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Find the *Thermo / Forma Scientific 3193* at our website: ***Click HERE***

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Models:

3193/3194 - LH Door Swing

3195/3196 - RH Door Swing

Water Jacketed Incubator

Manual No. 7043193 Rev-1

Important!
Read This Instruction Manual

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

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

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NOTE:

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

MANUAL NO. 7043193

1	IN-2030	1/96	Added warning "do not saturate sensor" dg
		1/94	Standard Product Manual
REV	**ECN**	**DATE**	**DESCRIPTION**

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GENERAL SAFETY NOTES

The Occupational Safety and Health Administration (O.S.H.A.) has revised Section 1910-147, The Control Of Hazardous Energy (Lockout/Tagout).

Hazardous energy may be: ***electric, air, hydraulic, water, steam, gravity, spring & all other equally hazardous energy.***

This revised regulation, states that you will de-energize all potential sources of energy (may be more than one energy source) prior to performing service or maintenance on any equipment. It also states that a lock shall be placed on the de-energized control, along with a verified test (use of a voltmeter or other equipment) to insure no accidental starts. If you are not familiar with this regulation, review the O.S.H.A. Regulation, Section 1910-147.

In field service, full compliance with this regulation is difficult at best. Troubleshooting must often be performed with hazardous energy applied; therefore extreme caution must be followed during these troubleshooting steps. ***Only Qualified Personnel Must Perform This Work.*** This phase of the repair work must be coordinated through the customer's facilities maintenance department or designated person.

When performing service or maintenance as an outside contractor/worker, follow the **Outside Work Force's Lockout/Tagout** system. Be alert for new types of lockout/tagout devices.

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

For your safety adhere to all ***DANGER*** and ***CAUTION*** statements.

Danger: This word is used to call attention to <u>immediate</u> hazards of equipment or conditions which, if not avoided, could result in personal injury, loss of life or property damage.

Caution: This word is used to call attention to <u>potential</u> hazards of equipment or conditions which, if not avoided, could result in personal injury, loss of life or property damage.

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Do You Need Information or Assistance on Forma Scientific Products?

If you do, please contact us 8:00 a.m. to 7:00 p.m. (Eastern Time) at:

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fservice@forma.com	Service E-Mail Address

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

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

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

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

Regardless of your needs, Forma's professional telephone technicians are available to assist you Monday through Friday from 8:00 a.m. to 7:00 p.m. Eastern Time. Please contact us by telephone or fax. If you wish to write, our mailing address is:

Forma Scientific, Inc.
PO Box 649
Marietta, OH 45750

International customers please contact your local Forma Scientific distributor.

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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 of the merchandise at its destination. 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. Failure to adequately describe such evidence of loss or damage may result in the carrier refusing to honor a damage claim.

Immediately call the delivering carrier and request that their representative perform an inspection. Do not discard any of the packing material and under no circumstances move the shipment from the receiving area.

1.3 Responsibility for Shipping Damage

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

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

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

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Section 2 - Installation and Start-up

2.1 Location

The incubator should be placed in a draft-free area of doors, windows, and air conditioning or heating ductwork. To help prevent microbial contamination, the incubator should also be removed from areas of high personnel traffic.

Place the unit on a firm, level surface capable of supporting the unit with water. (Approximate weight with water = 342 lbs or 155 kgs).

Adequate space should also be provided behind the incubator for electrical and gas connections.

2.2 Preliminary Disinfecting

Before installing the duct sheets and the shelves, remove the clear plastic film from the shelf brackets and duct sheets. Forma Scientific Inc. recommends disinfecting all interior surfaces (including both door gaskets). Rinse the surfaces, at least twice, with sterile distilled water (50K Ohm to 1 Meg Ohm range). Repeat rinsing until you are satisfied that all of the disinfectant-detergent has been removed. Also disinfect the CO_2 sensor and the blower wheel, taking care not to saturate the sensor.

The duct sheets and shelves must be washed with the same disinfectant solution and rinsed, at least twice, with sterile distilled water (50K Ohm to 1 Meg Ohm) prior to their installation in the chamber. Repeat rinsing until you are satisfied. When all surfaces are clean, proceed with the installation as noted.

Caution: After completing the decontamination procedure, it is recommended that the incubator be run and tested before placing any valuable contents inside the incubator chamber.

For the complete disinfecting process, refer to Section 4 of this manual.

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2.3 Installing the Shelf Brackets and Cam Latch Assembly to the Duct Sheets

Note: A plastic film coating on duct sheets and shelf brackets protects the finish during shipping and handling. This plastic coating must be "peeled-off" before protected parts are installed.

1. Locate the plastic bag containing the 10-32 x 1/2" truss head screws and wing nuts (20 each).

2. With the duct sheet in a vertical position, align and mount the shelf brackets to the unflanged side of the duct sheets.

Note: Wing nuts are installed on the flanged side of the duct sheets. Refer to Figure 2-1 on the following page.

a. Installing the Cam Latch Assembly

1. Locate the bag containing (2) #8-32 x 1" stainless steel truss head screws, (2) #8-32 wing nuts, (2) stainless steel spacer sleeves and (2) nylon cam latches.

2. Place stainless steel spacer sleeve over the #8-32 x 1" screw and insert it into the opening of the cam latch.

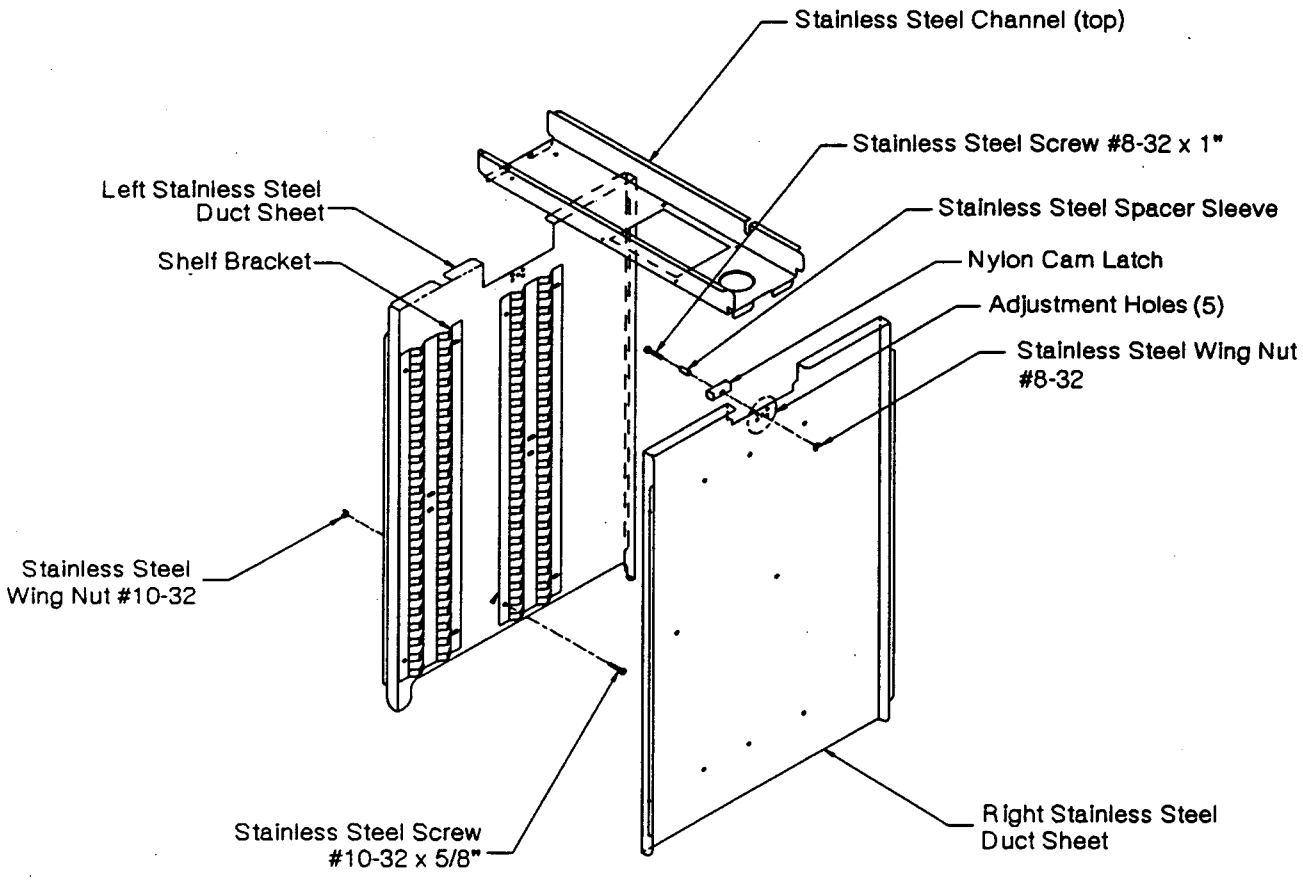
3. Locate the five (5) small adjustment holes at the top of each duct sheet. (Refer to Figure 2-1.)

4. Place the cam latch on the inside (or unflanged side) of duct sheet and position screw with spacer sleeve through the middle hole of the five hole adjustment. If duct the duct sheets appear to be too tight, or too loose, the cam latch assembly may be repositioned (up or down) one hole for proper alignment.

5. Secure screw on flanged side of duct sheet with #8-32 wing nut.

6. Repeat this procedure for the other duct sheet.

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Installing the Shelf Brackets, Duct Sheets and Cam Latch Assembly
Figure 2-1

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2.4 Installing the Duct Sheets (Refer to Figure 2-1)

Note: The left duct sheet has large notches in both top and bottom edges. The right-hand duct sheet has a notch in the top edge only.

1. *Carefully* put the right duct sheet into the incubator chamber with the flanges toward the wall.

2. Put the left duct sheet into the chamber with the square notch at the top and the flanges toward the wall. Allow the top of the left-side duct sheet to lie diagonally across the chamber, resting upon the right-side duct sheet.

3. Hook the top channel into the top opening of the right duct sheet. (Refer to Figure 2-1) The top channel must be positioned so that the brass CO_2 sample tube mounted in ceiling of incubator is aligned with the notched out area on the right rear side of the top channel. The round opening will align with the blower wheel when it is slid into place.

4. While supporting the blower channel, slide the left duct sheet up until it is vertical, making sure that the blower channel lines up into the slot on both duct sheets.

5. Turn cam latch to a vertical position (up against bottom side of top channel) to secure.

   If the duct sheets appear to be too tight or too loose, the cam latch assembly may be repositioned one hole for proper alignment.

2.5 Installing the Shelves

The shelves may be placed at any level in the chamber. Slide each shelf into the shelf bracket at the desired level.

2.6 Leveling

Check leveling by placing a bubble-type level on one of the shelves. Turn the hex nut on the leveling leg clockwise to lengthen the leveling leg or raise the unit. Turning the hex nut counterclockwise will shorten the leg or lower the unit. Be sure to level the incubator before filling the water jacket.

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Caution: To prevent injury to personnel and/or damage to equipment, lock the inner glass door and secure the outer door before tipping the unit to adjust the leveling feet. Do not attempt to tilt the incubator without assistance while adjusting the leveling feet.

2.7 Connecting Electrical Power

The 3193 Series Incubator is equipped with an IEC 320 electrical power inlet connector located on the back of the control cabinet. Remove the power cord from the shipping box and plug the female end of the cord into the inlet connector. The male end of the cord is plugged into an electrical outlet.

Caution: The power cord voltage rating must always conform to the incubator's operating voltage.

All 3193/3194 incubators are supplied with 115 volt, 60 Hz line cords. For international customers, 3194/3196 incubators are shipped with the proper line cord for the destination country. Line cords may be ordered from Forma Scientific by calling the Forma Service Department, 1-800-848-3080 or Fax 1-614-373-4189.

With the incubator power switch OFF, connect the unit to an adequate electrical power source. Refer to Section 7 for specific power requirements.

Forma Scientific, Inc. recommends that the incubator be connected to a separate electrical circuit.

2.8 Filling the Water Jacket

The water jacket fill fitting and water jacket vent hole are located on the top of the incubator frame behind the door. The fill fitting is protected by a black plastic cap.

Prior to shipment from the factory, 450 ML of rust inhibitor was placed into the water jacket of the incubator When filling, the rust inhibitor mixes with the distilled water (50K Ohm to 1 Meg Ohm) and provides a protective coating on the interior of the water jacket. Do not drain this solution from the water jacket on initial filling.

Before filling, turn on the incubator. The ADD WATER audible alarm will sound and the ADD WATER warning light will begin flashing. Pressing the red ENTER/SILENCE button will silence the audible alarm, but the ADD WATER warning light will continue to flash until the water in the chamber reaches the proper level.

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There are two methods of filling the water-jacket.

a. Funnel Fill Method

b. Tap Fill Method

Caution: Purity of the distilled water used in the water jacket and humidifier must be within the 50K ohm to 1 Meg ohm range to protect and prolong the life of the stainless steel water jacket. The use of tap water or distilled water outside of the specified range will decrease the operating life of the unit and will void the warranty.

a. Funnel Fill Method

A funnel and a length of vinyl tubing are contained in the accessories bag included with each incubator.

1. Verify that the water jacket drain valve on the bottom of the incubator frame is closed. The valve is located behind a protective metal cover and will require two screws to be removed. The valve is closed when the valve knob is vertical. Refer to Figure 2-2.

2. Attach the funnel into one end of the 3/8" I.D. vinyl tubing.

3. Remove the plastic protective cap from the fill fitting.

4. Attach the free end of the funnel tubing to the fill fitting.

5. Hold the funnel above the level of the fill fitting and pour the water into the funnel until the ADD WATER alarm light goes out. The water jacket holds about 13 gallons (49 liters) of water.

6. Add one additional quart (or one liter) of distilled water. The incubator is now properly filled.

7. Remove the tubing from the fill fitting and replace the plastic protective cap.

Note: The vent hole allows the air displaced by water entering the jacket to escape. It also prevents distortion of the chamber by allowing air to escape as the unit expands and contracts during heating and cooling. Water seepage may occur from vent hole when chamber temperature increases.

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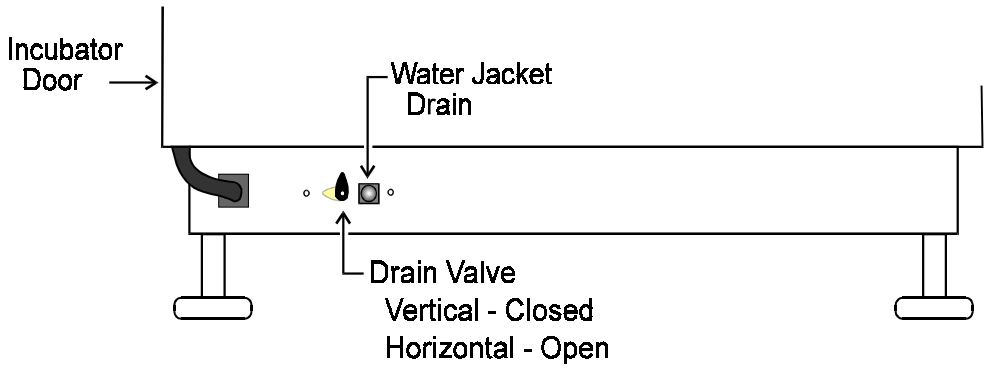


Figure 2-2
Incubator Base with Water Jacket Drain and Valve

b. Tap Fill Method

Three feet of 3/8" ID vinyl tubing is provided in the accessories bag included with each incubator. If the distilled water outlet is more than three feet from the incubator, more tubing and a connector will be required.

