

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

**Artisan Technology Group**
(217) 352-9330 | sales@artisantg.com | artisantg.com

**Full-service, independent repair center**
with experienced engineers and technicians on staff.

**We buy your excess, underutilized, and idle equipment**
along with credit for buybacks and trade-ins.

**Custom engineering**
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

**Expert team | Trust guarantee | 100% satisfaction**

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

**Visit our website - *Click HERE***

Thermo Forma

# Model: 3110 Series*

$CO_2$ Water Jacketed Incubator
Series II

# Operating and Maintenance Manual

**Manual No: 7033110 Rev. 9**

***Refer to listing of all models on Page i.***

**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.***

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

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

| Single Chamber Models | | | |
|---|---|---|---|
| **Model** | **$CO_2$ Sensor*** | **$O_2$** | **Voltage**** |
| 3110 | T/C | No | 115 |
| 3111 | T/C | No | 230 |
| 3120 | IR | No | 115 |
| 3121 | IR | No | 230 |
| 3130 | T/C | Yes | 115 |
| 3131 | T/C | Yes | 230 |
| 3140 | IR | Yes | 115 |
| 3141 | IR | Yes | 230 |

*T/C is a thermal conductivity sensor. IR is an infrared sensor.

**All units are 50/60 Hz.




**MANUAL NUMBER 7033110**

| REV | ECR/ECN | DATE | DESCRIPTION | By |
|---|---|---|---|---|
| 9 | 20221/IN-2959 | 3/4/02 | Updated 200 drawing for use with Models 5050/5060 Series (display bd) | ccs |
| -- | 20581/IN-3015 | 1/21/02 | Corrected temp sensor error sequence in chart on 4-1 | ccs |
| -- | 20484 | 11/21/01 | Removed all specific references to Model 2095 bath | ccs |
| 8 | 20374/IN-2994 | 11/7/01 | Updated 200 drawing - Kaizen, board hardware | ccs |
| 7 | 20336/PIP-034 | 10/10/01 | Removed blower motor cover, added nylon cable clamps | ccs |
| -- | 20015/IN-2942 | 5/21/01 | Removed top shelf tab from side duct for better HEPA fit | ccs |
| 6 | 19866/IN-2907 | 3/19/01 | Updated $O_2$ fuel cell warranty info from 2 years to 1 | ccs |
| 5 | 19473 | 2/20/01 | Added water jacket rust inhibitor information | ccs |



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

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

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

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



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

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

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

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



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

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

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

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



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

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

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

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

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

## Do You Need Information or Assistance on Thermo Forma Products?

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

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

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

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

Whatever Thermo 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 warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

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

Thermo Forma
Millcreek Road, PO Box 649
Marietta, OH 45750

International customers, please contact your local Thermo Forma distributor.

## Table of Contents

**Section 1** - Installation and Start-up . . . . . .1 - 1
1.1 Name and Description of Parts . . . . . .1 - 1
1.2 Control Panel Keys, Displays and Indicators . . . . . .1 - 2
1.3 Operating the Control Panel . . . . . .1 - 2
1.4 Displays . . . . . .1 - 3
1.5 Installing the Unit . . . . . .1 - 4
a. Choosing the Location . . . . . .1 - 4
b. Stacking the Incubators . . . . . .1 - 4
c. Preliminary Cleaning and Disinfecting . . . . . .1 - 5
d. Installing the Access Port Filter . . . . . .1 - 5
e. Installing the Air Sample Filter . . . . . .1 - 5
f. Installing the HEPA Filter . . . . . .1 - 5
g. Installing the Shelves . . . . . .1 - 6
h. Leveling the Unit . . . . . .1 - 6
i. Connecting the Unit to Electrical Power . . . . . .1 - 6
j. Filling the Water Jacket . . . . . .1 - 6
k. Filling the Humidity Pan . . . . . .1 - 6
l. Connecting the $CO_2$ Gas Supply . . . . . .1 - 7
m. Connecting the $N_2$ Gas Supply . . . . . .1 - 8
1.6 Incubator Start-Up . . . . . .1 - 8
a. Setting the Operating Temperature . . . . . .1 - 8
b. Setting the Overtemp Setpoint . . . . . .1 - 9
c. Setting the $CO_2$ Setpoint . . . . . .1 - 9
d. Setting the $O_2$ Setpoint . . . . . .1 - 9

**Section 2** - Calibration . . . . . .2 - 1
2.1 Calibration Mode . . . . . .2 - 1
a. Calibrating the Temperature . . . . . .2 - 1
b. Calibrating Thermal Conductivity $CO_2$ System . .2 - 1
c. Calibrating the Infra-Red $CO_2$ System. . . . . .2 - 1
d. Calibrating the $O_2$ System . . . . . .2 - 2
e. Calibrating Relative Humidity . . . . . .2 - 3

**Section 3** - Configuration . . . . . .3 - 1
3.1 Configuration Mode . . . . . .3 - 1
a. Turning the Audible Alarm ON/OFF . . . . . .3 - 1
b. New HEPA Filter . . . . . .3 - 1
c. Setting the REPLACE HEPA filter reminder . . . .3 - 1
d. Setting an Access Code . . . . . .3 - 1
e. Setting Low Temp Alarm Limit (tracking alarm) 3 - 1
f. Setting High Temp Alarm Limit (tracking alarm) 3 - 2
g. Enabling Temperature Alarms to Trip Contacts . .3 - 2
h. Setting Low $CO_2$ Alarm Limit (tracking alarm) .3 - 2
i. Setting High $CO_2$ Alarm Limit (tracking alarm) . .3 - 2
j. Enabling $CO_2$ Alarms to Trip Contacts . . . . . .3 - 2
k. Setting New Zero Number for T/C $CO_2$ Sensors .3 - 2
l. Setting New Span Number for T/C $CO_2$ Sensors .3 - 3
m. Setting a Low RH Alarm Limit . . . . . .3 - 3
n. Enabling RH Alarms to Trip Contacts . . . . . .3 - 3
o. Setting a Low $O_2$ Alarm Limit (tracking alarm) .3 - 3
p. Setting a High $O_2$ Alarm Limit (tracking alarm) .3 - 3
q. Enabling $O_2$ Alarms to Trip Contacts . . . . . .3 - 3
r. Enabling Temp/RH to be Displayed . . . . . .3 - 4
s. Enabling $CO_2$/$O_2$ to be Displayed . . . . . .3 - 4
t. Selecting a Primary Tank w/ Gas Guard Option . .3 - 4
u. Enabling the Gas Guard System . . . . . .3 - 4
v. Setting a RS485 Communications Address . . . . .3 - 4

**Section 4** - Alarms . . . . . .4 - 1
4.1 Alarms . . . . . .4 - 1
4.2 Sensor Fault Alarms . . . . . .4 - 2
a. REPL O2 SNSR (Alarm) . . . . . .4 - 2
b. O2 SNSR ERR (Alarm) . . . . . .4 - 2
c. CO2 SNSR ERR . . . . . .4 - 2
d. IR AUTOZ ERR . . . . . .4 - 2

**Section 5** - Routine Maintenance . . . . . .5 - 1
5.1 Disinfecting the Incubator Interior . . . . . .5 - 1
5.2 Cleaning the Cabinet Exterior . . . . . .5 - 2
5.3 Cleaning the Humidity Pan . . . . . .5 - 2
5.4 Reversing the Door Swing . . . . . .5 - 2
a. Reversing the Hinges for Exterior Door . . . . . .5 - 2
5.5 Replacing Fuses . . . . . .5 - 3
5.6 HEPA Filter Maintenance . . . . . .5 - 6
5.7 Replacing the Air Sample Filter . . . . . .5 - 7
5.8 Replacing the Access Port Filter . . . . . .5 - 7
5.9 Draining Water Jacket . . . . . .5 - 7
5.10 $O_2$ Sensor Fuel Cell . . . . . .5 - 7
5.11 Replacing the $O_2$ Sensor . . . . . .5 - 7
5.12 Adding or Replenishing the W/J Rust Inhibitor . . . .5 - 8

**Section 6** - Factory Installed Options . . . . . .6 - 1
6.1 Connections to External Equipment . . . . . .6 - 1
a. Connecting the Remote Alarm Contacts . . . . . .6 - 1
b. Connecting the RS485 Interface . . . . . .6 - 1
c. Connecting the Analog Output Boards . . . . . .6 - 1
6.2 Gas Guard for $CO_2$ or $N_2$ . . . . . .6 - 2
a. Connecting the $CO_2$ Gas Supplies . . . . . .6 - 2
b. Connecting the $N_2$ Gas Supplies . . . . . .6 - 2
c. Activating the Built-in Gas Guard: . . . . . .6 - 3
d. Operation of the $CO_2$ or $N_2$ Gas Guard: . . . . . .6 - 3
6.3 Humidity Readout . . . . . .6 - 3
a. Factors Affecting Humidity Level in Chamber: . .6 - 3
b. Accuracy of the Humidity Readout: . . . . . .6 - 4
6.4 Factory Installed Cooling Coil . . . . . .6 - 4
a. Installing the Cooling Coil Incubator . . . . . .6 - 4

**Section 7** - Specifications . . . . . .7 - 1

**Section 8** - Spare Parts . . . . . .8 - 1

**Section 9** - Electrical Schematics . . . . . .9 - 1

**Section 10** - Warranty Information . . . . . .

**Appendix A** - Supplements . . . . . .

# Section 1 - Installation and Start-up

## 1.1 Name and Description of Parts

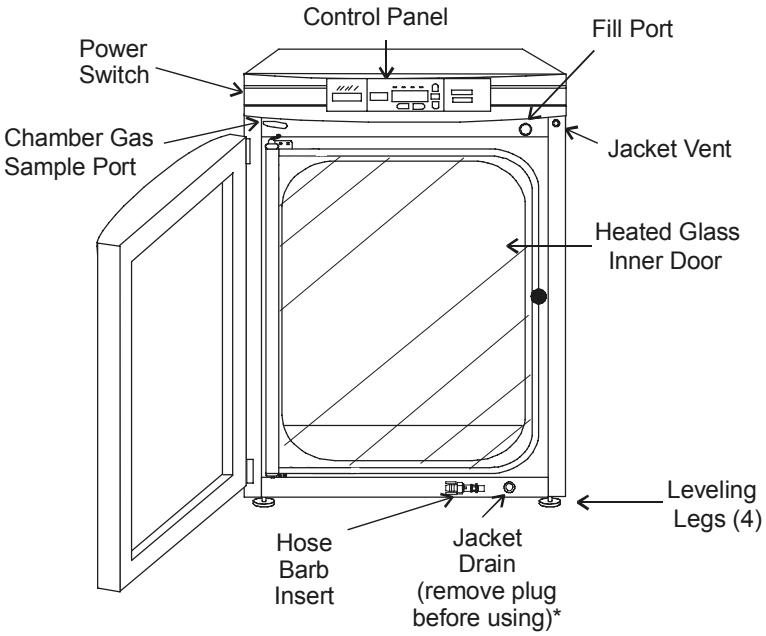



**Figure 1-1**
**Water Jacket Incubator**

- Outer Door - Reversible to opposite swing, see Section 5.4
- Heated Inner Door - Keeps chamber interior dry. Reversible to opposite swing, see Section 5.4.
- Chamber Gas Sample Port - Used for sampling chamber $CO_2$ content, using a Fyrite or similar instrument. Should be capped when controlling $O_2$.
- Main Power Switch
- Control Panel - Keypad, Displays and Indicators. (See Figure 1-2).
- Fill Port - Used for filling the water jacket.
- Water Jacket Vent- Do not cover! Allows air to escape from the water jacket during filling and normal expansion and contraction when the incubator heats or cools.
- Leveling Legs - Used to level the unit.
- Water Jacket Drain – Remove plug and use hose barb insert included. Plug when not in use.

**Note:** The incubators are stackable. See Section 1.5.

*When setting up the incubator, install the cover plate packed inside the incubator shipping carton.

### 1.2 Control Panel Keys, Displays and Indicators

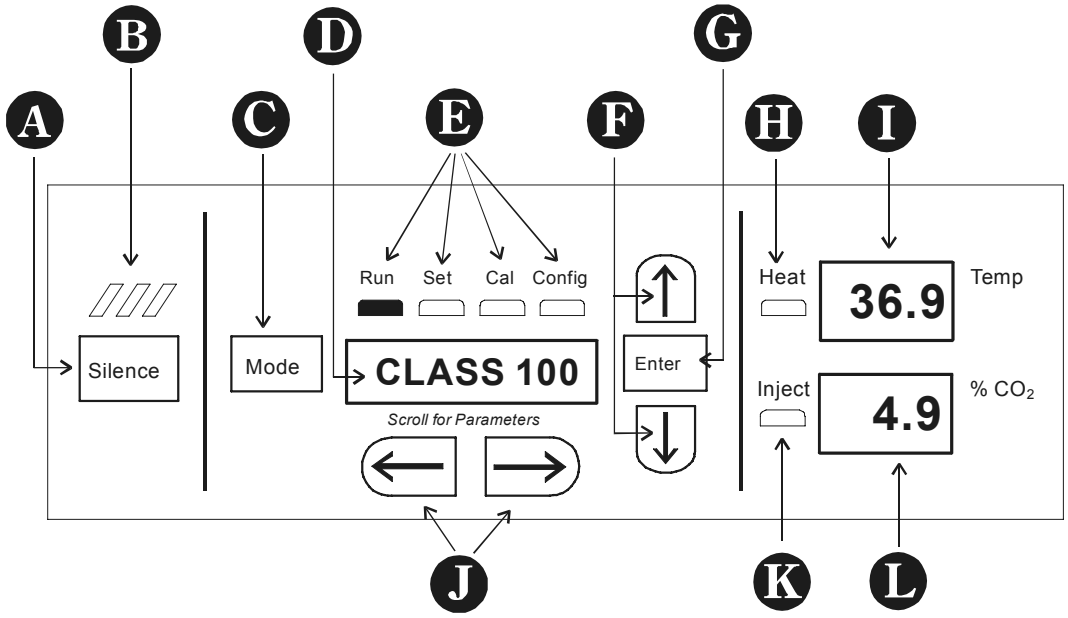



**Figure 1-2 Control Panel**

**A** SILENCE - Silences the audible alarm.

**B** Alarm Indicator - Pulses on/off during an alarm condition in the cabinet.

**C** MODE Select Switch - Used to select Run, Setpoints, Calibration and System Configuration Modes.

**D** Message Center - Displays system status.

**E** Mode Select Indicators-

**Run:** Run Menu

**Set:** Set Points Menu

**Cal:** Calibrate Menu

**Config:** Configuration Menu

**F** Up and Down Arrows: Increases or decreases the parameter values that are numbers, toggles the parameter values that are choices.

**G** Enter: Accepts changes to the calibration settings

**H** Heat Indicator: Lights when power is applied to the heaters.

**I** Temp Display: Can be programmed to display temperature continuously, RH continuously (with RH option), or toggle between temperature and humidity (with RH option). See Section 3.1, Configuration.

**J** Scroll for Parameters Keys: Scrolls the operator through the parameters of the mode that is selected.

**K** Inject Indicator: Lights when gas is being injected into the incubator. If the $\%CO_2/O_2$ display (item L) is continuously displaying $CO_2$, the light indicates $CO_2$ injection only. If the $\%CO_2/O_2$ display is continuously displaying $O_2$, light indicates $N_2$ injection. If the $\%CO_2/O_2$ is toggling, either a $CO_2$ or $N_2$ injection will cause the indicator to light.

**L** $\%CO_2/O_2$ display: Can be programmed to display $CO_2$ continuously or $O_2$ continuously (on units equipped with $O_2$), or toggle between $CO_2$ and $O_2$ (on units equipped with $O_2$) See Section 3.1, Configuration.

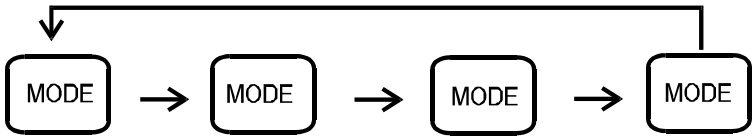
### 1.3 Operating the Control Panel




The Model 3110 Series water jacket incubator has four basic modes, which allow incubator setup. The modes are as follows: Run, Setpoints, Calibration and System Configuration.

- **Run** is the default mode that the incubator will normally be in during operation.
- **Set** is used to enter system setpoints for incubator operation.
- **Cal** is used to calibrate various system parameters to the customer's satisfaction.
- **Config** is the system configuration mode that allows for custom setup of various options.

The chart below shows the selections under each of the modes.

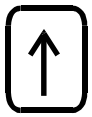



| RUN | SETPOINT | CALIBRATION | CONFIGURATION |
|---|---|---|---|
| **Default Mode** | **Temperature** | **Temp Offset** | **Audible** |
| | **Overtemp** | **CO2 Cal** | **New HEPA timer** |
| | **CO2** | *IR CO2 Span* | **Replace HEPA reminder** |
| | *O2* | *O2 Cal at 20.7%* | **Access Code** |
| | | *O2 Offset* | **Temp Lo Alarm** |
| | | *RH Offset* | **Temp Hi Alarm** |
| | | | **Temp Relay** |
| | | | **CO2 Lo Alarm** |
| | | | **CO2 Hi Alarm** |
| | | | **CO2 Relay** |
| | | | **CO2 Z & S #'s** |
| | | | *RH Lo Alarm* |
| | | | *RH Relay* |
| | | | *O2 Lo Alarm* |
| | | | *O2 Hi Alarm* |
| | | | *O2 Relay* |
| | | | *Display 1 Setup* |
| | | | *Display 2 Setup* |
| | | | *Gas Guard Setup* |
| | | | **RS485 Address** |

****Base Unit Displays**
***Option Displays*



**Scroll for Parameters Keys:** Steps the operator through the parameters of SET, CAL and CONFIG Modes. The right arrow goes to the next parameter, the left arrow returns to the previous parameter.



**Up Arrow**: Increases or toggles the parameter value that has been selected in the SET, CAL, and CONFIG Modes.




**Enter:** Must press Enter key to save to memory all changed values.



**Down Arrow:** Decreases or toggles the parameter values that have been selected in the SET, CAL and CONFIG Modes.




**Silence Key:** Press to silence the audible alarm. See Section 4 for alarm ringback times.

## 1.4 Displays

**Message Center**

Displays the system status (Mode) at all times. Displays CLASS 100 or SYSTEM OK during normal operation, or alarm messages if the system detects an alarm condition. See Section 4.1, Alarms. The display message CLASS 100 is a timing mechanism indicating that, under normal operating conditions with the HEPA filter installed, the air inside the chamber meets the Class 100 air cleanliness standard for particulates of 0.5 micron size or larger per cubic foot of air. (For further information on the Class 100 classification of air quality, see Appendix A.)

**Upper and Lower Displays**

These 7-segment displays vary depending upon the options present and the configuration chosen. The upper display can display temp or RH, or toggle between them. The bottom display can display $CO_2$ or $O_2$, or toggle between them. See Section 3.1, Configuration.

## 1.5 Installing the Unit

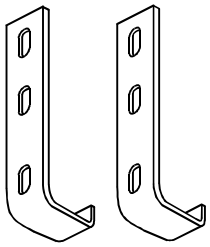
### a. Choosing the Location

1. Locate the unit on a firm, level surface capable of supporting the unit's operational weight of 365 lbs. (166kg).
2. Locate away from doors and windows and heating and air conditioning ducts.
3. Allow enough clearance behind the unit for electrical and gas hook-up.

### b. Stacking the Incubators

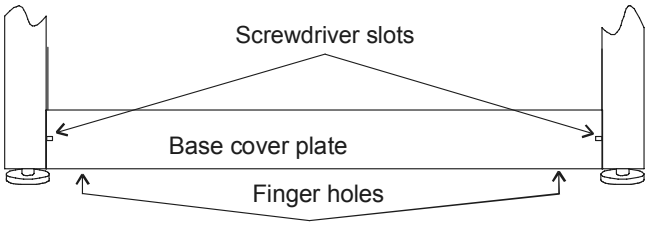


***If the units have been in service, disconnect the power cord connector and drain the water jacket of the designated top unit before stacking.***



**Note:** Stacking brackets (shown at left) stacking bolts, washers, and bolts for stacking are included with each unit.

**Figure 1-3 Stacking brackets**




Front of top Incubator **Figure 1-4**

1. Designate one incubator to be the top unit and the other as the bottom unit. Remove the base cover plate from the top unit using the finger holes in the base or using a slotted screwdriver. (Figure 1-4)

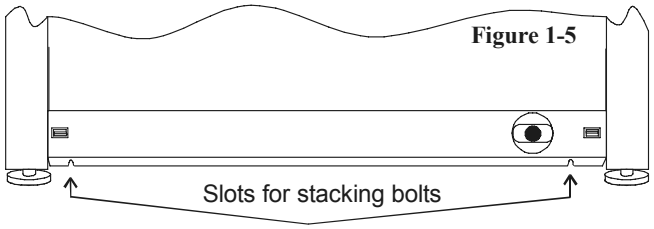



**Figure 1-5**

Front of top Incubator, base cover plate removed

2. Note the two slots in the base of the incubator which accommodate the stacking bolts. Refer to Figure 1-5.

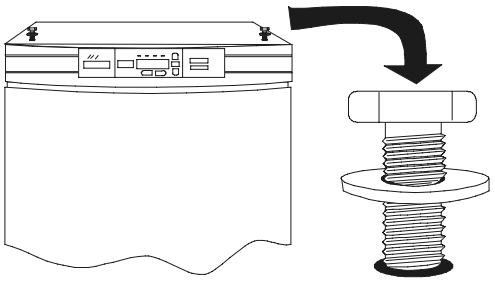



**Figure 1-6**

3. Remove the two plastic plugs from the bolt holes in the exterior top of the bottom unit. Install the 1/2" long 5/16-18 stacking bolts and washers into the bolt holes - do not tighten the bolts at this time. Refer to Figure 1-6.
4. Unscrew and remove the leveling feet from the top unit and lift it onto the bottom unit, off-setting the base of the top unit approximately 2-3 inches behind the stacking bolts and washers.



***This incubator weighs 265 lbs (120kg) before filling. Have sufficient personnel to lift it.***

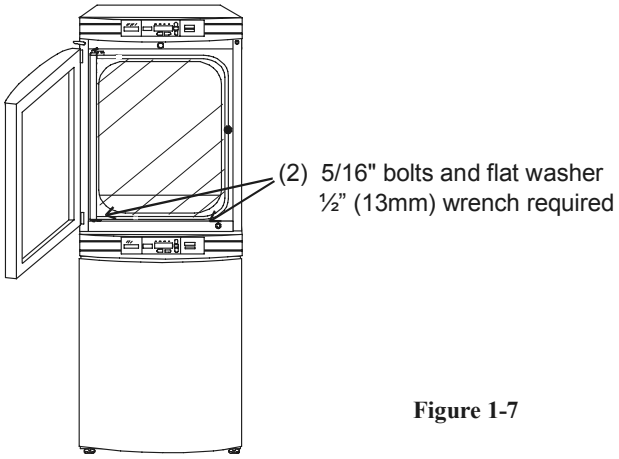



**Figure 1-7**

5. Align the sides of the top unit with the bottom unit and slide the top unit forward until the slots in the base of the top unit align with the 5/16" - 18 stacking bolts in the exterior top of the bottom unit. Refer to Figure 1-7.

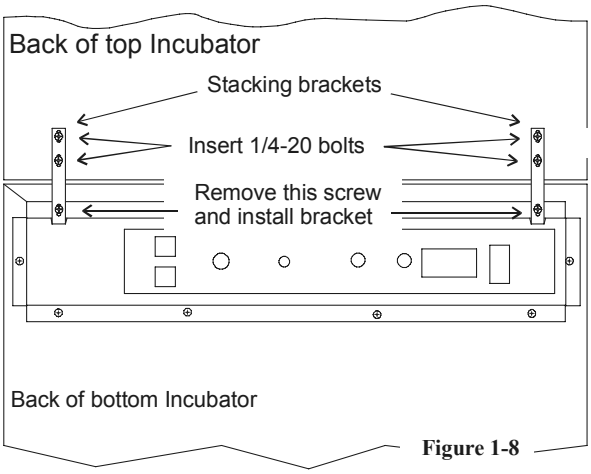



**Figure 1-8**

6. Remove and save the two screws from the back of the control panel on the bottom unit as identified in Figure 1.8.
7. Insert the stacking brackets into the slots on the rear of the control panel of the bottom unit as shown in Figure 1-5. Align the slots in the brackets with the mounting holes on the rear of the incubators. Secure the brackets with the screws saved above and the 1/4-20 bolts provided in the stacking kit. A 7/16" wrench or socket will be required for the bolts.
8. Secure the base of the top unit to the exterior top of the bottom unit by tightening the 5/16-18 stacking bolts using a 1/2" (13mm) wrench or suitable tool.
9. Replace the base cover on the top unit.
10. The stacked units are ready to be placed into service.

### c. Preliminary Cleaning and Disinfecting

1. Remove the protective plastic coating on the shelf supports and air duct, if present.
2. Using a suitable laboratory disinfectant, disinfect all interior surfaces including shelves and shelf supports, door gaskets, blower wheel and $CO_2$ sensor. Refer to Section 5.1.

### d. Installing the Access Port Filter

Locate the opening in the top left corner of the interior chamber. Remove the tape from the opening on the outside of the unit. Locate the stopper with filter in the hardware bag. Install in the opening inside the chamber. See Figure 1-12.

