF** position. The **ELECTRICAL SPECIFICATION PLATE** and the **ON/OFF SWITCH** are located on the side panel of the unit.

Connect the **POWER CORD** to the **POWER CONNECTOR** *(see Figure 3 below)* and the other end to a suitable, grounded receptacle.

Figure 3: C-24KC Rear View



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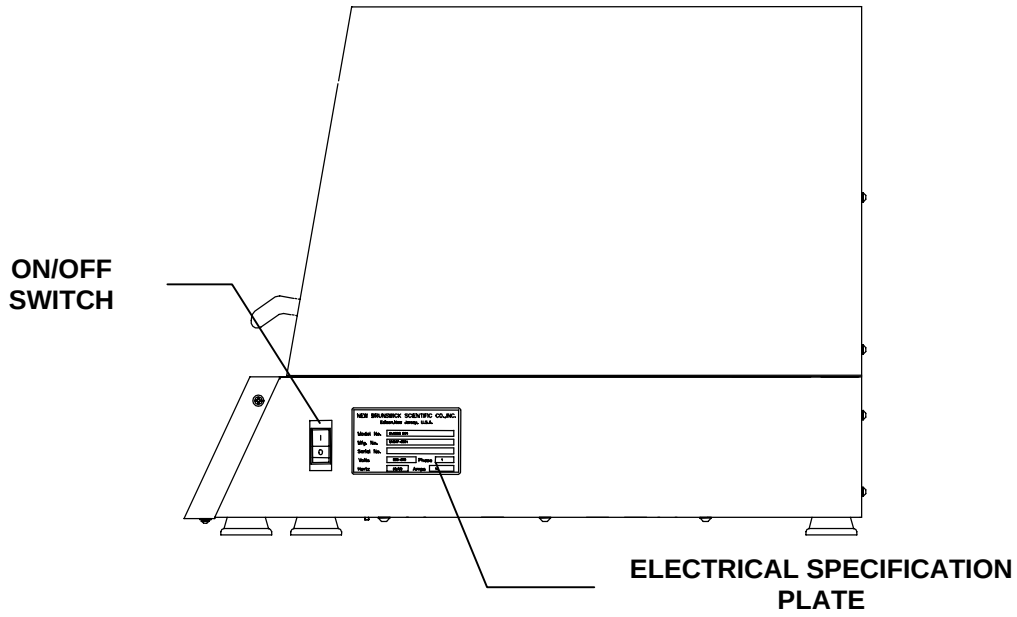
6 OPERATION

6.1 Starting the C-24KC

Voltage and frequency are set at the factory prior to shipping. For safety's sake, before you start the shaker, make sure that the voltage selector and frequency switch are set to match your electrical supply. This information is on the **ELECTRICAL SPECIFICATION PLATE** on the side of the unit *(see Figure 4 below)*.

To initially start the shaker, close the lid and turn the **ON/OFF SWITCH** on the side of shaker to the **ON** position. If the shaker begins to operate, the **LED DISPLAY** will track the speed as it accelerates to the last entered setpoint. The shaking action may be stopped or started by pressing the **START/STOP KEY**.

Figure 4: C-24KC Side View



NOTE:

The shaker will not operate if the lid is open. This is indicated by the word "lid" appearing in the LED DISPLAY.

6.2 Continuous (Unlimited) Run

1. Press **SELECT** until the **RPM INDICATOR** is illuminated.
2. If the display indicates that the shaker is **OFF**, press the **START/STOP KEY**.
3. Press either ▲ or ▼ **KEYS** to enter **SET MODE** (the **SET INDICATOR** will illuminate).

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4. Set the speed by using the ▲ or ▼ **KEYS** until the desired setpoint is displayed. Holding the ▲ or ▼ **KEYS** will cause the setting to change more rapidly.

NOTE:

The setpoint may be changed during a run without stopping the shaker by following steps 2-4. During speed changes, an audible alarm will sound and a visual alarm (flashing RPM INDICATOR) will flash until the speed returns to within 5 rpm of the setpoint.

6.3 Checking Any Setpoint

1. Press **SELECT** until the desired indicator is illuminated.
2. Press either ▲ or ▼ **KEYS** to enter the **SET MODE** and display the current setpoint.

CAUTION!
Holding the ▲ or ▼ for more than 0.5 seconds causes the speed setpoint to change. Should this occur, resetting will be necessary.

6.4 Timed Functions

The shaker may be programmed to automatically stop after a preset time period of 0.1 hour - 99.9 hours. There must be power to the shaker in order to set the timer. However, a timed run can be initiated while the unit is either shaking or stopped.

To set the timer:

1. Press the **SELECT KEY** until the **HRS INDICATOR** is illuminated.
2. Press either ▲ or ▼ **KEYS** to enter the **SET MODE** and set between 0.1 - 99.9 hours.
3. While the **SET INDICATOR** is illuminated, press the **START/STOP KEY** to program the time (and start the run). The **HRS INDICATOR** will light and remain on for the duration of the run. At the end of the timed run the display will read **OFF**, and the **HRS INDICATOR** will flash.

To disable the alarm (flashing **HRS INDICATOR**), press the **SELECT KEY** and change to any other function.

To cancel the timer without stopping the shaker:

Repeat steps 1 and 2, then immediately press the **START/STOP KEY**. The **HRS INDICATOR** will cease to flash and the display will read **OFF**.

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6.5 Audible Alarm Functions

The shaker has an audible alarm that is activated at the end of a timed run, or if the temperature is 1ºC or more from the setpoint, or if the speed is 5 RPM or more from the setpoint. It may be deactivated in the following way:

1. Press the **SELECT KEY** until the **HRS INDICATOR** is illuminated.
2. Simultaneously press the ▲ and ▼ **KEYS** . The **SET** and **MAINT INDICATORS** will flash.
3. While the **SET** and **MAINT INDICATORS** are flashing, press the **START/STOP KEY**. The **MUTE INDICATOR** will light to advise that the audible alarm has been deactivated.

To reactivate the alarm, repeat steps 1-3. The **MUTE INDICATOR** will be extinguished when the alarm has been reactivated.

6.6 Temperature Offset Calibration

The temperature probe and the temperature controller are calibrated together at the factory. The temperature probe measures the temperature of the air at the probe's location, near the heat exchanger return vent. The controller uses the probe input to adjust air temperature, up or down, to match the temperature setpoint.

Depending on various conditions within the chamber, such as flask placement and size, the heat produced by growing organisms, heat losses due to liquid evaporation from flasks, etc., the display temperature may differ from temperatures within the flasks themselves.

If you wish to have the temperature display ("Indicated Temperature") match the temperature at a given point, or match the average of a series of points within the chamber ("Actual Temperature"), proceed as follows:

1. Let the unit equilibrate at or near the desired temperature. Record the Indicated Temperature.
2. Record the Actual Temperature.
3. Calculate the temperature correction value: Actual Temperature – Indicated Temperature = Temperature Correction Value.
4. Press the **SELECT KEY** until the function **°C INDICATOR** illuminates.
5. Simultaneously press the ▲ and ▼ KEYS. The **SET** and **MAINT INDICATORS** will light.
6. While the **SET** and **MAINT INDICATORS** are illuminated, use the ▲ or ▼ KEY to set the display to the calculated Temperature Correction Value.

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NOTE:

The °C light will pulse rapidly for a short duration to indicate it is not operating in the factory default mode. It will pulse for a longer duration and less rapidly (with a frequency of approximately one second) to indicate temperature is more than one degree above or below setpoint.

To return to the factory calibration:

1. Press the **SELECT KEY** until the function **°C INDICATOR** illuminates.
2. Simultaneously press the ▲ and ▼ **KEYS**. The **SET** and **MAINT INDICATORS** will light.
3. While the **SET** and **MAINT INDICATORS** are illuminated, press the **START/STOP KEY**.

6.7 Temperature Setpoint

Press the **SELECT KEY** until the function **°C INDICATOR** illuminates. The temperature can be set from 15°C below the current ambient temperature up to 60.0°C. Increasing or decreasing the setpoint is accomplished with the ▲ or ▼ **KEYS**.

During operation, if the temperature of the chamber is more than 1.0°C higher or lower than the temperature setpoint, the audible and visual alarms are triggered. The visual alarm consists of a flashing **°C INDICATOR**. The alarms will automatically deactivate as the unit achieves the set temperature.

6.8 Total Running Time

The control modules of the C-24KC shaker tracks the time the shaker has been "**ON**". To display the accumulated running time:

1. Press **SELECT** until the **HRS INDICATOR** is illuminated.
2. Simultaneously press the ▲ and ▼ **KEYS**.

The **SET** and **MAINT INDICATORS** will flash and the accumulated running time will be displayed in hundreds of hours (i.e., "02" equals 200 hours; "102" equals 10,200 hours). This display will continue for 10 seconds and then default to the previous mode readout.

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6.9 Maint Indicator

After 10,000 hours of operation, the **MAINT INDICATOR** will illuminate. Preventive maintenance is recommended at this point. To deactivate the **MAINT INDICATOR**, perform the following:

1. Press **SELECT** until the **HRS INDICATOR** is illuminated.
2. Simultaneously press the ▲ and ▼ **KEYS**.
3. Press the ▼ **KEY**.