1. Verify that the water jacket drain valve on the bottom of the incubator frame is closed. The valve is located behind a protective metal cover and will require two screws to be removed. The valve is closed when the valve knob is turned vertical. Refer to Figure 2-2.

2. Remove the plastic protective cap from the fill fitting.

3. Connect the 3/8" I.D. vinyl tubing between the fitting and the distilled water tap.

4. Open the tap until water flows steadily into the water jacket.

Caution: A high rate of flow and high pressure can cause distortion to incubator chamber walls.

5. Turn the water off immediately when the ADD WATER alarm light goes out.

6. Using the funnel, add one additional quart (or one liter) of distilled water.

7. Remove vinyl tubing and reinstall the plastic protective cap.

Note: A small amount of water may seep from the vent port when the chamber temperature increases.

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2.9 Filling the Humidity Reservoir or Pan

Caution: Do not use plastic or glass pans for humidification as they will have an unpredictable effect on humidity level in the incubator. Use only the floor of the unit or the stainless steel humidity pan. Do not use demineralized or deionized water in the humidity reservoir or pan unless it has been boiled or sterilized immediately prior to use as it may be contaminated with bacteria.

Raising The Humidity Level In The Chamber

Frequent opening of the inner glass door will cause humidity loss from chamber and may result in desiccation of the product. Recovery times may also be affected.

1. The reservoir in the bottom of the incubator can be filled with 6.375 quarts (6 liters) of sterile, distilled (50K ohm to 1 Meg Ohm) water.

2. The humidity pan will hold 6.375 quarts (6 liters) of sterile, distilled (50K ohm to 1 Meg ohm) water and may be placed on the floor or inserted into the shelf brackets. This pan may be autoclaved.

The best humidity and temperature response from the humidity pan is obtained when the pan is placed directly on the incubator floor. Recovery times are approximately 20% longer when the humidity pan is placed in the shelf brackets. For the proper method of placing the humidity pan in the shelf brackets, refer to the instruction sheet supplied with the humidity pan.

The water level in the humidity reservoir should be checked frequently. If a disinfectant is added to the water in the reservoir, it should be changed once a week to help prevent microbial contamination. If no disinfectant is added to the sterile distilled water (50K Ohm to 1 Meg Ohm), the water should be changed at least twice a week.

It is very important that the water level in the reservoir or pan be kept relatively constant, as extreme fluctuations or "dry-outs" will have an adverse effect on the humidity level.

Caution: When installing the humidity pan, exercise care to avoid tearing the inner door gasket.

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2.10 Connecting the CO_2 Supply

For the most economical use of CO_2, a main supply of liquid CO_2 is recommended. The liquid CO_2 should be supplied from tanks (without siphon tubes) to ensure that only CO_2 gas enters the incubator injection system. It is also recommended that a two-stage pressure regulator with indicating gauges be installed at the supply cylinder outlet. The high pressure gauge should have an indicating range of 0 to 2000 PSIG to monitor tank pressure. The low pressure gauge should have a range of 0 to 30 PSIG to monitor actual input pressure to the incubator injection system. A suitable two-stage pressure regulator is available from Forma Scientific Inc. Part No. 965010

The CO_2 source must be regulated at a pressure level of 5 to 10 PSIG. Higher pressure levels may damage the CO_2 system. Pressure levels lower than 5 PSI will not affect the operation of the incubator, but will increase the CO_2 recovery time.

The CO_2 supply fitting is located on the rear of the control panel side-car of the incubator. (See Figure 3-1). Attach the vinyl CO_2 line securely to the barbed fitting and check the connection for leaks. After testing, turn the CO_2 supply off.

2.11 Setting the Chamber Temperature

With the power switch ON, press the "Set Mode" key until the "Set" indicator light is illuminated for the temperature setpoint. To adjust the temperature setpoint, press the "UP" or "DOWN" arrow key.

Pressing either key will change the display value by increments of 0.1°C. If either "ARROW" key is held down for more than two seconds, the display will increment automatically.

After adjusting the temperature setpoint, press the "Set Mode" key twice to return to the normal display.

Allow the unit to stabilize at set temperature for about eight hours before proceeding to Section 2.12.

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2.12 Zeroing the %CO_2 and Setting the Over Temp

Zeroing the %CO_2

1. Press the "Set Mode" key and it hold for about 3 seconds. "dor" will be displayed in the temperature display window and "ACTUAL % CO_2" will be displayed in the % CO_2 window.

2. Open outer and inner incubator doors *fully*. Press "Enter/Silence".

The Temperature display will go into a 90 second countdown and the CO_2 display will drop until it reaches zero. A "beep" will signal when the 90 seconds have elapsed.

3. "CLS" will now appear in the temperature display.

The CO_2% must be lower than 0.5% before closing the incubator doors.

4. Close the inner and outer incubator doors and press "Enter/Silence". The temperature display will now indicate the chamber temperature. The CO_2 display will display "CAL" for about three minutes while stabilization takes place. Then it will revert to the normal chamber temperature and CO_2 content.

Setting the Over Temp

1. Press the "Set Mode" key and hold it for about 3 seconds. "dor" will be displayed in the temperature display window and ACTUAL % CO_2 will be displayed in the % CO_2 window.

2. Press the "Set Mode" key again to set/change the over temperature. The % CO_2 display will go blank, the "Hi Limit" and "SET" indicator lights will be illuminated and the temperature display will indicate the over temperature setpoint.

3. Using the screwdriver mounted on the control panel (located directly below the Power Switch) turn the Over Temp set screw (located directly above the "UP" arrow key) to the desired setting (clockwise rotation increases the over temp setting, counterclockwise rotation decreases it). Press the "Set Mode" key to return to the normal display.

2.13 Setting the %CO_2

Turn on the CO_2 supply to the incubator. Press the "Set Mode" key twice. The "Set" indicator light will illuminate for the % CO_2. To adjust the % CO_2, press the "UP" or "DOWN" arrow key.

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Pressing either "ARROW" key will change the display value by increments of 0.1%. If either key is held down for more than two seconds, the display will increment automatically.

After adjusting the CO_2 setpoint and before leaving the CO_2 set mode, decide whether the audible CO_2 alarm is to be disabled. If so, press the "Enter/Silence" key. A decimal point will appear on the far right side of the CO_2 display.

The CO_2 alarm may be enabled (*no decimal point displayed*) or disabled (*decimal point displayed*) by pressing the "ENTER/SILENCE" key repeatedly.

Press the "Set Mode" key to return to the normal display.

2.14 RS-232 Output Interface

The 3193 series is equipped with an RS-232 Serial Communication Interface for remote transmission of sensor data. A standard DB-25S connector is located on the top back side of the control panel. The data is "dumb printer" formatted to permit connecting a computer or a serial printer. A wiring diagram of the RS-232 Interface Adapter is shown in Figure 2-3.

Three wires are used for the RS-232 interface:

TX Data = Pin 2
RX Data = Pin 3
Signal Ground = Pin 7

The data format is seven-bit ASCII with a leading zero (8th bit). Each character is transmitted with one start-bit, eight data-bits, and two stop-bits, totaling eleven bits. NO parity-bit is included. Baud rate is 1200.

A data transfer sequence is transmitted according to the following format. X refers to the variable numerical temperature or CO_2 data.

(LF) XX.X C (SP) (SP) XX.X % CO_2 (SP) (LF) (CR) (EOT)

LF - line feed
SP - space
R - carriage return
EOT - end of text

The incubator transmits temperature and CO_2 data one minute after power is first applied and every 60 minutes thereafter.

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The incubator responds to two ASCII commands from the remote: DC1 (XON), and DC3 (XOFF).

DC1 ("11" Hexadecimal):

The incubator will transmit temperature and CO_2 data upon receiving "DC1" or will restart 60 minute interval transmissions if they had been inhibited by a "DC3".

DC3 ("13" Hexadecimal):

Receiving a "DC3" from the remote inhibits the incubator from sending serial data indefinitely until a "DC1" is received (or incubator power is removed and then reapplied).

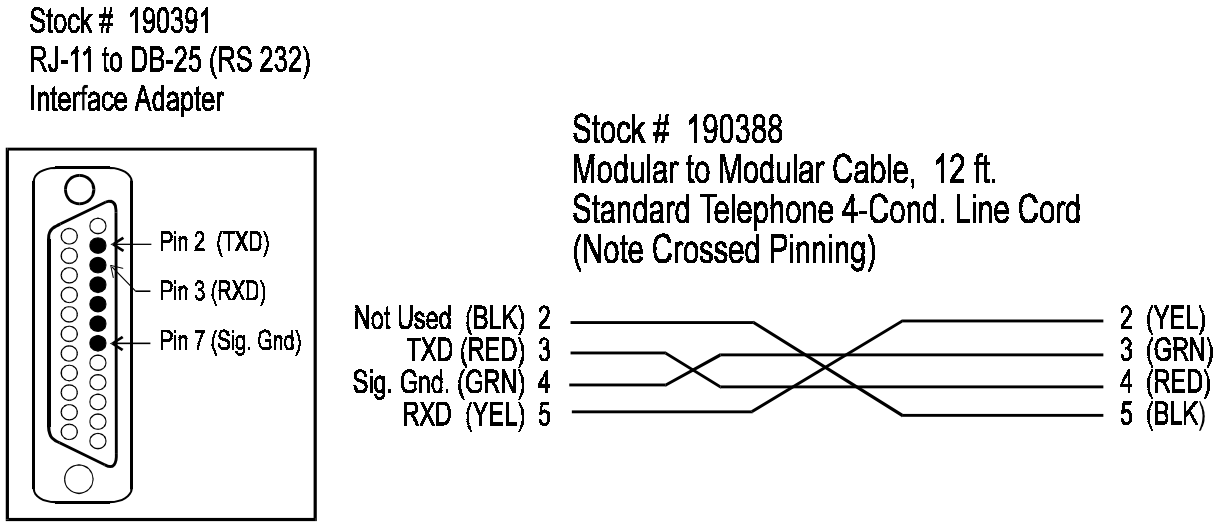


Figure 2-3
RS-232 (Factory Installed) Option, External Connections

2.15 Over Temperature Remote Alarm Contacts

The 3193 series incubators are equipped with a set of "dry" over temperature remote alarm contacts. The remote alarm contacts are located behind the side access panel. (Refer to Figures 5-1 or 5-2).

Terminal configuration for over temperature relay no power applied:

Alarm Condition

Alarm contacts 3 and 9 = CLOSED
Alarm contacts 6 and 9 = OPEN

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Power applied (normal condition):

Alarm contacts 3 and 9 = OPEN
Alarm contacts 6 and 9 = CLOSED

2.16 Keyboard "LOCK/UNLOCK" Feature

The keyboard "LOCK/UNLOCK" feature has been provided to protect against accidental or unauthorized entry. When the microprocessor is in the "Unlocked" condition ("UL"") all functions/modes are accessible and programmable.

When the microprocessor is in the locked condition ("L") the following functions/modes *are accessible, but not programmable:*

Temperature Setting
%CO_2 Setting
Zeroing the CO_2

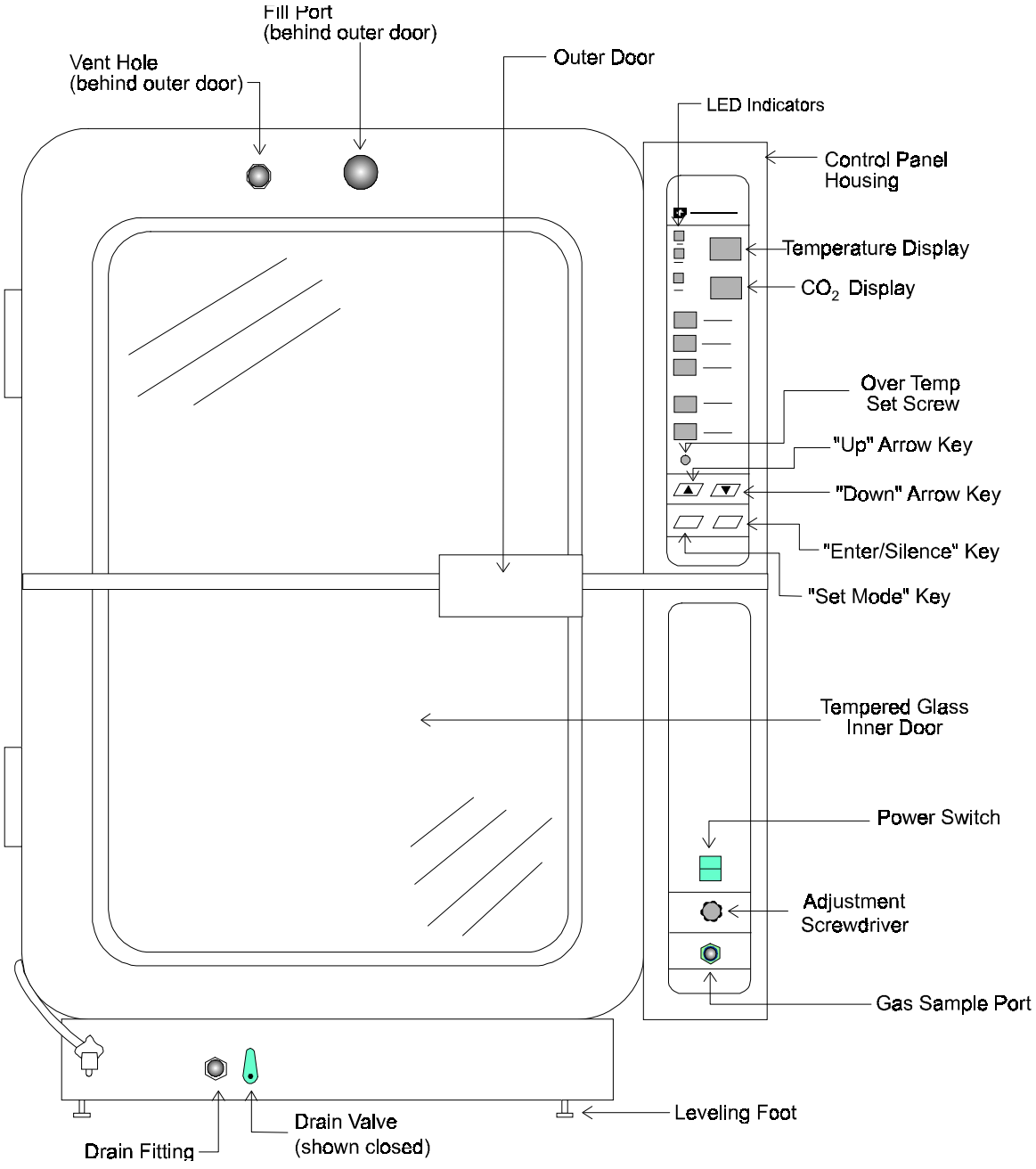
Access is denied to all calibration and test routines.

Note: The "Over Temp" setting *cannot* be locked out.

Caution: The access code for changing the "lock/unlock" condition of the microprocessor is factory-set at "063" and may not be changed. Therefore, to protect the confidentiality of the access code, it is important to keep this manual in a safe place.