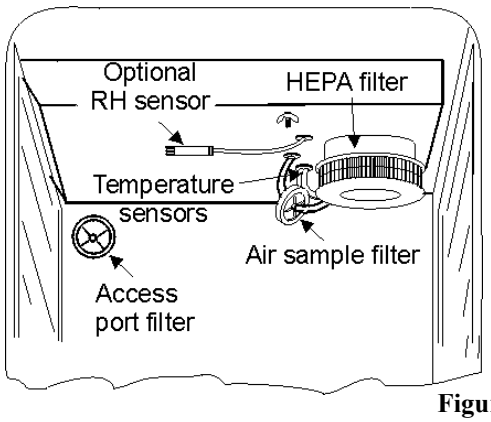



**Figure 1-9**

### e. Installing the Air Sample Filter

1. Remove the filter from the shipping bag.
2. Separate one section of the tubing from the filter. Install this section to the fitting on the blower plate.
3. After installing the top duct, connect the filter assembly to the tubing coming through the top duct.
4. Insert the free end of the air sample filter tubing into the larger hole in the back of the blower scroll. See Figure 1-9 for completed configuration.

### f. Installing the HEPA Filter

1. Remove the filter from the shipping box.
2. Remove the plastic coating from the filter, using caution not to touch the filter media.
3. Install the filter as shown in Figure 1-9.
4. To set-up an automatic REPLACE HEPA reminder, see Sections 3b and 3c.



***Use caution when handling the filter. The media can be damaged if it is mishandled.***
***To avoid damage to the incubator, do not operate the unit without the HEPA filter in place.***

### g. Installing the Shelves

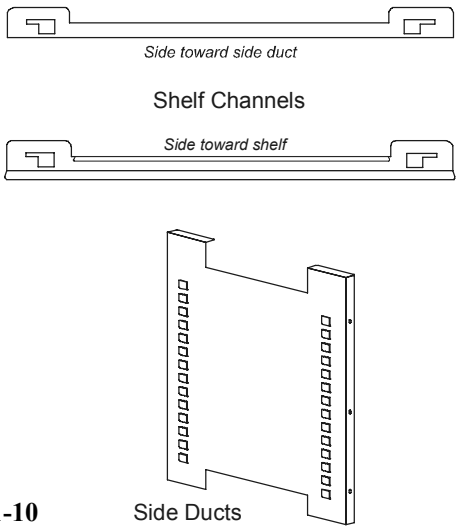



**Figure 1-10**

1. Install the side ducts with the tabs facing into the center of the chamber with their slots up. There are no right side or left side ducts, simply rotate one of them to fit the opposite side. Tilt the side ducts as they are placed in the chamber so the tops fit into the top air duct, then guide them into the vertical position. Figure 1-10 shows the duct as it would be oriented for the right side of the chamber.
2. Referring to Figure 1-10, note that there is no difference between left and right side shelf channels.

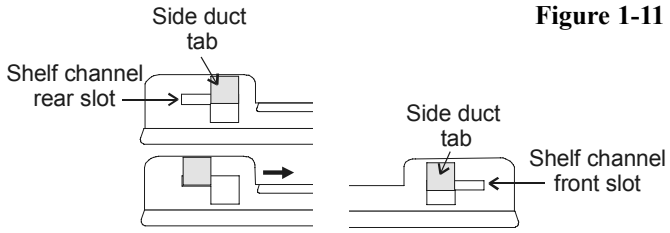



**Figure 1-11**

3. Install the shelf channels by placing the channel's rear slot over the appropriate rear tab on the side duct. Pull the shelf channel forward and engage the channel's front slot into the side duct's appropriate forward tab. Refer to Figure 1-11.
4. Figure 1-12 shows one of the channels installed on the right side duct.

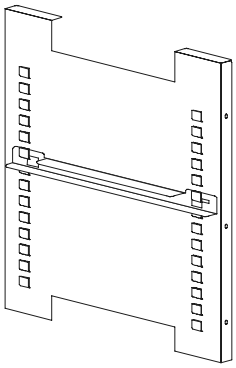


**Figure 1-12**

### h. Leveling the Unit

Check the unit for being level by placing a bubble-style level on one of the shelves. Turn the hex nut on the leveler counterclockwise to lengthen the leg, or clockwise to shorten it. Level the unit front-to-back and left-to-right.

### i. Connecting the Unit to Electrical Power

See the serial tag on the side of the unit for electrical specifications, or refer to the electrical schematics in Section 9 of this manual.



***Connect the incubator to a grounded dedicated circuit only.***
***The power cord connector is the mains disconnect device for the incubator. Position the unit so that it can be easily disconnected.***

Plug the provided power cord into the power inlet connector (See Figure 1-13) and into the grounded dedicated circuit.

**Electrical Specifications:** Models 3110, 3120, 3130, 3140 - 115V, 50/60Hz, 3.6A, 1 PH, 2W

Models 3111, 3121, 3131, 3141 - 230V, 50/60Hz, 2.0A, 1 PH, 2W

### j. Filling the Water Jacket

Turn the power switch on. ADD WATER will appear in the message center. Press the Silence key to silence the alarm.

**Note:** The fill port has a plug that must be removed before filling and replaced after filling is complete.



***Chlorine is detrimental to stainless steel. Using chlorinated tap water will void the water-jacket warranty!***

***Note:*** *High purity water (1M to 18M ohm/cm resistivity) is a very aggressive solvent and is considered slightly acidic. Ideal pH for the water in the jacket is 7. Sodium hydroxide may be used to change the pH of high purity water. It requires approximately 8ml of 0.05 normal sodium hydroxide per gallon of high purity water to raise the pH to 7. The water jacket holds appoximately 12 gallons. Sodium hydroxide and the rust inhibitor may be used in the same water jacket.*

Fill the water jacket with 11.7 gallons (43.5 liters) of distilled water with a resistance range of 50K to 1M Ohm/cm (conductivity range of 20.0 to 1.0 uS/cm). Vinyl tubing and a funnel for filling are included in the accessory bag shipped with the unit. Connect vinyl tubing to the fill port. See Figure 1.1.

When the jacket is full, the audible alarm will sound a continuous tone for 10 seconds and the alarm condition will be cleared. Refer to Section 4.1, Table of Alarms.

**Note:** Model 3110 Series Water Jacketed Incubator is shipped from the factory with a rust inhibitor added to the water inside the unit. *The rust inhibitor must be replenished every 2 years*. See Section 5.9 to drain the water jacket and Section 5.12 for the correct proportion of rust inhibitor to the water.

### k. Filling the Humidity Pan

For best operation of the incubator, sterilized distilled, demineralized or de-ionized water should be used in the humidity pan. Water purity should be in the resistance range of 50K Ohm/cm to 1M Ohm/cm, or a conductivity range of 20.0 uS/cm to 1.0 uS/cm. Refer to ASTM Standard D5391-93 or D4195-88 for measuring water purity.

Distillation systems, as well as some types of reverse osmosis water purity systems, can produce water in the quality range specified. Chlorinated tap water is not to be used as chlorine can deteriorate the stainless steel. Tap water may also have a high mineral content, which would produce a build-up of scale in the reservoir. High purity, ultra pure or milli-q water is not recommended as it is an extremely aggressive solvent and will deteriorate the stainless steel. High purity water has a resistance of above 1M to 18M Ohm/cm. Even high purity water can contain bacteria and organic contaminants. Water should always be sterilized or treated with a decontaminant, safe for use with stainless steel as well as safe for the product, prior to being introduced into the humidity pan.



***Distilled or de-ionized water used in the humidity pan must be within a water quality resistance range of 50K to 1M Ohm/cm to protect and prolong the life of the stainless steel. Use of water outside the specified range will decrease the operating life of the unit and void the warranty.***

Fill the humidity pan to within 1/2 inch of the top with sterile, distilled water. Place the pan directly on the incubator floor to ensure optimum humidity and temperature response.

For applications requiring higher humidity conditions, the pan should be placed against the left side wall of the incubator. The ductwork has been modified for this purpose. Also, on $CO_2$ control models, the $CO_2$ sample port may be capped to assist in achieving greater RH. In some ambients, this may cause condensation to form in the chamber.

**Note:** On $CO_2$ and $O_2$ control models, the gas sample port must be capped for proper $O_2$ control. It is recommended that the humidity pan be placed against the left side wall of the chamber to aid humidity recovery after door openings.

Check the level and change the water frequently to avoid contamination. Do not allow the water level to fluctuate significantly. “Dry-outs” will have an adverse effect on the humidity level.

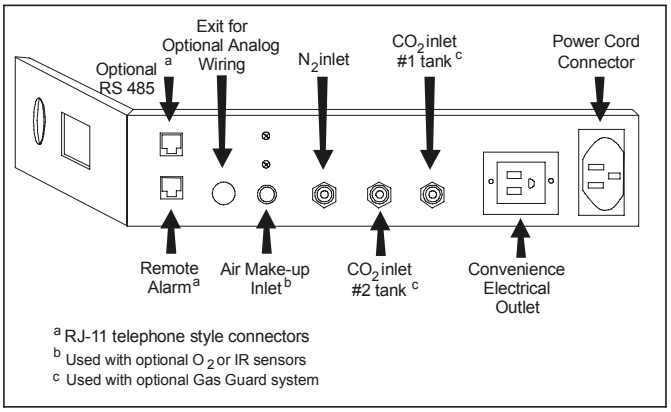



**Figure 1-13,**
**Rear Panel View, showing all options**

### l. Connecting the $CO_2$ Gas Supply



***High concentrations of $CO_2$ gas can cause asphyxiation! OSHA Standards specify that employee exposure to carbon dioxide in any eight-hour shift of a 40-hour work week shall not exceed the eight-hour time weighted average of 5000 PPM (0.5% $CO_2$). The short term exposure limit for 15 minutes or less is 30,000 PPM (3% $CO_2$). Carbon dioxide monitors are recommended for confined areas where concentrations of carbon dioxide gas can accumulate.***

The $CO_2$ gas supply being connected should be industrial grade 99.5% pure and should not contain siphon tubes. Install a two-stage pressure regulator at the cylinder outlet. The high pressure gauge at the tank should have 0-2000 psig range and the low pressure gauge, at the incubator inlet, should have a 0-30 psig range. Input pressure to the incubator must be maintained at 15 psig (103.4 kPa).

The incubator has serrated fittings on the back of the cabinet to connect the gas supply. Refer to Figure 1-13. The fitting is labeled CO2 Inlet #1 Tank. Make sure that the connections are secured with clamps. Check all fittings for leaks.

For units having the $CO_2$ Gas Guard option, refer to Section 6.2.

***This incubator is designed to be operated with $CO_2$ gas only. Connecting a flammable or toxic gas can result in a hazardous condition.***
***Gases other than $CO_2$ should not be connected to this equipment. $CO_2$ gas cylinders have UN1013 labeled on the cylinder and are equipped with a CGA 320 outlet valve. Check the gas cylinder for the proper identification labels.***
***The $CO_2$ gas supply being connected to the incubator should be industrial grade, 99.5% pure. Do not use $CO_2$ gas cylinders equipped with siphon tubes. A siphon tube is used to extract liquid $CO_2$ from the cylinder, which can damage the pressure regulator. Consult with your gas supplier to ensure that the $CO_2$ cylinder does not contain a siphon tube. Gas cylinders should also be secured to a wall or other stationary object to prevent them from tipping.***
***A two-stage $CO_2$ pressure regulator is required to be installed on the outlet valve of the gas cylinder. Input pressure to the incubator must be maintained at 15 psig (103.4 kPa) for proper performance of the $CO_2$ control system. (A single stage $CO_2$ pressure regulator will not maintain 15 psig (103.4 kP).***
***If higher purity $CO_2$ is desires inside the incubator (greater than 99.5% pure), the pressure regulator should be constructed with a stainless steel diaphragm along with specifying the purity of the $CO_2$ from the gas supplier. Follow the manufacturer's instructions to ensure proper and safe installation of the pressure regulator on the gas cylinder. Consult your facility safety officer to ensure that the equipment is installed in accordance with the codes and regulations that are applicable in your area.***

### m. Connecting the $N_2$ Gas Supply

This connection applies only to those units that have an $O_2$ system. The $N_2$ gas supply being connected should be 99.99% pure. Do not use liquid nitrogen. Follow the same steps as in the section above for preparing the $N_2$ tank for hookup to the incubator. For units having the $N_2$ Gas Guard option, refer to Section 6.2. Connect the vinyl lines from the $N_2$ tank to the serrated fitting labeled $N_2$ Inlet and secure with the provided clamp. Check all fittings for leaks.

## 1.6 Incubator Start-Up

Now that the incubator has been properly installed, connected to power, filled with water, humidity pan filled, and connected to gas supplies, system setpoints can be entered. The following setpoints can be entered in set mode: temperature, over temperature, $CO_2$, and $O_2$. To enter Set Mode, press the mode key until the Set indicator lights. Press the right and/or left arrow keys until the proper parameter appears in the message center. See Chart 1-1 for more detail.

### a. Setting the Operating Temperature

Incubator Models 3110, 3111 have an operating temperature range of 10 to 55°C, Models 3120, 3121 at 10 to 50°C, and Models 3130, 3131, 3140, and 3141 at 10 to 45°C. All units require the cooling coil option to run at any temperature lower that 5°C above ambient. The incubator is shipped from the factory with a temperature setpoint of 10°C. At this setting all heaters are turned off.

To change the operating temperature setpoint:

1. Press the Mode key until the Set indicator lights.
2. Press the right arrow until Temp XX.X is displayed in the message center.
3. Press the up/down arrow until the desired temperature setpoint is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run Indicator lights to go to run mode or right/left to go to next/previous parameter.

### b. Setting the Overtemp Setpoint



***The independent overtemp circuit is designed as a safety to protect the incubator only. It is not intended to protect or limit the maximum temperature of the cell cultures or customer's equipment inside the incubator if an overtemp condition occurs.***

The incubator is equipped with an independent circuit that monitors the air temperature in the cabinet. The independent overtemp circuit is designed as a safety for the incubator only. Should the system's temperature control fail, this circuit would cut out all heaters when the cabinet's temperature reaches the Overtemp setpoint. When an incubator is operating in an overtemp condition, the temperature control in the incubator will be ±1°C around the overtemp setpoint.

The overtemp's function is to prevent abnormally high temperatures that will occur if the heaters are locked on as a result of a failure in the main temperature control. Although the overtemp circuit will control the chamber temperature close to the overtemp setpoint, it is not intended to protect or limit the maximum temperature of the cell cultures or the equipment inside the chamber when the overtemp condition occurs.

The factory setting for the Overtemp is 40°C. It can be set over a range of temp setpoint + 0.5°C to 60°C. If the temperature setpoint is moved above the Overtemp setpoint, the Overtemp will automatically update to 1.0°C + the temp setpoint. It is recommended that the Overtemp setpoint be 1°C over the temp setpoint.

To set the Overtemp setpoint:

1. Press the Mode key until the Set indicator lights.
2. Press the right arrow until Otemp XX.X is displayed in the message center.
3. Press the up/down arrow until the desired Overtemp setpoint is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run Indicator lights to go to run mode or right/left to go to next/previous parameter.

### c. Setting the $CO_2$ Setpoint

All T/C $CO_2$ cells are precalibrated at the factory at 37°C, high humidity, and 10% $CO_2$. Therefore, if a temperature setpoint of 37°C has been entered, the humidity pan filled, and the $CO_2$ control is to run between 0-10% with a T/C $CO_2$ sensor, the $CO_2$ setpoint may be entered immediately. Otherwise, it is important to allow the unit 12 hours to stabilize at the temperature setpoint before entering the $CO_2$ setpoint.

All models of the incubator have a $CO_2$ setpoint range of 0.0% to 20.0%. The incubator is shipped from the factory with a $CO_2$ setpoint of 0.0%. At this setting, all $CO_2$ control and alarms are turned off.

To change the $CO_2$ setpoint:

1. Press the Mode key until the Set indicator lights.
2. Press the right arrow until CO2 XX.X is displayed in the message center.
3. Press the up/down arrow until the desired $CO_2$ setpoint is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run Indicator lights to go to run mode or right/left to go to next/previous parameter.

### d. Setting the $O_2$ Setpoint

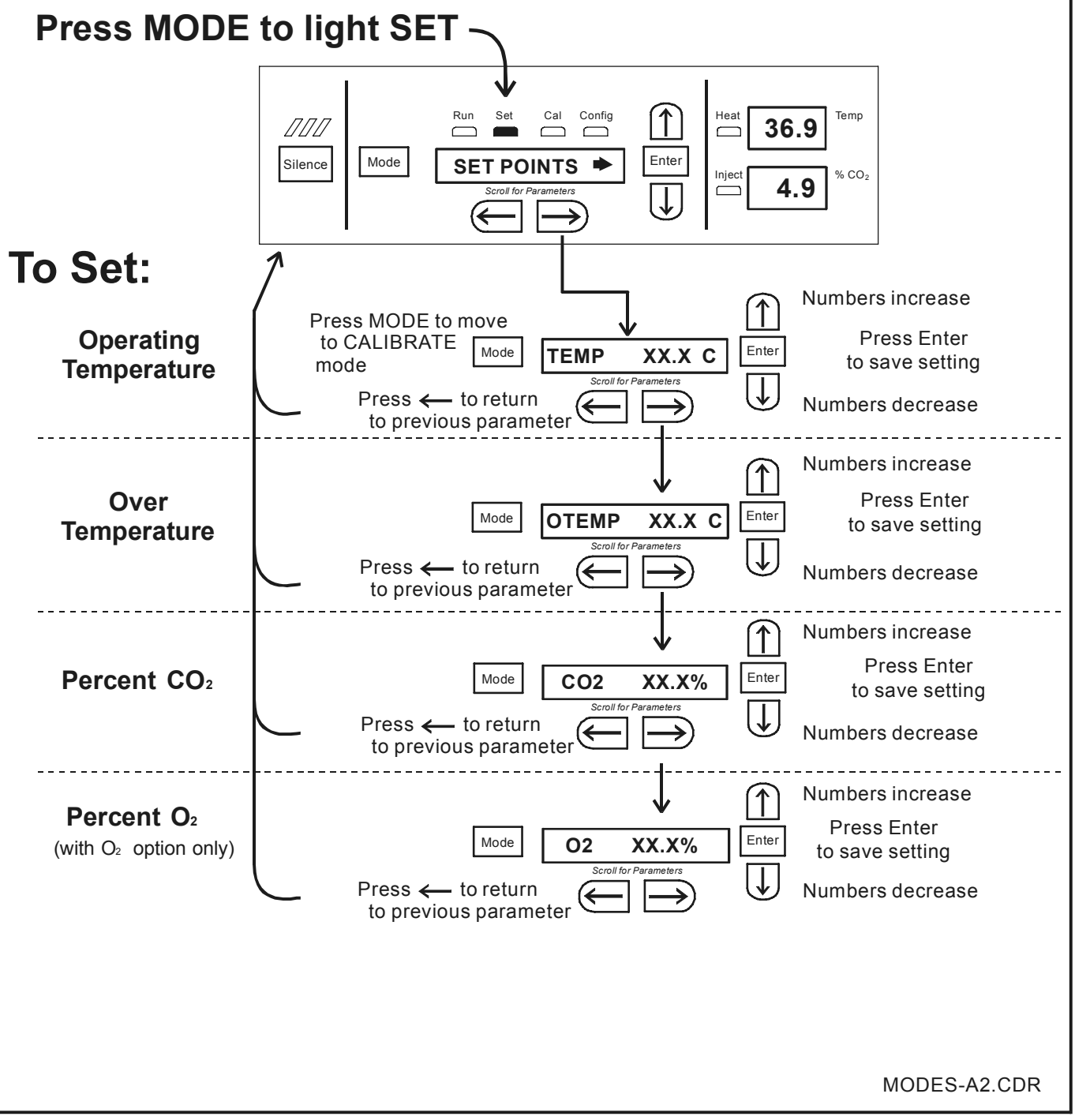
Models 3130, 3131, 3140, and 3141 of the incubator have a built-in $O_2$ control system. The $O_2$ setpoint range is 1.0% to 21.0%. The incubator is shipped from the factory with a $O_2$ setpoint of 21.0%. At this setting, all $O_2$ control and alarms are turned off. The gas sample port must be capped when running controlled $O_2$ levels.

To change the $O_2$ setpoint:

1. Press the Mode key until the Set indicator lights.
2. Press the right arrow until O2 XX.X is displayed in the message center.
3. Press the up/down arrow until the desired $O_2$ setpoint is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run Indicator lights to go to run mode or right/left to go to next/previous parameter.

Chart 1-1

# Set Mode



# Section 2 - Calibration

## 2.1 Calibration Mode

After the unit has stabilized, several different systems can be calibrated. In the Calibration Mode, the air temperature, $CO_2$ reading, $O_2$ reading, and RH reading can all be calibrated to reference instruments. To enter Calibration Mode, press the Mode key until the CAL indicator lights. Press the right and/or left arrow until the proper parameter appears in the message center. See Chart 3-1 for more detail.

Calibration frequency is dependent on use, ambient conditions, and accuracy required. Good laboratory practice would require at least an annual calibration check. On new installations, all parameters should be checked after the stabilization period. When using $O_2$ controls, all parameters should be checked before each test experiment, or at least every 6 months.

Prior to calibration, the user should be aware of the following system functions. While the unit is in Calibration Mode, all system control functions will be stopped so that the unit remains stable. Readout of the system being calibrated will appear as "—-" on the readout displays. If no keys are pressed for approximately five minutes while in Calibration Mode, the system will reset to Run Mode so that control functions can be reactivated.



***Before making an calibration or adjustments to the unit, it is imperative that all reference instruments be properly calibrated.***

### a. Calibrating the Temperature

Place the calibrated instrument in the center of the chamber. The instrument should be in the airflow, not against the shelf. Before calibration, allow the cabinet temperature to stabilize.

**Temperature Stabilization Periods**

**Start-Up** - Allow 12 hours for the temperature in the cabinet to stabilize before proceeding.

**Operating Unit** -Allow at least two hours after the display reaches setpoint for the temperature to stabilize before proceeding.

1. Press the Mode key until the CAL indicator lights.
2. Press the right arrow until TEMPCAL XX.X appears in the message center.
3. Press the up/down arrow to match the display to a calibrated instrument.
4. Press Enter to store the calibration into memory.
5. Press the Mode key to return to Run, or the right/left arrow to go to the next/previous parameter.

### b. Calibrating Thermal Conductivity $CO_2$ System

Models 3110, 3111, 3130 and 3131 have a thermal conductivity (T/C) $CO_2$ sensor. Thermal conductivity of the incubator atmosphere is not only effected by the quantity of $CO_2$ present, but also by the air temperature and the water vapor present in the incubator atmosphere. In monitoring the effects of $CO_2$, air temperature and absolute humidity must be held constant so any change in thermal conductivity is caused only by a change in $CO_2$ concentration.

Changing temperature or changing from elevated humidity levels to room ambient humidity levels would necessitate a recalibration of the $CO_2$ control.

**T/C $CO_2$ Sensor Stabilization Periods**

**Start-up** - The $CO_2$ sensor has been calibrated at the factory for 37°. Allow temperature, humidity, and $CO_2$ levels in the chamber to stabilize at least 12 hours before checking the $CO_2$ concentration with an independent instrument.

**Presently operating** - Make sure the chamber doors are closed. Allow at least 2 hours after the temperature and $CO_2$ displays reach their setpoints for chamber atmosphere stabilization.

1. Make sure stabilization periods outlined above are followed.
2. Sample the chamber atmosphere through the sample port with an independent instrument. Sample the atmosphere at least 3 times to ensure the accuracy of the instrument.
2. Press the Mode key until the CAL indicator lights.
3. Press the right arrow until CO2 CAL XX.X is displayed in the message center.
4. Press the up/down arrow to change the display to match the independent instrument.
5. Press Enter to store calibration.
6. Press the Mode key to return to Run Mode, or the right or left arrow keys to go to the next/previous parameter.

### c. Calibrating the Infra-Red $CO_2$ System.

Models 3120, 3121, 3140 and 3141 have an infra-red $CO_2$ sensor. Infra-red $CO_2$ sensors are not effected by chamber atmosphere temperature or humidity. However, the light detector in the sensor is effected by wide temperature changes. Therefore, changing temperature setpoints could necessitate a recalibration of the $CO_2$. Chamber temperature should be allowed to stabilize before checking $CO_2$ concentrations with an independent instrument, especially on start-up.

All models equipped with an IR/$CO_2$ sensor have an automatic calibration that occurs every 24 hours, and lasts for 5 to 6 minutes. During automatic calibration, the $CO_2$ display is blanked out and HEPA filtered room air is pumped through the $CO_2$ sensor. A new $CO_2$ calibration value is stored in memory for use as the 0.0% $CO_2$ reference point. The keypad/ control panel is locked during calibration, with the message center reading CO2 AUTO CAL.

**IR $CO_2$ Sensor Stabilization Times**

**Startup**- Allow the temperature and the $CO_2$ of the cabinet to stabilize at least 12 hours before proceeding.

**Operating Unit** - Allow $CO_2$ to stabilize at least 2 hours at setpoint before proceeding.

1. Measure the $CO_2$ concentration in the chamber through the gas sample port with a Fyrite or other independent instrument. Several readings should be taken to ensure accuracy.
2. Press the Mode key until the CAL indicator lights.
3. Press the right arrow until IR CAL XX.X appears in the message center.
4. Press the up/down arrow to adjust the display to match the independent instrument reading.
5. Press Enter to store calibration.
6. After Enter is pressed, the unit will go into a calibration cycle that will last 5 to 6 minutes. The control panel is locked during this calibration cycle.
7. Press the Mode key to return to Run Mode.

### d. Calibrating the $O_2$ System

Models 3130, 3131, 3140 and 3141 have an $O_2$ control sensor. The sensor is a fuel cell that puts out a linear millivolt signal based on $O_2$ content of the chamber. The fuel cell depletes over time depending on required $O_2$ levels, therefore the system should be calibrated before each test experiment, or at least every 6 months.

There are two methods available to calibrate the $O_2$ system.