6.10 Power Failure

In the event of a power failure, the C-24KC Benchtop Incubator Shaker is equipped with an automatic restart function.

If the shaker was in operation prior to the power interruption, the shaker will begin to operate at its last entered setpoint. The **LED DISPLAY** will flash, indicating that a power failure has occurred. Press any key to cease the flashing in the display.

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7 PREVENTIVE MAINTENANCE

*Although the C-24KC shaker requires no routine mechanical maintenance, the user should provide some routine preventive maintenance. After the shaker has operated for more than 10,000 hours, the **MAINT INDICATOR** on the control panel will illuminate. This means that the shaker requires a routine maintenance check.*

Preventive maintenance keeps your equipment in proper working condition. When periodically performed, maintenance results in longer life for your equipment and reduces time lost due to equipment failure. We suggest that you perform the maintenance procedures outlined in the following pages.



WARNING!
Always turn off the Shaker and disconnect the power cord from the power supply before performing any maintenance on the unit.

7.1 Acknowledging the MAINT Light

When the **MAINT STATUS INDICATOR** light comes on, the following steps will turn the light off:

1. Press the **SELECT KEY** until the **HRS FUNCTION INDICATOR** illuminates.
2. Simultaneously press the ▲**KEY** and the ▼**KEYS** and hold for a few seconds. The **MAINT STATUS INDICATOR** flashes.
3. Press the ▼**KEY** and the **MAINT** light will turn off.

7.2 Cleaning Procedures



WARNING!
Always **disconnect the power cord before performing *any* maintenance on the Shaker.**
Do not **immerse the Shaker in water or any liquids.**
Do not **use a cleaning fluid that is corrosive or flammable on or around the Shaker.**

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7.3 Cleaning External Surfaces

The unit may be cleaned using a damp cloth or any standard, household or laboratory cleaner to wipe down its outer surfaces. Do not use abrasive or corrosive compounds to clean this instrument, as they may damage the unit and void the warranty.

DO NOT USE window cleaning fluids, scouring compounds, gritty cloths, leaded or ethylene gasolines or solvents such as alcohol, acetone, carbon tetrachloride, etc.

The exercise of reasonable care in cleaning the chamber lid will minimize scratching.

The following techniques are recommended to clean the shaker:

1. Set the **ON/OFF POWER** Switch to **OFF**.
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Use a cloth dampened with mild detergent and water to wipe the exterior and interior of the shaker.
4. Rinse the cloth in clean water, and wipe the exterior and interior of the shaker.
5. Clean the viewing window with standard laboratory glass cleaner.
6. Reconnect the **POWER CORD** to the electrical outlet.

7.4 Condenser Fan Filter Cleaning

Every 3 to 6 months, you should remove accumulated dust from the **CONDENSER FAN FILTER**. The **CONDENSER FAN FILTER** is behind the front panel on the left side. If the shaker is located in a dusty environment, perform these cleaning procedures more often.

1. Set the **ON/OFF POWER** Switch to **OFF**.
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Before you can gain access to the front panel, open the door of the shaker. The door *must* be open all the way.
4. Using a Phillips head (+) screwdriver, remove the three screws that attach the hinged front panel to the housing. Gently lay down the front panel. Put the screws aside for reuse.
5. As you look into the shaker, the **CONDENSER FAN FILTER** is on the left side. Remove the two screws that hold the **FAN FILTER** to the grate; put them aside for reuse.
6. Wash the filter in warm soapy water, then rinse it thoroughly in cool water.
7. Allow the filter to dry completely before you put it back.
8. Using the two screws previously set aside, secure the **FILTER** to the grate.
9. Reinstall the hinged front panel using the three screws previously set aside. Tighten the screws with the Phillips head (+) screwdriver.
10. Close the door of the shaker.
11. Reconnect the **POWER CORD** to the electrical outlet.

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8 SERVICE PROCEDURES

The following sections describe basic service procedures and troubleshooting for the C-24KC. A qualified Service Engineer must perform the following procedures.

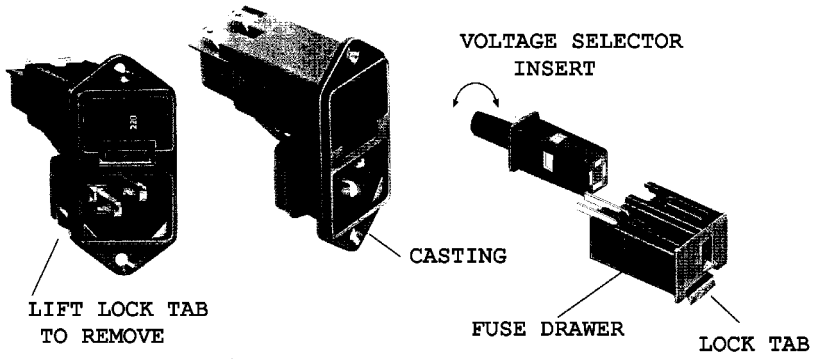
CAUTION!
The following procedures must be performed *only* by a qualified Electrical or Service Engineer.

8.1 Voltage Configuration

The C-24KC is set to the appropriate line voltage prior to shipment. The **VOLTAGE SELECTOR** is on the back panel of the shaker and is a universal power-entry device that can adapt to worldwide power requirements. If you relocate the shaker and need to reset the voltage, follow the procedure outlined below.

1. Verify that the shaker is disconnected from the power source.
2. Use a flat head screwdriver. Push the **FUSE DRAWER LOCK TAB** down and pull out the **FUSE DRAWER**.
3. Remove the **VOLTAGE SELECTOR INSERT** and rotate the selector until the desired voltage is found.

Figure 5: Voltage Selector



4. Place the **VOLTAGE SELECTOR INSERT** back into the **FUSE DRAWER**. Verify that the correct voltage is displayed through the **VOLTAGE WINDOW**.
5. Slide the **FUSE DRAWER** back into the **FUSE HOUSING** and verify that it locks into place.

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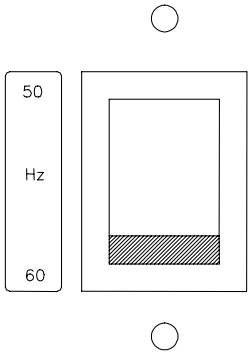
8.2 Setting Frequency

The C-24KC is set to the appropriate frequency prior to shipment. The **FREQUENCY SWITCH** (see drawing below) is on the back panel of the shaker. If you relocate the shaker and need to reset to the frequency, perform the following steps.

CAUTION!
If the C-24KC is being operated in Europe, CE Labeling requires that the following procedure be performed only by a qualified Electrical or Service Engineer.

1. Verify that the shaker is disconnected from the power source.
2. Slide the small red switch up for 50 Hz.
3. Slide the small red switch down for 60Hz.

Figure 6: Frequency Selector Switch



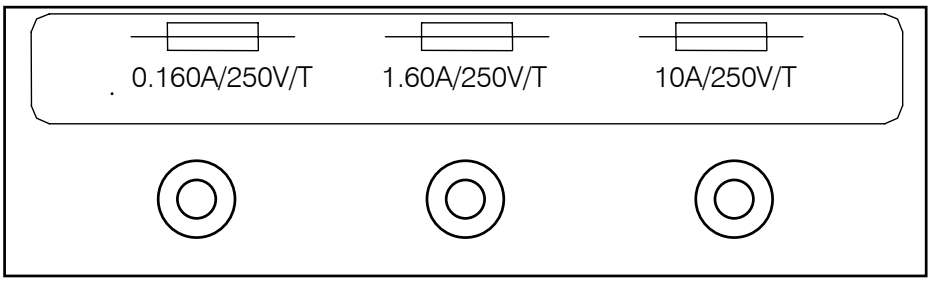
8.3 Fuse Replacement

There are three fuses for the C-24KC, housed behind the front panel. To replace a fuse, the qualified Electrical or Service Engineer will:

1. Set the **ON/OFF POWER** Switch to **OFF.**
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Open the door of the shaker to gain access to the front panel. The door *must* be open all the way.
4. Use a Phillips head (+) screwdriver to remove the three screws that secure the hinged front panel to the housing. Gently lay down the front panel, setting aside the screws for reuse.

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Figure 7: Fuse Holder Detail



5. Gently twist the black cap of the fuse. The fuse pops out.
6. Remove the bad fuse and replace it with a new one.
7. Replace the black cap and twist until tight.
8. Reinstall the front panel, securing it with the three screws previously set aside. Use a Phillips head (+) screwdriver to tighten the screws.
9. Close the door of the shaker, then reconnect the **POWER CORD** to the electrical outlet.

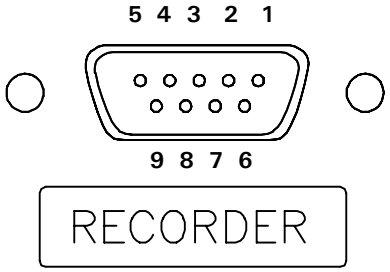
8.4 Accessory Recorder Connector

To record speed and temperature, an accessory recorder can be installed on the back panel of the shaker. The recorder should have the following capabilities:

- Two channels, required for Speed and Temperature. Each channel should have signal conditioning which accepts 0-5 volt input.
- The pin-out diagram and scale below identifies the application.