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Section 3 - Operation



Model 3193 Series Water Jacketed Incubator - Front View
Figure 3-1

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3.1 Control Panel (See Figure 3-2 and Figure 3-3)

a. Power Switch

The main power switch (located in the lower portion of the control panel) controls the ON/OFF power to the unit.

b. Over Temp Setpoint Adjustment Screwdriver

A small screwdriver, located directly below the power switch, has been provided for setting the over temperature setpoint. Twist the knob and pull outward. The knob is the handle of the screwdriver.

3. Gas Sample Port

A gas sample port has been provided for checking the CO_2 percentage by an independent measuring device. (e.g. FYRITE).

Caution: The gas sample port should never be capped as it serves as a vent for the incubator chamber.

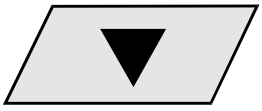
4. Up Arrow Key

Pressing the "UP" arrow key increases numerical values. Pressing this key for more than two seconds will cause the display to increment automatically.



5. Down Arrow Key

Pressing the "DOWN" arrow key decreases numerical values. If this key is held down for more than two seconds the display will increment automatically.



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6. Set Mode Key

Pressing the "Set Mode" key will allow the user to scroll through the various modes. In some modes this key also stores operator settings.

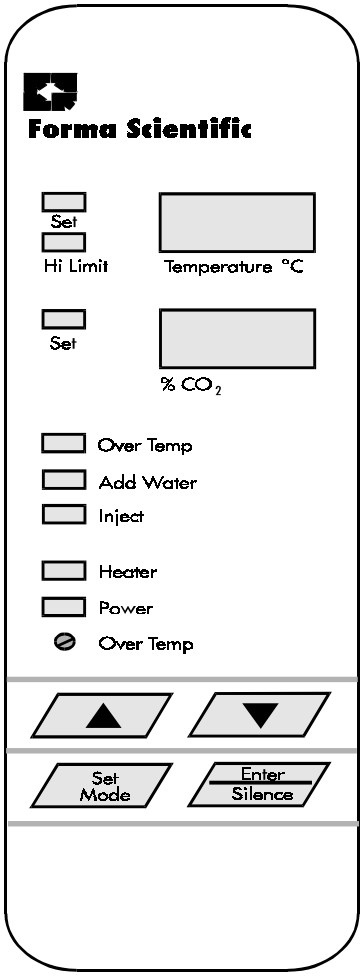


7. Enter/Silence Key

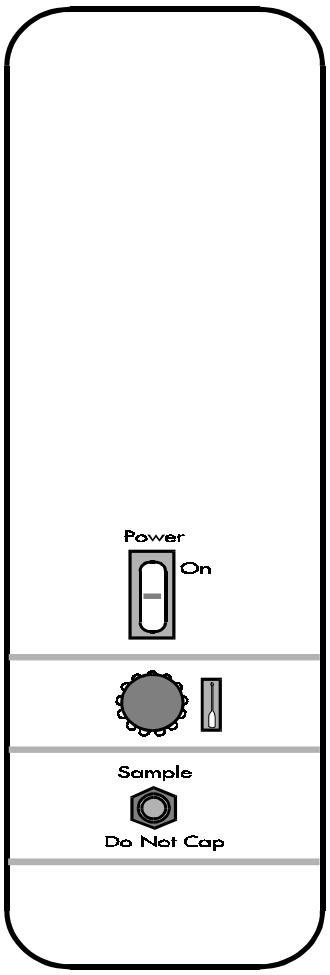
Pressing the "Enter/Silence" key silences alarms. It also allows new values to be entered in both the diagnostic and calibration modes.



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3193 Series Control Panel (top)
Figure 3-2



3193 Series Control Panel (bottom)
Figure 3-3

IMPORTANT!

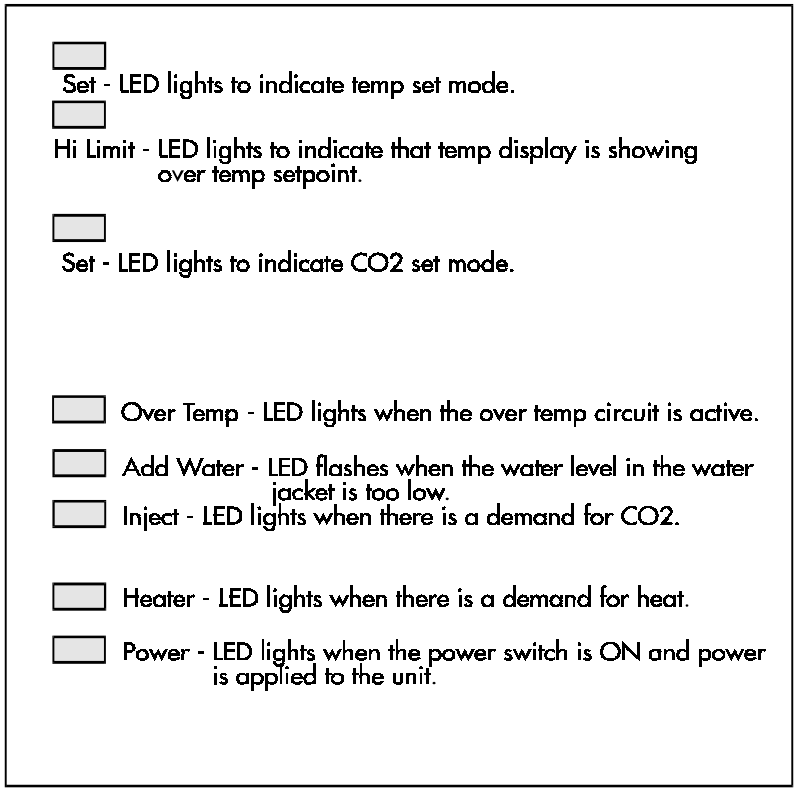
Certain key sequences for calibration and diagnostic functions require electronic test instruments. Altering factory set values, without such instruments, will result in improper operation of the incubator.

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3.2 Audible Alarms and LED Indicators

Audible Alarm:

Provides a pulsing "beep" tone whenever an alarm condition is present. Pressing the ALARM SILENCE key will silence the OVER TEMP alarm for approximately 15 minutes, and the ADD WATER alarm for approximately 30 minutes.



LED Indicators
Figure 3-4

3.3 Remote Alarm Relay System

A SPDT relay is provided for monitoring alarm conditions on the incubator. Connections are made by means of an RJ-11, telephone style jack, located on the rear of the cabinet. Figure 3-6 shows the connector diagram. Any of the incubator alarms will activate the relay.

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Alarm Condition	Visual Indicator	Audible Delay	Reset Delay (Ringback)
Temp.> Over Temp setpoint	OT LED ON	0	15 Minutes
CO_2 Sensor Fault	PP in CO_2 Display	0	15 Minutes
Temp Sensor Fault	PP in Temp Display	0	15 Minutes
Low Water in Jacket	Flash Add Water LED	0	30 Minutes
%CO_2>setpoint +1%	Flash CO_2 Set LED	15 Minutes	15 Minutes
%CO_2<setpoint - 1%	Flash CO_2 Set LED	15 Minutes	15 Minutes
Temp>setpoint +2°	Flash Temp Set LED	0	15 Minutes
Temp<setpoint -2°	Flash Temp Set LED	15 Minutes	15 Minutes

Control System Alarms
Figure 3-5

1. The alarm remains in the display until the alarm condition is corrected.

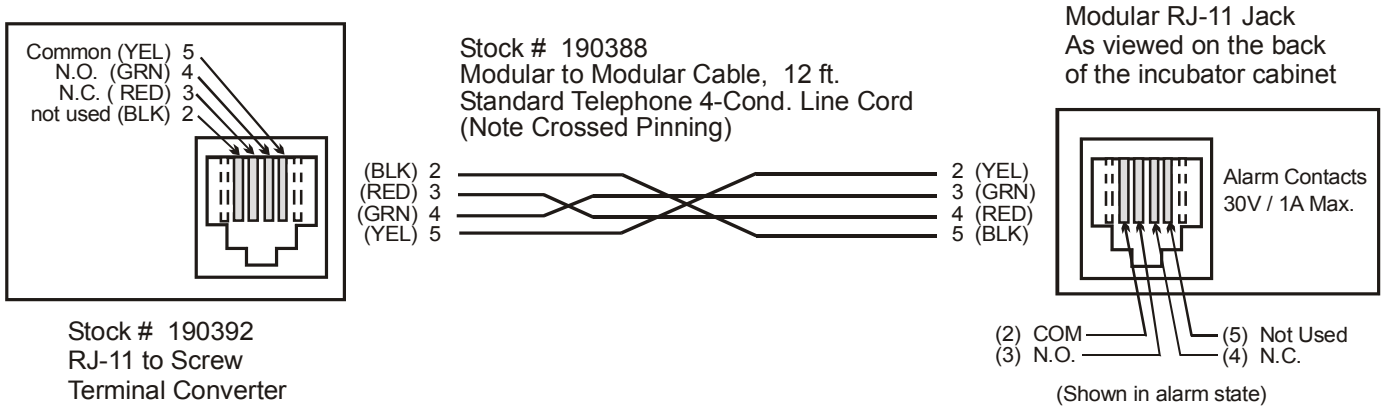
2. The add water audible alarm turns off when the water jacket is full.

3. The Low Temperature alarm is set to 9 hours on power-up. Resets to 15 minutes once "armed" by coming within two degrees of the temperature setpoint.

4. Temperature deviation alarms are de-activated when the temperature setpoint = 20.0° C.

5. CO_2 deviation alarms are de-activated when the CO_2 setpoint = 0.0 % CO_2.

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Connector Diagram
Figure 3-6

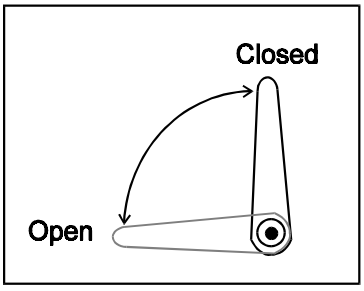
3.3 Fill Port and Vent Hole

The fill port is located in the top center of the cabinet frame behind the door gasket. During filling of the water jacket, air displaced by the entering water escapes through the vent located adjacent to the fill port.

Caution: A plugged vent hole can cause serious damage to the incubator chamber walls.

3.4 Fill/Drain Valve

A water jacket drain valve is located on the bottom of the cabinet frame and is protected by a metal cover. To access the drain valve, remove the two screws that secure the cover plate.



Water Jacket Drain Valve

When the valve lever is vertical, the valve is closed.

When the valve lever is horizontal, the valve is open.

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3.5 P.C. Board Alarm Silence Switch

It is necessary to open the control panel to gain access to the printed circuit board alarm silence switch. The Alarm Silence Switch disables all audible alarms. The switch also silences the beep tone when keys are pressed.

To open the control panel:

1. Remove the adjustment screwdriver from the control panel. (Refer to Figure 3-3.)

2. Insert blade of screwdriver through the small hole on the top right (top left on opposite door swing models) side corner immediately behind the control panel and depress the recessed button. The top of the control panel will swing open toward the front. The Alarm Silence Switch, SW1, is located on the back edge of the circuit board near the top. (Refer to Figure 5-1)

3. To disable the audible alarms, gently lift up on the top part of SW1 until it clicks (locks) in the up position. A fingernail is probably the best "tool" to grasp the top part of the switch.

or.....

On boards with a DIP style switch, slide the switch On to enable the alarm or Off to disable it.

3.6 Door Heat Control

The door heat control helps eliminate condensation in extreme environments. The door heat control may be set from 25% to 100%, in 5% increments. The door heat control is factory set at 75%. Refer to the following procedure for Setting the Door Heat %.

Caution: The door heat control should be changed only under extreme ambient conditions. Consult the Forma Scientific Service Department before making any door heat adjustments, as this can affect temperature uniformity.

To set the door heat %:

1. Press and hold the ENTER/SILENCE key and press the SET MODE key. "dH" will appear in the temperature display window and Door Heat % will be displayed in the % CO_2 window.

2. Press the UP or DOWN arrow key to increase or decrease the %. The door heat control may be set from 25% to 100%, in 5% increments.

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3. Press the SET MODE key again to lock the new value and return to the normal display.

3.7 Electrical Outlet (Accessory)

A single 115V (75 Watts Maximum) electrical outlet is located on the back side of the control panel.

3.8 Circuit Breaker (resettable)

The 5 amp circuit breaker is located on the bottom front underside of the control panel. If an overload condition occurs, the circuit breaker will trip, and the button will protrude from the circuit breaker assembly. Depressing the button will reset the circuit breaker.

If the circuit breaker trips again within a short time period, the unit should be checked by a qualified electrician.

3.9 Operation of "Normal" Modes

Listed below are the procedures for the four "NORMAL" set modes.

1. Temperature Set Mode
2. CO_2 Set Mode
3. CO_2 Zero Set Mode
4. Over Temp Set Mode

a. Temperature Set Mode - Setting The Chamber Temperature

The Temperature Set Mode monitors the system and activates the alarm whenever the temperature varies more than two degrees (plus or minus) from the set point. Although the alarm is sounded, the system will continue to try and control the temperature. The plus or minus two degrees is a fixed temperature tolerance and cannot be changed by the user.

The chamber temperature is set as follows:

1. With the power switch ON, press the SET MODE key, until the SET indicator light is illuminated for the temperature set point.

2. Adjust the temperature set point by pressing the UP or DOWN arrow key. Pressing either key will change the display value by increments of 0.1°C. If either arrow key is held down for more than two seconds, the display will increment automatically.

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3. After adjusting the temperature setpoint, press the SET MODE key twice to lock the temperature setting and return to the normal display.

Any time electric power is shut off to the incubator, the temperature alarm circuit is disabled for up to nine hours when the unit is restarted. This is to allow the system to reach the temperature set point. Should the set point be reached before nine hours have elapsed, the monitoring circuit will activate when the temperature is within two degrees of the set point.

b. CO_2 Set Mode - Setting The % CO_2

1. Press the SET MODE key until the SET indicator light is illuminated for the % CO_2.

2. Adjust the % CO_2 by pressing the UP or DOWN arrow key. Pressing either key will change the display value by increments of 0.1%. If either arrow key is held down for more than two seconds the display will increment automatically.

3. After adjusting the CO_2 set point, and before leaving the CO_2 Set Mode, decide whether the audible CO_2 alarm is to be disabled. If so, press the ENTER/SILENCE key. A decimal point will appear on the far right side of the CO_2 display.

Note: The CO_2 alarm may be "enabled" (No decimal point displayed) or "disabled" (Decimal point displayed) by pressing the ENTER/SILENCE key *repeatedly* while still in the CO_2 Set Mode.

4. Press the SET MODE key again to lock the CO_2 setting and return to the normal display.

c. CO_2 Zero Set Mode - Zeroing The %CO_2

1. Press the SET MODE key and hold for three seconds. DOR will be displayed in the temperature display window and ACTUAL % CO_2 will be displayed in the % CO_2 window.

2. Open the outer and inner incubator doors *fully* to allow CO_2 to escape from the incubator chamber. Press ENTER/SILENCE. The temperature display will begin a 90- second countdown and the CO_2 display will drop until it reaches zero. A "beep" will signal when 90 seconds have elapsed.

3. CLS will now appear in the temperature display.

Note: The CO_2% must be lower than .5% before closing the incubator doors.

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4. Close the inner and outer incubator doors, and press ENTER/SILENCE.

The temperature display will now indicate the chamber temperature. The CO_2 display will read "CAL" for several minutes while stabilization takes place, after which it will display the chamber CO_2 content.