- The preferred method calibrates the system to the known ambient $O_2$ value of 20.7% and checks the life of the sensor. This method should be used whenever a new sensor is installed.
- The second method available allows the system to be calibrated to an independent reference instrument by entering an offset.

**$O_2$ Calibration at 20.7%**

1. Press the Mode key until the CAL indicator lights.
2. Press the right arrow until the display reads O2 CAL@20.7%.
3. Press Enter.
4. OPEN DOOR appears on the display. Open the outer and inner doors.
5. The display reads CALIBRATING.
6. When calibration is complete, approximately 2 minutes, an audible tone will sound and the display returns to O2 CAL@20.7%.
7. The $O_2$ display will change to 20.7.
8. Press the Mode key to return to Run.

A new $O_2$ span value is stored in memory for use as the 20.7% $O_2$ reference point. The keypad/control panel is "locked-up" during calibration.



***If using an $O_2$ Fyrite, the accuracy of the instrument will be greatly affected by the concentration of $CO_2$ in the cabinet. Refer to the Fyrite operating manual.***

**$O_2$ Offset Calibration**

**Startup** - Allow the cabinet to stabilize at least 12 hours before proceeding.

**Operating Unit** - Allow $O_2$ to stabilize at least 2 hours at set point before proceeding.

Measure the $O_2$ concentration in the chamber through the gas sample port with an independent instrument. Several readings should be taken to ensure accuracy.

1. Press the Mode key until the CAL indicator lights.
2. Press the right arrow until O2 OFFS XX.X appears in the message center.
3. Press the up/down arrow to adjust display to independent instrument reading.
4. Press Enter to store calibration.
5. Press the Mode key to return to Run Mode.

### e. Calibrating Relative Humidity

All 3110 Series incubators can be equipped with an optional direct readout relative humidity sensor. This is a readout only of the chamber relative humidity. It does not provide any control of the relative humidity in the cabinet.

**Relative Humidity Stabilization Times**

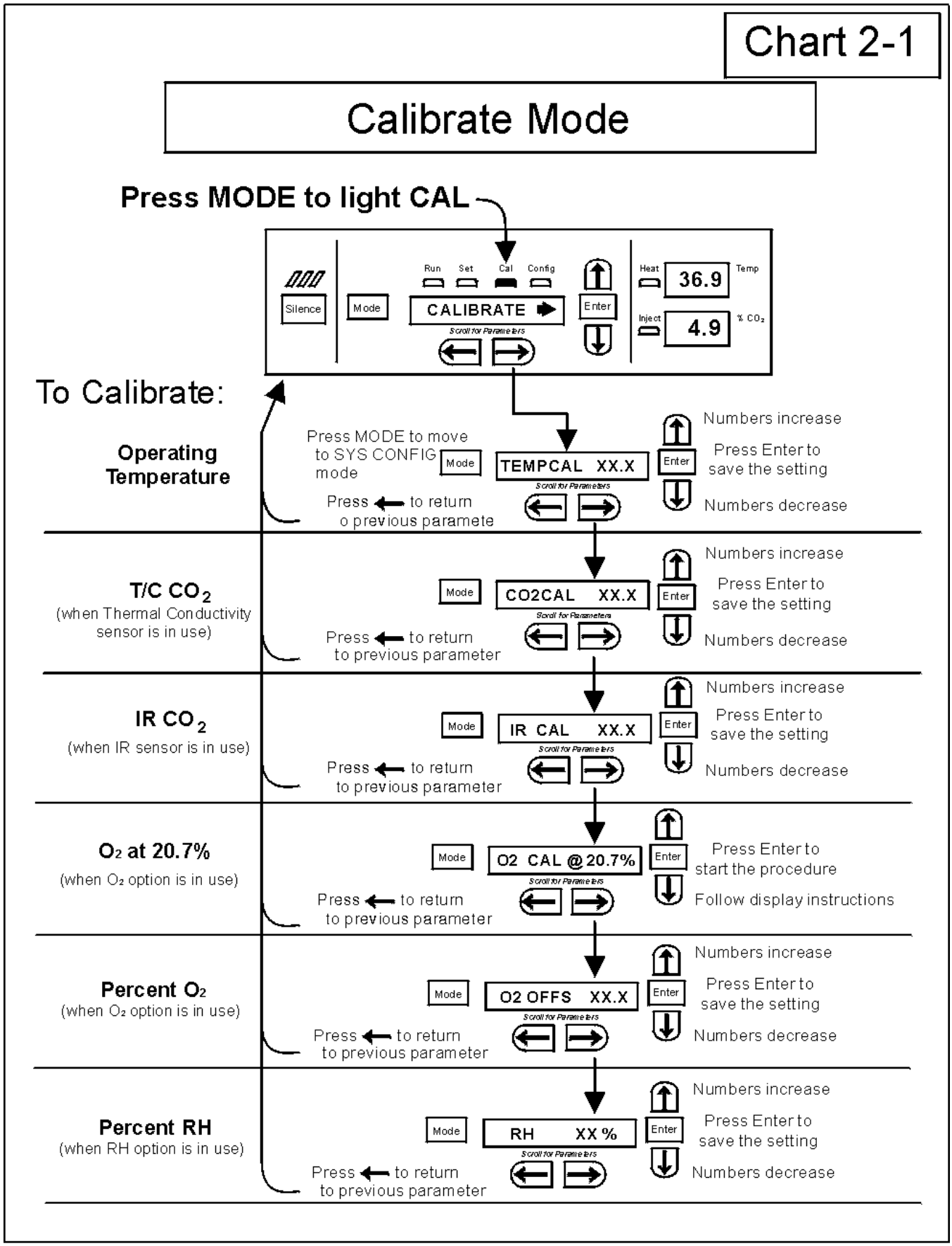
**Startup** - Allow 12 hours for the relative humidity and temperature in the chamber to stabilize before proceeding.

**Operating Unit** - Allow at least 2 hours after temperature display reaches setpoint for relative humidity to stabilize before proceeding.

1. Place an accurate independent instrument in the center of the chamber. Allow at least 30 minutes for RH to stabilize.
2. Press the Mode key until the CAL indicator lights.
3. Press the right arrow key until RH CAL XX appears in the message center.
4. Press the up/down arrow to match the display to the independent instrument.
5. Press Enter to store the calibration.
6. Press the Mode key to return to Run Mode.

If a reliable RH measuring device is not available, you may calibrate the display to a typical level.

1. Follow the RH stabilization periods outlined above.
2. With a full humidity pan and stable temperature, the relative humidity in the chamber will be 95%.
3. Using Steps 3-5 of the relative humidity sensor adjustment, adjust the display to 95%.
4. This calibration method should be accurate to within 5%.


Chart 2-1
Calibrate Mode
Press MODE to light CAL
Run
Set
Cal
Config
Heat
36.9
Temp
Silence
Mode
CALIBRATE
Enter
Inject
4.9
% CO2
Scroll for Parameters
To Calibrate:
Operating Temperature
Press MODE to move to SYS CONFIG mode
Mode
TEMPCAL XX.X
Enter
Numbers increase
Press Enter to save the setting
Numbers decrease
Press ← to return o previous paramete
T/C CO2
(when Thermal Conductivity sensor is in use)
CO2CAL XX.X
Press ← to return to previous parameter
IR CO2
(when IR sensor is in use)
IR CAL XX.X
O2 at 20.7%
(when O2 option is in use)
O2 CAL @20.7%
Press Enter to start the procedure
Follow display instructions
Percent O2
(when O2 option is in use)
O2 OFFS XX.X
Percent RH
(when RH option is in use)
RH XX %

# Section 3 - Configuration

## 3.1 Configuration Mode

There are many features available in Configuration Mode that allow custom setup of the incubator. These features are listed and described below. All features may not be necessary in all applications, but are available if needed. To enter Configuration Mode, press the Mode key until the Config indicator lights. Press the right or left arrow until the appropriate parameter appears in the message center. See Chart 3-1 for more detail.

### a. Turning the Audible Alarm ON/OFF

The audible alarm can be turned on or off. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Audible XXX is displayed in the message center.
3. Press the up/down arrow to toggle Audible ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### b. New HEPA Filter

When the REPLACE HEPA reminder is displayed and the visual alarm flashes, the specified time has elapsed and the HEPA filter should be replaced. To clear the display and reset the timer after replacing the HEPA filter with a new one, follow the steps below.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until NEW HEPA is displayed in the message center.
3. Press Enter to restart the timer and clear the REPLACE HEPA alarm.
4. Press the Mode key to return to Run Mode.

### c. Setting the REPLACE HEPA filter reminder

A HEPA filter replacement timer can be set for a specific amount of time, from 1 to 12 months of actual unit running time. Time will not accrue when the unit is turned off. The default time is 6 months. When the allotted time has run out, REPLACE HEPA appears in the display and the visual alarm flashes. To set the reminder, use the following procedure.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until REPL HEPA XX is displayed.
3. Press the up/down arrow to choose the number of months desired.
4. Press Enter to save the number.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

**Note:** After the reminder has been set, check the allotted time remaining by going to Config Mode, then pressing the right arrow until NEW HEPA XXX displays. This number is the remaining days before the filter replacement time specified runs out. For example, if 12 months was chosen in the REPL HEPA XX message screen, the NEW HEPA number would be 365 days.

### d. Setting an Access Code

A three-digit Access Code can be entered to avoid unauthorized personnel from changing the setpoints, calibration, or configuration. A setting of 000 will bypass the access code. The factory setting is 000.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Acc Code XXX is displayed in the message center.
3. Press the up/down arrow to change the access code.
4. Press Enter to save the access code.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### e. Setting Low Temp Alarm Limit (tracking alarm)

The low temp alarm limit is the deviation from the temperature setpoint, which will cause a low temp alarm. The low temp alarm is variable from 0.5° below setpoint to 5.0° below setpoint. The factory setting is 1.0° below setpoint. A minus sign (-) in the display indicates that the alarm setting is below the setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Temp LO -X.X is displayed in the message center.
3. Press the up/down arrow to change the low temp alarm limit.
4. Press Enter to save the low temp alarm limit.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### f. Setting High Temp Alarm Limit (tracking alarm)

The high temp alarm limit is the deviation from the temperature setpoint that will cause a high temp alarm. It should be noted that this varies from the Overtemp setpoint, in that the Overtemp setpoint configures an independent system that monitors temperature and shuts down the system heaters if necessary. The high temp alarm limit is simply set to enable an audible and visual alarm that notifies the user of a problem. The high temp alarm is variable from 0.5° above setpoint to 5.0° above setpoint. The factory setting is 1.0° above setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Temp Hi X.X is displayed in the message center.
3. Press the up/down arrow to change the high temp alarm limit.
4. Press Enter to save the high temp alarm limit.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### g. Enabling Temperature Alarms to Trip Contacts

High and Low temperature alarms can be programmed to trip the remote alarm contacts. A setting of ON will cause this, a setting of OFF will not allow temp alarms to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Tmp Rly XXX is displayed in the message center.
3. Press the up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### h. Setting Low $CO_2$ Alarm Limit (tracking alarm)

The low $CO_2$ alarm limit is the deviation from the $CO_2$ setpoint that will cause a low $CO_2$ alarm. The setpoint is variable from 0.5% $CO_2$ below setpoint to 5.0% $CO_2$ below setpoint. The factory setting is 1.0% $CO_2$ below setpoint. A minus (-) in the display indicates that the alarm setting is below the setpoint.

1. Press the Mode Key until the Config indicator lights.
2. Press the right arrow until CO2 LO -X.X is displayed in the message center.
3. Press the up/down arrow to change the low $CO_2$ alarm limit.
4. Press Enter to save the low $CO_2$ alarm limit.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### i. Setting High $CO_2$ Alarm Limit (tracking alarm)

The high $CO_2$ alarm limit is the deviation from the $CO_2$ setpoint that will cause a high $CO_2$ alarm. The setpoint is variable from 0.5% $CO_2$ above setpoint to 5.0% $CO_2$ above setpoint. The factory setting is 1.0% $CO_2$ above setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until CO2 Hi X.X is displayed in the message center.
3. Press the up/down arrow to change the high $CO_2$ alarm limit.
4. Press Enter to save the high $CO_2$ alarm limit.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### j. Enabling $CO_2$ Alarms to Trip Contacts

High and Low $CO_2$ alarms can be programmed to trip the remote alarm contacts. A setting of ON will cause this; a setting of OFF will not allow $CO_2$ alarms to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until CO2 Rly XXX is displayed in the message center.
3. Press the up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### k. Setting New Zero Number for T/C $CO_2$ Sensors

If a new T/C $CO_2$ sensor is being installed, the two numbers on the factory installed sticker on the T/C cell must be entered to calibrate the $CO_2$ in the unit.

**Note:** For the technician's convenience, a label containing the two numbers on the T/C cell is affixed inside the electronics drawer.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until T/CZ# XXXX is displayed in the message center.
3. Press the up/down arrow to change the zero number to match the sticker.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### l. Setting New Span Number for T/C CO2 Sensors

If a new T/C $CO_2$ sensor is being installed, the two numbers on the factory installed sticker on the T/C cell must be entered to calibrate the $CO_2$ in the unit.

**Note:** For the technician's convenience, a label containing the two numbers on the T/C cell is affixed inside the electronics drawer.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until T/CS# XXXX is displayed in the message center.
3. Press the up/down arrow to change the span number to match the sticker.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### m. Setting a Low RH Alarm Limit

On units that have the RH option installed, a low RH alarm limit may be entered. The low RH alarm limit is the %RH in the cabinet that will cause a low RH alarm. The setpoint is variable from setpoint 0 to 90 %RH. The factory setting is 0% RH, which will disable the alarm.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until RH Lo XX is displayed in the message center.
3. Press the up/down arrow to change the RH low alarm limit.
4. Press Enter to save the RH low alarm limit.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### n. Enabling RH Alarms to Trip Contacts

The low RH alarm can be programmed to trip the remote alarm contacts. A setting of ON will cause this, a setting of OFF will not allow the RH alarm to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until RH Rly XXX is displayed in the message center.
3. Press the up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### o. Setting a Low $O_2$ Alarm Limit (tracking alarm)

On models with a $O_2$ control system, $O_2$ alarms may be configured. The low $O_2$ alarm limit is the deviation from the $O_2$ setpoint that will cause a low $O_2$ alarm. The setpoint is variable from 0.5% $O_2$ below setpoint to 5.0% $O_2$ below setpoint. The factory setting is 1.0% $O_2$ below setpoint. A minus (-) in the display indicates that the alarm setting is below setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until O2 LO -X.X is displayed in the message center.
3. Press the up/down arrow to change the low $O_2$ alarm limit.
4. Press Enter to save the low $O_2$ alarm limit.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### p. Setting a High $O_2$ Alarm Limit (tracking alarm)

On models with a $O_2$ control system, $O_2$ alarms may be configured. The high $O_2$ alarm limit is the deviation from the $O_2$ setpoint that will cause a high $O_2$ alarm. The setpoint is variable from 0.5% $O_2$ above setpoint to 5.0% $O_2$ above setpoint. The factory setting is 1.0% $O_2$ above setpoint.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until O2 Hi X.X is displayed in the message center.
3. Press the up/down arrow to change the high $O_2$ alarm limit.
4. Press Enter to save the high $O_2$ alarm limit.
5. Press the Mode key to return to Run Mode or right/left to go to next/previous parameter.

### q. Enabling $O_2$ Alarms to Trip Contacts

On models with an $O_2$ control system, $O_2$ alarm contacts may be configured to trip the contacts. A setting of ON will cause this, a setting of OFF will not allow $O_2$ alarms to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until O2 Rly XXX is displayed in the message center.
3. Press the up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### r. Enabling Temp/RH to be Displayed

On units that are equipped with the RH option, the upper seven-segment display on the control panel can be configured to display Temp continuously, RH continuously, or toggle between Temp and RH. If the units does not have RH, the upper display will always display temperature. If temperature is set to ON and the RH is set OFF, temperature will be displayed continuously. If temperature is set to OFF and RH is set to ON, RH will be displayed continuously. If both are turned ON, the display will toggle between the two. The factory setting will default to toggle mode if the RH option is present.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Disp Tmp XXX or Disp RH XXX is displayed in the message center.
3. Press the up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### s. Enabling $CO_2$/$O_2$ to be Displayed

On models that are equipped with the $O_2$ system, the lower seven-segment display on the control panel can be configured to display $CO_2$ continuously, $O_2$ continuously, or toggle between $CO_2$ and $O_2$. If the units does not have $O_2$, the lower display will always display $CO_2$. If $CO_2$ is set to ON and the $O_2$ is set OFF, $CO_2$ will be displayed continuously. If $CO_2$ is set to OFF and $O_2$ is set to ON, $O_2$ will be displayed continuously. If both are turned ON, the display will toggle between the two. The factory setting will default to toggle mode if the $O_2$ system is present.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Disp CO2 XXX or Disp O2 XXX is displayed in the message center.
3. Press the up/down arrow to toggle the setpoint.
4. Press Enter to save the setpoint.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### t. Selecting a Primary Tank with the Gas Guard Option

On units equipped with the Gas Guard option, a primary tank can be selected. The primary tank will be either Tank 1 or Tank 2. The factory setting is Tank 1.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Tnk Sel X is displayed in the message center.
3. Press the up/down arrow to toggle the setting between 1 and 2 .
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### u. Enabling the Gas Guard System

On units equipped with the Gas Guard option, the Gas Guard system may be turned ON or OFF if it is not in use. The factory setting is OFF.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until Gas Grd XX is displayed in the message center.
3. Press the up/down arrow to toggle the setting ON/OFF.
4. Press Enter to save the setting.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

### v. Setting a RS485 Communications Address (1535 compatible only)

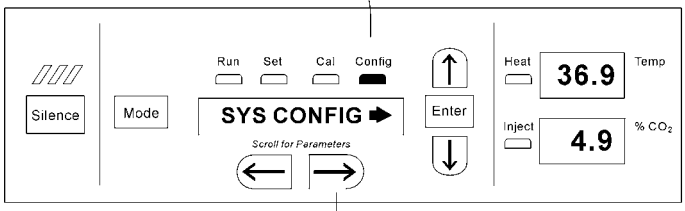
On units with the RS485 option, direct communication with the Thermo Forma 1535 Model alarm system can be established. Each piece of equipment connected to the 1535 must have a unique address. An address of 0-24 can be entered for the incubator. A setting of 0 is an invalid address that the 1535 will ignore. The factory setting for the RS485 address is 0.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until RS485 XX is displayed in the message center.
3. Press the up/down arrow to move the RS485 address.
4. Press Enter to save the RS485 address.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