A mating connector is required on the recorder cable (not supplied). This is a 9-pin male D subminiature connector—AMP Amplimite HDP-20 series or equivalent.)

Figure 8: 9-Pin Recorder Connector



Pin Number	*Signal Name*	*Scale*
6 2	Speed Ground	1V = 100 RPM
7 3	Temperature Ground	1V = 20°C

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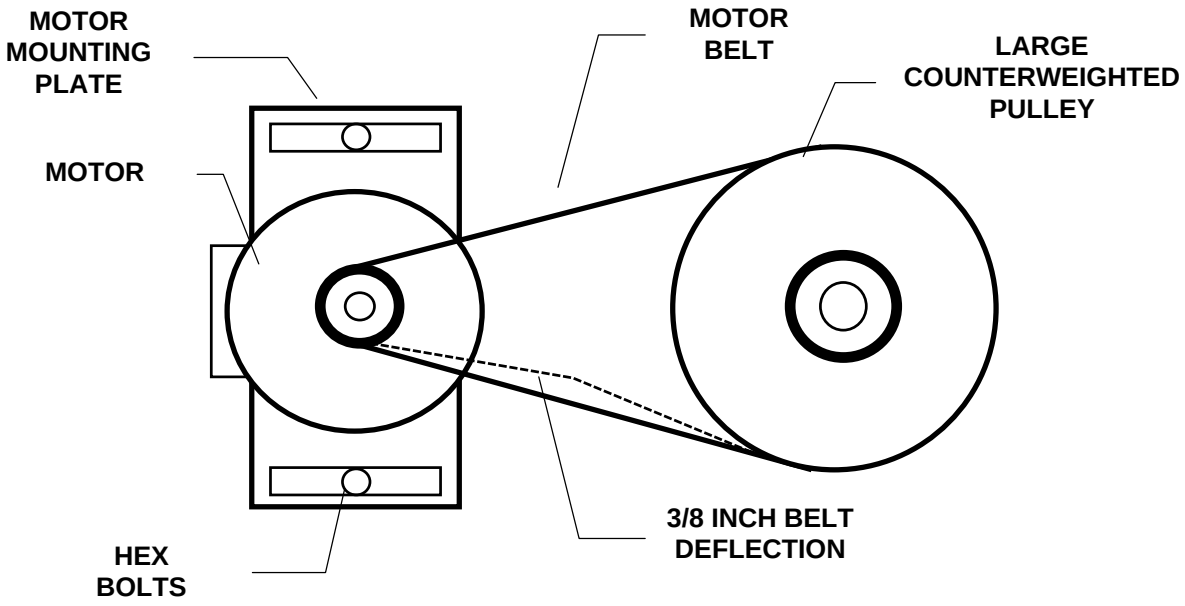
8.5 Motor Belt Replacement

WARNING!
***Always* keep fingers clear of the motor belt and pulley.**

The **MOTOR BELT** for the C-24KC is behind the front panel of the shaker. To replace the **MOTOR BELT**, the qualified Service Engineer will:

1. Set the **ON/OFF POWER SWITCH** to **OFF**.
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Open the door of the shaker to gain access to the front panel. The door *must* be open all the way.
4. Use a Phillips head (+) screwdriver to unscrew the three screws that attach the hinged front panel to the housing. Gently lay down the front panel and set aside the screws for reuse. Looking into the shaker, the **MOTOR ASSEMBLY** is on the left side.
5. Use the **HEX WRENCH** to loosen the two **HEX BOLTS** on the **MOTOR MOUNTING PLATE** *(see Figure 9)*.

Figure 9: Motor Belt Replacement



6. Gently slide the **MOTOR MOUNTING PLATE** toward the back of the shaker. This loosens the **MOTOR BELT** from the **MOTOR PULLEY** and the **LARGE COUNTER-WEIGHTED PULLEY**. Moving the **MOTOR MOUNTING PLATE** back will cause the **MOTOR BELT** to fall from both belt tracks.
7. Remove the old belt.
8. With one hand, place the new **MOTOR BELT** around the **MOTOR PULLEY** and with the other hand guide the **MOTOR BELT** around the **LARGE COUNTERWEIGHTED PULLEY**.

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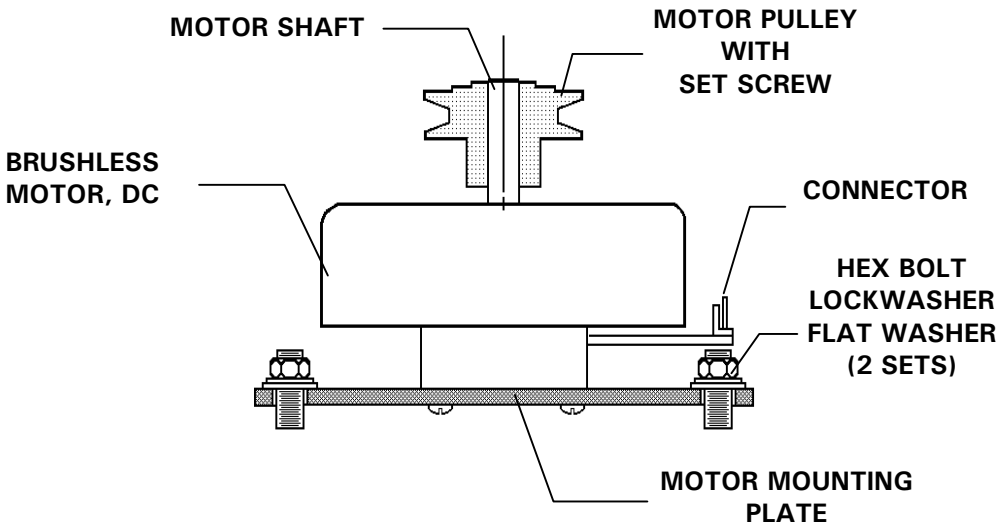
9. Move the **MOTOR MOUNTING PLATE** forward, until there is a slight resistance.
10. Verify that the **MOTOR BELT** has a slight pressure near the center. The recommended deflection is 3/8 inch (9.5 mm).
11. Use the **HEX WRENCH** to tighten the two **HEX BOLTS** on the **MOTOR MOUNTING PLATE**.
12. Reinstall the hinged front panel with the three screws previously set aside. Use a Phillips (+) head screwdriver to tighten the screws.
13. Close the door of the shaker.
14. Reconnect the **POWER CORD** to the electrical outlet.

8.6 Full Motor Assembly Replacement

To replace the full **MOTOR ASSEMBLY**, the qualified Service Engineer will:

1. Set the **ON/OFF POWER** Switch to **OFF**.
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Open the door of the shaker to gain access to the front panel. The door *must* be open all the way.
4. Use a Phillips head (+) screwdriver to unscrew the three screws that attach the hinged front panel to the housing. Gently lay down the front panel and set aside the three screws for reuse. Looking into the shaker, the **MOTOR ASSEMBLY** is on the left side.
5. Lift up the **WHITE CONNECTOR** from the **MOTOR BASE** and disconnect it.
6. Unscrew the **NUT** from the **SMALL SCREW STUD** to the right of the **MOTOR MOUNTING PLATE**.
7. Remove the **TWO GREEN/YELLOW GROUND WIRES**.
8. Use a **HEX WRENCH** to loosen the two **HEX BOLTS** on the **MOTOR MOUNTING PLATE**.

Figure 10: Motor Replacement



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9. Gently slide the **MOTOR MOUNTING PLATE** toward the back of the shaker, to loosen the **MOTOR BELT** from the **MOTOR PULLEY** and the **LARGE COUNTERWEIGHTED PULLEY**. Moving the **MOTOR MOUNTING PLATE** back will cause the **MOTOR BELT** to fall from both belt tracks.
10. Remove **MOTOR BELT** and set it aside.
11. Continue to loosen and remove the two **HEX BOLTS** and **WASHERS** from the **MOTOR MOUNTING PLATE**.
12. Tilt the **MOUNTING PLATE** backwards. Unscrew the **NUT** on the right, and remove the **GREEN/YELLOW GROUND WIRE** from underneath the **PLATE**.
13. Remove the old **MOTOR** and the **MOTOR MOUNTING PLATE**.
14. Tilt the new **MOTOR** upside down and place the **GREEN/YELLOW WIRE** over the **SMALL SCREW STUD**.
15. Tighten the **NUT**.
16. Align the **MOTOR PLATE** over the holes on the **SHAKER BASE** and verify that the **MOTOR PLATE** sits smoothly over the holes.
17. Replace and slightly tighten the two **HEX BOLTS** and **WASHERS** on the **MOTOR MOUNTING PLATE**.
18. With pne hand, place the **MOTOR BELT** around the **MOTOR PULLEY** and with the other hand guide the **MOTOR BELT** around the **LARGE COUNTERWEIGHTED PULLEY**.
19. Adjust the **MOTOR PULLEY** height so that the belt is level relative to the **DRIVE PULLEY**.
20. Move the **MOTOR MOUNTING PLATE** forward, until there is a slight resistance.
21. Verify that the **MOTOR BELT** has a slight pressure near the center. The recommended deflection is 3/8 inch (9.5 mm).
22. Tighten the two **HEX BOLTS** on the **MOTOR MOUNTING PLATE**.
23. Reinstall the two **GREEN/YELLOW GROUND WIRES** over the **SMALL SCREW STUD** to the right of the **MOTOR MOUNTING PLATE**, then reinstall the **GREEN GROUND WIRE**.
24. Tighten the **NUT** to the **SMALL SCREW STUD**.
25. Reconnect the **WHITE CONNECTOR** on the **MOTOR BASE** and verify that the pins are properly positioned.
26. Reinstall the hinged front panel using the three screws previously set aside. Use a Phillips head (+) screwdriver to tighten the screws.
27. Close the door of the shaker.
28. Reconnect the **POWER CORD** to the electrical outlet.