To remind the user to zero chamber CO_2, a factory-set prompt has been provided. Every thirty days a flashing prompt (between "CAL" and actual CO_2%) will appear in the CO_2 display.

The CO_2 clock determines the frequency at which the prompt will appear in the CO_2 display. The clock has been factory set at 30 days, but may be reset for frequencies ranging from 1-60 days. For instructions to change the CO_2 clock refer to Section 6.5.

Inquiries regarding the frequency of CO_2 zero may be addressed to Forma Scientific, Inc., Service Department, 1-800-848-3080.

d. Over Temp Set Mode - Set/Change The Over Temp

The Over Temp alarm is a separate circuit on the main microprocessor board. This is a safety feature which allows the over temperature monitor to continue to operate despite failures in other operating components. When the over temperature set point is exceeded, the Over Temp alarm will sound and the water jacket heating element will be turned off.

To set or change the Over Temp set point:

1. Press the SET MODE key and hold for three seconds. DOR will be displayed in the temperature display window and the ACTUAL % CO_2 will be displayed in the % CO_2 window.

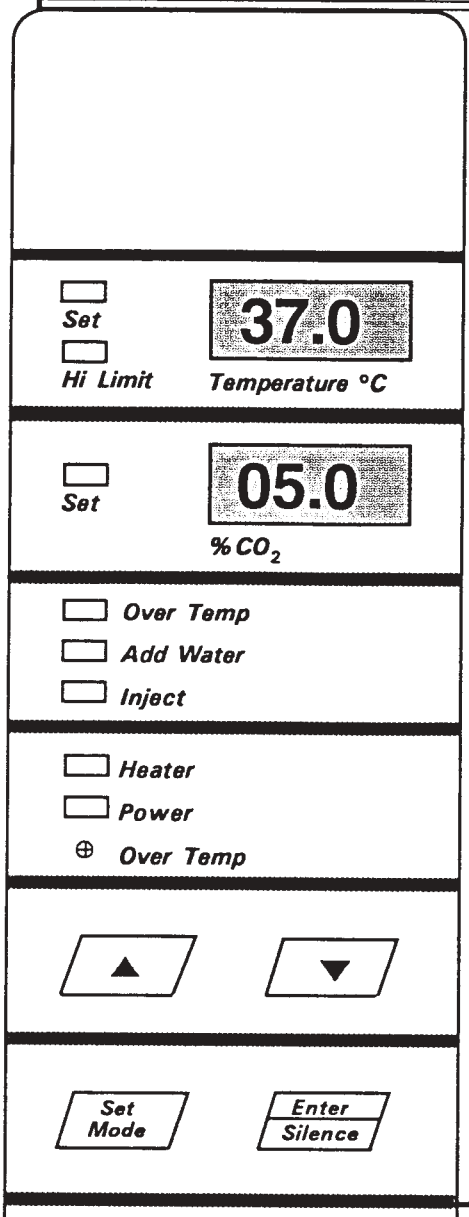
2. Press the SET MODE key again and the temperature display will indicate the Over Temp setting. The % CO_2 display will go blank and the HI LIMIT and SET indicator lights will illuminate.

3. Using the adjustment screwdriver (located directly below the Power Switch) turn the OVER TEMP set screw, located directly above the UP arrow key, to the desired setting. Clockwise rotation increases the over temperature setting, counterclockwise rotation decreases it.

3. Press the SET MODE key to return to the normal display.

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MICROPROCESSOR CONTROLLED INCUBATOR
ENVIRO-SCAN™ QUICK REFERENCE



- The next few pages describe the five most commonly used key sequences for the Enviro-Scan incubator control system: **Temperature Set, CO_2 Set, CO_2 Zero Set, Over Temp Set and Lock/Unlock Keyboard.**
- All Key sequences start from normal display.

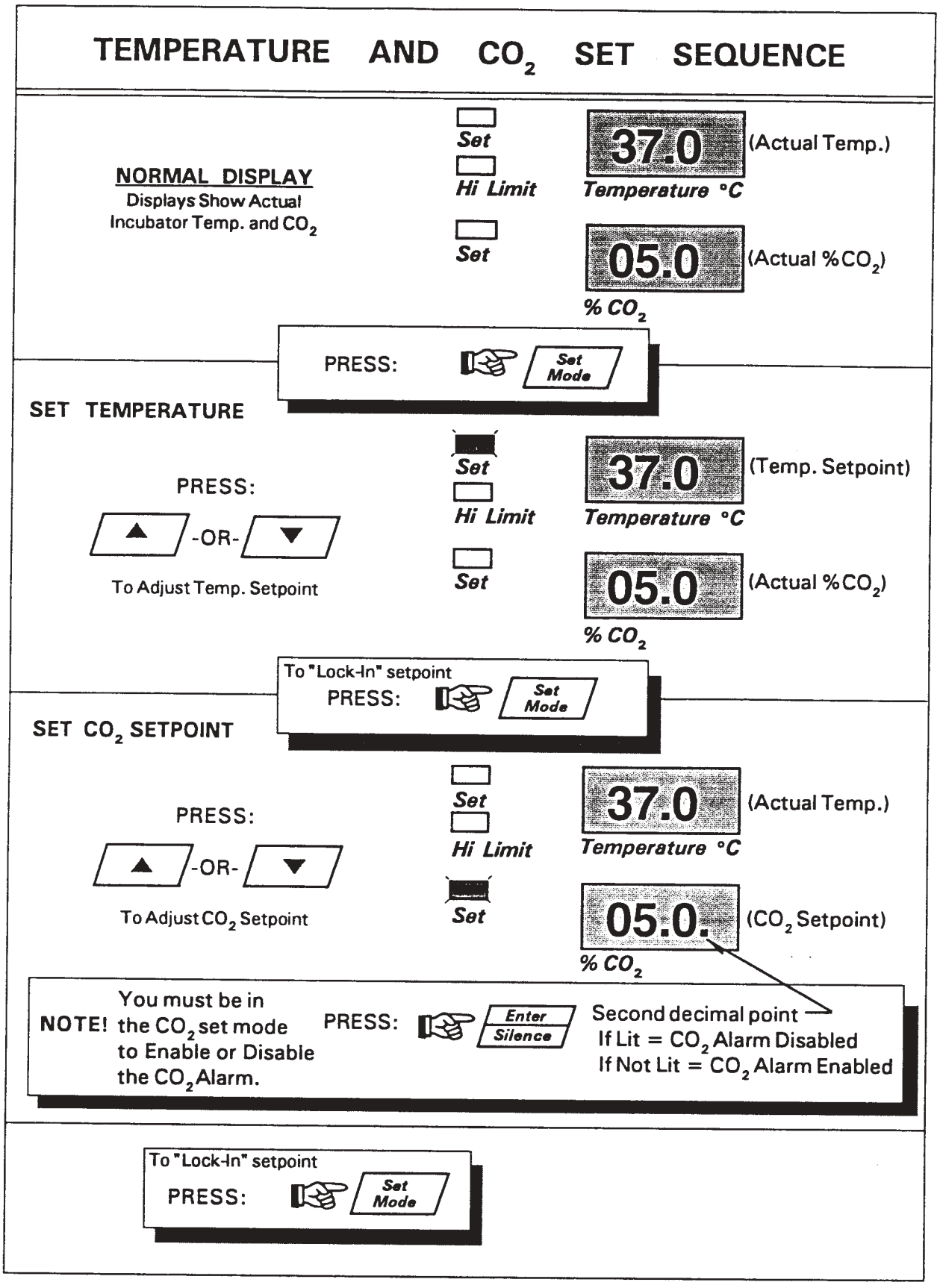
Set	Lights when setting or calibrating various functions
Hi Limit	Lights when Over Temp circuit is activated
	Temperature Display shows temperature, set points, or various calibration/diagnostic prompts
Set	Lights when setting or calibrating various functions
	CO_2 Display shows gas concentrations, set points, door heat % on, or various calibration/diagnostic prompts
Over Temp	Lights when over temp circuit is activated
Add Water	Lights when water jacket requires water
Inject	Lights as CO_2 is injected into chamber
Heater	Lights when heater is on
Power	Lights when power is on
⊕ *Over Temp*	Use screwdriver to adjust setpoint
▲	Increases display reading
▼	Decreases display reading
Set Mode	Push to show next display mode. In some modes, stores display values
Enter Silence	Silences alarms. During calibration, stores certain values

• IMPORTANT •

Additional key sequences for calibration and diagnostic fuctions require electronic test instruments. Altering factory set values without such instruments will result in improper operation of the control system.

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TEMPERATURE AND CO_2 SET SEQUENCE



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CO_2 ZERO SET

NORMAL DISPLAY
Displays Show Actual Incubator Temp. and CO_2

Set
Hi Limit
37.0 (Actual Temp.)
Temperature °C

Set
05.0 (Actual %CO_2)
% CO_2

PRESS & HOLD (3 SEC.) — Set Mode

"dor" will appear in the Temperature display.

Fully open outer and inner doors!

Set
Hi Limit
dor
Temperature °C

Set
05.0
% CO_2

PRESS: — Enter Silence

Temperature display will go into a 90 second countdown.

An audible "beep" will signal when the 90 seconds have elasped.

Set
Hi Limit
090
Temperature °C

Set
05.0
% CO_2

After the 90 seconds have elasped, "CLS" will appear in the Temperature display.

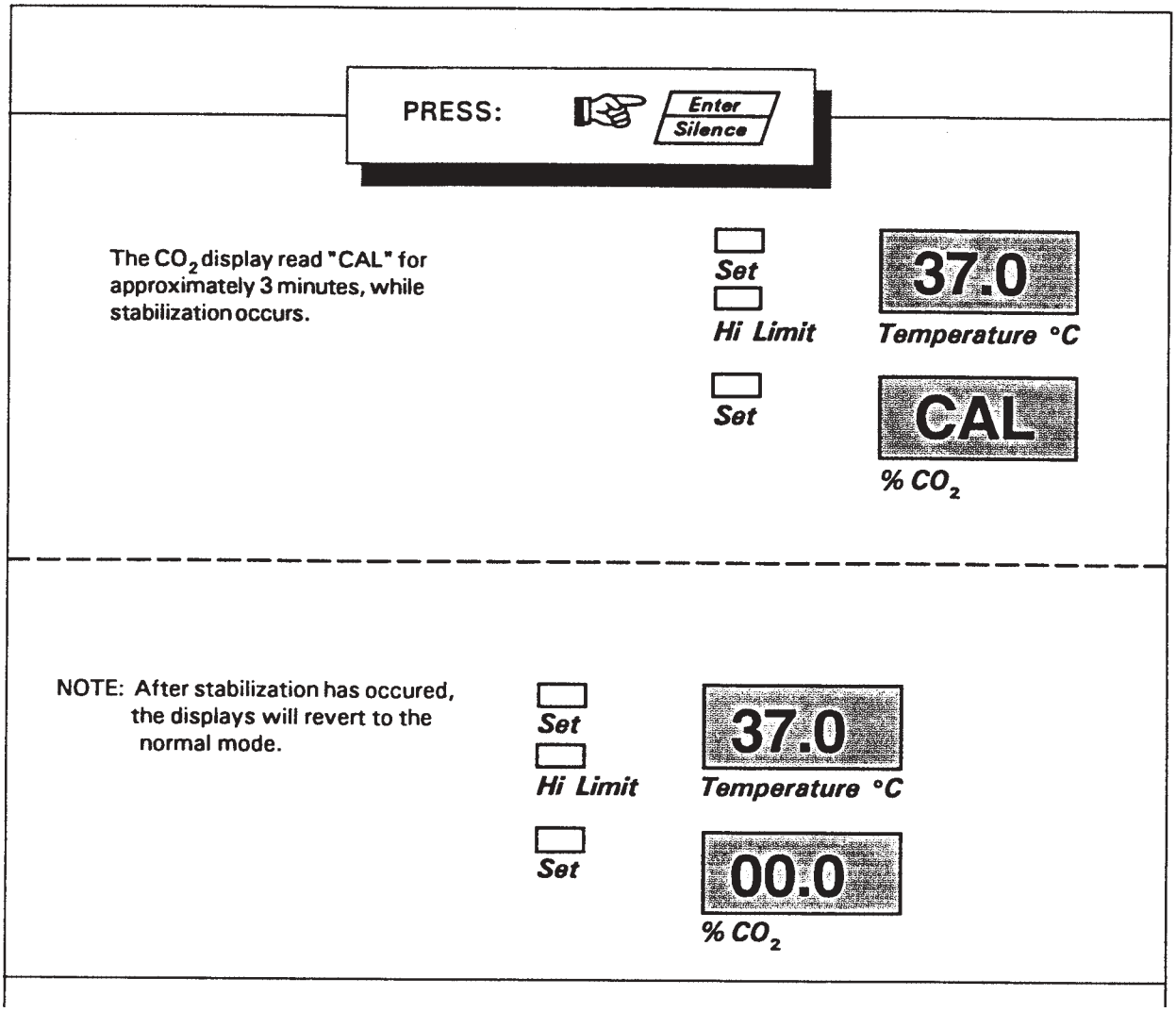
Close inner and outer doors.

Set
Hi Limit
CLS
Temperature °C

Set
00.0
% CO_2

continued

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OVERTEMP SET

NORMAL DISPLAY
Displays Show Actual
Incubator Temp. and CO_2

Set
Hi Limit
37.0 (Actual Temp.)
Temperature °C

Set
05.0 (Actual %CO_2)
% CO_2

PRESS & HOLD (3 SEC.) — Set Mode

"dor" will appear in the Temperature display.