# Chart 3-1

# Configure Mode

**Press MODE to light CONFIG**




## To Configure:

### Audible ON/OFF

Press MODE to return to RUN mode

Mode | AUDIBLE XX | Enter

Scroll for Parameters

Press ← to return to previous parameter

Turn ON audible alarm

Press Enter to save the setting

Turn OFF audible alarm

### NEW HEPA Filter

Mode | NEW HEPA XXX | Enter

Scroll for Parameters

Press ← to return to previous parameter

Press Enter to reset the timer

### REPLACE HEPA Timer

Mode | REPL HEPA XX | Enter

Scroll for Parameters

Press ← to return to previous parameter

Numbers increase

Press Enter to save the setting

Numbers decrease

### Access Code

Mode | ACC CODE XXX | Enter

Scroll for Parameters

Press ← to return to previous parameter

Numbers increase

Press Enter to save the setting

Numbers decrease

### Low Temp Alarm Limit

Mode | TEMP LO XX.XC | Enter

Scroll for Parameters

Press ← to return to previous parameter

Numbers increase

Press Enter to save the setting

Numbers decrease

### High Temp Alarm Limit

Mode | TEMP HI XX.XC | Enter

Scroll for Parameters

Press ← to return to previous parameter

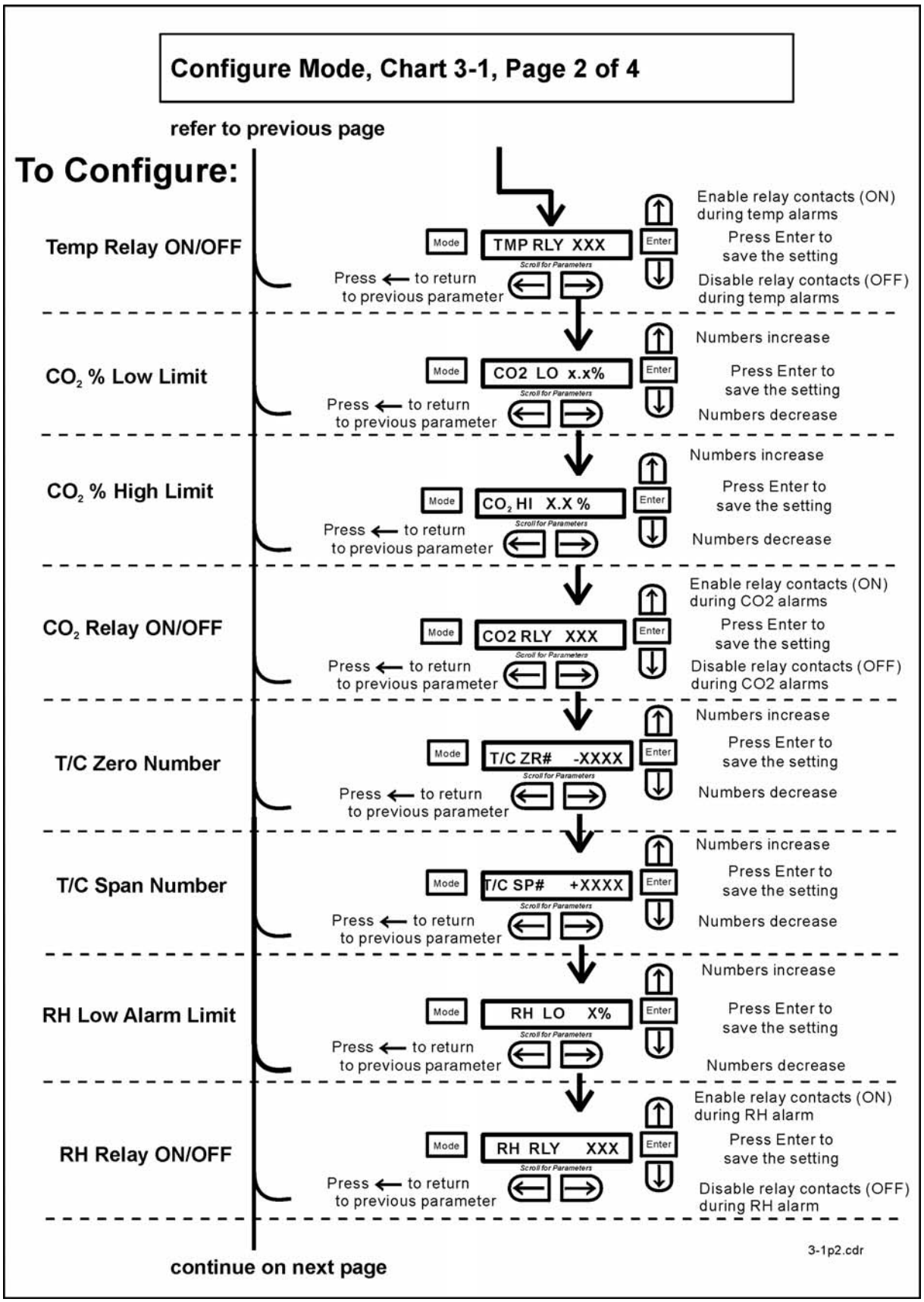
Numbers increase

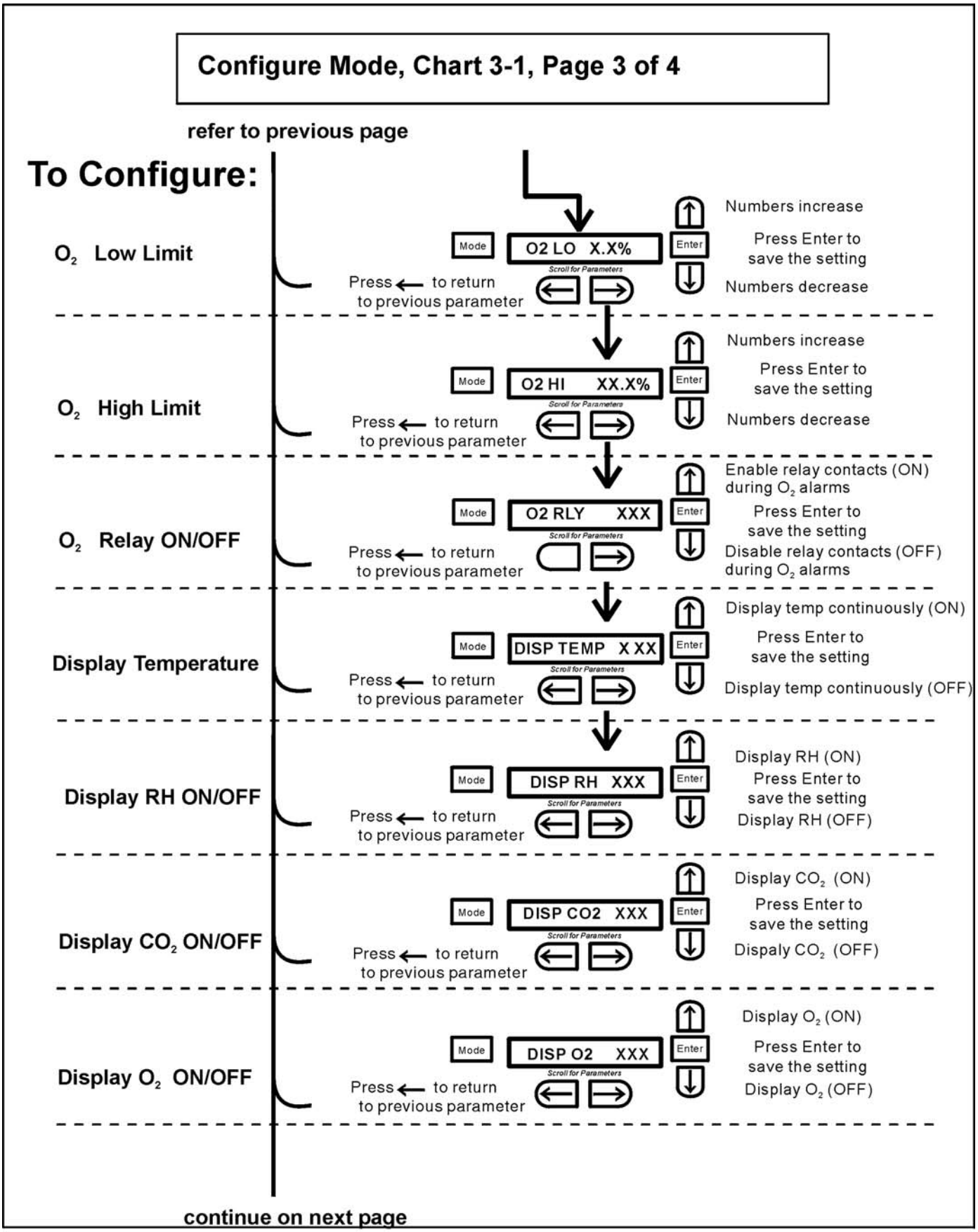
Press Enter to save the setting

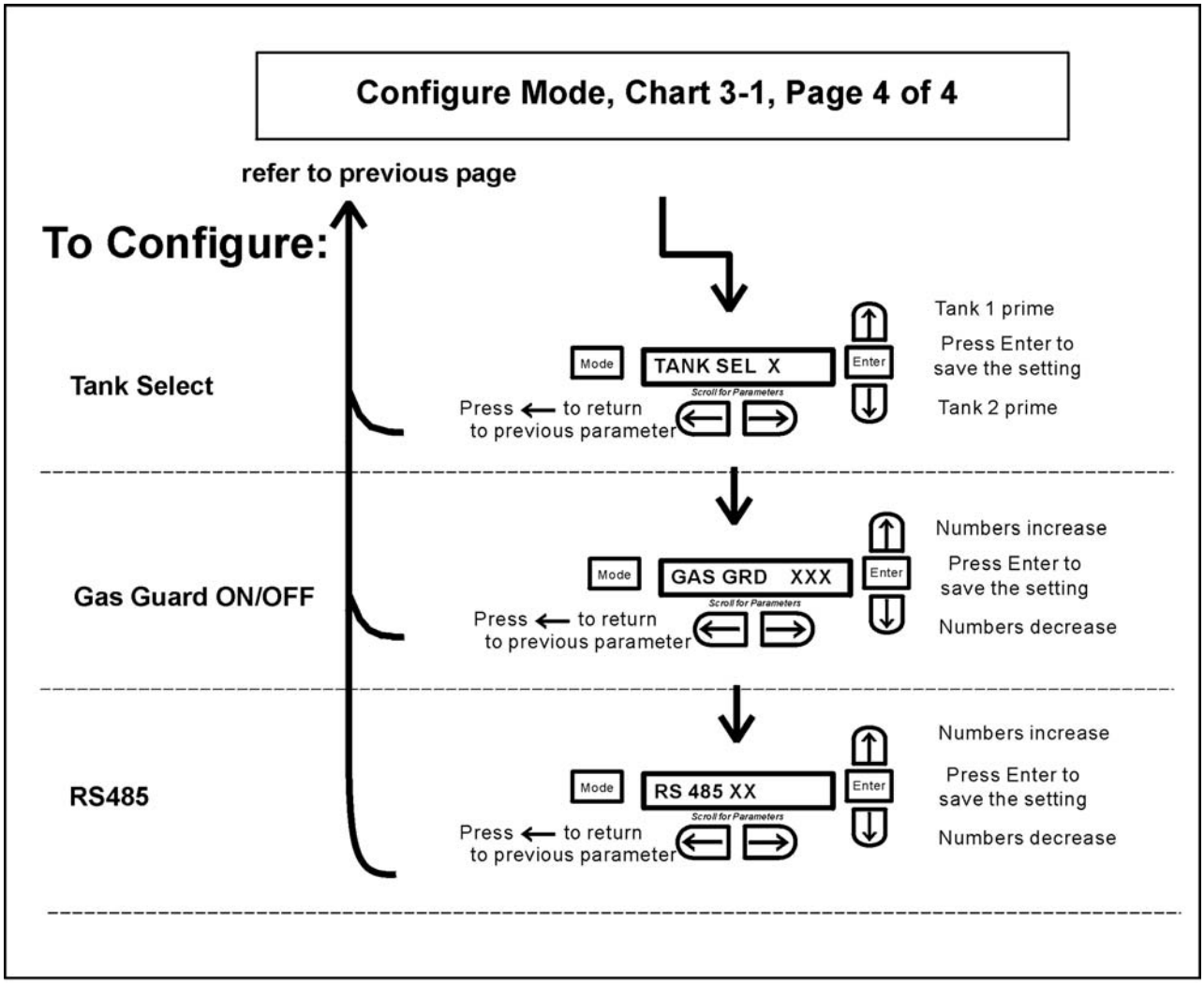
Numbers decrease

**continue on next page**

3-1p1.cdr


Configure Mode, Chart 3-1, Page 2 of 4
refer to previous page
To Configure:
Temp Relay ON/OFF
TMP RLY XXX
Enable relay contacts (ON) during temp alarms
Press Enter to save the setting
Disable relay contacts (OFF) during temp alarms
CO2 % Low Limit
CO2 LO x.x%
Numbers increase
Press Enter to save the setting
Numbers decrease
CO2 % High Limit
CO2 HI X.X %
Numbers increase
Press Enter to save the setting
Numbers decrease
CO2 Relay ON/OFF
CO2 RLY XXX
Enable relay contacts (ON) during CO2 alarms
Press Enter to save the setting
Disable relay contacts (OFF) during CO2 alarms
T/C Zero Number
T/C ZR# -XXXX
Numbers increase
Press Enter to save the setting
Numbers decrease
T/C Span Number
T/C SP# +XXXX
Numbers increase
Press Enter to save the setting
Numbers decrease
RH Low Alarm Limit
RH LO X%
Numbers increase
Press Enter to save the setting
Numbers decrease
RH Relay ON/OFF
RH RLY XXX
Enable relay contacts (ON) during RH alarm
Press Enter to save the setting
Disable relay contacts (OFF) during RH alarm
Mode
Enter
Scroll for Parameters
Press ← to return to previous parameter
3-1p2.cdr
continue on next page


Configure Mode, Chart 3-1, Page 3 of 4
refer to previous page
To Configure:
O2 Low Limit
Mode
O2 LO X.X%
Scroll for Parameters
Enter
Numbers increase
Press Enter to save the setting
Numbers decrease
Press ← to return to previous parameter
O2 High Limit
O2 HI XX.X%
O2 Relay ON/OFF
O2 RLY XXX
Enable relay contacts (ON) during O2 alarms
Disable relay contacts (OFF) during O2 alarms
Display Temperature
DISP TEMP X XX
Display temp continuously (ON)
Display temp continuously (OFF)
Display RH ON/OFF
DISP RH XXX
Display RH (ON)
Display RH (OFF)
Display CO2 ON/OFF
DISP CO2 XXX
Display CO2 (ON)
Dispaly CO2 (OFF)
Display O2 ON/OFF
DISP O2 XXX
Display O2 (ON)
Display O2 (OFF)
continue on next page


Configure Mode, Chart 3-1, Page 4 of 4
refer to previous page
To Configure:
Tank Select
Mode
TANK SEL X
Enter
Scroll for Parameters
Press ← to return to previous parameter
Tank 1 prime
Press Enter to save the setting
Tank 2 prime
Gas Guard ON/OFF
Mode
GAS GRD XXX
Enter
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Press Enter to save the setting
Numbers decrease
RS485
Mode
RS 485 XX
Enter
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Press Enter to save the setting
Numbers decrease
3-1p4.cdr

# Section 4 - Alarms

## 4.1 Alarms

The Model 3110 Series incubator alarm system is shown in the table below. When an alarm is active, the message appears in the LED message center. Pressing Silence disables the audible alarm for the ringback period. However, the visual alarm continues until the incubator returns to a normal condition. The alarms are momentary alarms only. When an alarm condition occurs and then returns to normal, the incubator automatically clears the alarm condition and the message center.

| Description | Message | Delay | Ringback | Relay |
|---|---|---|---|---|
| No alarm condition exists | SYSTEM OK/CLASS 100 | ----- | ----- | ----- |
| $CO_2$ System Auto Calibrating | CO2 AUTO CAL | ----- | ----- | ----- |
| Temp > Otemp Setpoint | SYS IN OTEMP | 0 min. | 15 min. | Yes |
| Temp Control Sensor Fault (See Sect 4.2) | TSNSR1 ERR | 0 min. | 15 min. | No |
| Over Temp Sensor Fault (See Sect 4.2) | TSNSR2 ERR | 0 min. | 15 min. | No |
| $CO_2$ Sensor Fault (See Sect 4.2c) | CO2 SNSR ERR | 0 min. | 15 min. | No |
| $O_2$ Sensor Fault ($O_2$ option, see Sect 4.2a) | O2 SNSR ERR | 0 min. | 15 min. | No |
| $O_2$ Sensor Low ($O_2$ option, see Sect 4.2a) | REPL O2 SNSR | 0 min. | ----- | No |
| $CO_2$ Sensor cannot be calibrated (IR option, see Sect. 4.2b) | REPL IR SNSR | 0 min. | 15 min. | No |
| Replace HEPA filter reminder – set time expired (See Sect. 3.1b & 3.1c) | REPLACE HEPA | 0 min. | ----- | No |
| Water low in jacket | ADD WATER | 0 min. | 15 min. | No |
| Inner Door is Open | DOOR OPEN | 15 min. | 15 min. | No |
| $CO_2$ > $CO_2$ High Tracking Alarm | CO2 IS HIGH | 15 min. | 15 min. | Programmable |
| $CO_2$ < $CO_2$ Low Tracking Alarm | CO2 IS LOW | 15 min. | 15 min. | ↓ |
| TEMP > TEMP High Tracking Alarm | TEMP IS HIGH | 0 min. | 15 min. | Programmable |
| TEMP < TEMP Low Tracking Alarm | TEMP IS LOW | 15 min. | 15 min. | ↓ |
| $O_2$ > $O_2$ High Tracking Alarm ($O_2$ option) | O2 IS HIGH | 15 min. | 15 min. | Programmable |
| $O_2$ < $O_2$ Low Tracking Alarm ($O_2$ option) | O2 IS LOW | 15 min. | 15 min. | ↓ |
| RH < RH Low Limit Alarm (RH option) | RH IS LOW | 30 min. | 30 min. | Programmable |
| $CO_2$ Auto-Zero Fault (IR option, see Sect. 4.6) | IR AUTOZ ERR | 0 min. | 15 min. | No |
| Tank 1 is low, switch to Tank 2 (Gas Guard) | TANK1 LOW | 0 min. | ---- | No |
| Tank 2 is low, switch to Tank 1 (Gas Guard) | TANK2 LOW | 0 min. | ---- | No |
| Both tanks are low (Gas Guard) | TANK 1 and 2 LOW | 0 min. | 15 min. | No |

***- All alarm delays and ringback times are +/- 30 seconds -***

When multiple alarm conditions occur, active messages are displayed in the message center one at a time, updating at 5 second intervals. Pressing Silence during multiple alarms causes all active alarms to be silenced and to ring back in 15 minutes.

The temperature alarms are disabled when the Temp setpoint is 10°C. The $CO_2$ alarms are disabled when the $CO_2$ setpoint is 0.0%. The $O_2$ alarms are disabled when the $O_2$ setpoint is 21.0%.

## 4.2 Sensor Fault Alarms

The microprocessor in the incubators continually scans all available sensors, except the $O_2$ (see Section 4.2a), to ensure that they are operating properly. Should an error be detected, the incubator will sound an alarm and display the appropriate message. If such an alarm occurs, contact your local distributor or the Thermo Forma Service department at 740-373-4763 or 1-888-213-1790 (USA and Canada) or fax 740-373-4189.

### a. REPL O2 SNSR (Alarm)

On units equipped with the $O_2$ system, the microprocessor checks the remaining life of the $O_2$ sensor whenever $O_2$ calibration @ 20.7% is performed. If the $O_2$ sensor declines to a certain level, REPL O2 SNSR appears in the display and the visual alarm flashes. This alarm alerts the user to replace the $O_2$ sensor at the earliest convenience. The unit will continue to function for some length of time. See Section 5.10 for replacing the $O_2$ sensor.

### b. O2 SNSR ERR (Alarm)

If the $O_2$ sensor declines to the point that control cannot be accurately performed, an O2 SNSR ERR alarm will sound and control is disabled.

### c. REPL IR SNSR (Alarm)

On units equipped with an IR $CO_2$ control system, calibration is done automatically using an Auto Zero system. If this system cannot properly calibrate the sensor, the REPL IR SNSR alarm will sound. The unit will continue to function for some length of time.

### c. CO2 SNSR ERR

If the cables or connectors between the main microprocessor board and the $CO_2$ sensor, or between the $CO_2$ board and the sensor head on I/R $CO_2$ units become loose or disconnected, the CO2 SNSR ERR alarm will occur.

#### I/R Units

On I/R incubators, the red light on the I/R module (Refer to Figure 5-4 for the location of the module circuit board) will be lit continuously if communication is lost between the $CO_2$ board and the sensor head. The $CO_2$ display will also be locked at 00.0 without injection. Turning the incubator off and on will not clear the alarm. Only proper connections of all the components will correct the alarm.

### d. IR AUTOZ ERR

On incubators equipped with I/R $CO_2$ control, calibration is done automatically using an Auto Zero system. Auto Zero occurs once every 24 hours. If, during the Auto Zero cycle, a $CO_2$ correction of more than 0.45% is detected, the IR AUTOZ ERR alarm will occur.

Possible problems which will cause this alarm are:

- Auto Zero pump, orifice, filter or tubing will not allow air to the sensor.

  Possibilities are:

  Defective or electrically disconnected air pump

  Kinked auto zero vinyl tubing

  Disconnected tubing between air pump and sensor

  Plugged filter or orifice on auto zero assembly

  Defective auto zero circuit
- Cabinet temperature has been increased significantly from a previous setpoint. (For example, the unit was calibrated and operating at 30°C and the setpoint is increased to 50°C) In this instance, calibrating the $CO_2$ will correct the alarm.
- There is high background $CO_2$ in the laboratory. This could be from leaks in the tank, regulator or vinyl $CO_2$ tubing.
- High $CO_2$ sensor calibration drift occurred. This will require replacement of the sensor.

Thermo Forma

# PREVENTIVE MAINTENANCE

## Incubators

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

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

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

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

**Tips for all incubators:**

- Do NOT use bleach or any disinfectant that has high chloros
- Use sterile, distilled or demineralized water.
- Avoid spraying cleaner on the $CO_2$ sensor.
- Do not use powdered gloves for tissue cultures.

Millcreek Road, Box 649 • Marietta, Ohio 45750 USA • 740-373-4763
USA and Canada 888-213-1790 • Telefax: 740-373-4189 • http://www.service@thermoforma.com

# Preventive Maintenance for Water Jacket Incubators

| Refer to Manual Section | Action | Daily | Weekly | Monthly | 3 to 6 Months | Yearly | 2 years |
|---|---|---|---|---|---|---|---|
| -- | Check $CO_2$ tank levels. | ✓ | | | | | |
| -- | Inspect door latch, hinges and door gasket seal. | | | | | ✓ | |
| 1.5j | Check water level in the humidity pan, ½" from top | | ✓ | | | | |
| 2.1 | * Verify and document $CO_2$, $O_2$, humidity and temperature calibration, as applicable | | | | | ✓ | |
| 5.1<br>5.3 | Perform a complete decontamination procedure. Wipe down interior, shelves and side ducts with disinfectant. Change or clean blower wheel and scroll. Clean top duct. Clean humidity pan. Rinse everything well with sterile distilled water. | Between experiments<br>*More frequent decontamination may be required, depending on use and environmental conditions* | | | | | |
| 1.5f | Change HEPA and gas filters, if applicable (*or as needed)* | | | | | ✓ | |
| 5.12 | Replenish rust inhibitor in water jacket. | | | | | | ✓ |

* Qualified service technicians only

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

## Section 5: Routine Maintenance

***Before using any cleaning or decontamination method except those recommended by the manufacturer, users must check with the manufacturer that the proposed method will not damage the equipment.***

### 5.1 Disinfecting the Incubator Interior

***If the units have been in service, disconnect the power cord connector before disinfecting.***

Use an appropriate disinfectant. All articles and surfaces to be disinfected must be thoroughly cleaned, rinsed and rough-dried.

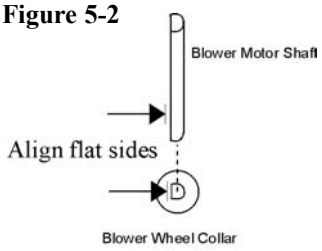
***Alcohol, even a 70% solution, is volatile and flammable Use it only in a well ventilated area that is free from open flame. If any component is cleaned with alcohol, do not expose the component to open flame or other possible hazard. Allow the alcohol to fully dry before turning power on.***

***Do not spray the T/C sensor with flammable solutions. The internal temperature of the $CO_2$ sensor is approximately 150°C when the unit is in operation. Allow sufficient time for the sensor to cool before cleaning.***

***Do not use strong alkaline or caustic agents. Stainless steel is corrosion resistant, not corrosion proof. Do not use solutions of sodium hypochlorite (bleach), as they may also cause pitting and rusting.***

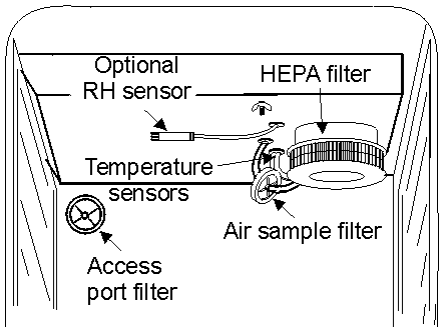
1. Turn the incubator off and disconnect the plug from the power source.
2. Remove the shelves, access port filter and side duct sheets. Remove the temperature sensors and the air sample filter tubing from the back of the blower scroll. If unit is equipped with the optional RH sensor, unfasten it from the clip on the top duct. See Figure 5-1.
3. Remove the filter from the air sample filter tubing. Carefully pull down and remove the HEPA filter.
4. Remove the wingnuts securing the top duct to the interior. Carefully slide the top duct down and off the temperature sensor, air sample filter tubing (and RH sensor, if applicable).
5. Wash the shelves, ducts, wingnuts and stopper with disinfectant and rinse with sterile water. Option: Autoclave shelves, ducts and wingnuts.
6. Remove the blower scroll by first pushing the black lever clip closest to you toward the scroll. Then turn the scroll to the right to disengage it from the blower scroll plate. Some manipulation may be required as the alignment holes are keyhole-shaped.
7. Remove the remaining wingnut, then pull down on the blower wheel. If a new wheel and scroll are going to be used, discard the old ones. If the old ones are being reused, wash all parts with disinfectant and rinse with sterile water.
8. Remove the blower scroll plate by first pushing the black lever clip toward the chamber ceiling. Then turn the plate to the left to disengage it from the alignment keyholes. Clean as above, or autoclave.
9. Wash the cabinet interior with disinfectant starting at the top and working down. Wash the inner door both inside and out. The cabinet and door must be rinsed with sterile water until the disinfectant has been removed. After the cabinet has been rinsed, spray with 70% alcohol.
10. Reinstall the blower scroll plate by aligning it with the larger end of the keyholes and turning it to the left to lock it on. Pull the black lever clip downward from the ceiling.
11. Install the blower wheel onto the motor shaft, aligning the d-shaped flat sides of each. See Figure 5-2. Secure the blower wheel with the wingnut. Make sure the wheel turns freely.

**Figure 5-2**




12. Locate the blower scroll over the blower wheel into the larger end of the keyholes on the scroll plate. Turn the scroll to the right to lock it into the keyholes. Pull the black lever clip closest to you toward the front of the unit.

**Figure 5-1**



13. Install the top duct by feeding the temperature sensors, air sample tubing (and RH sensor, if applicable) through the appropriate holes in the duct as it is raised to the top of the chamber. Be careful not to pull the grommets through the duct. See Figure 5-3.

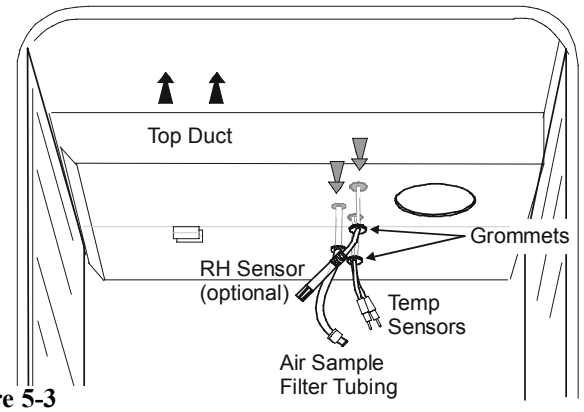



**Figure 5-3**

14. Locate the mounting studs and blower scroll into the appropriate holes in the top duct and install the wingnuts to secure the duct.
15. Install the air sample filter onto the top duct tubing.
16. Carefully pull the temperature sensors and air sample filter tubing down until they can be inserted approximately 1 inch into the appropriate holes in the back of the blower scroll. If applicable, place the optional RH sensor into the corresponding clip on the top duct. See Figure 5-4.

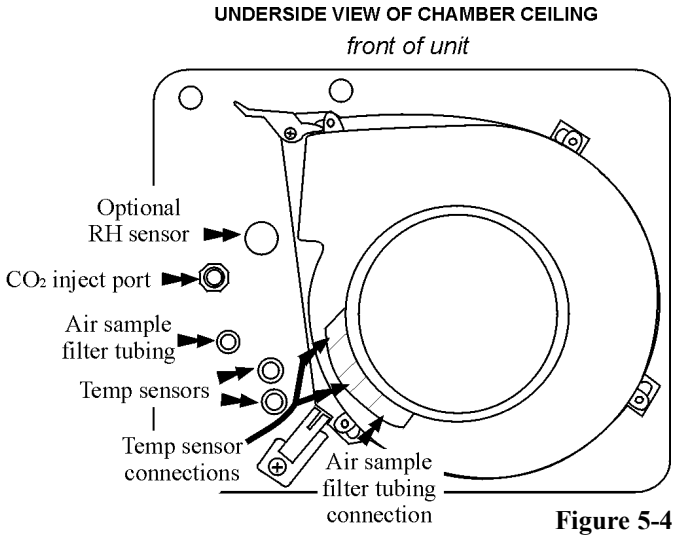



**Figure 5-4**

17. Install the HEPA Filter.
18. Install the left and right ducts, and the access port stopper with filter, spraying each with 70% alcohol.
19. Install the shelves and spray with 70% alcohol.
20. Plug the incubator in and turn the power switch on. Allow the unit to run empty for 24 hours before returning to service.

## 5.2 Cleaning the Cabinet Exterior

Clean the incubator exterior with a damp sponge or soft, well-wrung cloth and mild detergent dissolved in water. Dry with a soft cloth.

## 5.3 Cleaning the Humidity Pan

Clean the humidity pan with soap and water and a general use laboratory disinfectant. Rinse with sterile water and spray with 70% alcohol. The humidity pan may be autoclaved.

## 5.4 Reversing the Door Swing

For side-by-side operation or changing lab layouts, the inner and outer doors are field reversible. The procedure is written from the prospective of changing the door swing from a left-hand to a right-hand swing. All screw holes are pre-drilled for reversing the door. The tools required are a Phillips and a flatblade screwdriver.

***If the units have been in service, disconnect the power cord connector before reversing the door swing.***

### a. Reversing the Hinges for Exterior Door

*Review Illustration A on Page 5-4*. The following instructions will refer to the letters within the circles.

1. Open the outer door and remove it by lifting it off its hinge pins. Lay this door down on its face on a padded surface to prevent scratches.
2. Remove the two outer door hinges identified by the “A” in the illustration.
3. Remove the four nylon screws in locations “B”, which will be the new locations for the inner door hinges.
4. With the Phillips screwdriver, remove and save the four nylon screws from the outer door hinge mounting holes, noted as locations “C” on the right side of the door frame.
5. Remove the electrical connector on the top of the inner door hinge by carefully prying up the black strain relief.

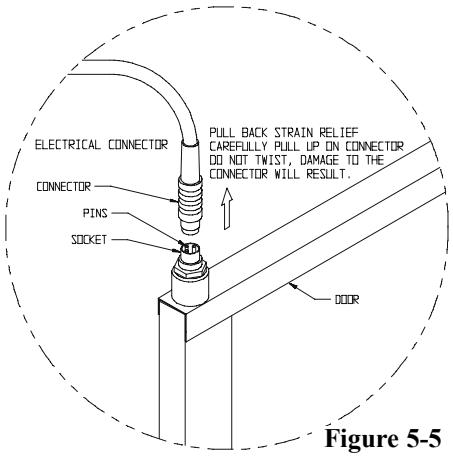



**Figure 5-5**

Refer to item “D” in the illustration and the drawing in Figure 5-5. The heater wiring connector is of yellow rubber which should be visible when the strain relief is moved upward as shown. Refer to connector manufacturer’s instructions in Appendix A of this manual.

6. Grasp the upper portion of the yellow connector and pull it up and out of the hinge socket.
7. Remove the inner door upper hinge, shown as “E”. This hinge will be inverted and become the lower inner door hinge when the hardware is reassembled. When removing the door, set it aside on a flat surface, taking care not to damage the electrical sockets on the top and bottom of the door frame. At this time, remove the 5/8” black plastic bushing from the hinge. This bushing will be inserted in the top hinge when the door is installed on the right side of the cabinet.