8.7 Partial Motor Assembly Replacement

The qualified Service Engineer will:

1. Unscrew the three Phillips head (+) screws, setting them aside for reuse, and separate the **MOTOR** from the **PLATE**.
2. Loosen the **PULLEY SET SCREW** and remove the **PULLEY** from the **SHAFT**. Save the **PULLEY**.
3. Mount the new **MOTOR** to the **MOTOR PLATE** with the three Phillips head (+) screws previously set aside.

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4. Reinstall the pulley, screwing the set screw to the shaft flat, without tightening.
5. Position this assembly back onto the shaker. Replace the two **HEX BOLTS & WASHERS** with new hardware, without tightening.
6. Replace the belt. Adjust the **MOTOR PULLEY** height so that the belt is level relative to the drive pulley. Tighten the set screw.
7. Adjust the belt tension by tightening the two **HEX BOLTS**.

8.8 Removing the Recirculating Fans

The qualified Service Engineer will:

1. Disconnect the **POWER CORD** from the electrical outlet.
2. Open the door of the shaker.
3. Remove the five screws that secure the twin fan mounting assembly, setting them aside for reuse.
4. Remove the wires from the twin fans.



WARNING!
Fan blades are extremely sharp and can cause serious injury. Handle with *EXTREME CARE!*

5. Remove the twin fan mounting assembly.

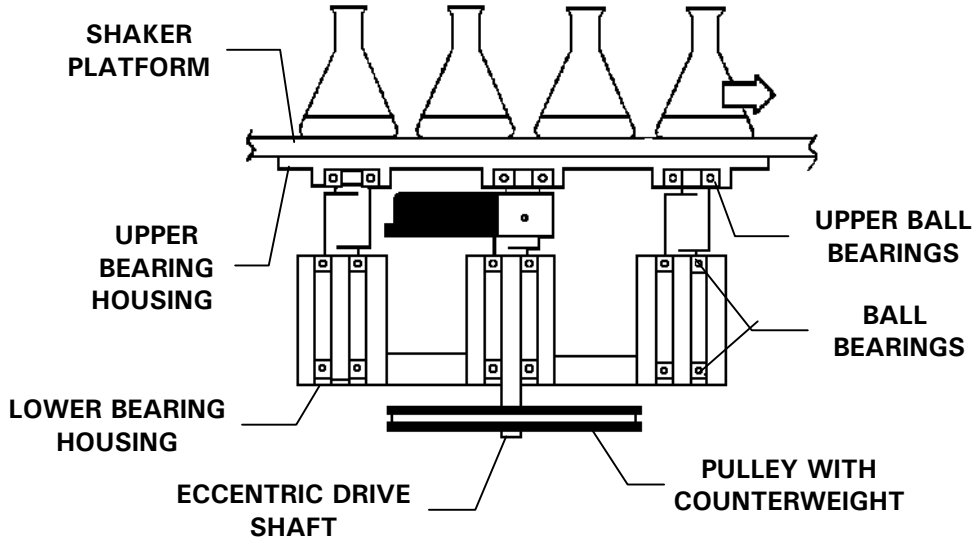
8.9 Bearing Housing Replacement

The qualified Service Engineer will:

1. Set the **ON/OFF POWER SWITCH** to **OFF** and disconnect the **POWER CORD** from the electrical outlet.
2. Open the door of the shaker to gain access to the front panel. The door *must* be open all the way.
3. Use a Phillips head (+) screwdriver to unscrew the three screws that attach the hinged front panel to the housing. Gently lay down the front panel and set aside the screws for reuse.
4. Unscrew the eight Phillips head (+) screws from the small panel on the left side of the shaker.
5. Use the **HEX KEY** to remove the four **HEX SCREWS** from the center of the shaker platform. Set the platform aside.
6. Remove the four **NUTS** from the **STUD SCREWS** that secure the **BEARING HOUSING**.
7. Use a **HEX WRENCH** to loosen the two **HEX BOLTS** on the **MOTOR MOUNTING PLATE**.

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Figure 11: Bearing Housing Replacement



8. Gently slide the **MOTOR MOUNTING PLATE** toward the back of the shaker to loosen the **MOTOR BELT** from the **MOTOR PULLEY** and the **LARGE COUNTERWEIGHTED PULLEY**. Moving the **MOTOR MOUNTING PLATE** back causes the **MOTOR BELT** to fall from both belt tracks.
9. Remove **MOTOR BELT** and set it aside.
10. Use an **ALLEN KEY** to remove the **ALLEN SCREW** from the **LARGE BEARING HOUSING PULLEY**.
11. Remove the **LARGE BEARING HOUSING PULLEY** from the **BEARING HOUSING SHAFT**.
12. Remove the **BEARING HOUSING**.
13. Place the new **BEARING HOUSING** inside the shaker.
14. Reinstall and tighten the four **NUTS** on the **STUD SCREWS**.
15. Reinstall the **LARGE BEARING HOUSING PULLEY** on the **BEARING HOUSING SHAFT**. Reinsert the **ALLEN SCREW** and tighten with the **ALLEN KEY**.
16. Put the set screw in place on the shaft flat without tightening it.
17. Place the **MOTOR BELT** around the **MOTOR PULLEY**. Guide the **MOTOR BELT** around the **LARGE BEARING HOUSING PULLEY**. Move the **MOTOR MOUNTING PLATE** forward, until there is a slight resistance.
18. Adjust the belt so that the belt is level relative to the **MOTOR PULLEY**.
19. Verify that the **MOTOR BELT** has a slight pressure near the center. The recommended deflection is 3/8 inch (9.5 mm).
20. Tighten the two **HEX BOLTS** on the **MOTOR MOUNTING PLATE**.
21. Reinstall and tighten the four **NUTS** on the **STUD SCREWS** to secure the **BEARING HOUSING**.
22. Reinstall the shaker platform. Reinstall the four **HEX SCREWS** in the center of the platform, tightening them with the **HEX KEY**.

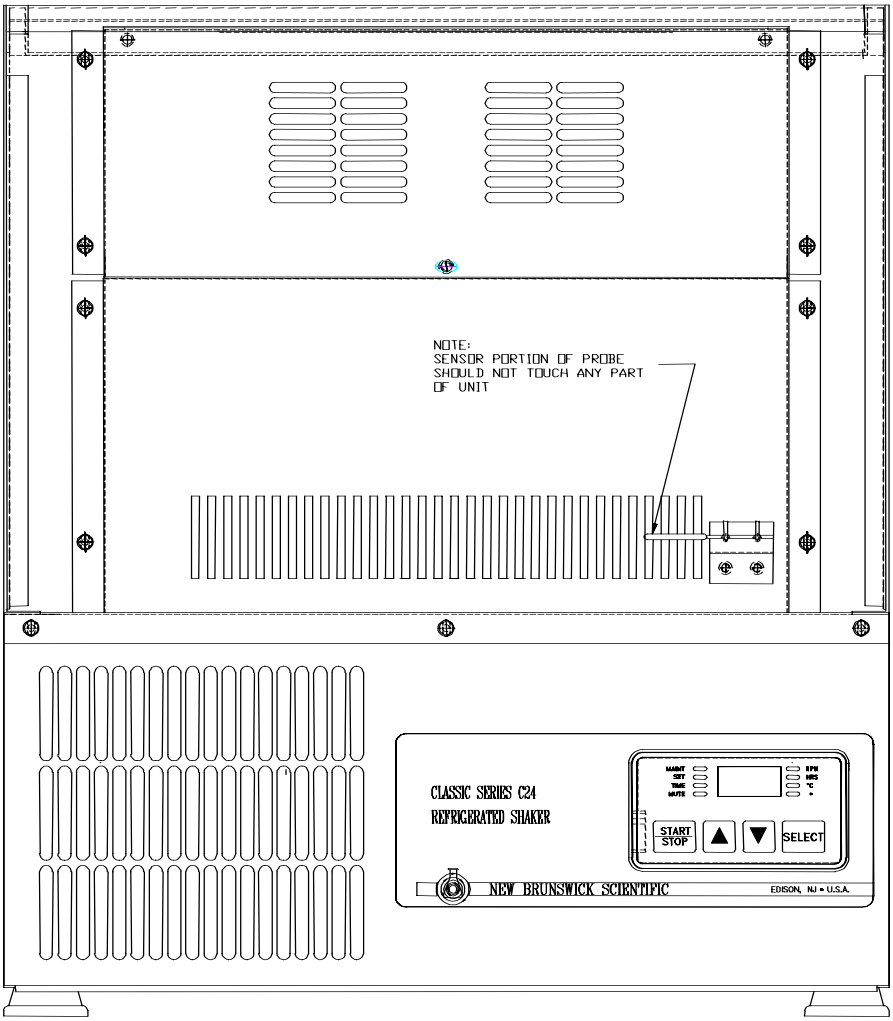
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23. Reinstall the small panel on the left side of the shaker. Secure it with the eight Phillips head (+) screws previously set asidse. Tighten with a Phillips head (+) screwdriver.
24. Reinstall the hinged front panel using the three screws previously set aside. Use a Phillips head (+) screwdriver to tighten the screws.
25. Close the door of the shaker.