Set
Hi Limit
dor
Temperature °C

Set
05.0
% CO_2

PRESS: — Set Mode

SET / CHANGE OVER TEMP

⊕ Over Temp: Decrease / Increase

Use Screwdriver (provided)
To Adjust Over Temp Limit

Set
Hi Limit
40.0 (Over Temp Setpoint)
Temperature °C

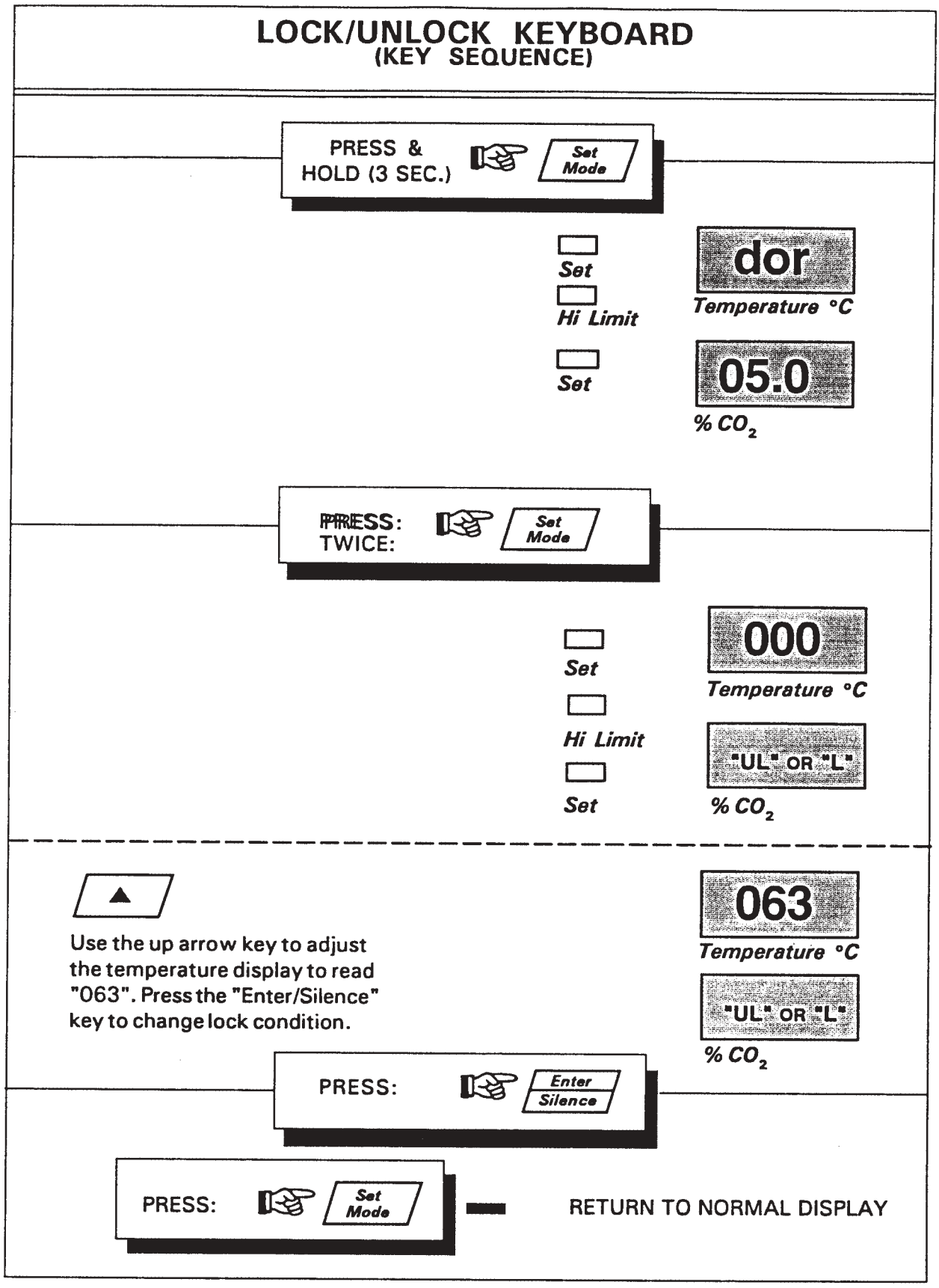
Set
% CO_2

PRESS: — Set Mode

RETURN TO THE NORMAL DISPLAY

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LOCK/UNLOCK KEYBOARD
(KEY SEQUENCE)



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SILENCING ALARMS

TO SILENCE ALARMS:	TOUCH:	NOTE:
CO_2 Alarm Set	Enter / Silence	• Check Gas Supply • Service Unit If Necessary
Add Water	Enter / Silence	• Alarm Reactivates 30 Min. After Silencing Unless Corrected • Replenish Water In Jacket
Over Temp	Enter / Silence	• Alarm Reactivates 15 Min. After Silencing Unless Corrected • Check Over Temp Limit Set Point • Service Unit If Necessary • Heating Elements Shut Off Until Corrected
Temp Alarm Set	Enter / Silence	• Alarm Reactivates 15 Min. After Silencing Unless Temp. Is Within +/- 2° C of Set Point • Alarm Delayed Up to 9 Hours Upon Power-Up • Service Unit If Necessary

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Section 4 - Routine Maintenance

4.1 Disinfecting the Incubator Interior

The incubator must be disinfected with an approved laboratory chemical. All articles and surfaces to be disinfected must be thoroughly cleaned and rough dried.

Danger: ***Alcohol, even a 70% solution, is volatile and flammable. Use it only in a well ventilated area that is free from open flame. If any component is cleaned with alcohol, do not expose the component to open flame or other possible hazard.***

Caution: ***Do not use strong alkaline or caustic agents. Stainless steel is corrosion resistant, not corrosion proof. Do not use solutions of sodium hypochlorite (purex, clorox, etc.), as they will cause pitting and rust.***

> ***Warning! Make sure not to saturate the CO_2 sensor during the disinfecting process. Saturating the sensor can lead to sensor failure and possible loss of the incubator's contents.***

1. Remove shelves and duct sheets and clean all interior surfaces.

2. Rinse the surfaces at least twice with sterile distilled water (50K Ohm to 1 Meg Ohm) or until all of the disinfectant-detergent has been removed.

3. Thoroughly clean the inner door gasket.

4. Clean the inside of the glass door with the disinfecting solution and rinse with sterile distilled water (50K Ohm to 1 Meg Ohm).

5. Wash the shelves and duct sheets with the solution.

6. Rinse with sterile distilled water. Repeat rinsing until all of the disinfectant-detergent has been removed.

7. If desired, all surfaces can then be wiped or sprayed with 70% alcohol.

8. Reinstall the duct sheets and shelves.

9. Operate the incubator for 24 hours to assure removal of trace vapors.

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Caution: After completing the decontamination procedure, Forma Scientific recommends that the incubator be run and tested before placing any valuable contents inside the incubator chamber.

4.2 Cleaning the Cabinet Exterior

The incubator exterior may be cleaned with soap and water and a general use laboratory disinfectant.

4.3 Draining the Water Jacket

Caution: Disconnect the unit from the electric power source.

For best results, the water in the water jacket should be changed yearly. Refer also to Figure 3-1 and Sections 3.3 and 3.4.

1. Remove the metal cover on the bottom frame of the incubator which protects the drain and drain valve.
2. Attach a piece of 3/8" vinyl tubing to the barbed drain fitting.
3. Place the other end of the tubing into a drain or large container. Remember, the water jacket capacity is about 13 gallons.
4. Open the drain by turning the drain lever counterclockwise to horizontal .
5. When the jacket has been completely drained, return the valve lever to vertical.

4.4 Changing the CO_2 Filter *(For qualified service personnel only!)*

Caution: Disconnect unit from power source.

Under conditions of normal use and the purity of gas being used, the CO_2 filter should be serviceable for about five years. If the CO_2 filter becomes clogged, replace with Forma Part No. 770001.

1. Remove the side access panel from the control housing.
2. Locate the CO_2 filter from the CO_2 inlet fitting.
3. Remove and save the clamps securing the filter to the tubing. It is best to SLIDE the clamps apart sideways when removing.
4. Install the new CO_2 filter.
5. Secure the filter with clamps.

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Section 5- Service

Caution: Servicing must be performed by qualified service personnel!

5.1 General Troubleshooting Guide (Table 5-1.)

Symptom	Possible Cause
No Power Light on Control Panel.	• Power Line Cord Disconnected. • Circuit Breaker Tripped/Open • Loose 40 Pin Connector on Microprocessor Board. • Defective Transformer.
No CO_2, But Inject light is "ON".	• Loss of Main CO_2 Supply. • Break in Main CO_2 Supply. • Defective CO_2 Solenoid.
CO_2 Setpoint and Display Agree; FYRITE Reads Lower.	□ FYRITE not Zeroed. □ FYRITE Filter is Dry. □ FYRITE Fluid Need to be Replaced. □ Chamber Humidity has Decreased. □ CO_2 Control not Zeroed Correctly. □ Defective CO_2 Sensor.
CO_2 Display and FYRITE Read 0%: CO_2 Inject light is ON, Setpoints are "OK".	□ Loss of Main CO_2 Supply. □ Clogged CO_2 In-Line Filter. □ Defective CO_2 Sensor. □ Defective CO_2 Solenoid.
Over Temp Cannot be Adjusted.	□ Operator not in Over Temp Set Mode. □ Defective Microprocessor Board.
Add-Water Light ON.	□ Low Water in Chamber. □ Water Purity not within Specification.
Keys Become Inoperative and Display Remains Fixed (Locked-Up).	□ Operator Error in Calibration Procedure. □ (Turn Unit OFF, the back ON.)
Heat Indicator ON; Not Heat in Chamber	□ 3CR Relay Defective. □ 1CR Relay Defective.
Blower Not Working.	□ Blower Wheel Binding Against Top Blower Duct. □ Defective Blower Motor. □ 1CR Relay Defective. □ Upper Blower Wheel Binding Against Insulation.
Display Problems in General.	□ Defective Microprocessor Board.
Unit is locked up, Error Code “PP” shows in the display.	□ CO_2 Sensor is out of range for the microboard. Possible Sensor problem. □ Call Forma Scientific, Inc. Service Department at 1-800-848-3080

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5.2 Test Point Guide

The purpose of this Test Point Guide is to aid the user/service technician in the prompt isolation of system failures.

- Digital Voltmeter Required (Calibrated within one year)

To gain access to the Test Points:

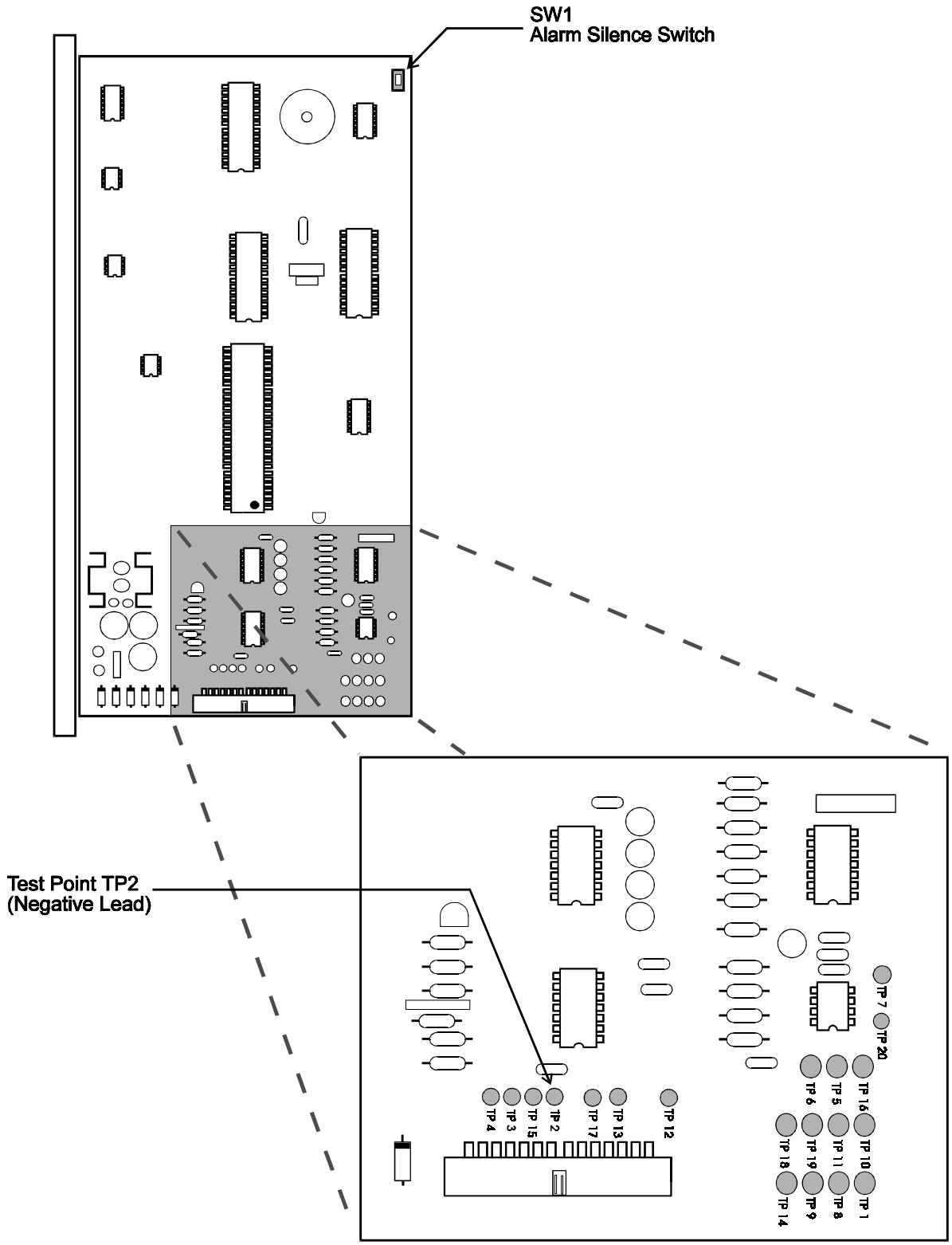
1. Remove the adjustment screwdriver from the control panel.

2. Insert the blade of the screwdriver through the small hole on the top right (top left on opposite swing) side corner of the incubator cabinet immediately behind the control panel. Depress the recessed button. The top of the control panel will "swing" open toward the front. The Test Points are located on the bottom edge of the microprocessor board and are labeled "TP1" to "TP20". (See Figure 5-1.)

3. Place the Negative lead of the digital voltmeter on Test Point 2 (TP2) and the Positive lead on each test point.

4. Locations of the test points are illustrated in Figure 5-1. Approximate voltage levels are listed in Table 5-2.

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Test Point Locations, Main Microprocessor Circuit Board
Figure 5-1

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Test Point	Description	Approximate Value
1	1/2 of Transformer Secondary	1/2 of Transformer Secondary
2	Power Common	0 (Zero)
3	CO_2 Solenoid Driver	OFF: 11.9 VDC ON: .8 VDC
4		
5	Door Heater Relay Driver	OFF: 11.9 VDC ON: .8 VDC
6	Main Heater Relay Driver	OFF: 11.9 VDC ON: .8 VDC
7	Temp Probe Voltage	.3 to .4 VDC
8	1/2 of Transformer Secondary	1/2 of Transformer Secondary
9	CO_2 Signal Common	0 (Zero)
10	CO_2 Signal	0-1 VDC
11	Over Temp Probe	.3 to .4 VDC
12	Analog Common	0 (Zero)
13	Add-Water Signal	Empty: 10.3 VAC Full: .03 VAC
14	Over Temp Relay Driver	OFF: .1 VDC ON: .11.9 VDC
15	U18 Regulator Output	11.8 to 12.0 VDC
16	U14 Negative Voltage Output	-7 to -8 VDC
17	U5 Regulator Output	4.8 to 5.0 VDC
18	Unregulated DC to U5	Around 21 VDC
19	U6 Regulator Output	4.8 to 5.0 VDC
20	U4 Reference Output	2.4 to 2.5 VDC

Circuit Board Test Point Voltages
Table 5-2

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5.3 Replacing the Chamber Heat Relay (See Figure 5-3 or Figure 5-4)

Caution: Disconnect the unit from its power source.

1. Remove the side access panel and set it aside.
2. Locate the chamber heat relay (3 CR), mounted in the top position on the inside back wall.
3. Carefully disconnect the wires to the heat relay and note their connections.
4. Remove the two mounting screws located on the back of the unit that secure the chamber heat relay. Save the mounting screws.
5. Install the new chamber heat relay.
6. Reconnect the wires (Refer to Figure 5-3 or Figure 5-4).
7. Reinstall the access panel.

5.4 Replacing the Door Heat Relay (See Figure 5-3 or Figure 5-4)

Caution: Disconnect the unit from its power source.

1. Remove the side access panel and set aside.
2. Locate the door heat relay (2 CR), mounted in the second position from the top on the inside back wall.
3. Carefully disconnect wires to the heat relay, and make note of their configuration to insure proper connection to the new door heat relay.
4. Remove the two screws from the back side of the unit that secure the door heat relay. (Save mounting screws)
5. Install new door heat relay.
6. Reconnect wires (Refer to Figure 5-3 or Figure 5-4).
7. Reinstall access panel.