***The frame along the hinge side of the inner glass door has electrical connectors mounted on the frame at both the top and bottom of the door. Be careful not to damage the connectors by resting the weight of the door on them. Place the inner glass door on a flat surface where it cannot be damaged before moving on to the next step.***

8. Remove the lower inner door hinge, “F”. Note that this hinge will be inverted and become the upper inner door hinge when the hardware is reassembled. Also, remove the 1” long white plastic bushing from the center of the hinge and insert it into the hinge removed in the step above.
9. The shoulder of the bushing must be on top as shown in Illustration B. Install the black plastic bushing into the hinge just removed and which will be the top hinge when the door is reversed. Refer also to Figure 5-5.
10. Remove the two nylon screws at location “G”.
11. Remove the door strike plate at location “H” and install the two nylon screws just removed into the vacant holes.
12. Remove the two outer Phillips screws on the frame beneath the control panel, identified as “I” in the illustration. Remove only the two outer screws and pull the electronics tray out about one-inch.
13. *Refer to Illustration B on Page 5-5*.
14. Verify that the nylon screws have been installed in the vacant door strike holes, identified as “J”.
15. Move the door heater cable to the slot on the right side of the tray as shown in location “K”.
16. Push any excess cable into the tray area, making sure the wire will not be damaged when the tray is pushed back in and secured.
17. Install the lower inner door hinge, identified as location “L” in the drawing. (This was the top inner door hinge removed in Step 7 and should have the white plastic bushing installed.) Do not completely tighten the screws.
18. Insert the inner door into the lower hinge with the latch to the left. Align the door to the chamber opening and place the upper hinge in position as identified as “M”.
19. Insert the screws into the hinge but do not completely tighten them.
20. Match the pins on the yellow connector with the socket on the door. Press the connector completely into the socket and slide the strain relief down until no yellow is visible on the plug as shown in “N” of Figure 5-6.

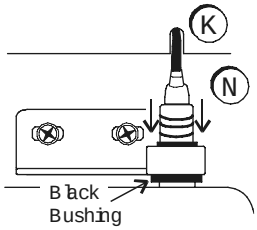


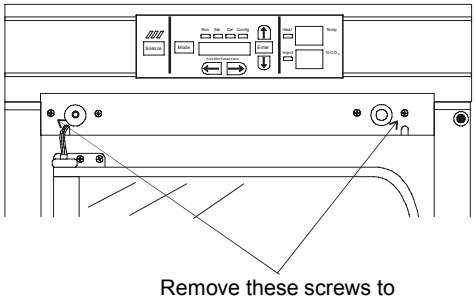
**Figure 5-6**

21. Push the power cable completely into the slot in the electronics tray. Press the tray into position and secure it with the screws at the “S” locations.
22. Align the silver power buss visible through the glass along the hinge side of the door with the gasket along the right side of the chamber opening.
23. When both hinges are in place with the hinge screws still loosened, push up on the bottom hinge. This will shift both hinges and the door upward. Tighten the hinge screws.
24. Attach the strike plate at location “O”, aligning it so the knob secures the door against the gasket.
25. Attach the outer door hinges at the “P” locations.
26. Install the nylon screws at the “R” locations.
27. Install the nylon screws in the “Q” locations.
28. Assemble the outer door to the incubator and return the unit to service.

## 5.5 Replacing Fuses

***The electronics drawer contains hazardous voltages. Replacing the fuses should be done by qualified personnel only.***

**Figure 5-7**



# Left Hinge Door

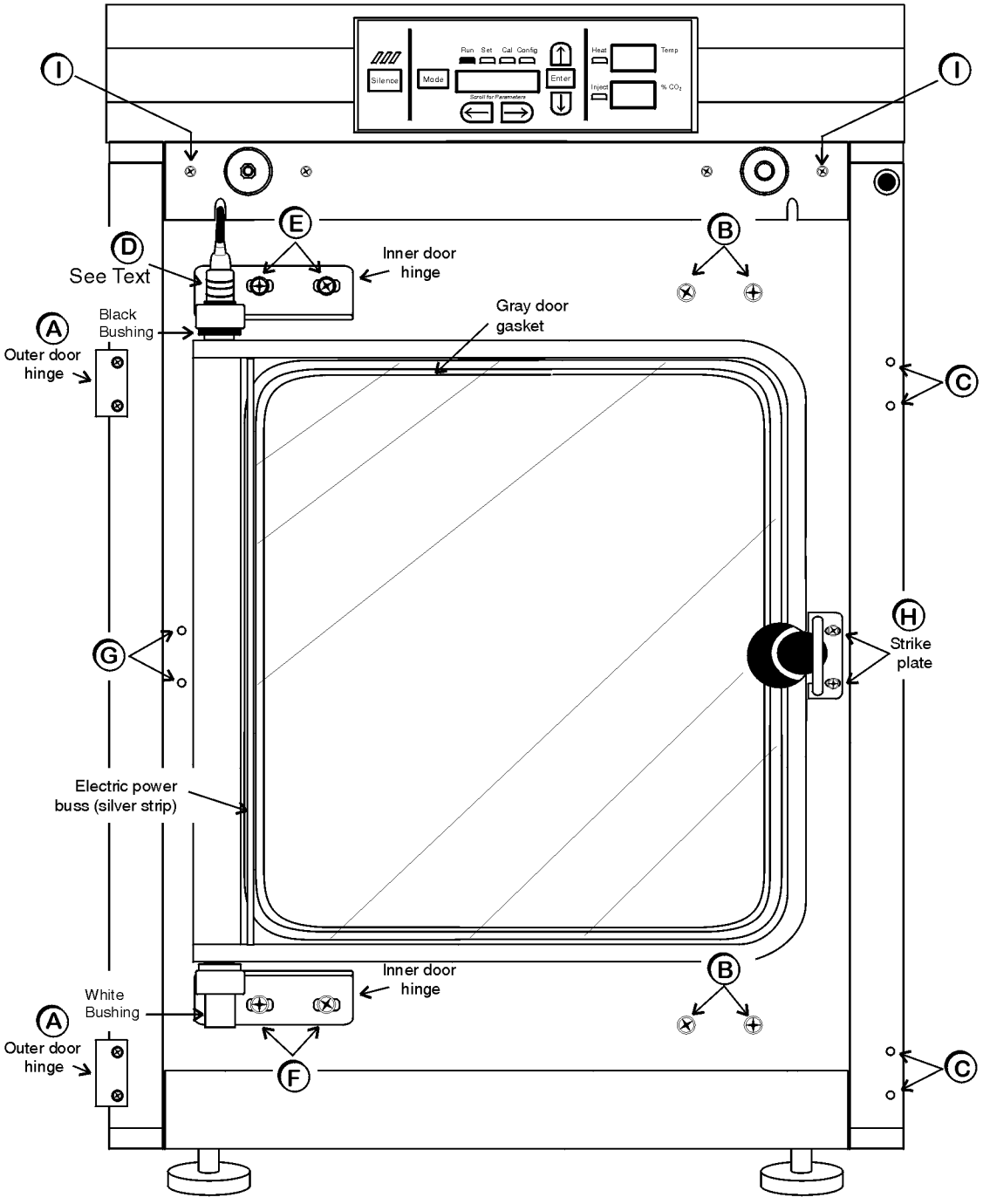



Illustration A

# Right Hinge Door

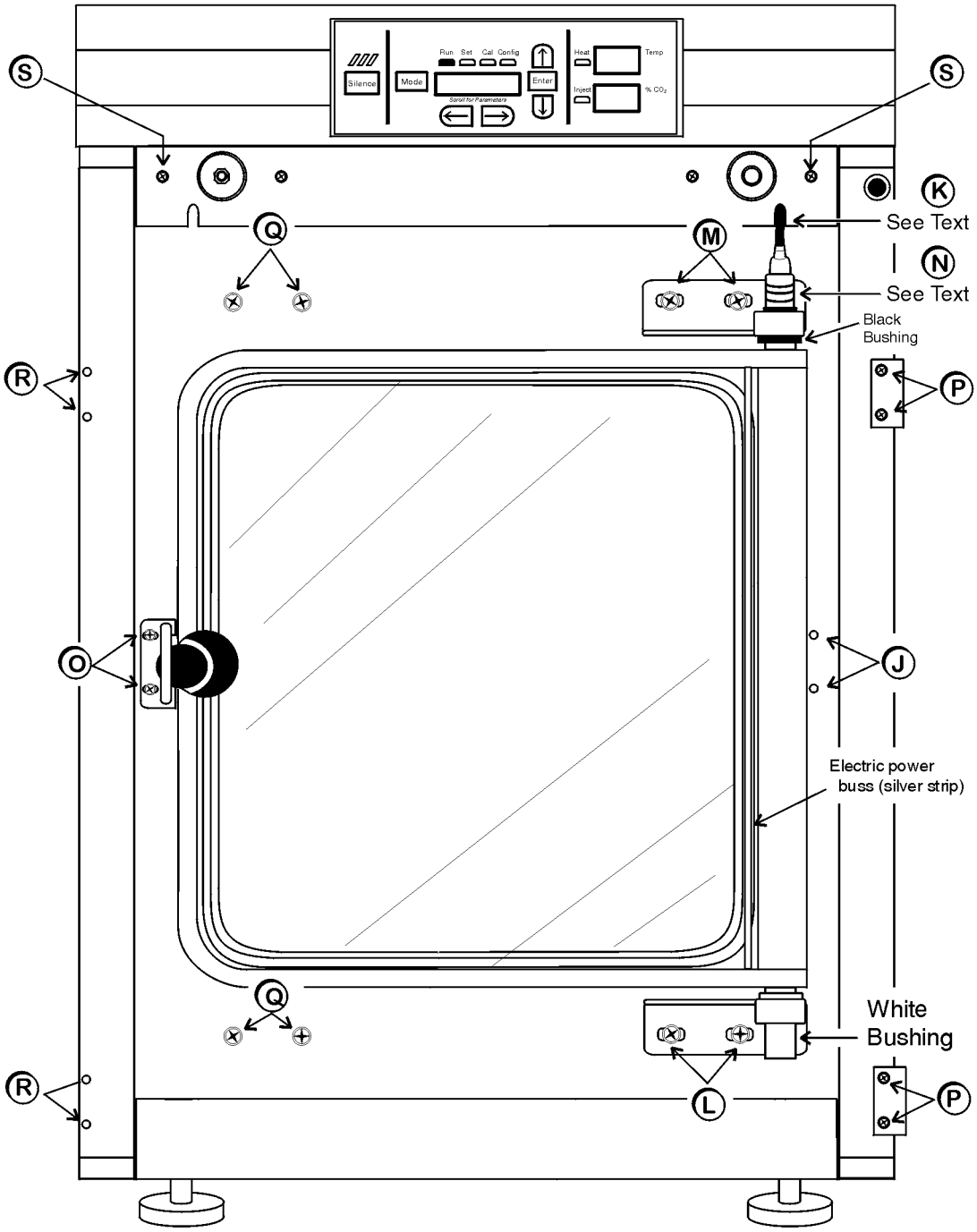



Illustration B

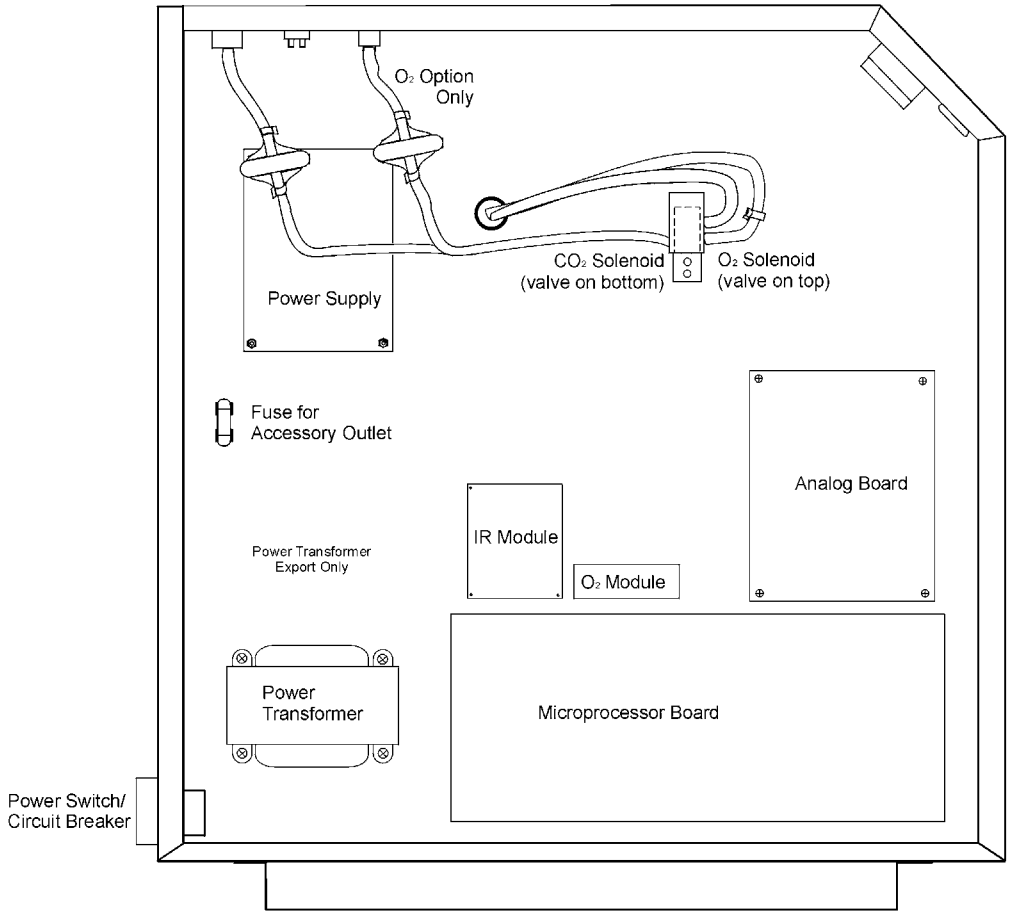



**Figure 5-8, Electronics Drawer**

There are three fuses in the incubator that can be replaced. To replace a fuse:

1. Turn off the incubator's power switch.
2. Unplug the power cord from the wall outlet.
3. Open the exterior cabinet door.
4. Remove two screws as shown. See Figure 5-7.
5. Carefully slide out electronics drawer.

| Fuse # | Manufacturers Part # | Amperage Rating | Rupture Speed | IEC Letter Code |
|---|---|---|---|---|
| F1 | BUSS GMC-3.5A | 3.5 Amp | Time-Lag | T |
| F4 | BUSS GMC-2.5A | 2.5 Amp | Time-Lag | T |
| 115 VAC ACC | BUSS GMC - 1.0A | 1.0 Amp | Time-Lag | T |
| 230 VAC ACC | BUSS BK-GMC-500ma | 0.5 Amp | Time-Lag | T |

**Table 5-1, Fuse Replacement Chart**

There are two fuses on the main microboard labeled F1 24VAC Door Heater and F4 24VAC Collar Heater. Refer to Figure 5-8 for the location of the main microboard. Remove the fuse and replace it with a new one of the same specification. Refer to Table 5-1.

The other replaceable fuse is the accessory outlet fuse mounted to the floor of the electronics drawer. To locate the fuse, refer to Figure 5-8. Remove the fuse and replace with a new one of the same specification.

1. When the fuse has been replaced, slide the electronics drawer back in, being very careful to place the door heater cable back into the provided slot so that the drawer does not pinch the cable.
2. Replace the two screws removed earlier.
3. Close the exterior door.
4. Plug the power cord back into the dedicated, grounded circuit.
5. Turn on power switch. If the unit operates properly, it may now be returned to service.

There is one fuse in the incubator that is not replaceable. This fuse is intended for catastrophic failure only and is located on the power supply circuit board in the electronics drawer. See Figure 5-8. If this fuse is blown, the power supply must be replaced. Contact the factory for more information.

## 5.6 HEPA Filter Maintenance

Replace the HEPA filter when the REPLACE HEPA reminder is displayed. The REPLACE HEPA reminder can be set to alarm after a specified time from 1 to 12 months. The reminder default is the factory recommended setting of 6 months. For details, see Sections 3.1b and 3.1c.

### 5.7 Replacing the Air Sample Filter

The air sample filter should be replaced whenever the HEPA filter is replaced. On the inside of the chamber, connected into the back of the blower scroll, is the air sample filter and its connecting tubing. Disconnect the tubing from the back of the scroll, then remove the filter from the tubing and discard. Install the new filter. Connect it securely to the air sample filter tubing, then insert the tubing into the back of the blower scroll.

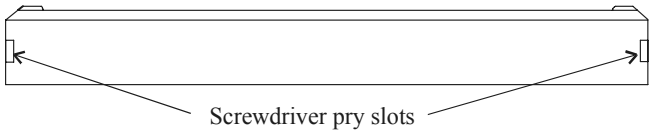
### 5.8 Replacing the Access Port Filter

The access port filter should be replaced whenever the HEPA filter is changed. The filter is connected to the stopper in the upper left corner of the chamber back wall. Remove the filter from the connecting tube and discard. Install the new filter.

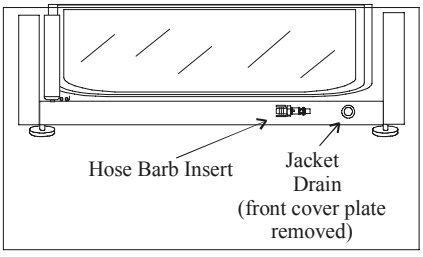
### 5.9 Draining Water Jacket

1. Turn the unit off. Remove the plug from the power source.
2. Remove the front cover plate below the door. There are small flatblade screwdriver pry slots on each end of the plate to help remove it. See Figure 5-9.

**Figure 5-9, Front Cover Plate Below the Door**




3. Remove the drain plug. Retain for use after draining is complete.
4. Connect the hose barb insert to the drain on lower front of the water jacket and to the drain hose.




**Remove the drain plug before connecting the insert. Fitting will not seat correctly if plug is not removed.**

**Figure 5-10, Water Jacket Drain and Hose Barb Insert**

5. After water jacket has finished draining, remove the hose barb insert and secure on the front of the unit. See Figure 5-10 and 5-11.
6. Install the plug into the drain on the incubator
7. Install cover plate.
8. To fill the water jacket, see Section 1.5j. Be sure to add the rust inhibitor to the water when filling. For the proportions of rust inhibitor to water and the part number, see Section 5.12.

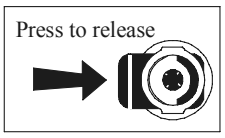



**Figure 5-11**

### 5.10 $O_2$ Sensor Fuel Cell (Models 3130/3131, 3140/3141)

The $O_2$ sensor output declines over time, even if the unit is not in use. Replace the sensor every 30 months to ensure consistent output and to prevent the possibility of failure in the middle of a test experiment.

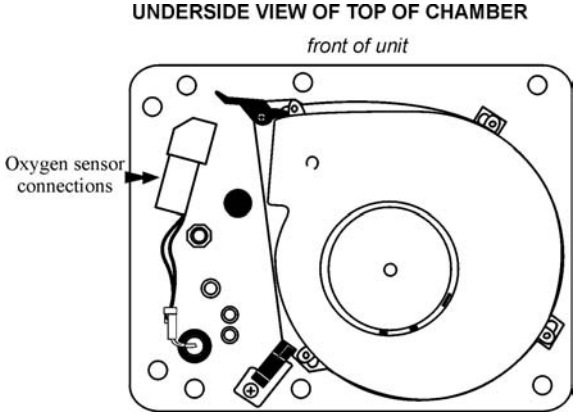



**Figure 5-12**

### 5.11 Replacing the $O_2$ Sensor (Models 3130/3131, 3140/3141)

The $O_2$ sensor is located on the blower scroll plate in the chamber of the unit. To replace it, refer to Figure 5-12 and 5-13 and follow the steps below.

1. Turn the unit off and disconnect the plug from the power source.
2. Remove the top duct by removing 2 wingnuts.
3. Locate the sensor on the scroll plate.
4. Lift up slightly on the tab securing the sensor wire terminal connection. Be careful not to break the tab off. See enlarged detail of Figure 5-13.

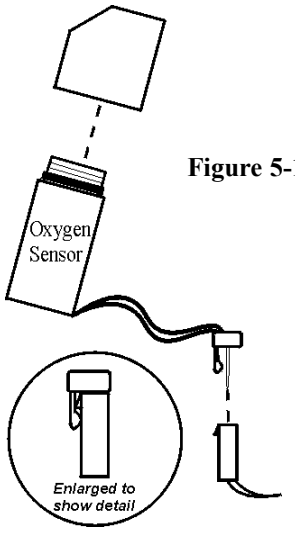



**Figure 5-13**

5. Disconnect the terminals from each other. Note the orientation of the terminals.
6. The $O_2$ sensor is screwed into the brass fitting. Unscrew the old sensor and discard.
7. Screw the new sensor in firmly. Be careful not to cross-thread.
8. Orient the terminals as previously and connect.
9. Install the top duct and tighten the 2 wingnuts.
10. Plug the unit in. Calibrate the $O_2$ system using the O2 CAL@20.7% method as described in Section 2.1d.
11. Allow the unit to run until the temperature stabilizes. Check the $O_2$ and $CO_2$ operation and return the unit to service.

### 5.12 Adding or Replenishing the Rust Inhibitor

The Model 3110 Series incubators are shipped from the factory with a rust inhibitor added to the water in the jacket. This inhibitor must be replenished every 2 years. Mix 1 bag/bottle of the rust inhibitor with a gallon of water in the resistance range from 50K to 1M Ohm/cm. Drain a gallon of water from the jacket and replace it with the rust inhibitor mixture.

***Note:*** *High purity water (1M to 18M ohm/cm resistivity) is a very aggressive solvent and is considered slightly acidic. Ideal pH for the water in the jacket is 7. Sodium hydroxide may be used to change the pH of high purity water. It requires approximately 8ml of 0.05 normal sodium hydroxide per gallon of high purity water to raise the pH to 7. The water jacket holds appoximately 12 gallons. Sodium hydroxide and the rust inhibitor may be used in the same water jacket.*

| | |
|---|---|
| Rust Inhibitor (0.5 lb.) bag | 1900100 |
| Rust Inhibitor (800ml) bottle (use in units with a cooling coil) | 1900101 |
| Sodium Hydroxide (0.05N) | 130082 |

# Section 6 - Factory Installed Options

## 6.1 Connections to External Equipment

### a. Connecting the Remote Alarm Contacts

**CAUTION**
Contains Parts and Assemblies Susceptible to Damage by Electrostatic Discharge (ESD)

A set of relay contacts are provided to monitor alarms through an RJ-11 telephone style connector on the back of the cabinet. Refer to Figure 1-13 for the location of the alarm connector.

The remote alarm provides a NO (normally open) output, a NC (normally closed) output and COM (common). Refer to Figure 6-1.

The contacts will trip on a power outage or an over temperature condition. The contacts may also be programmed to trip or not trip on temperature alarms, $CO_2$ alarms, $O_2$ alarms, and RH alarms. See Section 3.1, System Configuration.

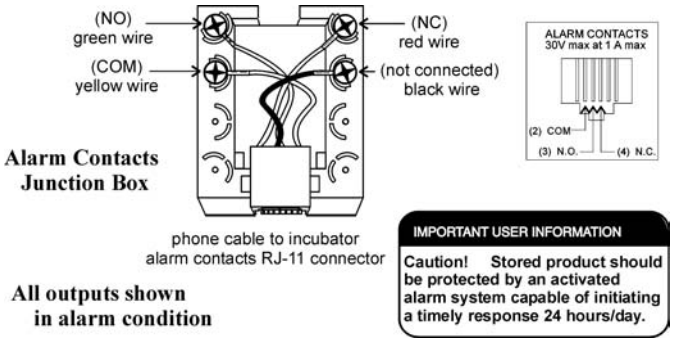



**Figure 6-1**

### b. Connecting the RS485 Interface (190523)

All incubator models can be purchased with the RS485 communications option. This option allows the incubator to be directly connected to a Thermo Forma Model 1535 alarm system without the use of a communications module. A junction box is provided with each RS485 option. Refer to Figure 6-2 for wiring details.

To allow the incubator and the 1535 to communicate, an address must be allocated on the 1535. Refer to Section 5.8 of the 1535 operating manual. The same address number must be assigned to the incubator. Refer to Section 3.1 of this manual, System Configuration.

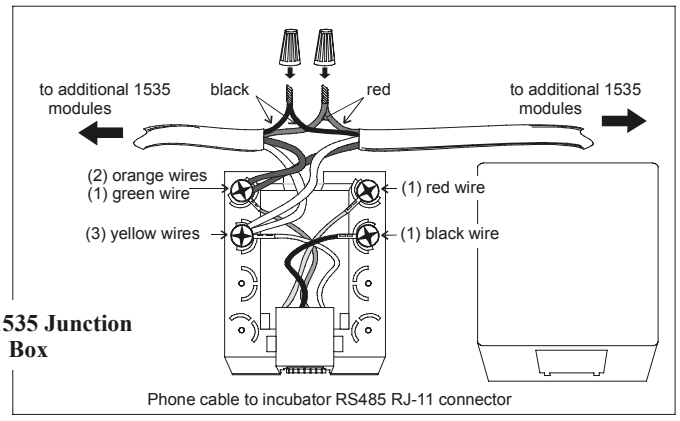



**Figure 6-2**

### c. Connecting the Analog Output Boards (190512, 190543, 190544)

***The electronics drawer contains hazardous voltages. Opening the drawer and/or wiring in an analog board should be performed by qualified personnel only.***

The analog output board is an option that allows the incubator to output analog signals representing the air temperature of the cabinet, the $CO_2$ content , the $O_2$ content, and the relative humidity, depending upon which systems are in the incubator. There are three different analog output board options available : 0-1V, 0-5V, or 4-20mA signals. Negative display readings will output 0V. The outputs do not have isolated grounds. Refer to Figure 6-3 for output specifications of the three boards.