8.10 Temperature Sensor Adjustment

The temperature sensor is located in the bottom right of the center panel on the chamber's back wall. It is held in place by a bracket and can be adjusted horizontally. *(See Figure 12 below).*

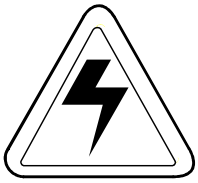
Figure 12: Temperature Sensor Adjustment



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1. Set the **ON /OFF POWER SWITCH** to **OFF**.
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Adjust the sensor so that the sensor portion of the probe does not touch the unit. Secure the sensor to the bracket with tie wraps.

8.11 ESD Precautions



WARNING!
***Do not* attempt to change boards or electronic components unless you are a qualified Service Engineer.**

Integrated circuits are extremely sensitive and susceptible to damage from electrostatic discharge. Read and follow the ESD Precautions before attempting to replace boards.

- Do not remove components from their antistatic packaging until you are ready to insert into sockets or install boards.

- Before handling components or boards, touch an unpainted portion of the system unit chassis for a few seconds.

- Wear a grounding wrist strap while working on components. The wrist strap *must* be connected to a grounded work station. Wrist straps are available at most electronic component stores.

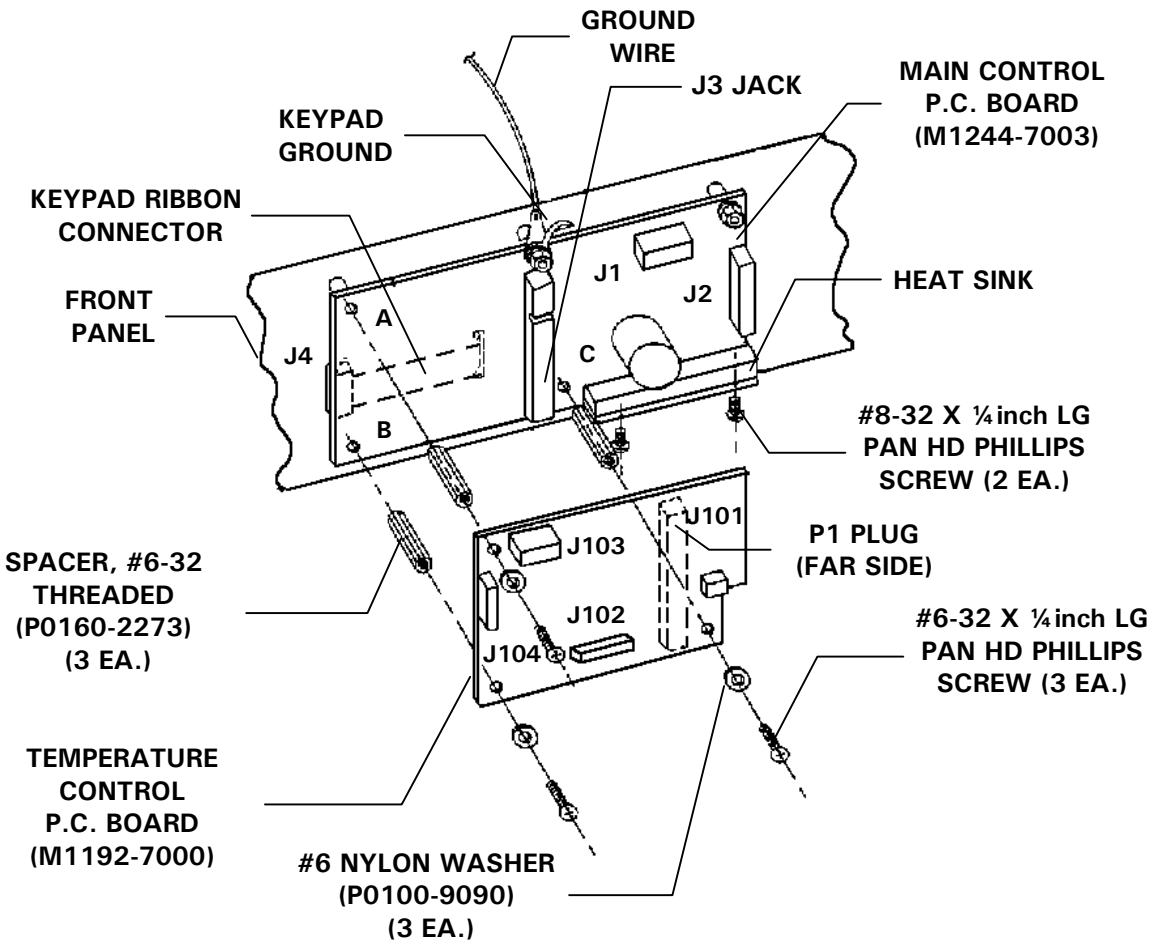
8.12 Replacing the Temperature Control Board

To replace the **TEMPERATURE CONTROL BOARD**, the qualified Electrical or Service Engineer will:

1. Set the **ON/OFF POWER** Switch to **OFF**.
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Open the door of the shaker to gain access to the front panel. The door *must* be open all the way.
4. Use a Phillips head (+) screwdriver to remove the three screws that secure the hinged front panel to the housing. Gently lay down the front panel, setting aside the three screws for reuse.

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Figure 13: Temperature Board Replacement



Looking down at the inside of the panel, the **TEMPERATURE CONTROL BOARD** is on the right side of the panel. The **TEMPERATURE CONTROL BOARD** lays on top of the **MAIN CONTROL BOARD**.

5. Disconnect the harness wires from connectors **J101**, **J102**, **J103** and **J104**.

NOTE:

Make a note of how the wires are positioned before or while disconnecting.

6. Use a Phillips head (+) screwdriver to remove the three screws. Remove nylon washers.
7. Using caution, disconnect the **TEMPERATURE CONTROL BOARD** from the **MAIN CONTROL BOARD**. Apply force perpendicular to the plane of the board; *do not* lift from one end.

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8. Ensure that the board to board connectors are properly positioned. Snap the new **TEMPERATURE CONTROL BOARD** onto the **MAIN CONTROL BOARD**. Verify that no pins are visible and the board is secure.
9. Replace the three nylon washers. Reinstall the three ¼″ screws. Use a Phillips head (+) screwdriver to tighten the screws.
10. On the **TEMPERATURE CONTROL BOARD**, reconnect the harness wires to connectors **J101**, **J102**, **J103** and **J104**. Ensure that all connectors are properly positioned and secure. Verify that no pins are visible.
11. Reinstall the hinged front panel, securing it with the three screws previously set aside. Use a Phillips head (+) screwdriver to tighten the screws.
12. Close the door of the shaker, then reconnect the **POWER CORD** to the electrical outlet.

8.13 Replacing the Main Control Board



WARNING!
***Do not* attempt to change boards or electronic components unless you are a qualified Service Engineer.**

Integrated circuits are extremely sensitive and susceptible to damage from electrostatic discharge. Read and follow the ESD Precautions, outlined above, before attempting to replace boards.

To replace the **MAIN CONTROL BOARD**, the qualified Electrical or Service Engineer will *(referring to Figure 13 above)*:

1. Set the **ON/OFF POWER** Switch to **OFF**.
2. Disconnect the **POWER CORD** from the electrical outlet.
3. Open the door of the shaker to gain access to the front panel. The door *must* be open all the way.
4. Use a Phillips (+) head screwdriver and unscrew the three screws that attach the hinged front panel to the housing. Gently lay down the front panel.

Looking down, the **MAIN CONTROL BOARD** of the C-24KC is on the right side of the panel. The **TEMPERATURE CONTROL BOARD** lies on top of the **MAIN CONTROL BOARD**. One must remove the **TEMPERATURE CONTROL BOARD** to access the **MAIN CONTROL BOARD**.

5. Disconnect the harness wires from **CONNECTORS J101**, **J102**, **J103** and **J104** on the **TEMPERATURE CONTROL BOARD**.