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5.5 Replacing the Over Temp Relay (See Figure 5-4 or Figure 5-5)

Caution: Disconnect the unit from its power source.

1. Remove the side access panel and set it aside.
2. Locate the Over Temp relay (1 CR) mounted in the third position from the top on the inside back wall.
3. Carefully disconnect the wires to the relay and note their locations.
4. Remove the two screws from the back of the incubator that secure the Over Temp relay. (Save the mounting screws)
5. Install the new Over Temp relay.
6. Reconnect the wires.
7. Reinstall the access panel.

5.6 Replacing the CO_2 Solenoid (See Figure 5-3 or Figure 5-4)

Caution: Disconnect the unit from its power source.

1. Remove the side access panel.
2. Locate the CO_2 solenoid mounted on the fourth position from the top on the inside back wall and disconnect the tygon tubing attached to it. Note how tthe ubing is installed so that it can be properly connected to the new solenoid.
3. Disconnect the wiring to the solenoid noting the connections.
4. Remove the screws that secure the solenoid in place. Do not remove spacer located between solenoid and back wall.
5. Remove the solenoid and install the new solenoid. Make sure to connect the wiring and tubing as noted in Figure 5-3 or Figure 5-4. "INLET" and "OUTLET" are marked on the side of the solenoid.

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5.7 Replacing the Transformer (See Figure 5-3 or Figure 5-4)

Caution: Disconnect unit from power source.

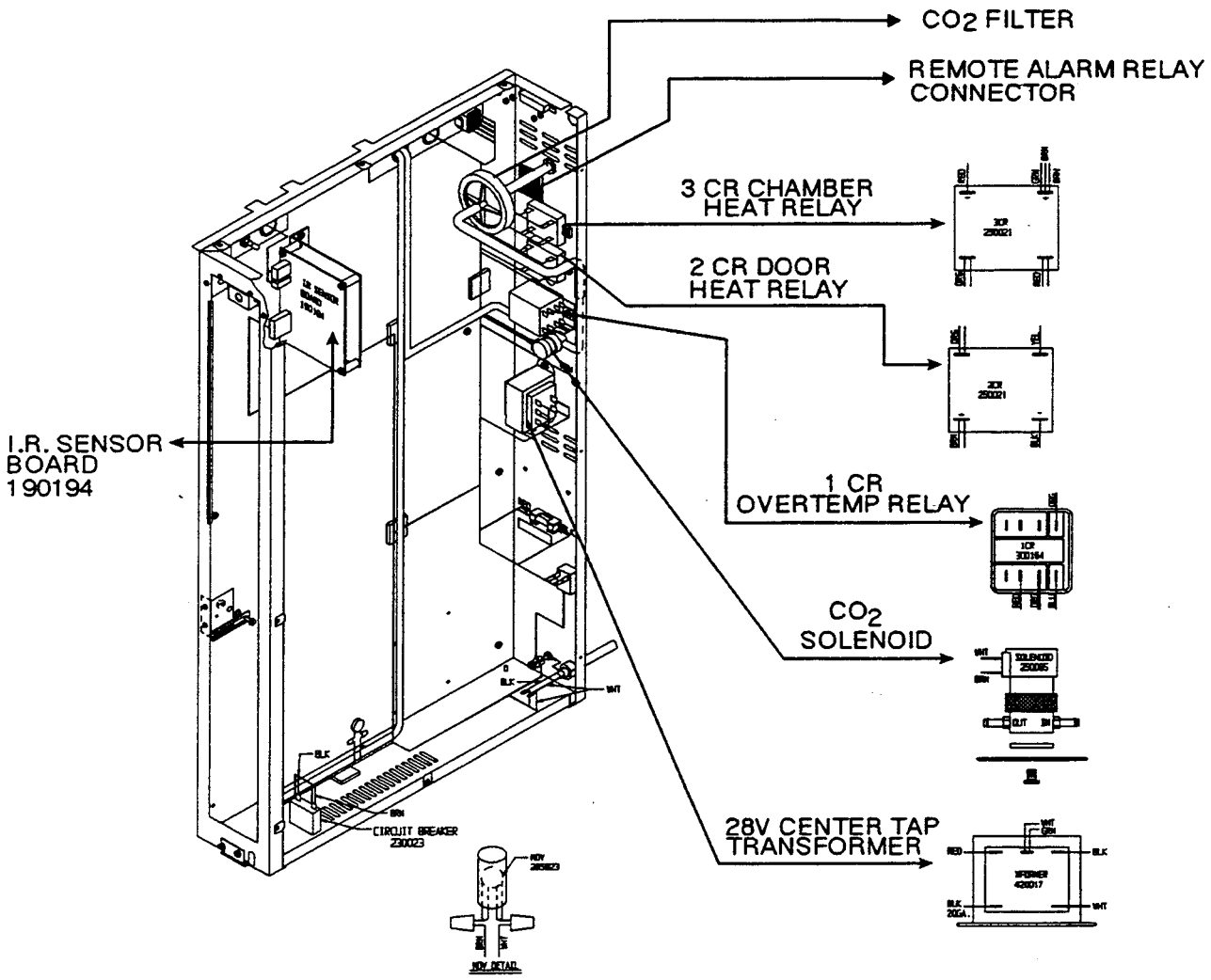
1. Remove the side access panel and set aside.
2. Locate the transformer mounted in the fifth position from the top on the inside back wall.
3. Carefully disconnect the wires to the transformer, noting their locations.
4. Remove the two screws from the back of the incubator that secure the transformer. Save the mounting screws and lock washers.
5. Install the new transformer, placing the lock washers between the transformer and the back wall of the cabinet.
7. Reconnect the wires (Refer to Figure 5-3 or Figure 5-4).
8. Reinstall the access panel.

5.8 Replacing the Circuit Breaker (See Figure 5.3 or Figure 5.4)

Caution: Disconnect unit from power source.

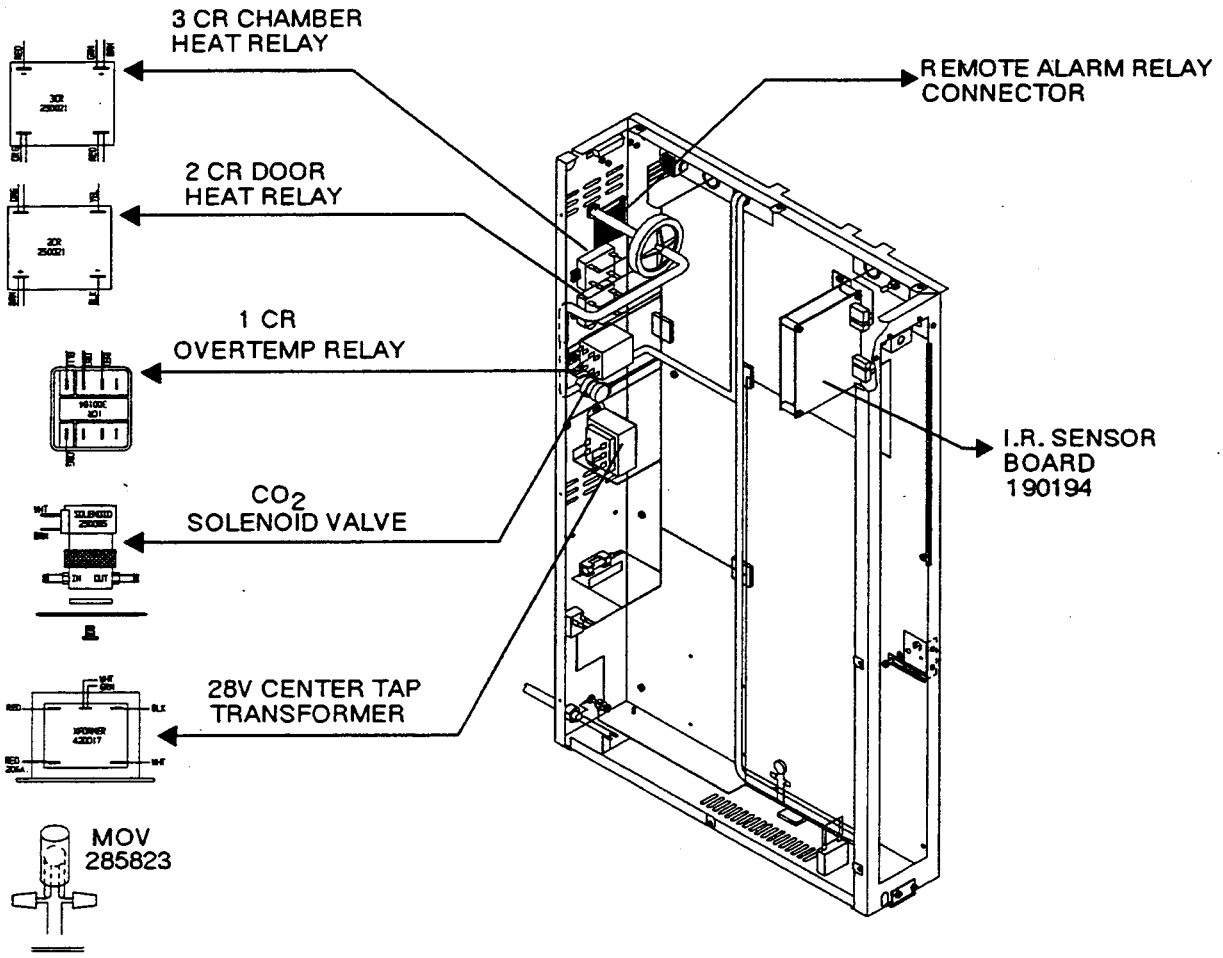
1. Remove the side access panel and set aside.
2. Locate the circuit breaker mounted on the bottom of the control panel wrap.
3. Carefully disconnect wires to the circuit breaker and note their locations.
4. Remove the knurled nut that secures the circuit breaker assembly.
5. Install the new circuit breaker.
6. Reconnect the wires (Refer to Figure 5-3 or Figure 5-4).
7. Reinstall the access panel.

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Component Location
Model 3193 (3194)
Figure 5-3

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Component Location
Model 3195 (3196)
Figure 5-4

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5.9 Replacing the CO_2 Sensor

Caution: Disconnect the unit from its power source.

1. The CO_2 sensor is mounted in the chamber ceiling. Remove all shelves and duct sheets.

2. Remove the two wing nuts securing the CO_2 sensor. The mounting plate and sensor will drop down into the chamber area.

3. Disconnect the tygon tubing attached to the sensor by cutting the tubing approximately three to four inches from the top of the sensor.

4. Disconnect wiring to sensor. Twist the connector to loosen and pull to disconnect.

5. Before installing new sensor, cut the tubing on the new sensor to a length of three to four inches.

Note: Make sure that the gasket is above the mounting plate before connecting the tubing. Once the barbed connector has been installed in the ends of the tubing, it can be removed *only* by cutting the tubing.

6. Using the small barbed connector (supplied), connect the short piece of tubing from the sensor to the supply line tubing.

7. Connect the new CO_2 sensor to the incubator wiring.

8. With the gasket in position, *carefully* return the sensor to its original opening. Make sure to tighten the wing nuts securely to properly seal the gasket.

9. Remove the protective sheath from the sensor head.

10. After the sensor has been replaced, the CO_2 must be calibrated. Refer to Section 5.10 for the calibration .

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5.10 CO_2 Calibration

1. "Zeroing" The I/R Circuit Board.

a. Turn the incubator on and set the CO_2 setpoint to 0.0%. Allow the incubator to stabilize for about 8 hours with no CO_2 present.

b. With the incubator display in the normal mode, press and hold the ENTER/SILENCE key and press the DOWN arrow key. Press the SET MODE key three times. A Millivolt signal will appear in the "Temp" display and "03" will appear in the "%CO_2" display.

Note: A (---) in the "Temp" display indicates that the voltage is out of range. A (.) appearing after the Millivolt signal indicates a negative voltage.

c. Open the outer and inner incubator doors *fully* to allow CO_2 to escape from the incubator chamber. Remove the side access panel and set it aside. If the side access panel cannot be removed, place the adjustment screwdriver into the hole on the upper front corner of the side access panel and push the button fastener to lower the control panel.

d. Locate the I/R Circuit Board. (Refer to Figure 5-3 or Figure 5-4)

e. Turn the **fine zero adjustment** fully *clockwise*. (See Figure 5-5) A clicking sound indicates the end of the adjustment pot travel.

f. Locate and turn the **coarse zero adjustment** so that the Millivolt signal in the "Temp" display reads "500" +/- 050 MV.

g. Turn the **fine zero adjustment** until the Millivolt signal in the "Temp" display reads "000" +/-010 MV. **Note:** Decimal point indicates negative number. Press the **set mode** repeatedly to return to the display.

If unable to reach 000 +/-010 on the display signal, call Forma Scientific, Inc. Service Department at 1-800-848-3080 for assistance.

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2. "Spanning" the I/R Circuit Board.

a. Close the incubator doors and set the CO_2 to the desired level. Allow the unit to stabilize for about 20 minutes.

b. With the incubator display in the normal mode, press and hold the ENTER/SILENCE key and press the DOWN arrow key. Press the SET MODE key three times. A Millivolt signal will appear in the "Temp" display and "03" will appear in the "%CO_2" display.

c. Measure the CO_2 content on an independent test instrument (FYRITE or other).

d. Look up FYRITE CO_2 value on the table **I/R Circuit Board Response** (Figure 5-6) at the end of this section. Adjust SPAN pot on the I/R board (Refer to Figure 5-5) until the Millivolt signal on the CO_2 display is within +/-010MV of the reading on the table.

3. "Zeroing" the %Co_2

a. Press the "Set Mode" key and hold for about 3 seconds. "dor" will be displayed in the temperature display window and ACTUAL % CO_2 will be displayed in the % CO_2 window.

b. Open the outer and inner incubator doors *fully* to allow CO_2 to escape from the incubator chamber. Press "Enter/Silence". The temperature display will go into a 90 second countdown and the CO_2 display will drop until it reaches zero. A "beep" will signal when the 90 seconds have elapsed.

c. "CLS" will now appear in the temperature display.

Note: The CO_2% must be lower than .5%, before closing the incubator doors.

d. Close inner and outer incubator doors and press "Enter/Silence".
The temperature display will now read chamber temperature. The CO_2 display will read "CAL" for about three minutes while stabilization takes place, after which it will display chamber CO_2 content.

4. "Spanning" the %CO_2

a. Set the CO_2 to desired setpoint. Allow 20 minutes for CO_2 to stabilize.

b. Read the CO_2 content on an independent test instrument (FYRITE or other). Press "Enter/Silence" and "Up" arrow key to enter the calibrate mode.

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c. Step through the calibrate mode by pressing the "Set Mode" key, until "CS" appears in the temperature display. Use the up and down arrow keys to match the CO_2 display with the test instrument.

d. Press the "Enter/Silence" key to store the new calibration value. Press the "Set Mode" key to scroll through the remaining modes.

5.11 Replacing the I/R Circuit Board (See Figure 5-3 or Figure 5-4)

Caution: Disconnect the unit from its power source.