**Figure 6-3 Analog Output Board Specifications**

| | **190512 4-20mA** Output Scaling 4-20 mA Equals | **190544 0-1V** Output Scaling 0-1 V Equals | **190543 0-5V** Output Scaling 0-5V Equals |
|---|---|---|---|
| Temp | 0.0-100°C | 0.0-100°C | 0.0-100°C |
| RH | 0-100%RH | 0-100 % RH | 0-100 % RH |
| $CO_2$ | 0.0-100.0% $CO_2$ | 0-100.0 % $CO_2$ | 0-100.0 % $CO_2$ |
| $O_2$ | 0.0-100.0% $O_2$ | 0-100.0 % $O_2$ | 0-100.0 % $O_2$ |

To wire in the analog output board, Thermo Forma recommends wire Part # 73041, which is a 22-gauge, 3-conductor wire with a shield. This is readily available from other vendors including Alpha Part #2403, and Deerborn Part # 972203.

1. Turn off the incubator's power switch and unplug the power cord from the wall outlet.
2. Open the exterior cabinet door and remove the two screws shown in Figure 6-4.

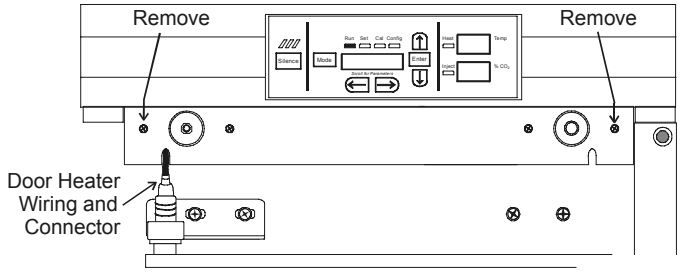



**Figure 6-4**

3. Carefully slide out electronics drawer and locate the Analog Output board. (Figure 6-5)

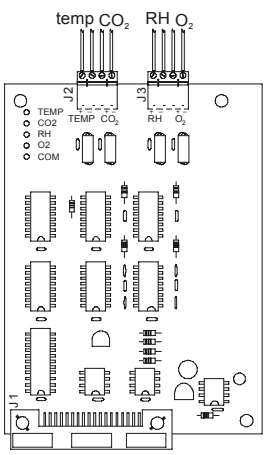



**Figure 6-5**

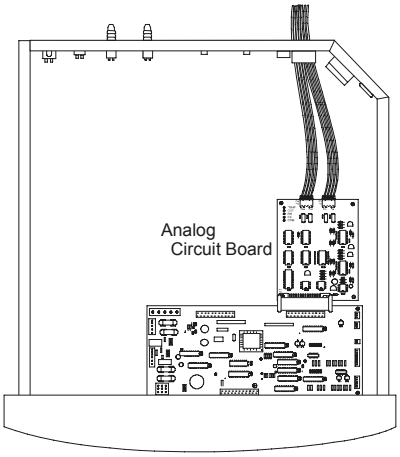



**Figure 6-6**

4. Each system monitored ( Temp, $CO_2$, $O_2$, RH) requires two conductors. Feed the wire through the analog wiring inlet on the back of the drawer. See Figure 6-6.
5. Strip the ends of each conductor and wire to the appropriate terminals of connectors J2 and J3 on the analog board.
6. When wiring is completed, slide the electronics drawer back in being very careful to place the door heater cable back into the provided slot so that the drawer does not pinch the cable. See Figure 6-4.
7. Replace the two screws removed earlier and return the unit to service.

## 6.2 Gas Guard for $CO_2$ or $N_2$ (190640/190642)

The 3110 Series incubators can be equipped with a built-in gas guard system that will operate with either a $CO_2$ or a $N_2$ gas supply. Only one gas guard can be installed on each unit. The gas guard uses two pressure switches to continuously monitor the pressures of two independent $CO_2$ or $N_2$ supplies and automatically switches from one supply to the other when the supply pressure drops below 10 psig (0. 690 bar). The gas guard is not designed to be used with multiple incubators.

Both of the $CO_2$ or the $N_2$ gas supplies must be equipped with two-stage pressure regulators. The high pressure gauge at the tank should have a 0-2000 psig range and the low pressure gauge should have a 0-30 psig range. The gas supply to the incubator must be maintained at 15 psig (1.034 bar). Gas pressures below 15 psig (1.034 bar) will cause nuisance alarms to occur on incubators equipped with the built-in Gas Guard.

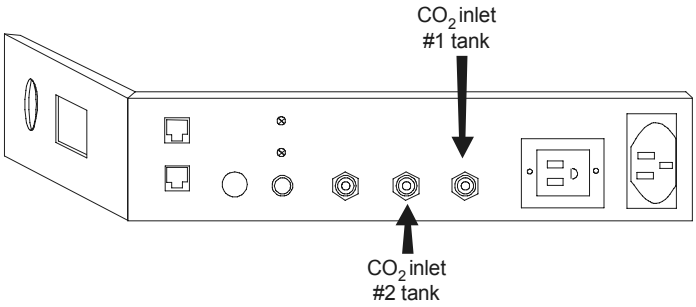



**Figure 6-7, $CO_2$ fittings**

### a. Connecting the $CO_2$ Gas Supplies (refer to Figures 6-7 and 6-9):

The $CO_2$ inlets for a built-in gas guard are located on the rear of the electronics drawer. Using 1/4" ID tubing, connect one of the CO2 supply tanks to the fitting labeled $CO_2$ Inlet #1 Tank. Connect the second $CO_2$ supply tank to the fitting labeled $CO_2$ Inlet #2 Tank. Install 3/8" hose clamps to secure the 1/4" ID tubing to the fittings on the rear of the drawer.

### b. Connecting the $N_2$ Gas Supplies (refer to Figure 6-8):

The $N_2$ inlets for a built-in gas guard are located on the rear of the electronics drawer. Using 1/4" ID tubing, connect one of the $N_2$ supply tanks to the fitting labeled $N_2$ Inlet #1 Tank. Connect the second $N_2$ supply tank to the fitting labeled $N_2$ Inlet #2 Tank. Install 3/8" hose clamps to secure the 1/4" ID tubing to the fittings on the rear of the drawer.

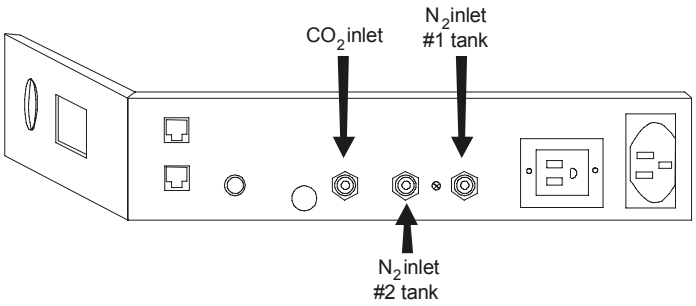



**Figure 6-8, $N_2$ fittings**

### c. Activating the Built-in Gas Guard:

The built-in Gas Guard is not turned on when shipped from the factory. In addition, the Tank Select for the gas guard is specified as Tank 1 when shipped from the factory. Refer to Section 3, Configuration, to activate the Gas Guard or change the Tank Select from 1 to 2. If the operator does not want to use the Gas Guard, the incubator will function normally by supplying $CO_2$ (or $N_2$) through the $CO_2$ Inlet #1 Tank (or the $N_2$ Inlet #1 Tank).

### d. Operation of the $CO_2$ or $N_2$ Gas Guard:

With the Gas Guard in operation, the incubator will use the gas supplied through $CO_2$ (or $N_2$) Inlet #1 Tank until the pressure drops below approximately 10 psig. At this time, the Gas Guard automatically switches to the gas supplied through $CO_2$ (or $N_2$) Inlet #2 Tank.

In addition, the incubator automatically changes the Tank Sel in Configure mode from 1 to 2 to indicate that the incubator is now using gas supplied through $CO_2$ (or $N_2$) Inlet # 2 Tank. If the gas supply to $CO_2$ (or $N_2$) Inlet #1 Tank is replenished, the incubator will continue to operate using the gas supplied through $CO_2$ (or $N_2$) Inlet #2 Tank unless the operator changes the Tank Select from 2 to 1 through the Configure mode. Refer to Section 3, Configuration.

An audible alarm and two visual alarms occur on the control panel when the gas guard switches from one supply to the other. The audible alarm will sound until the operator presses the Silence key on the control panel. A visual alarm in the Message Center will read Tank 1 Low while the audible alarm is sounding, but will be removed once the operator presses the Silence key.



***Both the audible and visual alarms described above do not ring back once the Silence key is pressed***

However, there is a second visual alarm, Tank Low, that illuminates in red below the Silence key on the control panel when either of the two gas supplies fall below 10 psig (0.690 bars). The Tank Low remains illuminated as long as the gas guard detects a low pressure on either of the gas supply lines. This message is a reminder for the operator to replace or check for insufficient gas supply to the incubator.

If the gas guard does not detect an adequate gas supply at the $CO_2$ (or $N_2$) Inlet #1 Tank or $CO_2$ (or $N_2$) Inlet #2 Tank, a visual and audible alarm will again occur on the control panel. The visual alarm in the Message Center will read Tank 1&2 Low. The audible alarm will continue to ring until the Silence key is pressed. The audible alarm will ring back every 15 minutes after the alarm is silenced, if the Gas Guard continues to detect that both gas supply pressures are below 10 psig (0.690 bars).

## 6.3 Humidity Readout (190643)

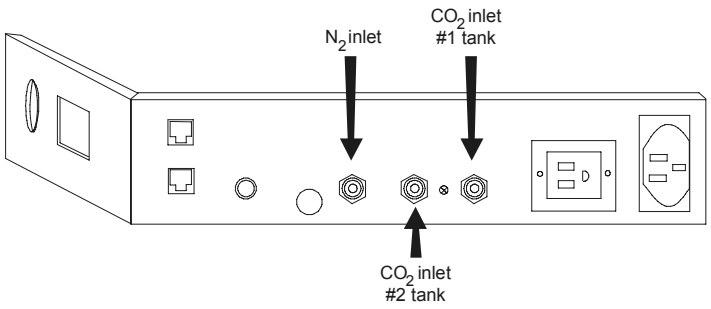



**Figure 6-9**

The 3110 Series incubators can be equipped with a humidity sensor to monitor the relative humidity (RH) inside the chamber. The sensor is mounted to the top air duct and provides a signal that is displayed in 1% increments on the control panel. The humidity readout can be displayed continuously or toggles with the temperature readout. In addition, a low alarm limit can be set on the humidity readout which will detect when the humidity pan runs dry. Refer to Section 3, Configuration.

### a. Factors Affecting Humidity Level in Chamber:

- Water level in the humidity pan
- Frequency of door openings
- Humidity pan location; floor, shelf, in duct
- Air leakage through the gaskets
- Gas sample port capped
- $N_2$ purge on incubators with $O_2$ control.
- Humidity levels in $O_2$ units (3130, 3131, 3140, 3141) will be reduced, depending on the amount of $N_2$ required to control the $O_2$ level in the chamber.

The following table lists some typical RH levels at different $O_2$ and $CO_2$ percentages.

***Incubators equipped with a Thermal Conductivity $CO_2$ sensor rely on a constant level of relative humidity in order to accurately measure and control the $CO_2$ concentration in the incubator.***

| $O_2$% | $CO_2$% | RH% (±5%) |
|---|---|---|
| 1% | 2.5% | 55% |
| 2% | 5% | 60% |
| 5% | 10% | 75% |
| 10% | 10% | 80% |
| 21% | 5% | 95% |

**Figure 6-10**

### b. Accuracy of the Humidity Readout:

The sensor is capable of measuring relative humidity from 10% to 100% with an accuracy of ±5% above 90%. See Section 2, Calibration for details on calibrating the humidity readout.

## 6.4 Factory Installed Cooling Coil (190645)

**Note:** For customer convenience, the following item is included in the shipping materials:12 ft. of 3/8" I.D. vinyl tubing, 4 clamps.

The operating (setpoint) temperature range of the incubator with the cooling coil installed is from +5°C above ambient down to +15°C.

The cooling coil incubator incorporates a finned, U-shaped copper pipe installed within the water jacket. This pipe routes chilled water supplied by a laboratory bath.

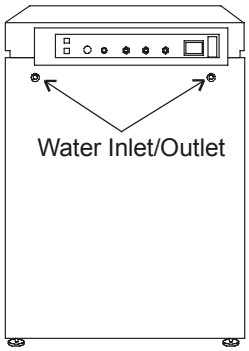



**Figure 6-11, Back of Unit**

Verify that the supply line pressure does not exceed 20 psig (138KPa).

When the cooling coil is in use, several factors affect the uniformity inside the incubator chamber: the temperature difference between the operating temperature set point and the bath water temperature; the flow rate of the chilled water, and the on-time percentage of the door heaters.

As determined in carefully controlled laboratory tests, the smaller the difference between the temperature of the bath and the setpoint temperature of the incubator, the better the uniformity. However, decreasing this temperature difference does cause less control of the system because if the bath does not cool the water jacket adequately, the heaters do not cycle and the chamber temperature simply drifts with the ambient temperature of the room.

Tests have shown that as a starting point, operating the bath at 2°C to 3°C below the incubator's operating setpoint temperature, with a cooling water flow rate of 1/2 to 1 GPM (gallons per minute), should result in good control and uniformity.

Because of the efficiency of the cooling coil design, it is possible for condensation to occur on the outside of the incubator's water jacket when operating in certain ambient temperature and relative humidity conditions. The condensation will then saturate the fiberglass insulation between the water jacket and the incubator cabinet.

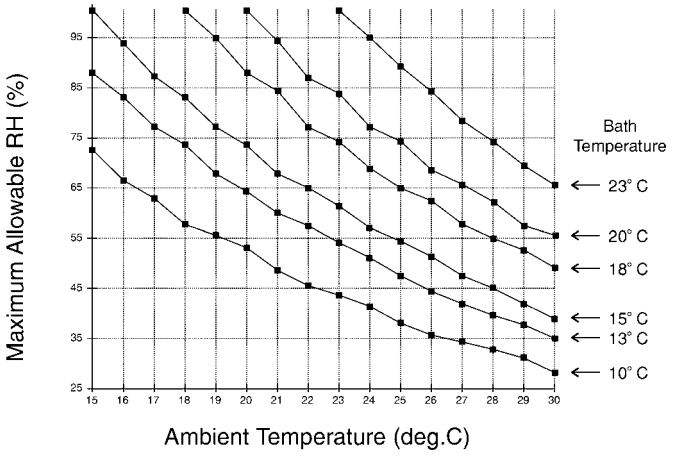



**Figure 6-12**
**RH Limits to Avoid Water Jacket Condensation**

Using psychometric data from the Carrier Psychometric Chart, curves of maximum allowable RH versus ambient temperature can be plotted for different incubator/bath conditions (Refer to Figure 6-12).

For example, if the bath is to be operated at 15°C and the ambient temperature is about 28°C, the RH in the room must be less than 45% to avoid condensation forming between the chamber water jacket and the outside of the cabinet.

### a. Installing the Cooling Coil Incubator

Locate the (2) grey plastic hose barbs shipped inside the incubator. Insert the smooth end of the barb into the fittings on the back of the cabinet. Either can be used as the water inlet or outlet to the bath. Cutting the vinyl tubing in half, the bath can be located up to six feet from the incubator.

# Section 7 - Specifications

*Specifications are based on nominal voltages of 115V or 230V in ambients of 22°C to 25°C.

| | |
|---|---|
| **Temperature** | |
| Control | ±0.1°C |
| Range | +5°C above ambient to +55°C (131°F) |
| Uniformity | ±0.2°C @ +37°C |
| Tracking Alarm | ±User programmable high/low |
| **Temperature Safety** | |
| Sensor | Precision thermistor |
| Controller | Independent analog electronic |
| Setability | 0.1°C |
| **$CO_2/O_2$** | |
| $CO_2/O_2$ Control | Better than ±0.1% |
| $CO_2$ Range | 1-20% |
| $O_2$ Range | 2-20% |
| Inlet Pressure | 15 PSIG (1.034 bars) |
| $CO_2$ Sensor | T/C or IR |
| $O_2$ Sensor | Fuel Cell |
| Readability | 0.1% |
| Setability | 0.1% |
| Tracking Alarm | User programmable |
| **Humidity** | |
| RH | Ambient to 95% @ +37°C (98.6°F) |
| Humidity Pan | 0.8 gal. (3 liters) standard |
| Optional | Display in 1% increments |
| **Fittings** | |
| Fill Port | 3/8” barbed |
| Drain Port | 1/4” barbed |
| Access Port | 1-1/4” (3.18cm) removable neoprene plug |
| $CO_2$ Inlet | 1/4” hose barbed |
| **Unit Heat Load** | |
| 115V/230V | 344 BTUH (100 Watt) |
| **Shelves** | |
| Dimensions | 18.5” x 18.5” (47.0cm x 47.0cm) |
| Construction | Stainless steel, perforated, electropolished |
| Surface area | 2.4 sq. ft. (0.22 sq. m) |
| Max. per Chamber | 54.6 sp. Ft. (5.5 sq. m) |
| Loading | 35 lb. (16kg) slide in and out<br>50 lb. (23kg) stationary |
| Standard | 4 |
| Maximum | 23 |

**Construction**

| | |
|---|---|
| Water Jacket Volume | 11.7 gal. (43.5 liters) |
| Interior Volume | 6.5 cu. ft. (184.1 liters) |
| Interior | Type 304, mirror finish, stainless steel |
| Exterior | 18 gauge, cold rolled steel |
| Outer Door Gasket | Four-sided, molded magnetic vinyl |
| Inner Door Gasket | Removable, feather-edged, silicone |

**Electrical**

| | |
|---|---|
| 115V Models | 90-125VAC, 50/60 Hz, 1 PH, 3.6 FLA |
| 230V Models | 180-250VAC, 50/60 Hz, I PH, 2.0 FLA |
| Circuit Breaker/Power Switch | 6 Amp/2 Pole |
| Accessory Outlet | 75 Watts max. (one per chamber) |
| Alarm Contacts | Deviation of temp., $CO_2$, $O_2$, and RH, power fail through customer connections through jack on back of unit. 30V, 1A max. |
| Optional Data Outputs | RS-485, 0-1V, 0-5V, 4-20mA |
| Installation Category | Overvoltage Category II<br>Pollution Degree 2 |
| Maximum Leakage Current | With ground disconnected, 0.65mA<br>Maximum permissible leakage, 3.5mA |

**Dimensions**

| | |
|---|---|
| Interior | 21.4” W x 26.8” H x 20.0” F-B<br>(54.4cm x 68.1cm x 50.8cm) |
| Exterior | 25.9” W x 39.6” H x 24.9” F-B<br>(63.0cm x 100.3cm x 68.6cm) |

**Weight (per unit)**

| | |
|---|---|
| Net | 265 lb. (120 kg) |
| Net Operational | 365 lb. (166 kg) |
| Shipping | 324 lb. (147 kg) |

**Safety Specifications**

| | |
|---|---|
| Altitude | 2000 meters |
| Temperature | 5°C to 40°C |
| Humidity | 80% RH at or below 31°C,<br>decreasing linearly to 50% RH at 40°C |
| Mains Supply Fluctuations | Operating Voltage Range |
| Installation Category 2[1] | |
| Pollution Degree 2[2] | |
| Class of Equipment | |

---

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

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

# Section 8 - Spare Parts

### a. All Models

| Part # | Description |
|---|---|
| 360171 | Liquid Level Switch |
| 103065 | Feather Gasket |
| 113002 | 5/16-18 Glide Foot |
| 132046 | 115/230V Dual Heater |
| 132049 | Face Heater 40W, 24VAC |
| 190630 | Heated Inner Door |
| 190618, 190619 | Inner Door Hinges |
| 190618 | Right, Inner Door Hinge |
| 700013 | 0.500” Flanged Nylon Bearing |
| 990026 | Door Gasket w/ Magnet |
| 290137 | Temp Probe 2252 Ohm |
| 191634 | Micro Board |
| 190609 | Display Board |
| 230153 | 6A Circuit Breaker/Switch |
| 460157 | Line Filter/Power Inlet |
| 420096 | 130VA Transformer, International, 14/28V S |
| 230135 | 1 AMP Fuse for 115V Outlet |
| 230159 | 3.5 Amp Fuse - Microboard |
| 230158 | 2.5 Amp Fuse - Microboard |
| 250085 | Solenoid Valve 12V 10-32” Ports |
| 770001 | Bacterial Air Filter ($CO_2$ line, air sample and access port) |
| 156114 | Motor 2-Pole 115VAC |
| 100113 | Blower Wheel 3.5x1.5 CCW |
| 190846 | Blower Scroll Assembly |
| 760175 | HEPA Filter |
| 103072 | Blower Plate Gasket |
| 290090 | CO2 Sensor Assembly |
| 103074 | CO2 Sensor Plate Gasket |
| 130097 | #6 Silicone Stopper w/ 3/8” Hole |
| 180001 | Polypropylene Funnel |
| 430108 | Line Cord Set |
| 110084 | Drain Plug |
| 1900067 | Filter Replacement Kit (includes [2] 770001 and [1] 760175) |
| 1900018 | Blower Motor Replacement Kit |

### b. Spare Parts for 230 V units (3111, 3121, 3131, 3141):

| Part # | Description |
|---|---|
| 420097 | 43VA Transformer, INT. SRS |
| 460138 | Power Outlet, Snap-In Receptacle |
| 230120 | 1/2 AMP Fuse for 230 V outlet |

### c. Spare Parts for IR or $O_2$ units (3120, 3121, 3130, 3131, 3140 and 3141):

| Part # | Description |
|---|---|
| 190885 | IR Sensor |
| 191646 | $O_2$ Circuit Board |
| 250119 | AC Solenoid |
| 770001 | Filter |
| 250118 | Valve, Sol, $O_2$, 12VDC, 4W |
| 290083 | $O_2$ Sensor Fuel Cell |
| 190661 | IR Sensor Filter |

### d. Spare Parts for Gas Guards (190640/190642):

| Part # | Description |
|---|---|
| 250121 | Solenoid Valve, 3 WAY, 12VDC |
| 360213 | Pressure Switch |