6. Use a Phillips head (+) screwdriver to remove the three screws. Remove the nylon washers.

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7. Using caution, disconnect the **TEMPERATURE CONTROL BOARD** from the **MAIN CONTROL BOARD**. Apply force perpendicular to the plane of the board; *do not* lift from one end. Set the **TEMPERATURE CONTROL BOARD** aside.
8. On the **MAIN CONTROL BOARD**, disconnect the harness wires from **CONNECTORS J1** and **J2**.
9. Remove the five **HEX SPACERS** and the five 5/16 inch **HEX BOLTS**.
10. Remove the **GREEN GROUND WIRE**.
11. Remove the **KEY PAD GROUND LEAD**.
12. Remove two screws that fasten the **HEAT SINK** to the front panel.
13. Lift the board slightly and disconnect the **KEY PAD RIBBON CONNECTOR** from **J4**.
14. Apply heat sink compound to the **HEAT SINK BRACKET**.
15. Position the gray insulator on the solder side of the new **MAIN CONTROL BOARD** and reconnect the **KEY PAD RIBBON CONNECTOR** to the **J4 CONNECTOR**.
16. Verify that the five ¼ inch **SPACERS** are lined up with the **MOUNTING STUDS**. Set the new **MAIN CONTROL BOARD** in place.
17. Tighten the two screws to the **HEAT SINK BRACKET**.
18. Reconnect the **KEY PAD GROUND LEAD**.
19. Reconnect the **GROUND WIRE**.
20. Reconnect the harness wires to **CONNECTORS J1** and **J2**. Ensure that all connectors are properly positioned and secure. Verify that no pins are visible.
21. Ensure that the board to board connectors are properly positioned. Snap the **TEMPERATURE CONTROL BOARD** onto the **MAIN CONTROL BOARD**. Verify that no pins are visible and the board is secure.
22. Replace the nylon washers. Reinstall the three ¼″ screws. Use a Phillips head (+) screwdriver to tighten the screws.
23. On the **TEMPERATURE CONTROL BOARD**, reconnect the harness wires to connectors **J101**, **J102**, **J103** and **J104**. Ensure that all connectors are properly positioned and secure. Verify that no pins are visible.
24. Reinstall the hinged front panel and secure in place with the three screws previously set aside. Use a Phillips head (+) screwdriver to tighten the screws.
25. Close the door of the shaker.
26. Reconnect the **POWER CORD** to the electrical outlet.

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9 TROUBLESHOOTING

If any problems occur with your shaker, do not attempt to perform any service on the unit other than specified in this manual. Unauthorized servicing may void the warranty. Please contact your local NBS Service Department or local NBS distributor.

In any correspondence with NBS, please refer to the Model Number, Manuafacturing Part Number and Serial Number of your shaker. This information is on the **ELECTRICAL SPECIFICATION PLATE** on the side of the unit *(see Figure 4)*.

9.1 Troubleshooting Guide

Symptom	*Possible Cause*	*Solution*
LED Display does not illuminate	Power cord not connected	Verify power cord is plugged into power source
	No power supplied to power source	Verify power source is active
	Fuse may need replacement	Verify fuse voltage/Verify fuse is good
	Motor may need replacement	Call local NBS Service Department or contact your local NBS distributor
LED reads ACC	Motor not operating properly	Call local NBS Service Department or contact your local NBS distributor
LED reads ERR	Temperature Probe not making proper contact	Call local NBS Service Department or contact your local NBS distributor
Shaker does not move	Fuse may need replacement	Verify fuse voltage/Verify fuse is good
	Motor may need replacement	Call local NBS Service Department or contact your local NBS distributor

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10 REPLACEMENT PARTS & ACCESSORIES

When ordering replacement or accessory parts, or requesting service information, please provide the Model Number and Serial Number of your shaker. This information is on the **ELECTRICAL SPECIFICATION PLATE** which is located on the side panel of the unit.

10.1 Replacement Parts

Spare Part Description	*Quantity*	*NBS Part Number*
Bearing Housing Assembly 1″ stroke	1	M1233–6330
Bearing Housing Assembly 3/4″ stroke	1	M1233–6331
Belt	1	P0700–7090
Bridge Rectifier	1	P0460–4091
Evaporator	1	K0620–1360
Fan, Internal	2	P0620–2536
Filter	1	M1233–9501
Fuse 10 AMP SloBlo®–Compressor/F3	1	P0380–3162
Fuse 1.6 AMP SloBlo®–Electronics/F2	1	P0380-3532
Fuse 0.16 AMP SloBlo®	1	P0380-3710
Heater–250 Watt	1	P0620–1380
Motor	1	M1195–4001
PCB Assembly, Main Control	1	M1244-7003
PCB Assembly, Temperature Control	1	M1192–7000
RTD Assembly	1	M1195–8001
Solid State Relay	1	P0400–3151
Solid State Relay	1	P0400–3011
Switch Actuator (Lid)	1	M1247-0510

10.2 Accessories

10.2.1 Cleaning Supplies

Part Description	*NBS Part Number*
Door & Lid Polishing Kit	P0860-0949

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10.2.2 Dedicated Platforms

Accessory Description	*Capacity*	*NBS Part Number*
50 ml Erlenmeyer Flasks	64	M1119-9903
125 ml Erlenmeyer Flasks	34	M1191-9904
250 ml Erlenmeyer Flasks	25	M1191-9905
500 ml Erlenmeyer Flasks	16	M1191-9906
1 L Erlenmeyer Flasks	9	M1191-9907
2 L Erlenmeyer Flasks	5	M1191-9908
2800 mL Fernbach Flasks	4	M1233-9932

10.2.3 Universal Platform

The following is a list of flask capacities for the Universal Platform (M1250-9902). Flask clamps are ordered separately.

Flask Type	*Capacity*
10 ml Erlenmeyer Flasks	109
25 ml Erlenmeyer Flasks	64
50 ml Erlenmeyer Flasks	45
125 ml Erlenmeyer Flasks	21
250 L Erlenmeyer Flasks	18
500 L Erlenmeyer Flasks	14
1 L Erlenmeyer Flasks	8
2 L Erlenmeyer Flasks	5
2800 ml Fernbach Flasks	4

10.2.4 Accessory Flask Clamps

Clamp Type	*NBS Part Number*
10 ml Erlenmeyer Clamp	ACE-10S
25 ml Erlenmeyer Clamp	M1190-9004
50 ml Erlenmeyer Clamp	M1190-9000
125 ml Erlenmeyer Clamp	M1190-9001
250 ml Erlenmeyer Clamp	M1190-9002
500 ml Erlenmeyer Clamp	M1190-9003
1 L Erlenmeyer Clamp	ACE-1000S
2 L Erlenmeyer Clamp	ACE-2000S
2800 ml Fernbach Flask Clamp	ACFE-2800S

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10.2.5 Carriers and Test Tube Racks

Accessory Description	*NBS Part Number*
Utility Carrier with rubber mat and 2 cross bars for captivating glassware and other containers	M1194-9909
Utility Tray with rubber mat for shaking 96 well plates, petri dishes and other labware at low speeds.	M1194-9910
Angled Test Tube Rack Holder for user supplied test tube racks that are 4-5 in. (10-13 mm) wide and up to 15 inches (38 mm) long. Capacity: 2 racks/platform.	TTR-210*
Angled Test Tube Rack Spacer for use with TTR-210 to accommodate test tube racks that are less than 5 inches (13 mm) wide and up to 15 inches (38 mm) long.	TTR-215*
Microtiter Plate Carrier, capacity up to 5 microtiter plates	TTR-221*
80-tube (8-11mm ∅) Adjustable Angle Test Tube Rack	M1289-0100✧
60-tube (12-15mm ∅) Adjustable Angle Test Tube Rack	M1289-0200✧
42-tube (15-18mm ∅) Adjustable Angle Test Tube Rack	M1289-0300✧
30-tube (18-21mm ∅) Adjustable Angle Test Tube Rack	M1289-0400✧
22-tube (22-26mm ∅) Adjustable Angle Test Tube Rack	M1289-0500✧
20-tube (26-30mm ∅) Adjustable Angle Test Tube Rack	M1289-0600✧
Microplate Holder, stack 3 deep-well or 9 standard microplates	M1289-0700✧

*Universal Platform Required

✧ Platform capacity is 4 racks

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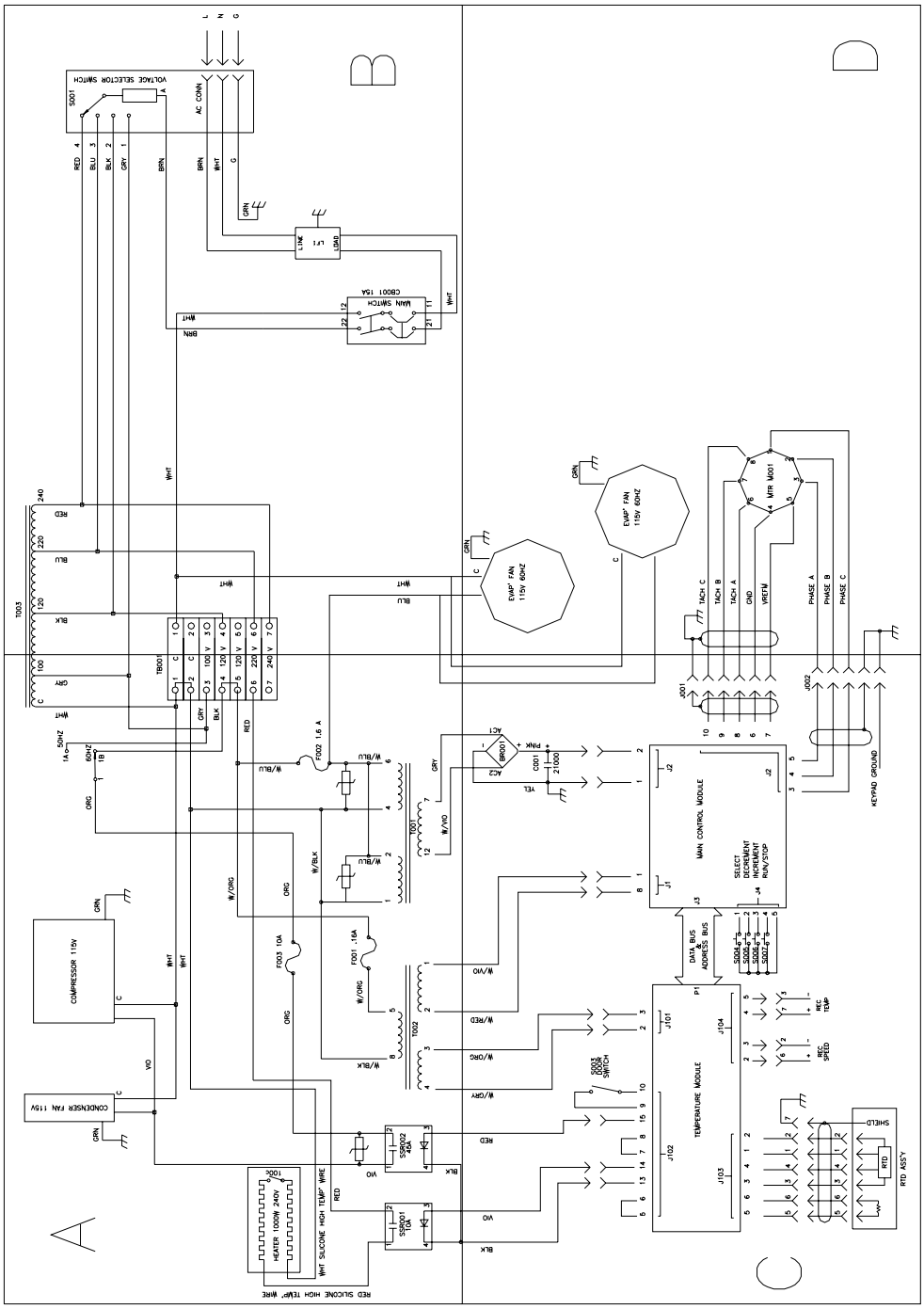
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11 DRAWINGS

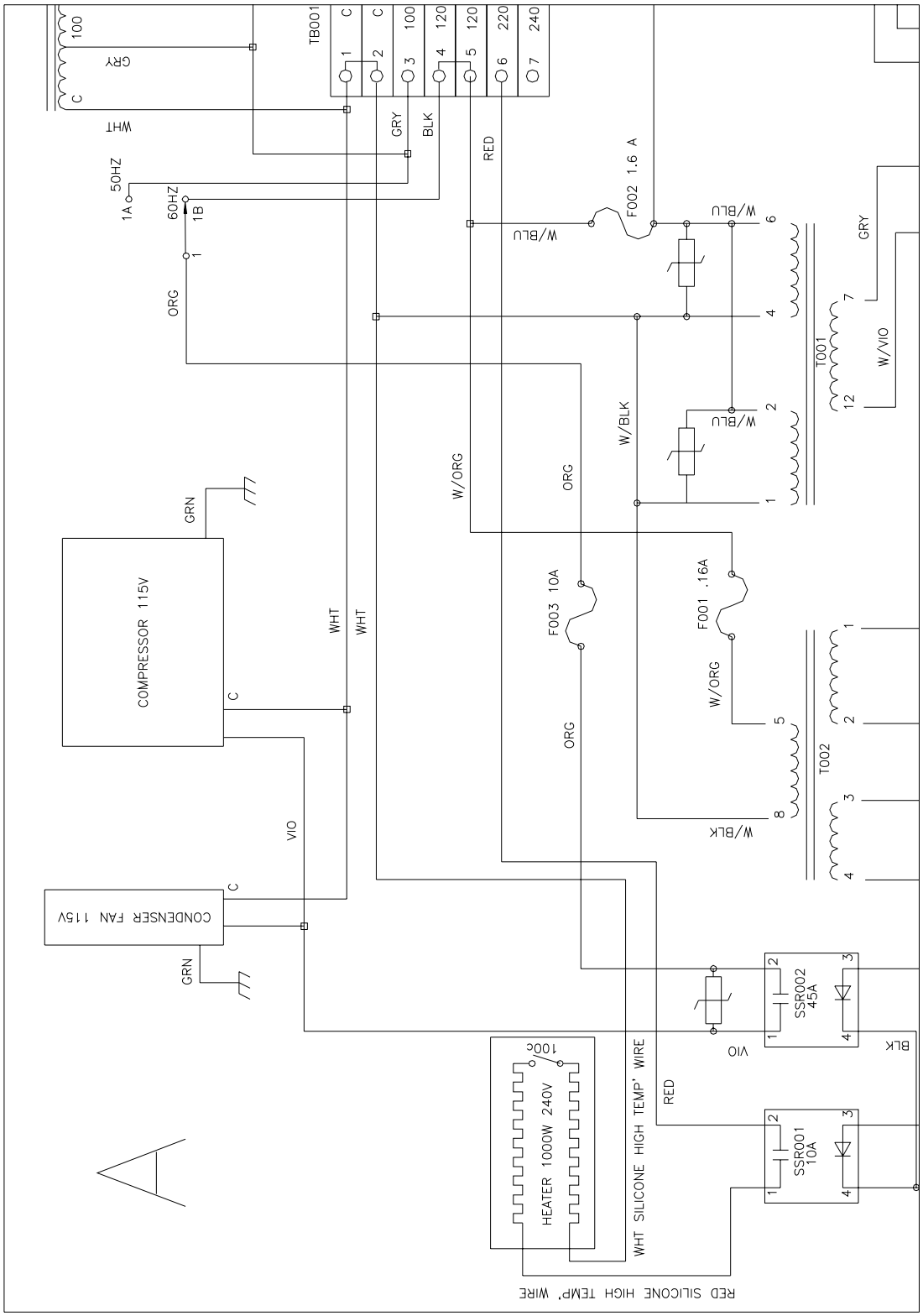
11.1 Control Schematic

Figure 14: Control Schematic Overview



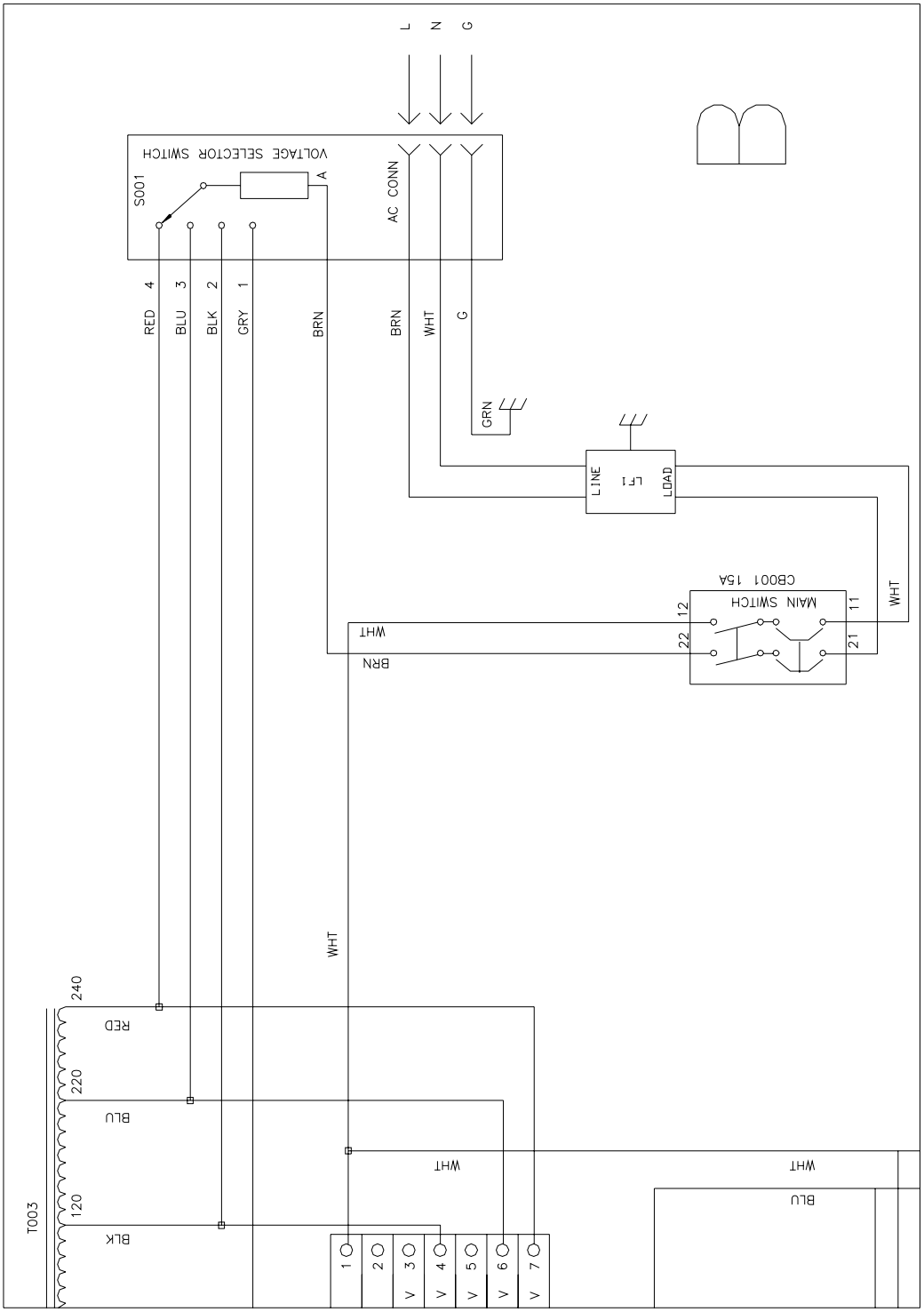
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Figure 15: Control Schematic, Quadrant A



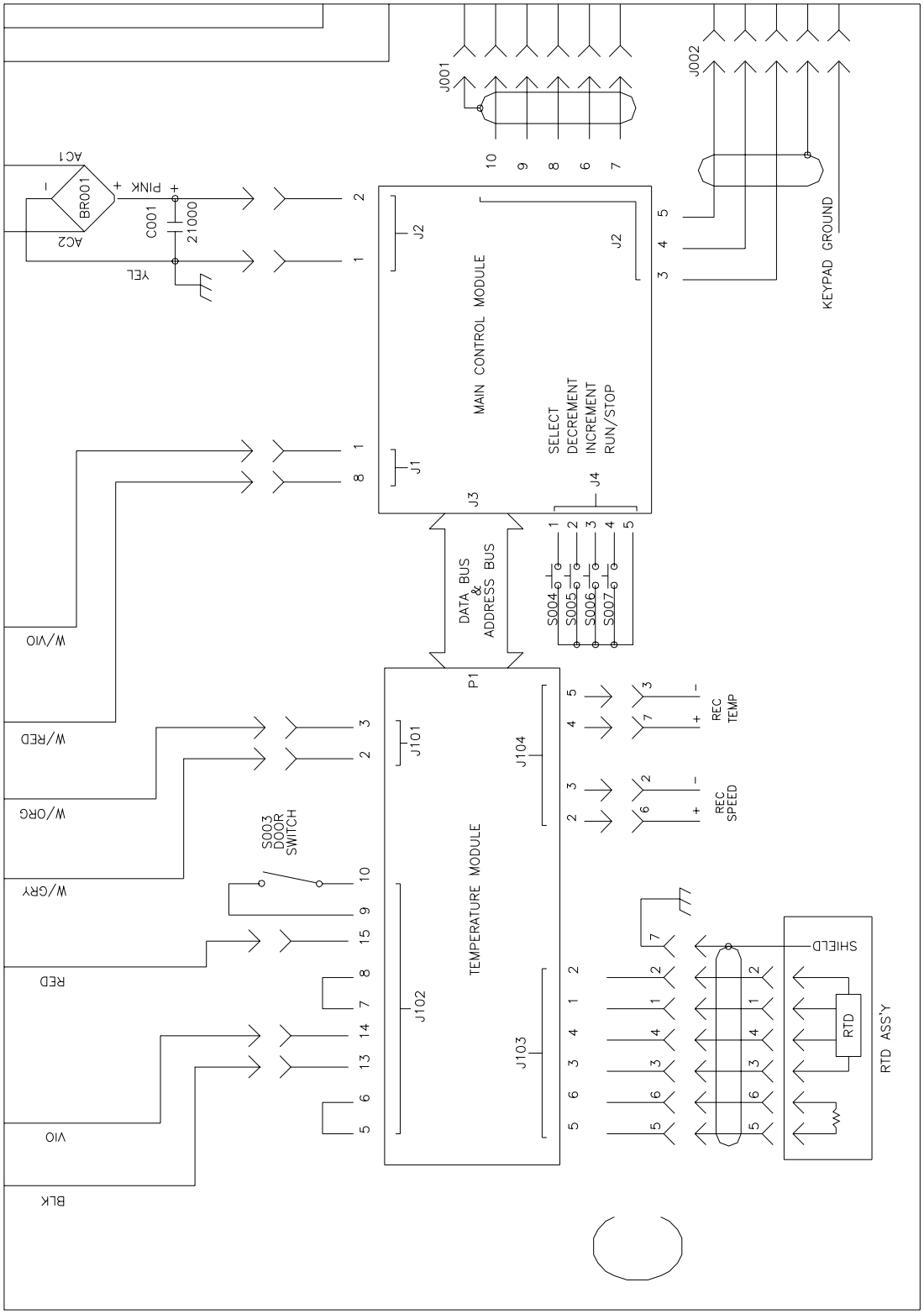
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Figure 16: Control Schematic, Quadrant B



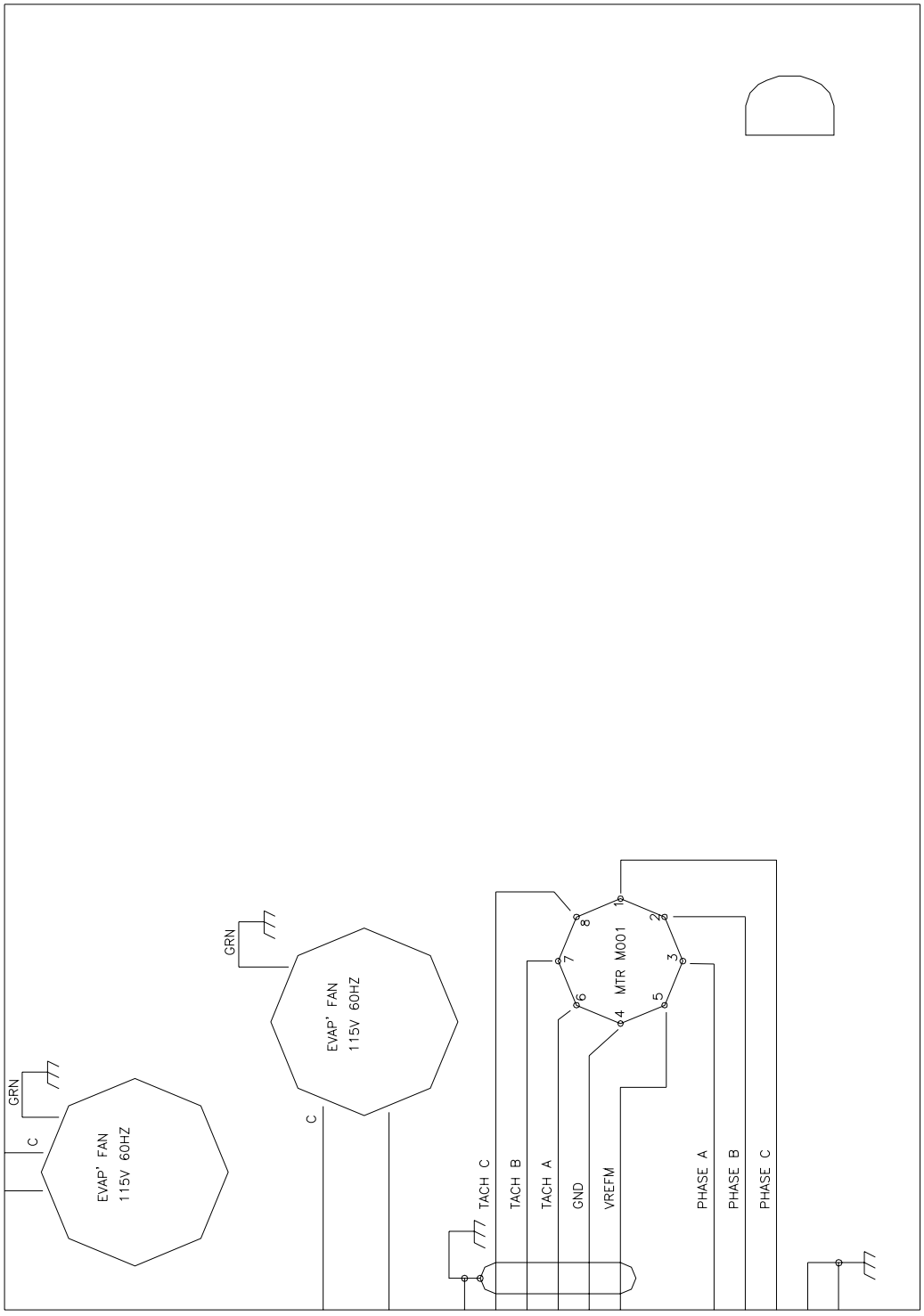
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Figure 17: Control Schematic, Quadrant C



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Figure 18: Control Schematic, Quadrant D



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