1. Remove the side access panel and set it aside.

2. Disconnect all wiring from the circuit board, noting the wiring configuration to the 12 Volt power supply.

3. Remove the four screws securing the board and remove the board.

4. Using the disposable anti-static wrist strap install the new I/R circuit board.

5. Connect the wiring to the new board making sure the 12 Volt DC wiring is properly connected.

6. After the I/R circuit board been replaced, the CO_2 must be calibrated. Refer to Section 5.10 for the calibration procedure .

5.12 Replacing the Temperature Thermistor

Caution: Disconnect unit from power source.

1. Remove the two screws located on the top front edge that secure the top panel.

2. Remove top panel by pulling out about 5" and then lifting up. Set the panel aside.

3. Remove silicone sealant from the defective Thermistor opening.

4. Pull the Thermistor out of the probe sheath and cut the cable.

5. Attach the new Thermistor by using electrical in-line connectors.

6. Place the Thermistor into the probe sheath making sure the Thermistor tip is fully extended into the sheath.

7. Reseal the opening with silicone or similar sealant material.

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5.13 Replacing the Blower Motor

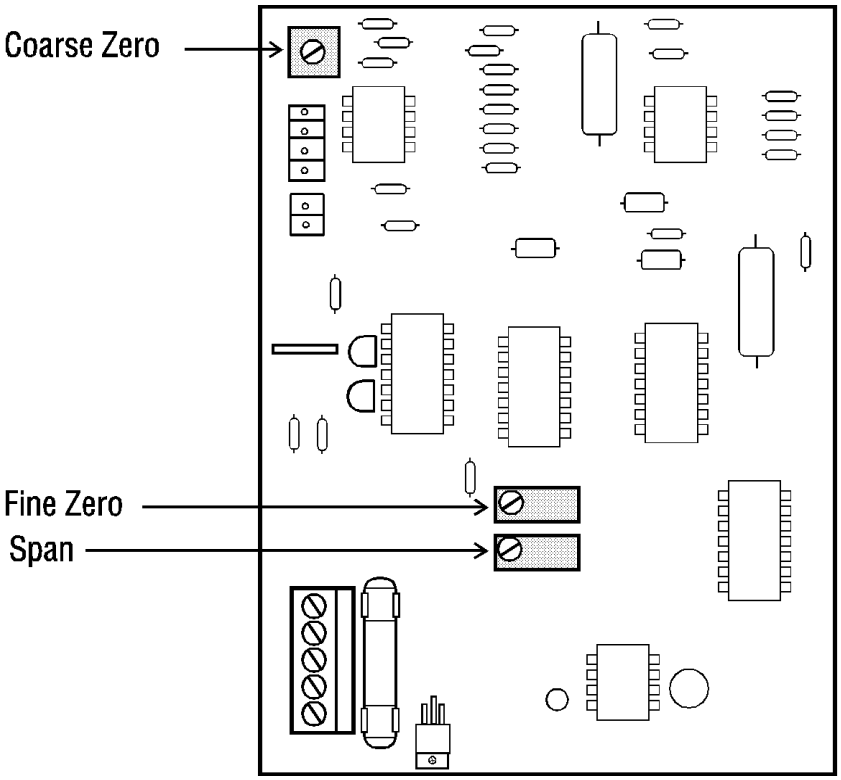
Caution: Disconnect the unit from its power source.

1. Remove the shelves, duct sheets and blower channel from the incubator interior.
2. Remove the blower wheel by firmly pulling it down.
3. Remove the four (4) wing nuts that secure the blower mounting plate to the incubator ceiling.
4. Remove the two (2) screws securing the top of the incubator.
5. Loosen the clamp securing the tygon tubing.
6. Pull blower motor assembly down into chamber area.
7. Disconnect the wires to the blower motor.
8. Disconnect the vinyl tubing from the mounting plate.

   Note: Record the different sizes of vinyl tubing and their proper connections.
9. Remove the two #6 nuts, washers and nylon spacers that secure the blower motor. Save the spacers and the blower shield plate.
10. Install the new blower motor using the original nylon spacers and blower shield plate.
11. Connect the blower motor.
12. When reinstalling the motor assembly make sure that the vinyl tubing is not kinked or pinched.

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I/R Circuit Board



I/R Circuit Board
Figure 5-5

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$\%CO_2$	Millivolts	$\%CO_2$	Millivolts
0.0	000		
0.5	092	10.5	756
1.0	168	11.0	772
1.5	231	11.5	788
2.0	286	12.0	804
2.5	334	12.5	819
3.0	376	13.0	833
3.5	415	13.5	848
4.0	450	14.0	861
4.5	483	14.5	875
5.0	513	15.0	887
5.5	542	15.5	900
6.0	568	16.0	912
6.5	594	16.5	924
7.0	617	17.0	934
7.5	641	17.5	945
8.0	662	18.0	955
8.5	682	18.5	965
9.0	702	19.0	975
9.5	721	19.5	986
10.0	738	20.0	999 to ---

I/R Circuit Board Response
Figure 3-6

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Section 6 - Calibration (Fine Tuning)

6.1 Calibrating (Fine Tuning) the Incubator

"Fine Tuning" is moving calibration values less than one whole number. The following procedure should be used for "fine tuning" adjustment *only*.

Note: If calibration values are to be changed are greater than one whole number, please consult the Forma Scientific, Inc., Service Department.

Example: Temperature Set = 37°C
Temperature Actual + 36.6°
Temp Difference = +.4° which is less than 1

Listed below, in the sequence in which they appear, is a reference table showing the different calibration modes. The (*) located beside the calibration mode signifies which modes may be changed by the user.

Note: All modes without the (*) must be by-passed by pressing the SET MODE key.

Display	Description
HO	Temperature (Heat) Zero
HS	Temperature (Heat) Span
CO	CO_2 Zero
*CS	CO_2 Span
LO	Over Temp (Limit) Zero
LS	Over Temp (Limit) Span
*HOF	Temperature (Heat) Offset
*LOF	Over Temp (Limit) Offset
xx.x xx.x	Actual Chamber Temp (Temp Display) Over Temp Setpoint (CO_2 Display)
*CC	CO_2 Clock Reset

Calibration Modes
Figure 6-1

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a. Calibrating

With the incubator display in the "NORMAL" mode, press and hold the "Enter/Silence" key and press the "UP" arrow key.

The temp Zero value will be displayed in the temperature window and "HO" will be displayed in the %CO_2 window. Press the "SET MODE" key repeatedly to scroll through the display Select the mode to be calibrated.

Note: The calibration procedure may be aborted at any time by repeatedly pressing the "SET MODE" key until the normal display appears.

6.2 Recalibrating CO_2 (SPAN)= (CS)

a. ZEROING THE %CO_2

1. Press the "Set Mode" key and hold for about 3 seconds. "dor" will be displayed in the temperature display window and ACTUAL % CO_2 will be displayed in the % CO_2 window.

2. Open the outer and inner incubator doors *fully* to allow CO_2 to escape from incubator chamber. Press ENTER/SILENCE. The temperature display will go into a 90 second countdown and the CO_2 display will drop until it reaches zero. A "beep" will signal when the 90 seconds have elapsed.

3. "CLS" will now appear in the temperature display.

   Note: The CO_2% must be lower than .5%, before closing the incubator doors.

4. Close the inner and outer incubator doors, and press ENTER/SILENCE. The temperature display will now read chamber temperature. The CO_2 display will read "CAL" for approximately three minutes while stabilization takes place. It will then display the chamber CO_2 content.

5. Set the CO_2 to the desired setpoint. Allow 20 minutes for the CO_2 to stabilize.

6. Read the CO_2 content on an independent test instrument (FYRITE or other). Press ENTER/SILENCE and UP arrow key to enter the calibrate mode.

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7. Step through calibrate mode by pressing the SET MODE key, until "CS" appears in the temperature display. Use the arrow keys to match the CO_2 display with the test instrument.

   Depending upon the CO_2 values, a 10 second delay may occur in the CO_2 display reading. Continue pressing the UP or DOWN arrow keys to match the CO_2 display with the test instrument.

8. Press the ENTER/SILENCE key to store the new calibration value. Press the SET MODE key to scroll through the remaining modes.

6.3 Recalibrating Temperature (HEAT) Offset= (HOF)

Scroll to the Temperature Offset mode, "HOF" will appear in the $\%CO_2$ window and the Cabinet Temperature value will be displayed in the Temperature window. To recalibrate, press the UP or Down arrow key to raise or lower the display to match the chamber temperature. Press the ENTER/SILENCE key to store the new calibration value.

6.4 Recalibrating Over Temp (LIMIT) Offset= (LOF)

1. Scroll to the Over Temp Offset mode. "LOF" will appear in the CO_2 window and the Over Temp Offset value will be displayed in the Temperature window.

2. The Over Temp indicator light must be off. If it is illuminated, turn the Over Temp Set Screw clockwise until the indicator goes out.

3. To recalibrate, press the UP or DOWN arrow key to raise or lower the display to match the chamber temperature. Press the ENTER/SILENCE key to store the new calibration value.

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6.5 Resetting the CO_2 Clock (CC)

The CO_2 clock determines the frequency at which the CO_2 zero prompt will appear in the CO_2 display.

The clock has been factory set with a 30 day default value, but may be reset for frequencies ranging from 1-60 days. Inquiries regarding the frequency of the CO_2 zero prompt may be addressed to Forma Scientific, Inc., Service Department, 1-800-848-3080.

1. Press ENTER/SILENCE and UP arrow key simultaneously to enter the calibrate mode.

2. Step through the calibrate mode by pressing the SET MODE key, until "CC" appears in the temperature display.

3. Press the UP or DOWN arrow key to raise or lower the display to the desired frequency (1-60 days).

4. Press the ENTER/SILENCE key to store the new value.

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Section 7 - Specifications

Temperature

Control	±0.1°C @ +37°C
Range	+5°C above ambient to +45°C
Sensor	Precision thermistor
Controller	Microprocessor, proportional
Setpoint	Digital
Display	Digital LED
Readability	0.1°C
Setability	0.1°C
Uniformity	±0.2°C

Temperature Safety

Sensor	Thermistor
Controller	Independent analog electronic
Setpoint	Digital (tamper resistant adjustment)
Readability	0.1°C
Setability	0.1°C

CO_2

CO_2 Gas Control	Better than ±0.1%
Range	0-20%
Inlet Pressure	10 PSIG
HEPA Filter	0.2 micron, disposable
Sensor	Infrared
Calibration	Auto-zero
Controller	Microprocessor
Setability	Digital LED
Readability	0.1%
Setpoint	0.1%
Alarm Differential and Delay	±1.0% (nominal) approx. 15 minutes

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Humidity

Humidity	Ambient or 96 RH ±2% @ +37°C
Humidity Reservoir	1.6 gal. (6 liters)
Humidity Pan	1.6 gal. (6 liters) standard

Fittings

Fill Port	1/4" (.63 cm) FPT
Drain Port	3/8" (.95 cm) barbed fitting with manual drain valve
Access Port	1.25" (3.17 cm) with neoprene removable plug

CO_2 Inlet	1/4" (0.63 cm) barbed

Unit Heat Load (Per Chamber)

115V	480 BTUH (140 Watt)
220V	560 BTUH (160 watt)

Shelves

Standard	5
Maximum	21
Dimensions	17.75" (45.10 cm) x 17.75" (45.10cm)
Construction	Stainless steel, perforated, electropolished
Surface Area	2.2 sq ft (0.2 sq m) per shelf
Maximum Per Chamber	46.2 sq ft (4.2 sq m)
Flatness	±.032" (.08 cm) off horizontal plane
Clearance	Adjustable on 1" (2.54 cm centers)
Loading	35 lbs (16 kg) slide in and out
	50 lbs (23 kg) stationary

Construction

Water Jacket Volume	11.5 gallons (43.5 liters)
Interior	304 2B stainless steel
Exterior	Cold rolled steel
Insulation	1-1/2" (3.8 cm) fiberglass

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Inner Door	1/4" (0.63 cm) fully tempered safety glass with cam action latch
Inner Door Gasket	Non-porous feather edge silicone
Outer Door Gasket	Four sided molded magnetic vinyl
Finish	Powder coated, durable, easily maintained surface. Salt spray test exceeds 1,000 hours per ASTM standard B117-85

Electrical

Models 3193/3195	90-130 VAC 50/60 Hz, 1PH, 4.2 FLA
Models 3194/3196	180-260 VAC 50/60 Hz, 1PH, 2.2 FLA
Circuit Breaker	5 Amps
Power Switch	2 pole
Line Cord	8 ft. (2.4 cm)
Data Output	RS232, temperature and CO_2
Accessory 120V Outlet	One per chamber, 75 watts maximum

Certification

CSA	Standard 151 except Models 3194/3196
UL Listed	Standard 1262 except Models 3194/3196

Dimensions

Exterior (Single)	29.12"W x 36.12"H x 24.06"F-B (73.96 cm x 91.67 cm x 61.12 cm)
Interior	19.75"W x 26.75"H x 18.75"F-B (50.16 cm x 67.94 cm x 47.63 cm)
Volume per Chamber	5.7 cu ft (161.4 liters)
Exterior (Stacked)	29.12"W x 72.25"H x 24.06"F-B (73.96 cm x 183.51 cm x 61.12 cm)

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Weights	**Single**	**Stacked**
Net	235 lbs (107 kg)	470 lbs (213 kg)
Net Operational	342 lbs (150 kg)	684 lbs (310 kg)
Shipping Weights		
Motor	310 lbs (141 kg)	600 lbs (272 kg)
Air	360 lbs (163 kg)	720 lbs (327 kg)
Ocean	410 lbs (186 kg)	820 lbs (372 kg)

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Section 8 - Accessories

8.1 Incubator Accessories

Catalog No.	Description
190247	Decontamination Kit
190048	Caster Assembly
190198	Analog Recorder Interface for 1525/1530
190204	Floor Stand
224140	Electropolished Stainless Steel Shelf
500171	Tissue Culture Shelf
237001	Stainless Steel Humidification Pan
246010	Vinyl Tubing, 3/16" I.D. (Available by the foot)
190204	Floor Stand
770001	Disposable Microbiological Filter, 99.97%

8.2 General Accessories

Catalog No.	Description
155021	CO_2 FYRITE Analyzer Kit 0-20%
220051	Replacement Fluid for CO_2 Analyzer (Three bottles per carton)
965010	Two-Stage Regulator, CO_2
853227	LCD Pocket Digital Thermometer
285722	Glass Thermometer, 0°C to 100°C

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Section 9 - Parts List

Models 3193 and 3195

Stock #	Description
156065	Blower Motor (2-Pole, 115VAC)
190328	Microprocessor Control Board
250021	Chamber Heat Relay (Solid State)
250021	Door Heat Relay (Solid State)
300164	Over Temp Relay (12VDC)
250085	CO_2 Solenoid Valve
190342	CO_2 Sensor Assembly
190194	CO_2 I/R Circuit Board
400296	Feather Gasket (Inner Door)
431142	Magnetic Gasket (Outer Door)
770001	CO_2 Filter (Disposable)
230023	Circuit Breaker (5A)
230094	Glass Fuse .3A (Slow-Blow Type)
420017	Transformer (28VCT)
224140	Electropolished Stainless Steel Shelf
890155	Inner Glass Door
950016	Door Cord w/Special Plug (15', 4W)
430108	Standard Cordset

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Models 3194 and 3196

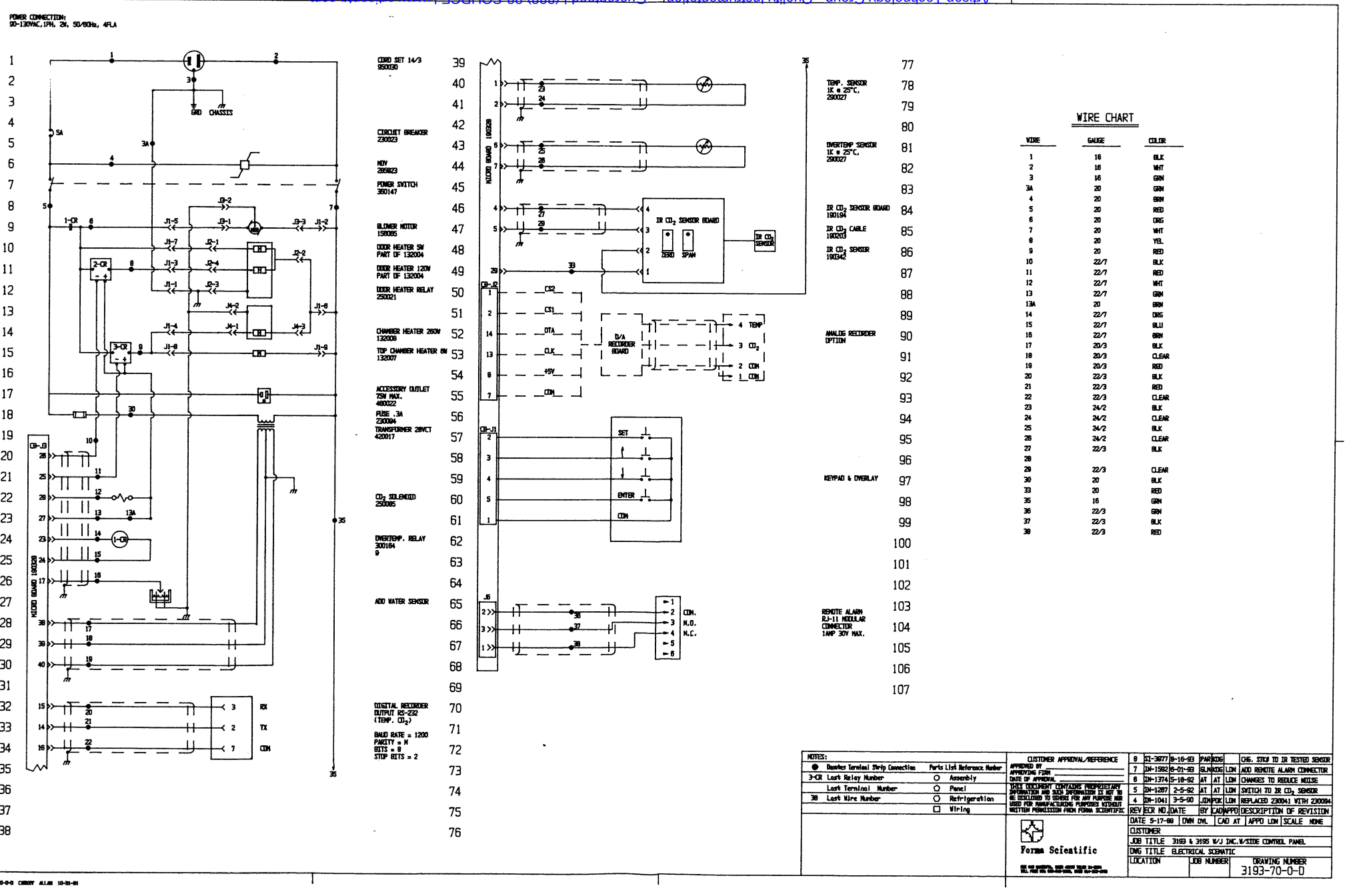
Stock #	Description
156065	Blower Motor (2-Pole, 115VAC)
100065	Mounting Gasket for Blower Motor
190328	Microprocessor Control Board
250021	Chamber Heat Relay (Solid State)
250021	Door Heat Relay (Solid State)
300164	Over Temp Relay (12VDC)
250085	CO_2 Solenoid Valve
190342	CO_2 Sensor Assembly
190194	CO_2 I/R Circuit Board
400296	Feather Gasket (Inner Door)
431142	Magnetic Gasket (Outer Door)
770001	CO_2 Filter (Disposable)
230023	Circuit Breaker (5A)
230094	Glass Fuse .3A (Slow-Blow Type)
420017	Transformer (28VCT)
224140	Electropolished Stainless Steel Shelf
890155	Inner Glass Door
950016	Door Cord w/Special Plug (15', 4W)
430109	Export Cordset

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Section 10 - Electrical Schematics

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CORD SET 14/3
950090

CIRCUIT BREAKER
230023

MOV
285823

POWER SWITCH
360147

BLOWER MOTOR
158085

DOOR HEATER 5W
PART OF 132004

DOOR HEATER 120W
PART OF 132004

DOOR HEATER RELAY
250021

CHAMBER HEATER 260W
132008

TOP CHAMBER HEATER 6W
132007

ACCESSORY OUTLET
250 MAX.
480022

FUSE .3A
230094

TRANSFORMER 28VCT
420017

CO_2 SOLENOID
250085

OVERTEMP. RELAY
300184
9

ADD WATER SENSOR

DIGITAL RECORDER
OUTPUT RS-232
(TEMP. CO_2)

BAUD RATE = 1200
PARITY = N
BITS = 8
STOP BITS = 2

TEMP. SENSOR
1K @ 25°C,
290027

OVERTEMP SENSOR
1K @ 25°C,
290027

IR CO_2 SENSOR BOARD
190194

IR CO_2 CABLE
190205

IR CO_2 SENSOR
190342

ANALOG RECORDER
OPTION

KEYPAD & OVERLAY

REMOTE ALARM
RJ-11 MODULAR
CONNECTOR
1AMP 30V MAX.

WIRE CHART

WIRE	GAUGE	COLOR
1	16	BLK
2	16	WHT
3	16	GRN
3A	20	GRN
4	20	BRN
5	20	RED
6	20	ORG
7	20	WHT
8	20	YEL
9	20	RED
10	22/7	BLK
11	22/7	RED
12	22/7	WHT
13	22/7	GRN
13A	20	BRN
14	22/7	ORG
15	22/7	BLU
16	22/7	BRN
17	20/3	BLK
18	20/3	CLEAR
19	20/3	RED
20	22/3	BLK
21	22/3	RED
22	22/3	CLEAR
23	24/2	BLK
24	24/2	CLEAR
25	24/2	BLK
26	24/2	CLEAR
27	22/3	BLK
28		
29	22/3	CLEAR
30	20	BLK
33	20	RED
35	16	GRN
36	22/3	GRN
37	22/3	BLK
38	22/3	RED

NOTES:

● Denotes Terminal Strip Connection	Parts List Reference Number
3-CR Last Relay Number	○ Assembly
Last Terminal Number	○ Panel
38 Last Wire Number	○ Refrigeration
	□ Wiring

CUSTOMER APPROVAL/REFERENCE

APPROVED BY
APPROVING FIRM
DATE OF APPROVAL

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REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
8	SI-3977	8-16-93	PAR	KDS		CHG. STR# TO IR TESTED SENSOR
7	IM-1982	6-01-93	GLM	KDS	LDN	ADD REMOTE ALARM CONNECTOR
6	IM-1374	5-18-92	AT	AT	LDN	CHANGES TO REDUCE NOISE
5	IM-1287	2-5-92	AT	AT	LDN	SWITCH TO IR CO_2 SENSOR
4	IM-1041	3-5-90	JDM	PDK	LDN	REPLACED 230041 WITH 230094

Forma Scientific

DATE 5-17-98 | DWN DVL | CAD AT | APPD LDN | SCALE NONE

CUSTOMER

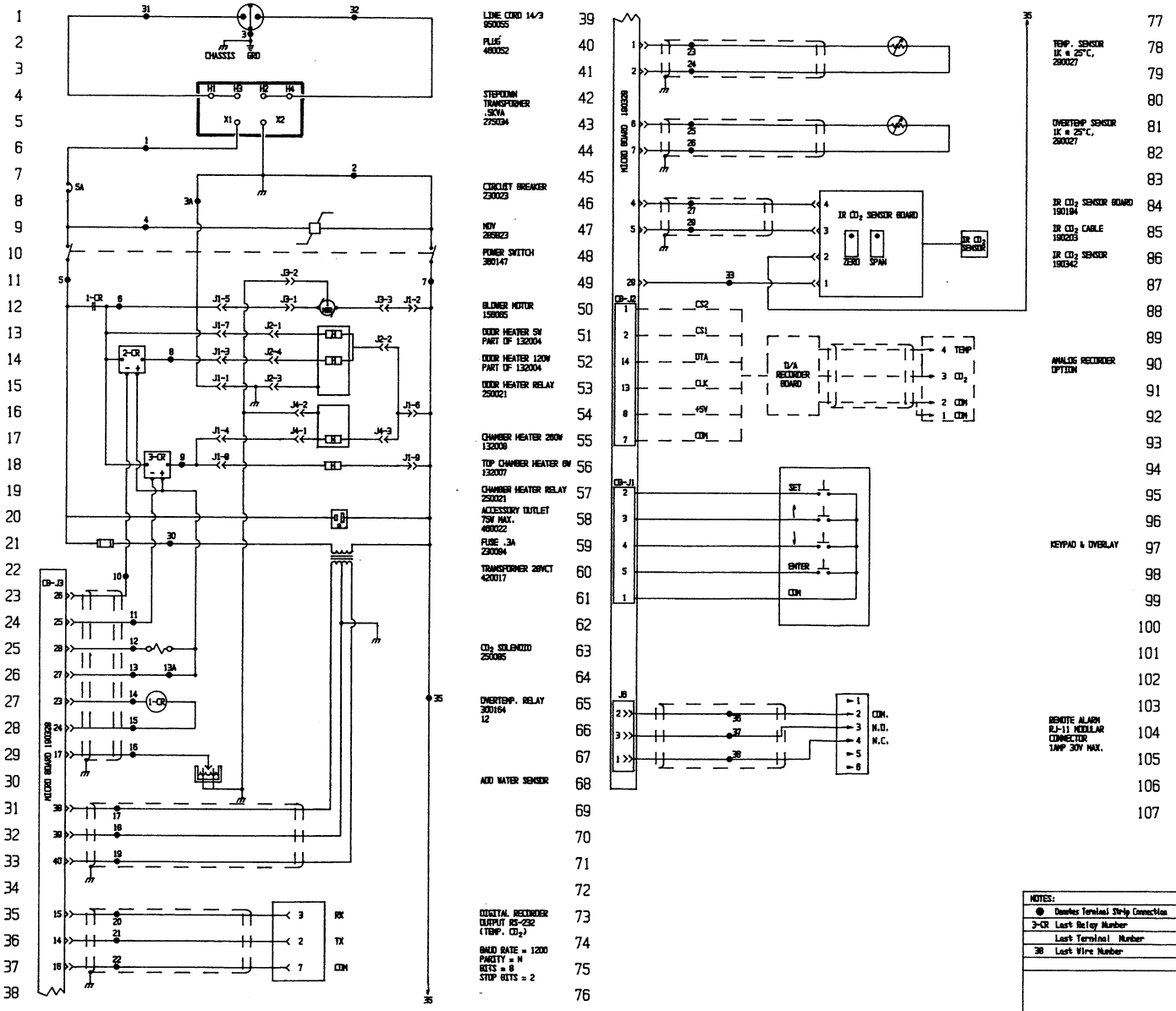
JOB TITLE 3193 & 3195 W/J INC.W/SIDE CONTROL PANEL

DWG TITLE ELECTRICAL SCEMATIC

LOCATION | JOB NUMBER | DRAWING NUMBER 3193-70-0-D

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POWER CONNECTION:
190-260VAC, 2W, 50/60Hz, 1.9FLA



LINE CORD 14/3
950055

PLUG
460052

STEPDOWN TRANSFORMER .5KVA
275094

CIRCUIT BREAKER
230023

MOV
285823

POWER SWITCH
380147

BLOWER MOTOR
150065

DOOR HEATER 5W
PART OF 132004

DOOR HEATER 120W
PART OF 132004

DOOR HEATER RELAY
250021

CHAMBER HEATER 280W
132008

TOP CHAMBER HEATER 6W
132007

CHAMBER HEATER RELAY
250021

ACCESSORY OUTLET
75W MAX.
480022

FUSE .3A
230084

TRANSFORMER 28VCT
420017

CO_2 SOLENOID
250085

OVERTEMP. RELAY
300164
12

ADD WATER SENSOR

DIGITAL RECORDER
OUTPUT RS-232
(TEMP. CO_2)

BAUD RATE = 1200
PARITY = N
BITS = 8
STOP BITS = 2

TEMP. SENSOR
1K @ 25°C,
280027

OVERTEMP SENSOR
1K @ 25°C,
280027

IR CO_2 SENSOR BOARD
190194

IR CO_2 CABLE
190205

IR CO_2 SENSOR
190342

ANALOG RECORDER OPTION

KEYPAD & OVERLAY

REMOTE ALARM
RJ-11 MODULAR CONNECTOR
1AMP 30V MAX.

WIRE CHART

WIRE	GAUGE	COLOR
1	18	BLK
2	18	WHT
3	18	GRN-YEL
3A	20	GRN
4	20	BRN
5	20	RED
6	20	ORG
7	20	WHT
8	20	YEL
9	20	RED
10	22/7	BLK
11	22/7	RED
12	22/7	WHT
13	22/7	GRN
13A	20	BRN
14	22/7	ORG
15	22/7	BLU
16	22/7	BRN
17	20/3	BLK
18	20/3	CLEAR
19	20/3	RED
20	22/3	BLK
21	22/3	RED
22	22/3	CLEAR
23	24/2	BLK
24	24/2	CLEAR
25	24/2	BLK
26	24/2	CLEAR
27	22/3	BLK
28		
29	22/3	CLEAR
30	20	BLK
31	18	BRN
32	18	BLU
33	20	RED
35	18	GRN
36	22/3	GRN
37	22/3	BLK
38	22/3	RED

NOTES:
- Denotes Terminal Strip Connection
- 3-CR Last Relay Number
- Last Terminal Number
- 38 Last Wire Number

Parts List Reference Number
- Assembly
- Panel
- Refrigeration
- Wiring

CUSTOMER APPROVAL/REFERENCE
APPROVED BY
APPROVING FIRM
DATE OF APPROVAL

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REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
8	SI-3077	8-16-93	PAR	KOG	LON	CHG. STKU TO IR TESTED SENSOR
7	IN-1592	6-01-93	GLM	KOG	LON	ADD REMOTE ALARM CONNECTION
6	IN-1374	5-18-92	AT	AT	LON	CHANGES TO REDUCE NOISE
5	IN-1287	2-5-92	AT	AT	LON	SWITCH TO IR CO_2 SENSOR
4	IN-1041	3-5-90	JDN	PK	LON	REPLACED 230041 WITH 230084

Forma Scientific

DATE 5-17-88	DWN JDN	CAD AT	APPD LON	SCALE NONE	
CUSTOMER					
JOB TITLE 3194 & 3198 W/J INC.W/SIDE CONTROL PANEL					
DWG TITLE ELECTRICAL SCEMATIC					
LOCATION	JOB NUMBER	DRAWING NUMBER 3194-70-0-0			

3194-70-0-0 CHKBY ALAN 10-24-01

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