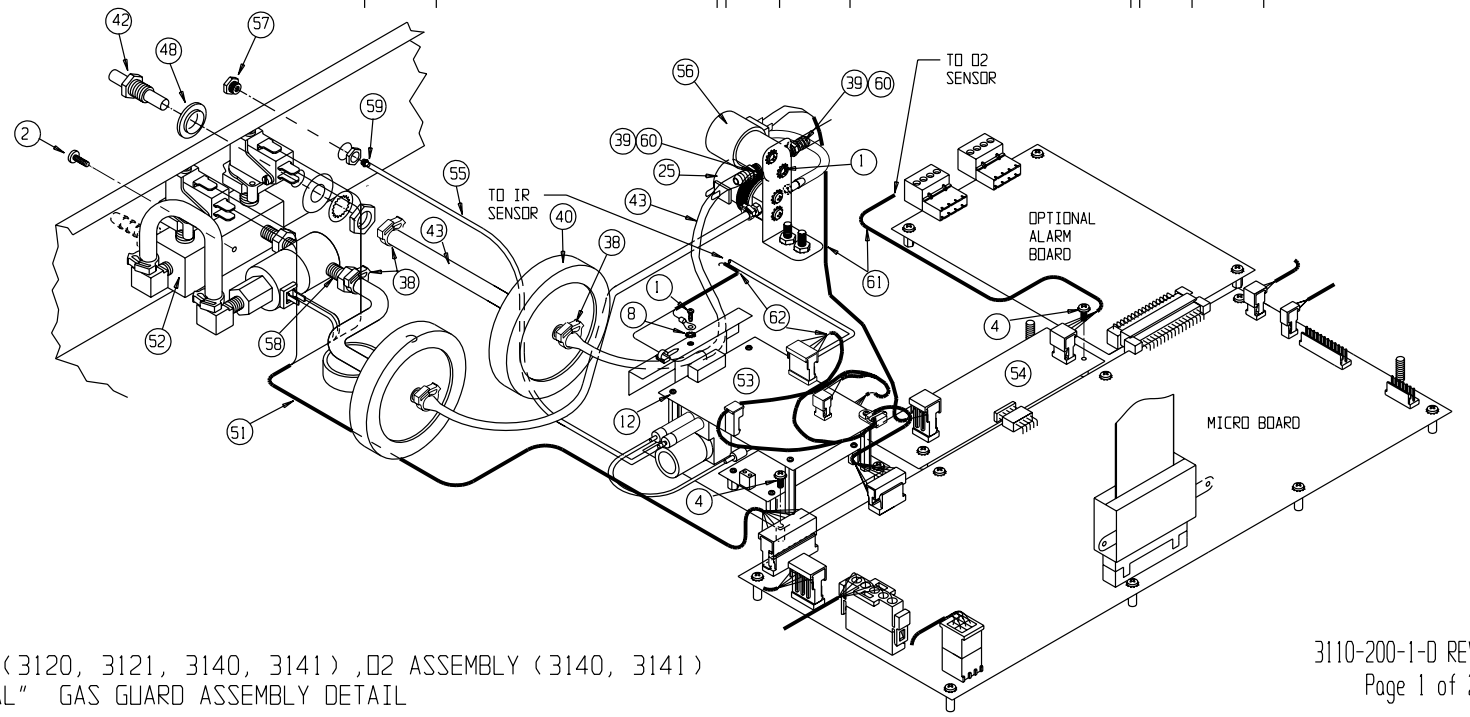
### e. Spare Parts for Humidity Readout (190643):

| Part # | Description |
|---|---|
| 290154 | RH Sensor Assembly, 1 Ft |

### f. Spare Parts for Data Output Options:

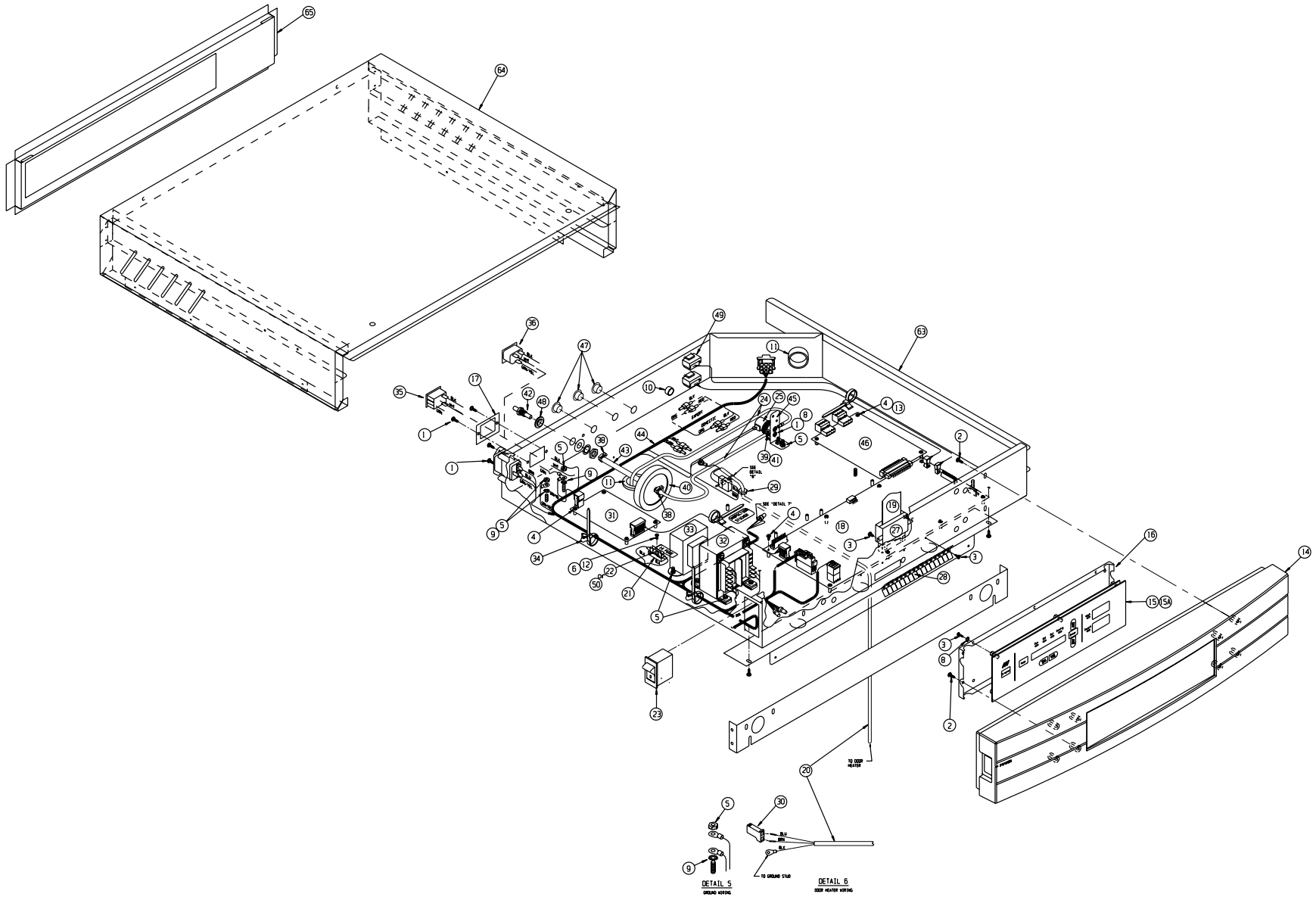
| Part # | Description |
|---|---|
| 190512 | Analog Output Board 4-20 mA |
| 190543 | Analog Output Board 0-5V |
| 190544 | Analog Output Board 0-1V |
| 73041 | 24 Gauge 3 Conductor, Analog Output Wire |
| 190523 | RS485 Output Kit |

| SYM | STK # | DESCRIPTION | SYM | STK # | DESCRIPTION | SYM | STK # | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| 1 | 22049 | 6-32 X 3/8 PHP SCREW | 26 | 270107 | FERRITE, SPLIT, 1/2 OD CABLE | 48 | 730044 | SHOULDER WASHER, .385 |
| 2 | 22052 | 8-32 X 3/8 PHP SCREW | 27 | 270108 | FERRITE 40 PDS. RIBBON CABLE | 49 | 190523 | RS-485 "OPTION" |
| 3 | 22115 | 6-32 X 1/4 PHP SCREW | 28 | 270139 | BERYLLIUM COPPER FINGERS, 6" | 50 | 230120 | FUSE, 0.5A , 5 X 20MM (EXP) |
| 4 | 590032 | 4-40 X 1/4 PHP SEM SCREW | 29 | 340030 | LIQUID TIGHT CONNECTOR | 51 | 190522 | HARNESS, GAS GUARD |
| 5 | 23002 | 8-32 LK/WASHER HEX NUT | 30 | 370472 | CAP, 2 POS. MINI MATE-N-LOK | 52 | 190641 | GAS GUARD MANIFOLD ASSEMBLY |
| 6 | 23006 | 4-40 LK/WASHER HEX NUT | 31 | 400119 | SWITCHER PWR SUPPLY 40W | 53 | 190885 | IR CO2 SYSTEM (SENSOR & BOARD) |
| 7 | | | 32 | 420096 | 130VA XFMR, INT'L 12/24V | 54 | 191646 | WIRED O2 INTERFACE BOARD |
| 8 | 23030 | 6 SS INT TOOTH LK/WASHER | 33 | 420097 | 43VA XFMR, INT'L 115/230V | 55 | 246008 | 1/16 ID TYGON TUBING |
| 9 | 23059 | 8 SS EXT TOOTH LK/WASHER | 34 | 440022 | PUSH MOUNT TIE & ANCHOR | 56 | 250118 | O2 SOLENOID VALVE,12VDC |
| 10 | 30014 | 1/2 IN SNAP BUSHING | 35 | 460024 | SNAP-IN RECEPT., 120V (DOM) | 57 | 350006 | 1/8 HOSE X 10-32 MUN,F ADAPTER |
| 11 | 30087 | 1-1/4 SNAP BUSHING | 36 | 460138 | SNAP-IN RECEPT, 230V (EXP) | 58 | 380220 | 1/8 MPT X 1/4 HOSE ADAPTER |
| 12 | 59007 | 4-40 X 3/8 PHP SCREW | 37 | 460157 | PWR ENTRY/RFI LINE FILTER | 59 | 840027 | 1/16 TUBE X 10-32 NYLON |
| 13 | 127051 | SPACER, M/F 4-40THD,.375 | 38 | 600034 | SNAPPER HOSE CLAMP, .375 | 60 | 840035 | 1/8 MPT X 3/16 HOSE ADAPTER |
| 14 | 180172 | CONTROL PANEL BEZEL | 39 | 600063 | SNAPPER HOSE CLAMP, .312 | 61 | 1900052 | HARNESS-O2 SENSOR & BOARD |
| 15 | 190609 | CONTROL PANEL, DISPLAY | 40 | 770001 | DISPOSABLE FILTER, 99.97 | 62 | 190715 | HARNESS- I/R SENSOR & BOARD |
| 15A | 1900609 | CONTROL PANEL, DISPLAY (5060/62) | 41 | 840008 | HOSE FITTING, 10-32 X 5/32 | 63 | 1900606 | COMPONENT DRAWER |
| 16 | 190615 | DISPLAY BOARD MOUNT | 42 | 840020 | BULHEAD FTG, BRASS 1/4 | 64 | 190605 | CONTROL HOUSING WRAP |
| 17 | 190994 | OUTLET MOUNT, 3110 (DOM) | 43 | 950013 | VINYL TUBING 1/4 ID | 65 | 190605 | CONTROL HOUSING BACK |
| 18 | 191634 | MICRO BOARD | 44 | 1900050 | HARNESS,3110 II DRAWER | | | |
| 19 | 194021 | RIBBON CABLE 34 POS. | 45 | 1900054 | SOLENOID MOUNT | | | |
| 20 | 210085 | CORDSET W/FEMALE RECEPTACLE | 46 | 190571 | ANALOG BRD, 4-20MA "OPTION" or | | | |
| 21 | 230105 | FUSEBLOCK 5 X 20MM | -- | 190572 | ANALOG BRD, 0-5V "OPTION" or | | | |
| 22 | 230135 | FUSE, 1 A TD, 5 X 20MM (DOM) | -- | 190573 | ANALOG BRD, 0-1V "OPTION" | | | |
| 23 | 230153 | 6A DPDT CKT BKR/SWITCH | 47 | 34014 | PE HOLE PLUG, BLACK | | | |
| 24 | 246010 | VINYL TUBING, 3/16 ID | | | | | | |
| 25 | 250085 | CO2 SOLENOID VALVE, 12 VDC | | | | | | |



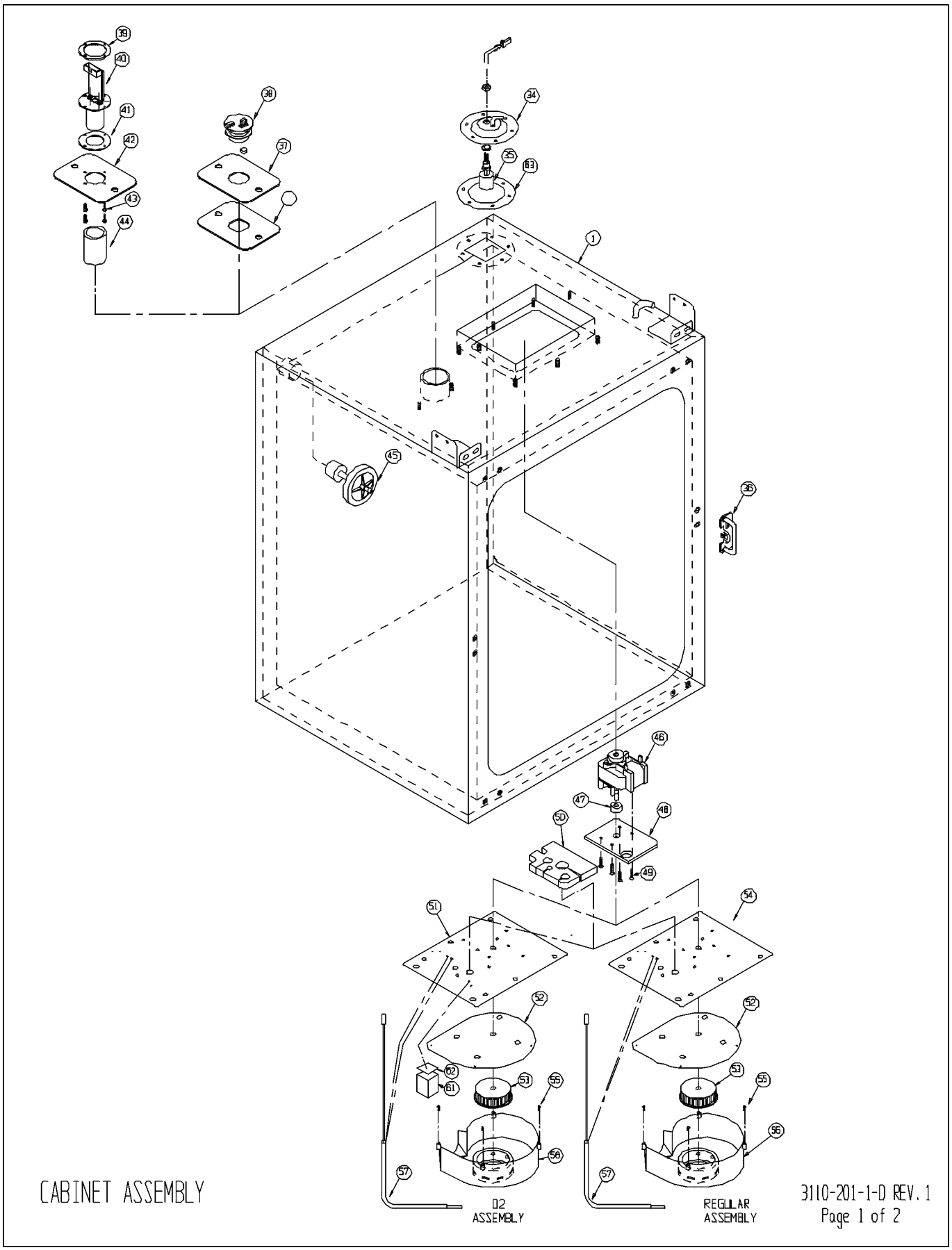

I/R ASSEMBLY (3120, 3121, 3140, 3141) ,O2 ASSEMBLY (3140, 3141) AND "OPTIONAL" GAS GUARD ASSEMBLY DETAIL

3110-200-1-D REV. 3
Page 1 of 2



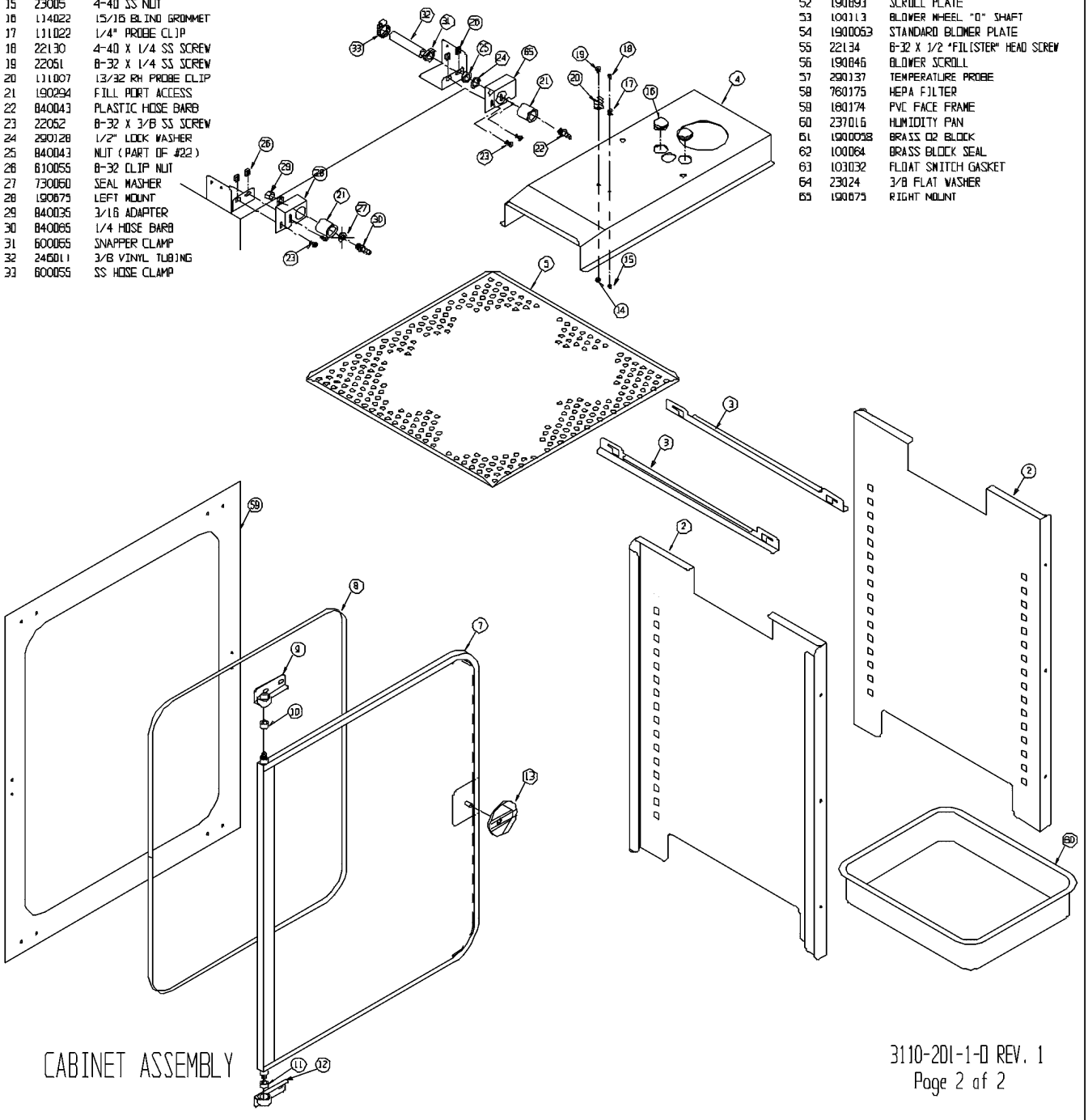

ELECTRONICS DRAWER

3110-200-1-D REV. 3
Page 2 of 2


CABINET ASSEMBLY
D2
ASSEMBLY
REGULAR
ASSEMBLY
3110-201-1-D REV. 1
Page 1 of 2

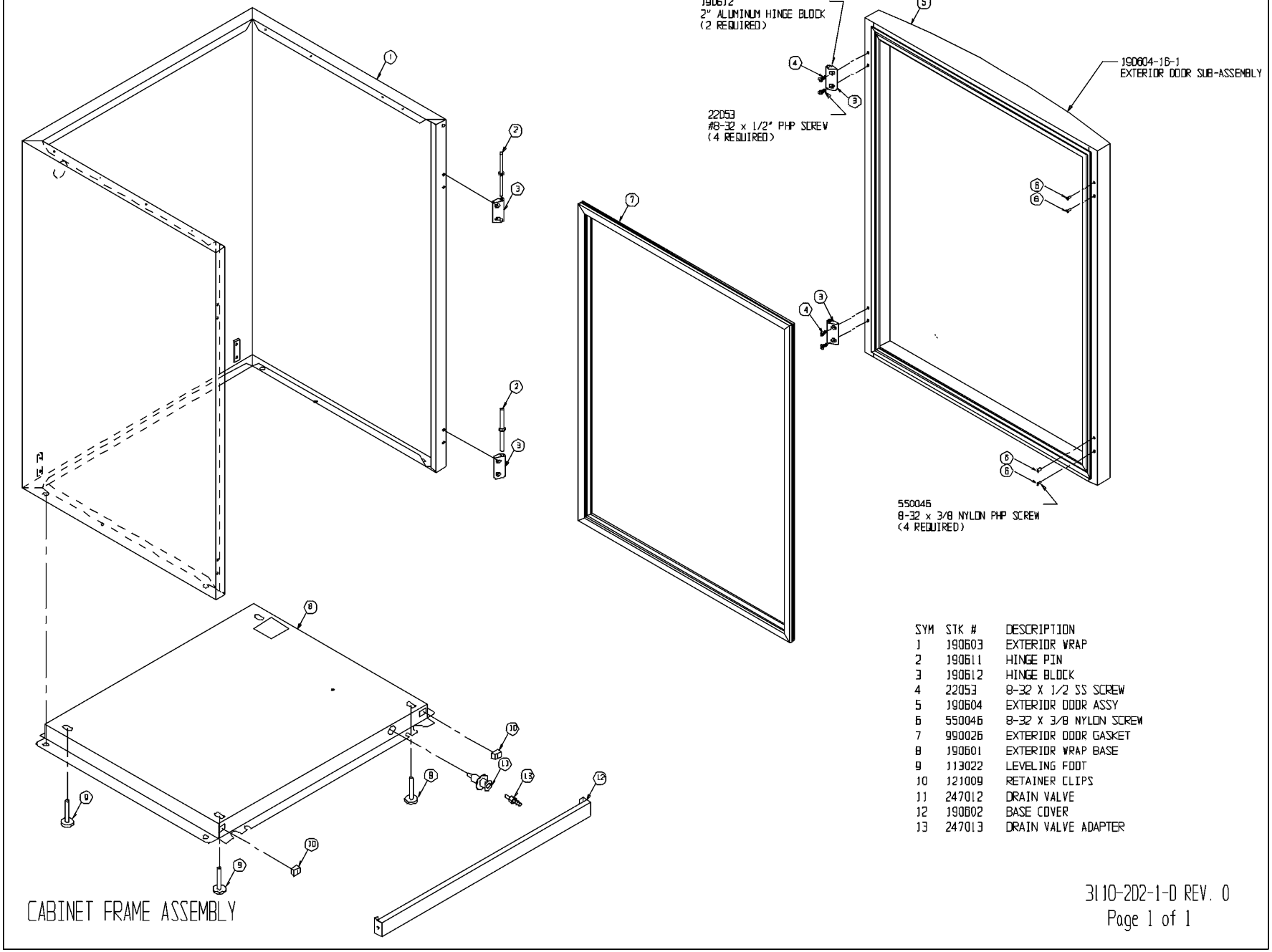
| SYM | STK # | DESCRIPTION |
|---|---|---|
| 1 | 1900600 | WATER JACKET CHAMBER |
| 2 | 190723 | INTERIOR DUCT SHEETS |
| 3 | 190664 | SHELF CHANNELS |
| 4 | 1900056 | TOP DUCT( 1900057 COPPER ) |
| 5 | 224175 | SHELF |
| 7 | 190730 | INNER GLASS DOOR |
| 8 | 103065 | INNER DOOR GASKET |
| 9 | 190618 | TOP INNER DOOR HINGE |
| 10 | 700013 | TOP INNER DOOR HINGE BUSHING |
| 11 | 700046 | BOTTOM INNER DOOR HINGE BUSHING |
| 12 | 190610 | BOTTOM INNER DOOR HINGE |
| 13 | 190210 | INNER DOOR KNOB |
| 14 | 23010 | 8-32 SS NUT |
| 15 | 23005 | 4-40 SS NUT |
| 16 | 114022 | 15/16 BLIND GROMMET |
| 17 | 111022 | 1/4" PROBE CLIP |
| 18 | 22130 | 4-40 X 1/4 SS SCREW |
| 19 | 22051 | 8-32 X 1/4 SS SCREW |
| 20 | 111007 | 13/32 RH PROBE CLIP |
| 21 | 190294 | FILL PORT ACCESS |
| 22 | 840043 | PLASTIC HOSE BARB |
| 23 | 22052 | 8-32 X 3/8 SS SCREW |
| 24 | 290128 | 1/2" LOCK WASHER |
| 25 | 840043 | NUT ( PART OF #22 ) |
| 26 | 610055 | 8-32 CLIP NUT |
| 27 | 730060 | SEAL WASHER |
| 28 | 190675 | LEFT MOUNT |
| 29 | 840035 | 3/16 ADAPTER |
| 30 | 840065 | 1/4 HOSE BARB |
| 31 | 600065 | SNAPPER CLAMP |
| 32 | 245011 | 3/8 VINYL TUBING |
| 33 | 600055 | SS HOSE CLAMP |

| SYM | STK # | DESCRIPTION |
|---|---|---|
| 34 | 190306 | FLOAT SWITCH MOUNT |
| 35 | 360171 | FLOAT SWITCH |
| 36 | 190634 | INNER DOOR LACTH |
| 37 | 190649 | TC SENSOR PLATE |
| 38 | 290090 | TC SENSOR |
| 39 | 190712 | IR MOUNTING RING |
| 40 | 190708 | "DCS" IR SENSOR |
| 41 | 103083 | IR SENSOR GASKET |
| 42 | 190711 | IR MOUNTING PLATE |
| 43 | 221130 | 4-40 X 1/4 SS SCREW |
| 44 | 190708 | IR SENSOR FILTER ( PART OF ITEM 40) |
| 45 | 190985 | FILTERED STOPPER ASSEMBLY |
| 46 | 156114 | BLOWER MOTOR |
| 47 | 730069 | MOTOR SHAFT SEAL |
| 48 | 190655 | MOTOR SPACER PLATE |
| 49 | 590023 | 8-32 X 3/4 SS SCREWS |
| 50 | 190867 | BLOWER PLATE INSULATION |
| 51 | 1900055 | D2 BLOWER PLATE ASSY |
| 52 | 190893 | SCROLL PLATE |
| 53 | 100113 | BLOWER WHEEL "D" SHAFT |
| 54 | 1900053 | STANDARD BLOWER PLATE |
| 55 | 221134 | 8-32 X 1/2 "FILISTER" HEAD SCREW |
| 56 | 190846 | BLOWER SCROLL |
| 57 | 290137 | TEMPERATURE PROBE |
| 58 | 760175 | HEPA FILTER |
| 59 | 180174 | PVC FACE FRAME |
| 60 | 237016 | HUMIDITY PAN |
| 61 | 1900058 | BRASS D2 BLOCK |
| 62 | 100064 | BRASS BLOCK SEAL |
| 63 | 103032 | FLOAT SWITCH GASKET |
| 64 | 23024 | 3/8 FLAT WASHER |
| 65 | 190675 | RIGHT MOUNT |



CABINET ASSEMBLY

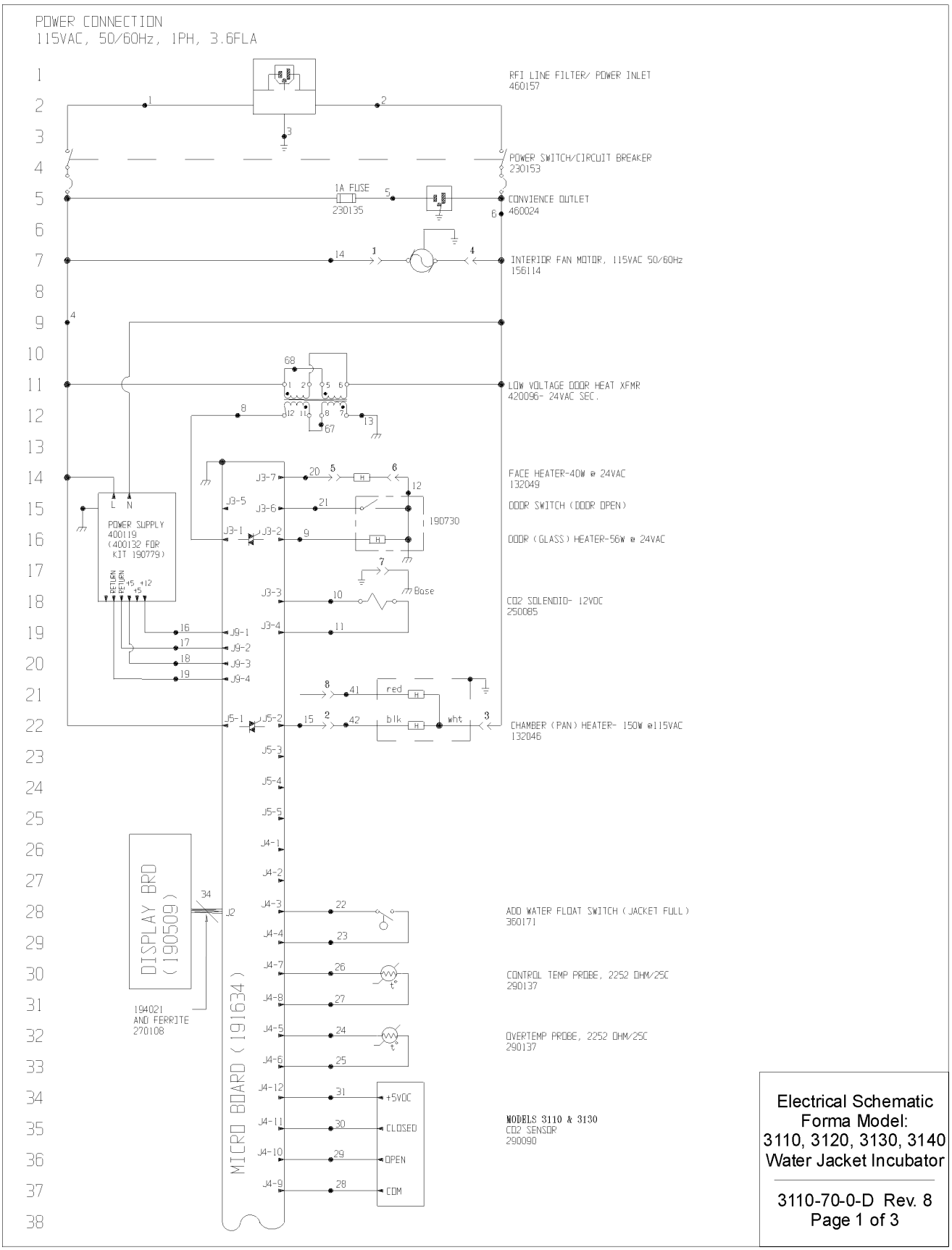
3110-2D1-1-D REV. 1
Page 2 of 2




| SYM | STK # | DESCRIPTION |
|---|---|---|
| 1 | 190603 | EXTERIOR WRAP |
| 2 | 190611 | HINGE PIN |
| 3 | 190612 | HINGE BLOCK |
| 4 | 22053 | 8-32 X 1/2 SS SCREW |
| 5 | 190604 | EXTERIOR DOOR ASSY |
| 6 | 550046 | 8-32 X 3/8 NYLON SCREW |
| 7 | 990026 | EXTERIOR DOOR GASKET |
| 8 | 190601 | EXTERIOR WRAP BASE |
| 9 | 113022 | LEVELING FOOT |
| 10 | 121009 | RETAINER CLIPS |
| 11 | 247012 | DRAIN VALVE |
| 12 | 190602 | BASE COVER |
| 13 | 247013 | DRAIN VALVE ADAPTER |

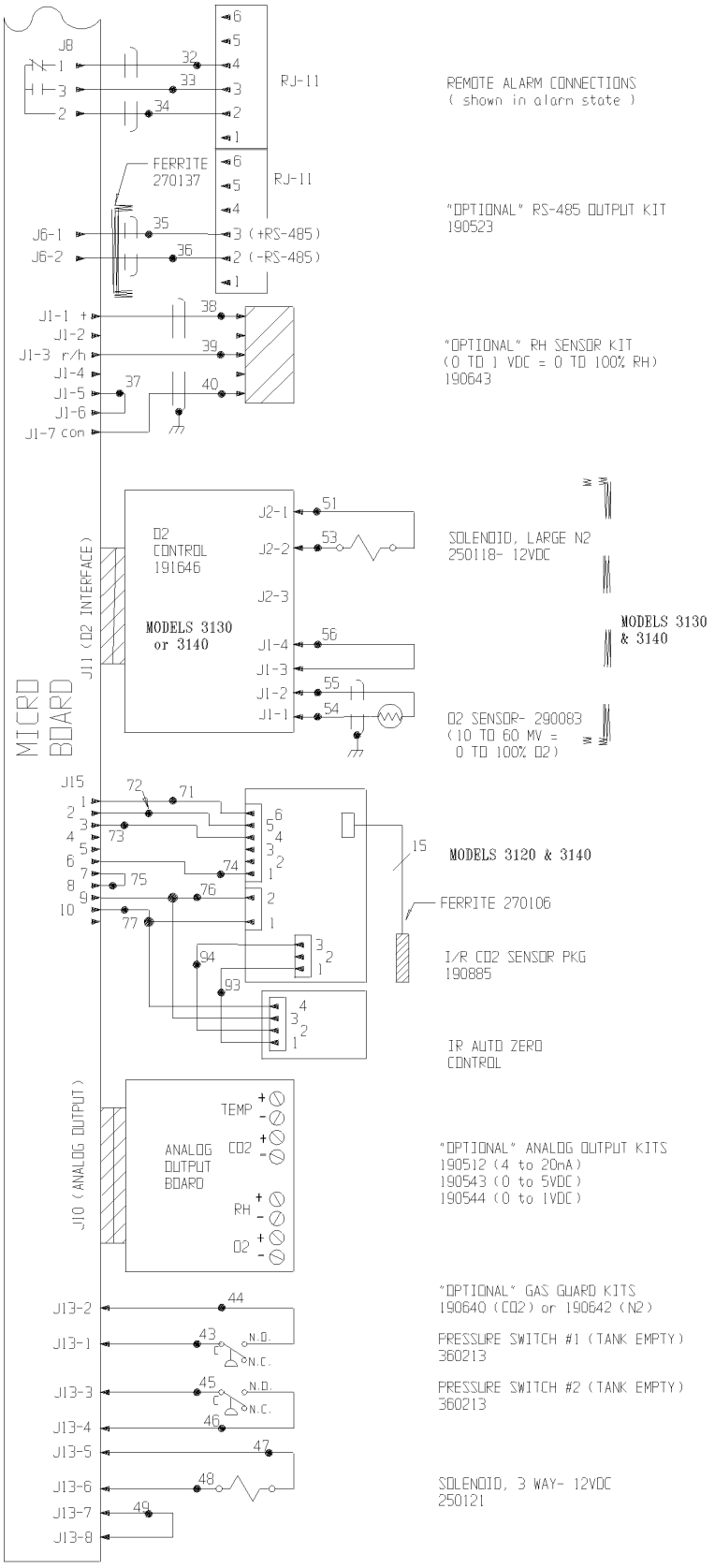
3110-202-1-D REV. 0
Page 1 of 1

# Section 9 - Electrical Schematics




Electrical Schematic
Forma Model:
3110, 3120, 3130, 3140
Water Jacket Incubator

3110-70-0-D Rev. 8
Page 1 of 3




Electrical Schematic
Forma Model:
3110, 3120, 3130, 3140
Water Jacket Incubator

3110-70-0-D Rev. 8
Page 2 of 3

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

WIRE REFERENCE CHART

| NO. | GA. | COLOR | NO. | GA. | COLOR | NO. | GA. | COLOR |
|---|---|---|---|---|---|---|---|---|
| 1 | 16 | BROWN | 26 | 22 | YELLOW | 52 | N/U | |
| 2 | 16 | BLUE | 27 | 22 | YELLOW | 53 | 20 | PURPLE |
| 3 | 16 | GRN/YEL | 28 | 22 | GREEN | 54 | 22/2 | RED |
| 3B | 16 | GREEN | 29 | 22 | GRAY | 55 | 22/2 | BLACK |
| 4 | 18 | BLACK | 30 | 22 | PURPLE | 56 | 22 | BLACK |
| 5 | 18 | BLACK | 31 | 22 | ORANGE | 57 | | |
| 6 | 18 | WHITE | 32 | 22/3 | BLACK | | N/U | |
| 7 | N/U | | 33 | 22/3 | RED | 66 | | |
| 8 | 18 | BROWN | 34 | 22/3 | WHITE | 67 | 18 | RED |
| 9 | 18 | BLUE | 35 | 22/2 | RED | 68 | 18 | ORANGE |
| 10 | 18 | YELLOW | 36 | 22/2 | BLACK | 69 | N/U | |
| 11 | 18 | YELLOW | 37 | 22 | BLACK | 70 | N/U | |
| 12 | 18 | BLACK | 38 | 22/3 | BLACK | 71 | 22 | BLUE |
| 13 | 18 | GREEN | 39 | 22/3 | RED | 72 | 22 | ORANGE |
| 14 | 18 | BLUE | 40 | 22/3 | GREEN | 73 | 22 | YELLOW |
| 15 | 18 | ORANGE | 41 | 18 | RED | 74 | 22 | BROWN |
| 16 | 18 | RED | 42 | 18 | BLACK | 75 | 22 | BLACK |
| 17 | 18 | GREEN | 43 | 20 | RED | 76 | 22 | RED |
| 18 | 18 | ORANGE | 44 | 20 | RED | 77 | 22 | GREEN |
| 19 | 18 | GREEN | 45 | 20 | BLUE | 78 | | |
| 20 | 18 | ORANGE | 46 | 20 | BLUE | | 24/15 | I/R CABLE |
| 21 | 22 | BROWN | 47 | 20 | ORANGE | 91 | | |
| 22 | 22 | BLUE | 48 | 20 | ORANGE | 92 | 22 | BLACK |
| 23 | 22 | BLUE | 49 | 20 | BLACK | 93 | 22 | BROWN |
| 24 | 22 | RED | 50 | N/U | | 94 | 22 | WHITE |
| 25 | 22 | RED | 51 | 20 | YELLOW | | | |

N/U= Not Used

SENSOR REFERENCE VALUES

| | |
|---|---|
| CO2 (290090) | DIFFERENCE VOLTAGE OF 3-6MV/%CO2<br>J4-9 & J4-10 TO J4-9 & J4-11 |
| RH (190643) | J1-7 & J1-1 = 12VDC<br>J1-7 & J1-3 = 10MV/%RH |
| O2 (290083) | J6-1 & J6-2 = 12MV @ 21%O2 |

NOTES:

| | | | |
|---|---|---|---|
| ⊕ | Denotes Terminal Strip Connection | Parts List Reference Number | |
| | Last Relay Number | ○ | Assembly |
| | Last Terminal Number | ⬠ | Panel |
| | Last Wire Number | ⬡ | Refrigeration |
| →>— | Denotes Pin & Socket Connection | □ | Wiring |

CUSTOMER APPROVAL/REFERENCE
APPROVED BY _____
APPROVING FIRM _____
DATE OF APPROVAL _____

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

Forma Scientific

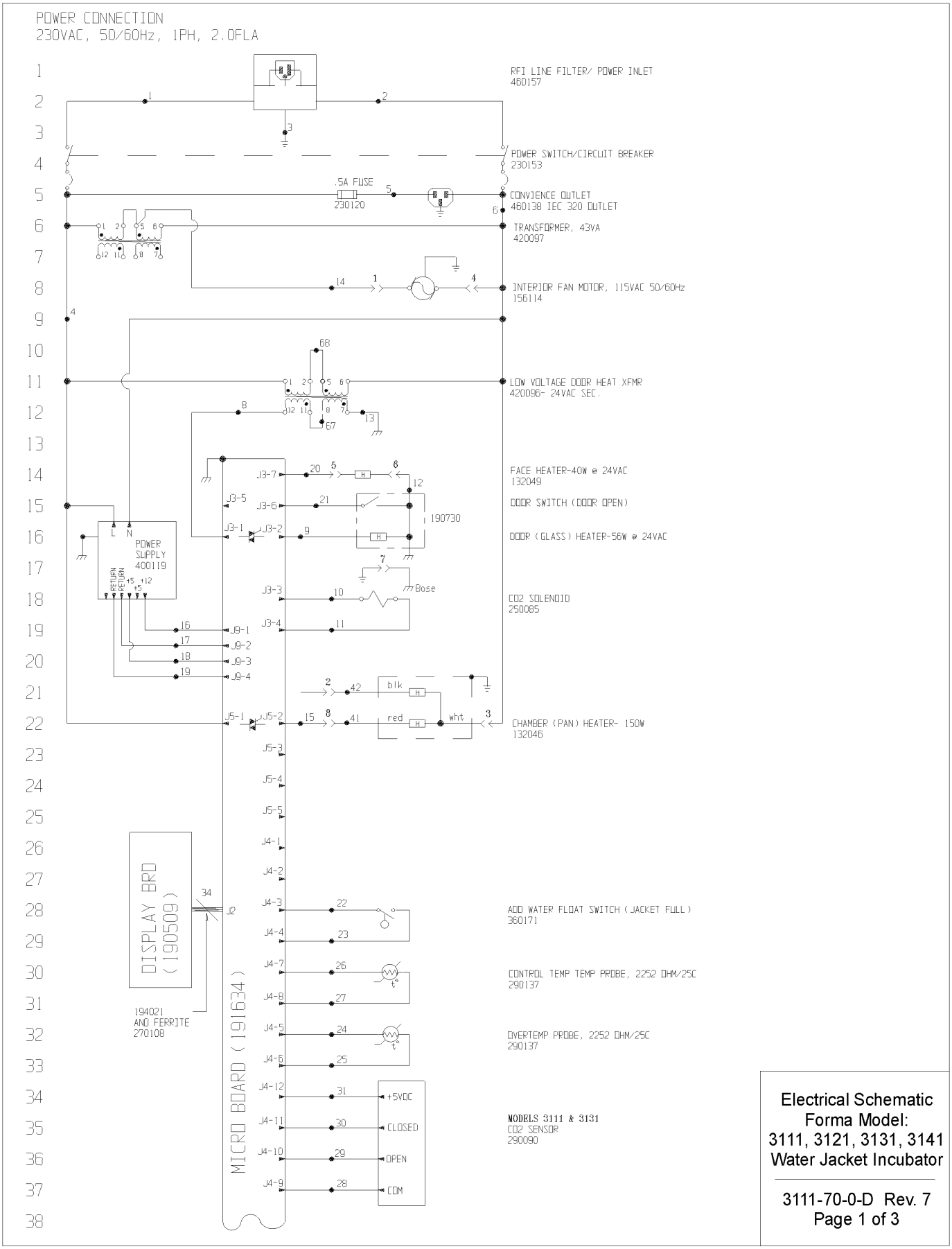
BOX 649 MARIETTA, OHIO 45750
TOLL FREE USA 800-848-3060, OHIO 740-373-4763

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 8 | SI-7897 | 06-05-00 | GLM | GJG | LDN | UPDATE PER CHANGES FROM "UL" TESTING |
| 7 | SI-7897 | 05-01-00 | GLM | GLM | DNF | UPDATE PER LEVEL 5 P.L.CHANGES |
| 6 | IN-2460 | 01-18-99 | RLM | KDG | LDN | CHG. 184032 AIR PUMP TO 184058 |
| 5 | SI-7008 | 5-21-98 | GLM | GLM | LDN | IR SENSOR REVISION |
| 4 | IN-2343 | 11-19-97 | GLM | KDG | LDN | NOTED 400132 USED ON KIT |

DATE Mar 2000 | DWN GLM | CAD GLM | APPD DNF | SCALE NA
CUSTOMER MODELS 3110, 3120, 3130, & 3140
JOB TITLE MODULAR WATER JACKET INCUBATOR 115 VOLT (DOM.)
DWG TITLE ELECTRICAL SCHEMATIC
LOCATION INCUBATR | JOB NUMBER | DRAWING NUMBER 3110-70-0-D

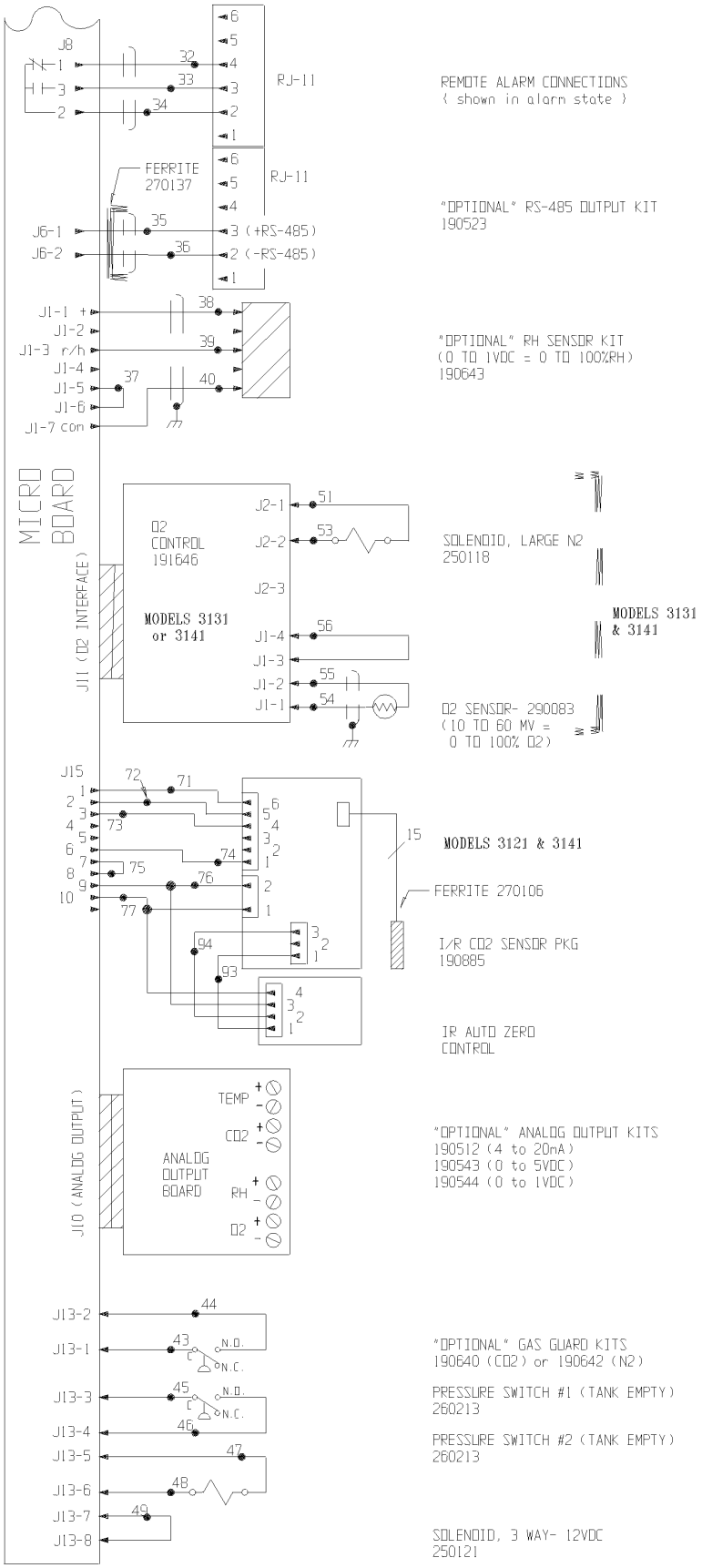
Electrical Schematic
Forma Model:
3110, 3120, 3130, 3140
Water Jacket Incubator

3110-70-0-D Rev. 8
Page 3 of 3




Electrical Schematic
Forma Model:
3111, 3121, 3131, 3141
Water Jacket Incubator

3111-70-0-D Rev. 7
Page 1 of 3




Electrical Schematic
Forma Model:
3111, 3121, 3131, 3141
Water Jacket Incubator

3111-70-0-D Rev. 7
Page 2 of 3

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

WIRE REFERENCE CHART

| NO. | GA. | COLOR | NO. | GA. | COLOR | NO. | GA. | COLOR |
|---|---|---|---|---|---|---|---|---|
| 1 | 16 | BROWN | 26 | 22 | YELLOW | 52 | N/U | |
| 2 | 16 | BLUE | 27 | 22 | YELLOW | 53 | 20 | PURPLE |
| 3 | 16 | GRN/YEL | 28 | 22 | GREEN | 54 | 22/2 | RED |
| 3B | 16 | GREEN | 29 | 22 | GRAY | 55 | 22/2 | BLACK |
| 4 | 18 | BLACK | 30 | 22 | PURPLE | 56 | 22 | BLACK |
| 5 | 18 | BLACK | 31 | 22 | ORANGE | 57 | | |
| 6 | 18 | WHITE | 32 | 22/3 | BLACK | | N/U | |
| 7 | N/U | | 33 | 22/3 | RED | 66 | | |
| 8 | 18 | BROWN | 34 | 22/3 | WHITE | 67 | 18 | RED |
| 9 | 18 | BLUE | 35 | 22/2 | RED | 68 | 18 | ORANGE |
| 10 | 18 | YELLOW | 36 | 22/2 | BLACK | 69 | N/U | |
| 11 | 18 | YELLOW | 37 | 22 | BLACK | 70 | 22 | BLACK |
| 12 | 18 | BLACK | 38 | 22/3 | BLACK | 71 | 22 | BLUE |
| 13 | 18 | GREEN | 39 | 22/3 | RED | 72 | 22 | ORANGE |
| 14 | 18 | BLUE | 40 | 22/3 | GREEN | 73 | 22 | YELLOW |
| 15 | 18 | ORANGE | 41 | 18 | RED | 74 | 22 | BROWN |
| 16 | 18 | RED | 42 | 18 | BLACK | 75 | 22 | BLACK |
| 17 | 18 | GREEN | 43 | 20 | RED | 76 | 22 | RED |
| 18 | 18 | ORANGE | 44 | 20 | RED | 77 | 22 | GREEN |
| 19 | 18 | GREEN | 45 | 20 | BLUE | 78 | | I/R |
| 20 | 18 | ORANGE | 46 | 20 | BLUE | | 24/15 | CABLE |
| 21 | 22 | BROWN | 47 | 20 | ORANGE | 91 | | |
| 22 | 22 | BLUE | 48 | 20 | ORANGE | 92 | 22 | BLACK |
| 23 | 22 | BLUE | 49 | 20 | BLACK | 93 | 22 | BROWN |
| 24 | 22 | RED | 50 | N/U | | 94 | 22 | WHITE |
| 25 | 22 | RED | 51 | 20 | YELLOW | | | |

N/U= Not Used

SENSOR REFERENCE VALUES

| | |
|---|---|
| CO2 (290090) | DIFFERENCE VOLTAGE OF 3-6MV/%CO2<br>J4-9 & J4-10 TO J4-9 & J4-11 |
| RH (190643) | J1-7 & J1-1 = 12VDC<br>J1-7 & J1-3 = 10MV/%RH |
| O2 (290083) | J6-1 & J6-2 = 12MV @ 21%O2 |

NOTES:

| | | | |
|---|---|---|---|
| ⊕ | Denotes Terminal Strip Connection | Parts List Reference Number | |
| | Last Relay Number | ○ | Assembly |
| | Last Terminal Number | ⬠ | Panel |
| | Last Wire Number | ⬡ | Refrigeration |
| →>— | Denotes Pin & Socket Connection | □ | Wiring |

CUSTOMER APPROVAL/REFERENCE

APPROVED BY _____

APPROVING FIRM _____

DATE OF APPROVAL _____

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

Forma Scientific

BOX 649 MARIETTA, OHIO 45750
TOLL FREE USA 800-848-3080, OHIO 740-373-4763

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|
| 7 | SI-7897 | 06-05-00 | GLM | GJG | LDN | UPDATE PER CHANGES FROM "UL" TESTING |
| 6 | SI-7897 | 05-01-00 | GLM | GLM | DNF | UPDATE PER LEVEL 5 P.L.CHANGES |
| 5 | IN-24 0 | 01-18-99 | RLM | KDG | LDN | CHG. 184032 AIR PUMP TO 184058 |
| 4 | SI-7008 | 5-21-98 | GLM | GLM | LDN | IR CO2 SENSOR REVISION |
| 3 | IN-2276 | 5-27-97 | GLM | GLM | M.H. | IMPLIMENT DCS IR CO2 SENSOR |

DATE 9-24-95 | DWN GLM | CAD GLM | APPD DNF | SCALE

CUSTOMER MODELS 3111, 3121, 3131 & 3141

JOB TITLE MODULAR WATER JACKET INCUBATOR 230 VOLT (EXPORT)

DWG TITLE ELECTRICAL SCHEMATIC

| LOCATION | JOB NUMBER | DRAWING NUMBER |
|---|---|---|
| INCUBATR | | 3111-70-0-D |

Electrical Schematic
Forma Model:
3111, 3121, 3131, 3141
Water Jacket Incubator

3111-70-0-D Rev. 7
Page 3 of 3

**Thermo** Forma

**Millcreek Road, P.O. Box 649**
**Marietta, Ohio 45750**
**U.S.A.**

Telephone (740) 373-4763
Telefax (740) 373-4189

**Artisan Technology Group** is an independent supplier of quality pre-owned equipment

## Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

## We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

## Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP