



Forma Direct Heat CO₂ Incubator

Model 310 Series

Operating and Maintenance Manual 7010310 Rev. 20

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Model	CO2 Sensor*	Voltage**	Temp °C Max
310	T/C	115	55
311	T/C	230	55
320	IR	115	50
321	IR	230	50
350†	T/C	115	45
351†	T/C	230	45
360†	IR	115	45
361†	IR	230	45

* T/C is a thermal conductivity sensor.

IR is an infrared sensor.

** All units are 50/60 Hz.

† Copper interior

MANUAL NUMBER 7010310

20	41105	10/31/17	Updated auxillary outlet electrical info	bpg
19	41345	5/02/17	Added F-gas statement, removed certifications	bpg
18	40087/IN-4743	7/27/16	Changed label on remote alarm artwork to note - pg 6-1	ccs
17	40639	4/22/16	Added risk assessment information	ccs
16	31343/IN-4592	10/22/14	New magnetic door switch (exploded drawing, electrical schematics) RoHS	ccs
15	29174/IN-4469	3/21/14	Solenoid change - update 203 drawing and schematics (pgs 8-5 & 9-1 to 9-3)	ccs
14	30649/IN-4446	1/28/14	Updated electrical schematics - display board	ccs
13	29704/IN-4310	3/29/13	Changed wingnut in blower assembly to hex nut (310-202-1-D)	ccs



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

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

Warning If this unit is not used in the manner specified in this operating manual, the protection provided by the equipment design may be impaired. ▲

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

Intended Use: The 310 Series Direct Heat Incubators are designed to maintain an optimal environment for the incubation of tissue and cell samples. These models are designed to maintain temperature and Carbon Dioxide levels as set by the operator as well as monitoring chamber relative humidity. CO₂ is controlled using either a thermo conductivity cell, or an infra-red sensor. T

The incubators are approved for general purpose use as a Microbiological Incubator (21 CFR 866.2540) and are also approved use in assisted reproductive procedures for the incubation of ova and embryos (21 CFR 884.6120).

Non-intended Use: The 310 Series Direct Heat Incubators are not intended for use where electrical or physical contact with the patient is established.

These incubators are not intended for use by the general public.

These units are not intended for use within the patient environment. These units are not to be used outdoors.

These incubators are not intended to be operated in potentially explosive environments and are not intended for use with flammable materials.

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



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



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



Asphyxiation Hazard Warning. High concentrations of CO₂ and N₂ can displace oxygen and cause asphyxiation!



Lifting Hazard Warning. The incubator weighs more than 200lbs (91kgs). Take adequate safety measures when moving this device.



4-Person Lift. The incubator weighs more than 200 lbs (91kgs). It is recommended that four persons lift this device together to move it.



WEEE Compliance: Thermo Fisher Scientific has contracted with companies for recycling/disposal in each EU Member State. For further information, send an email to weee.recycle@thermofisher.com.



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

Do You Need Information or Assistance on Thermo Scientific Products?

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

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

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

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

Thermo Fisher Scientific (Asheville) LLC
401 Millcreek Road, Box 649
Marietta, OH 45750

International customers, please contact your local Thermo Scientific distributor.

Warranty Notes

Information You Should Know Before Requesting Warranty Service

- **Locate the model and serial numbers.** A serial tag is located on the unit itself.
- For equipment service or maintenance, or with technical or special application inquiries, contact Technical Services at 1-800-438-4851 or 1-740-373-4763 (USA and Canada). Outside the USA, contact your local distributor.

Repairs NOT Covered Under Warranty

- **Calibration of control parameters.** Nominal calibrations are performed at the factory; typically $\pm 1^{\circ}\text{C}$ for temperature, $\pm 1\%$ for gases, and $\pm 5\%$ for humidity. Our service personnel can provide precise calibrations as a billable service at your location. Calibration after a warranty repair is covered under the warranty.
- **Damage resulting from use of improper quality water, chemicals or cleaning agents detrimental to equipment materials.**
- **Service calls for improper installation or operating instructions.** Corrections to any of the following are billable services:
 - 1) electrical service connection
 - 2) tubing connections
 - 3) gas regulators
 - 4) gas tanks
 - 5) unit leveling
 - 6) room ventilation
 - 7) adverse ambient temperature fluctuations
 - 8) any repair external to the unit
- **Damage resulting from accident, alteration, misuse, abuse, fire, flood, acts of God, or improper installation.**
- **Repairs to parts or systems resulting from unauthorized unit modifications.**
- **Any labor costs other than that specified during the parts and labor warranty period, which may include additional warranty on CO₂ sensors, blower motors, water jackets, etc.**

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Section 1 Installation and Start-Up

Incubator components are described below.

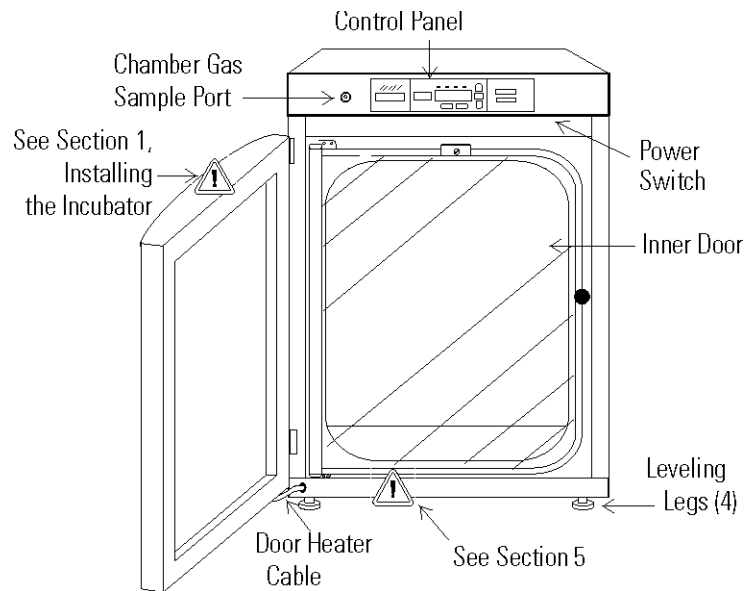


Figure 1-1. Model 310 Series Direct Heat Incubator

- Outer Door - Reversible to opposite swing, see Section 5
- Inner Door - Reversible to opposite swing, see Section 5
- Chamber Gas Sample Port - Used for sampling chamber CO₂ content for calibration (Section 2).
- Main Power Switch
- Control Panel - Keypad, Displays and indicators (Figure 1-2)
- Leveling Legs - Used to level the unit

Note The incubators are stackable. Information follows. ▲

Control Panel Keys, Displays & Indicators

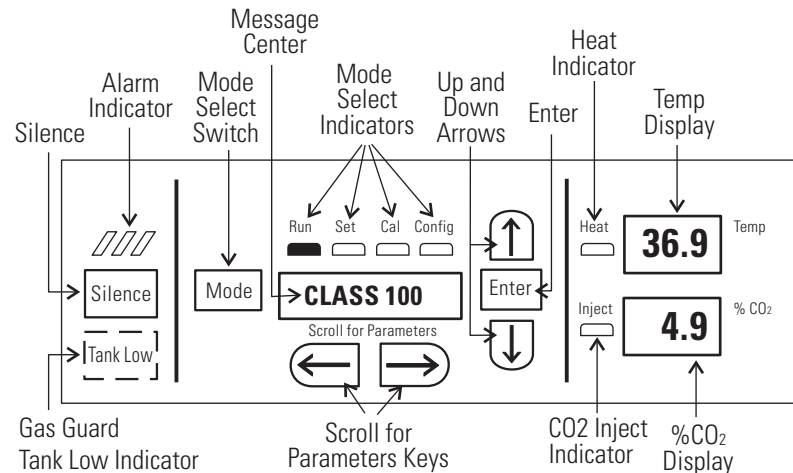


Figure 1-2. Control Panel

Tank Low Indicator - Used with Gas Guard, lights when gas tank is low, if applicable.

Silence - Silences the audible alarm. See Section 4 for ringback times.

Alarm Indicator - Light pulses on/off during an alarm condition in the cabinet.

Mode Select Switch - Used to select Run, Setpoints, Calibration and System Configuration Modes.

Message Center - Displays the system status (Mode) at all times. Displays SYSTEM OK during normal operation, or alarm messages if the system detects an alarm condition. See Section 4, Alarms.

Mode Select Indicators - Lights when modes are selected

Up and Down Arrows - Increases or decreases the parameter values, toggles between mode choices.

Enter - Press Enter to store a changed value into computer memory.

Heat Indicator - Lights when power is applied to the heaters.

Temp Display - Program to display temperature continuously, RH continuously (with RH option), or toggle between temperature and humidity (with RH option). See Section 3, Configuration.

% CO2 Display - Displays CO₂ percentage continuously.

CO₂ Inject Indicator - Lights when CO₂ is being injected into incubator.

Scroll for Parameters Arrows - Steps the operator through the parameters of selected modes. Right arrow goes to next parameter, left arrow returns to previous.

Control Panel Operation

The Model 310 Series direct heat incubator has four basic modes which allow incubator setup: Run, Setpoints, Calibration, System Configuration.

Run is the default mode which 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.

Config 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 Cal¹	Access Code
	CO₂	IR Cal²	Temp Lo Alarm
		<i>RH Cal</i>	Temp Relay
			CO₂ Lo Alarm
			CO₂ Hi Alarm
			CO₂ Relay
			<i>T/C CO₂ SP #' *</i>
			<i>T/C CO₂ ZR #' *</i>
			<i>RH Lo Alarm</i>
			<i>RH Relay</i>
			<i>Display Temp</i>
			<i>Display RH</i>
			<i>Tank Select</i>
			<i>Gas Guard Setup</i>
			RS485 Address

¹ T/C units only

² IR units only

*T/C units only

Base Unit Displays

Option Displays

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 shows CO₂ continuously.

Installing the Incubator

Warning Single and stacked units must be installed against a wall or similar structure. Maintain a three-inch clearance behind the incubator for electrical and gas hook-ups. ▲

1. Locate the unit on a firm, level surface capable of supporting the unit's weight of 205 lbs. plus the estimated total sample and user equipment weight. The overall space should be well ventilated and large enough that the concentration of carbon dioxide (CO₂) gas cannot accumulate, thus displacing the oxygen (O₂) to dangerous levels in the room. Read Connecting CO₂ Gas Supply below carefully.
2. Locate the incubator away from exterior doors and windows as changes in outdoor temperatures and contact with direct sunlight can affect the anti-condensation functions of the unit.
3. Position the door opening away from forced air heating and cooling ducts as these can carry dust, dirt, and other contaminants into the incubator chamber, as well as negatively affect the door opening recovery time.
4. Position the door opening away from forced air heating and cooling ducts as these can carry dust, dirt and other contaminants into the incubator chamber, as well as negatively affecting the door opening recovery time.
5. It is recommended that the unit be placed on a manufacturer approved stand or roiller base, not directly on the floor, as the air movement created each time the door is opened, will pull dust, dirt and other contaminants into the incubator chamber.

Stacking the Incubators

Caution When stacking incubators, the direct heat incubator must be the top unit. Never stack a water-jacketed incubator on top of a Model 310 Series unit. ▲

Warning With incubators in a stacked configuration, do not leave both exterior doors open at the same time. ▲

Note Two stacking brackets (Figure 1-3) and mounting hardware are included in the parts bag shipped with each incubator. ▲

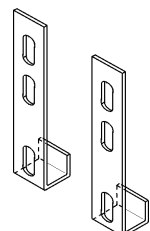


Figure 1-3.
Stacking Brackets

Stacking the Incubators (continued)

1. Remove and discard the slotted head screws on the top of the bottom incubator (Figure 1-4). Replace with 5/16 HH bolts and flatwashers included in the stacking kit. Do not tighten.

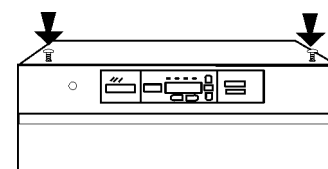


Figure 1-4. Slotted Head Screws

2. Remove the kickplate from below the door on the top incubator (Figure 1-5). Two Phillips screws secure the plate. Note the notches at the base of the incubator frame.
3. Disconnect the door cable from the connector behind the plate. Lift the door off the hinge pins and set it aside. The hinge pins are not attached to the brackets and may fall out when door is lifted off.

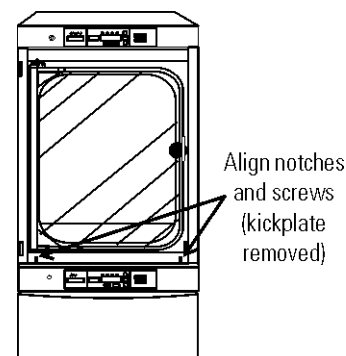


Figure 1-5. Align



Warning This incubator weighs 205 lbs (93kg). Do not lift the incubator by the outer door as this could damage the hinges and/or the outer door may come loose. Note that the outer door can be removed to reduce weight and make it easier to lift the unit by its corners. Have sufficient personnel available to lift the unit into place using proper lifting techniques according to local EHS policies. Lift from both sides of the unit (left and right, not front and back), holding it from the bottom. Do not push or pull the incubator along the floor as this could damage the leveling feet. ▲

4. Unscrew and remove the leveling feet from the top unit and lift it onto the bottom unit, offsetting the base of the top unit approximately 2-3 inches behind the screws identified by the arrows in Figure 1-4.
5. Align the sides of the top unit with the bottom unit and slide the top unit forward until the notches in the base of the top unit align with the bolts in the top of the bottom unit. The flatwashers should slide over the base frame. Tighten bolts.
6. Remove the four nylon plugs on the upper part of the incubator back.
7. Install the stacking brackets on the back of the control panel on the bottom unit. Refer to Figure 1-6.

Figure 1-6. Brackets Installed

Stacking the Incubators (continued)

8. Align the slots in the brackets with the mounting holes on the back of the top incubator. Secure the brackets with the screws provided in the stacking kit.
9. Make sure the hinge pins are in the hinge brackets. Slide the door onto the hinge pins.
10. On the front of the unit, secure the door heater cable to the connector below the door and replace the kick plate on the top unit, taking care not to crimp cable.

Preliminary Cleaning and Disinfecting

Remove protective plastic from shelf channels, duct sheets, and air duct, if present.

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

Using a suitable laboratory disinfectant such as quaternary ammonium, thoroughly clean all interior surfaces to remove any residue which may remain from production of the incubator. Refer to Section 5.

Installing the Shelves

1. Install the large sheet metal shelf supports with the tabs facing into the center of the chamber with their slots up. There are no right side or left side supports. Simply rotate one of them to fit the opposite side. Tilt the shelf supports as they are placed in the chamber so the tops fit into the top air duct, then guide them into the vertical position. Figure 1-7 shows the support as it would be oriented for right side of chamber.

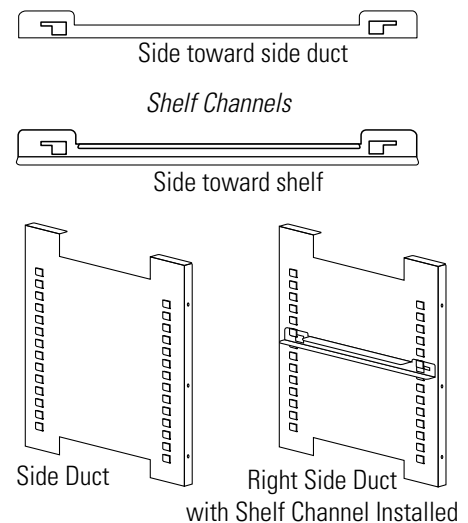


Figure 1-7. Shelf Channels and Ductwork

2. Note there is no difference in the left side and right side shelf channels.

Installing the Shelves (continued)

3. Install the shelf channels by placing the channel's rear slot over the appropriate rear tab on the shelf support. Pull the shelf channel forward and engage the channel's front slot into the shelf support's appropriate forward tab (Figure 1-8). Note that if a shelf is installed in any of the bottom 3 rows of side duct tabs that it will need to be removed to take out the humidity pan to clean and add water.

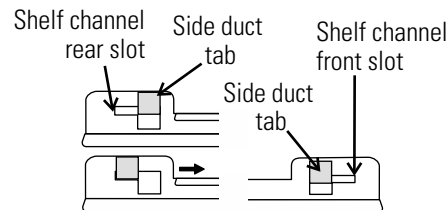


Figure 1-8. Channel Ends

4. The shelf can be installed with the sides up forming a tray that can be easily removed with all of its samples, or with the sides down allowing the samples to be carefully slid off individually. The shelf can be partially pulled out to access samples not in the front, but be careful to not pull the shelf out too far as there are no stops to prevent the shelf from falling out.

Installing Access Port Filter

Locate the opening in the top left corner on the inside of the chamber. Remove the tape covering the opening on the outside of the unit. Locate the stopper with filter in the hardware bag. Install the assembly in the opening inside the chamber. See Figure 1-9.

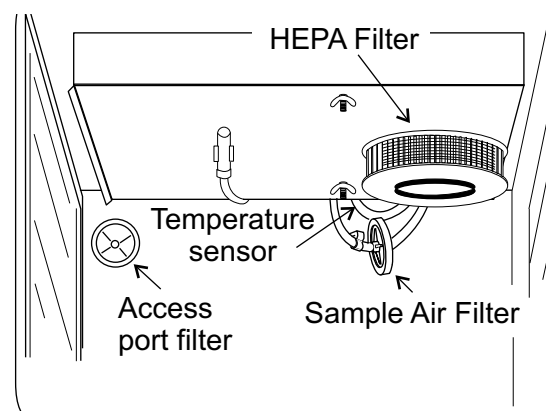


Figure 1-9. Filter and Sensor Locations

Installing (optional) HEPA Filter

Note There are standard and Volatile Organic Chemical (VOC) HEPA filters available. Install and install the correct filter for the given application (see Section 8).

Caution Handle the HEPA filter very carefully as the filter media can be easily damaged. Do not touch the filter media during installation. ▲

1. Remove the filter from the shipping box.
2. Remove the plastic coating from the filter and inspect the filter for any visible signs of damage.
3. Install the filter as shown in Figure 1-9.

Installing (optional) HEPA Filter (continued)

4. The default HEPA filter replacement reminder was set at the factory for 6 months. Refer to Section 3 to change the timer value.

Caution To avoid damage to the incubator, do not operate the unit without the HEPA filter in place. If higher RH is needed and CLASS 100 air quality conditions are not required, use the restrictor plate instead of the HEPA filter in order to maintain proper air flow. ▲

Installing the Air Sample Filter

1. Remove the filter from the shipping bag.
2. Assemble air sample filter assembly to black hose barb behind top duct.
3. Insert the other end of the filter assembly into larger hole in air intake to the blower. Refer to Figure 1-10.
4. Verify temperature sensor is installed into smaller hole in intake, as in Figure 1-10.

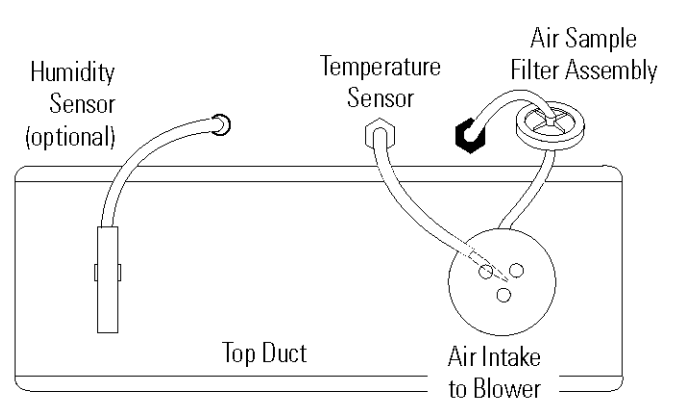


Figure 1-10. View of Chamber Ceiling

Leveling the Unit

Check for 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.

Connecting the Unit to Electrical Power

See the serial tag on the side of the unit, or Specifications section, for electrical specifications or refer to the electrical schematics at the end of this manual.

Caution Connect the incubator to a grounded dedicated circuit only. The power cord connector is the mains disconnect device for the incubator. Position the unit to allow unobstructed access to the power cord so that it can be easily disconnected in case of an emergency. ▲

Plug the provided power cord into the power inlet connector on the back of the cabinet (See Figure 1-11), then into the grounded, dedicated, electrical circuit.

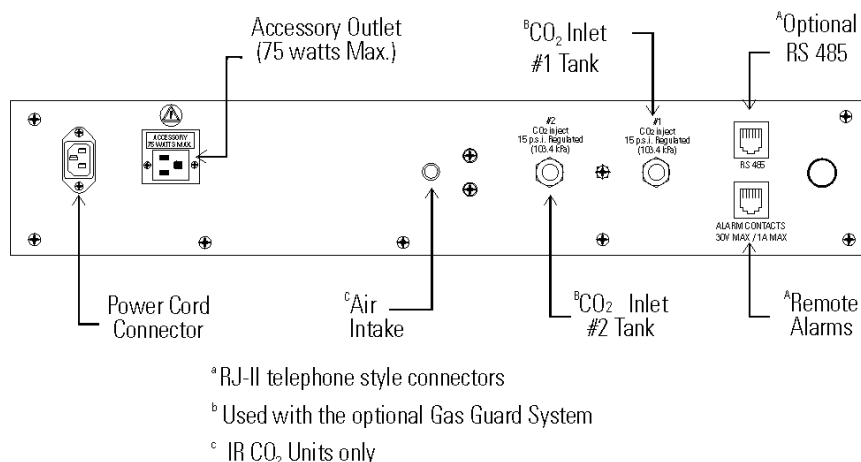


Figure 1-11. Connections on Unit Back

Filling the Humidity Pan

Caution Chlorine is detrimental to stainless steel. Using chlorinated tap water or additives that contain chlorine will void water-jacket warranty! ▲

Fill the humidity pan with sterile pure water to within 1/2" of the top with 0.8 gal. (3 liters) of water. If the water cannot be sterilized, a 2% solution of quaternary ammonium can be used as a disinfectant additive to control bacteria and other organic contaminants, if desired. Place the pan directly in the center of the incubator floor to ensure best humidity and temperature response.

Filling the Humidity Pan (cont.)

For best operation of the incubator, the recommended water type is sterile distilled Type 2 water with a pH between 7 and 9, and a resistivity between 50k Ω - 1M Ω -cm (conductivity of 1-20 μ S/cm). Reverse osmosis (RO), deionized (DI), and ultrapure Type 1 water can corrode stainless steel, copper, glass, and other incubator components over time because high purity water with low ionic content and high resistivity will actively pull ions from these materials. If sterile distilled Type 2 water is not readily available, then these other water types could be used by adding the necessary amount of a sterile solution of weak sodium bicarbonate to raise the pH between 7 and 9 and lower the resistivity between 50k Ω - 1M Ω -cm (conductivity of 1-20 μ S/cm).

For applications requiring higher humidity, the pan should be placed against the left side wall of the incubator. The ductwork has been designed for this purpose. condensation to form in the chamber. This will also accelerate humidity recovery after door openings. Even higher humidity conditions can be achieved by removing the humidity pan altogether and adding water directly to the bottom of the incubator chamber, being careful to not fill it any more than the bottom edge of the silicone door gasket. Also the chamber gas sample port (Figure 1-1) can be capped to assist in achieving greater RH.

Warning Clean up any excessive condensation to prevent it from dripping onto the floor creating a possible slip hazard. For stacked incubators, this may also include the drip channel on the bottom unit used to direct water away from the electronics drawer. ▲

For applications requiring less humidity, place the pan in the center of the incubator chamber.

Warning After the humidity pan is in place, clean up any water that may have spilled in the unit or onto the floor during this process to prevent a possible slip hazard. For stacked incubators, this may also include the drip channel (just behind the face of the control panel drawer) on the bottom unit used to direct water away from the electronics drawer. ▲

Caution 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, as well as CO₂ calibration. ▲

Connecting the CO₂ Gas Supply

Warning High concentrations of CO₂ gas can cause asphyxiation! Refer to local EHS policies regarding employee exposure to CO₂. Carbon dioxide monitors are recommended for confined areas where concentrations of carbon dioxide gas can accumulate. ▲

Note For customer convenience, 12 feet of 1/4" ID vinyl tubing with two 3/8" hose clamps are included in the shipping materials for connecting the unit to the gas supply.

The incubator has 1/4" barbed fittings on the back of the cabinet to connect the gas supply. Refer to Figure 1-11. The fitting is labeled CO₂ Inlet #1. Install 3/8" hose clamps to secure the 1/4" ID tubing to the barbed fitting on the regulator and the rear of the electronics drawer.

Warning This incubator is designed to be operated with CO₂ gas only. Connecting a flammable or toxic gas can result in a hazardous condition. Gases other than CO₂ should not be connected to this equipment.

The CO₂ gas supply being connected to the incubator should be industrial grade, 99.5% pure. Do not use CO₂ gas cylinders equipped with siphon tubes. A siphon tube is used to extract liquid CO₂ from the cylinder which can damage the pressure regulator. Consult with your gas supplier to ensure that the CO₂ cylinder does not contain a siphon tube. ▲

A two-stage CO₂ pressure regulator is required to be installed on the outlet valve of the gas cylinder. The high pressure gauge at the tank should have a 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) maximum, for proper performance of the CO₂ control system.

If higher purity CO₂ is desired 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 CO₂ from the gas supplier. Follow the manufacturer's instructions to ensure proper and safe installation of the pressure regulator on the gas cylinder. Gas cylinders should be secured to a wall or other stationary object to prevent tipping. Position the gas cylinders to allow unobstructed access to the pressure regulators so that they can be easily turned off in case of an emergency. Consult your facility safety officer to ensure that the equipment is installed in accordance with the codes and regulations applicable in your area. ▲

Note Stored product should be protected by an activated alarm system capable of initiating a timely response 24 hours/day. These alarms provide interconnect for centralized monitoring. See Factory Installed Options, Section 6 for more information.

For units having the CO₂ Gas Guard option, refer to Section 6.

Incubator Start-Up

With the incubator properly installed and connected to power, the humidity pan filled, and the unit connected to gas supplies, system setpoints can be entered. The following setpoints can be entered in Set mode: Temperature, Overtemperature and CO₂. 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.

Caution It is the responsibility of the user to validate the proper operation of each incubator in their specific application(s) with respect to unit location, operating environment, and settings. ▲

Setting the Operating Temperature

Model 310 Series incubators have an operating setpoint temperature range of 10°C to 50°C, depending on ambient temperature. The incubator can only accurately control temperature as low as +5°C above ambient unless it has been installed with the cooling coil option at the factory which allows the incubator to run at lower temperatures. See Cooling Coil, Section 6. The incubator is shipped from the factory with a temperature setpoint of 10°C. At this setting, all heaters and alarms are turned off. To change the operating temperature setpoint:

1. Press the Mode key until the Set indicator lights.
2. Press right arrow until “TEMP XX.XC” is displayed in message center.
3. Press up/down arrow until desired temperature setpoint is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run indicator lights for Run mode or press the right/left arrow keys to go to next/previous parameter.

Setting the Overtemp Setpoint

Caution In the event that the heaters are locked on as a result of a failure in the main temperature control, 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. Should the main temperature control fail, the overtemp circuit will disconnect power to all heaters when the chamber temperature reaches the Overtemp setpoint. When the chamber temperature falls below the Overtemp setpoint, the overtemp circuit will reconnect power to all heaters. An incubator operating in the overtemp condition will maintain the chamber temperature approximately 1°C around Overtemp setpoint.

Setting the Overtemp Setpoint (continued)

The factory overtemperature setpoint (default) is 40°C. However, the overtemp can be set up to 55°C in 0.5° increments. If the incubator's operating temperature setpoint is set above the overtemp setpoint, the overtemp setpoint will automatically update to 1°C above the temperature setpoint. It is recommended that the overtemp setpoint be maintained at 1°C over the operating temperature setpoint.

To set the Overtemp setpoint:

1. Press the Mode key until the Set indicator lights
2. Press the right arrow until OTEMP XX.XC is displayed in the message center
3. Press the up or down arrow key until the desired Overtemp setpoint is displayed
4. Press Enter to save the setting
5. Press the Mode key until the Run indicator lights or press the right or left arrow to go to the next or previous parameter.

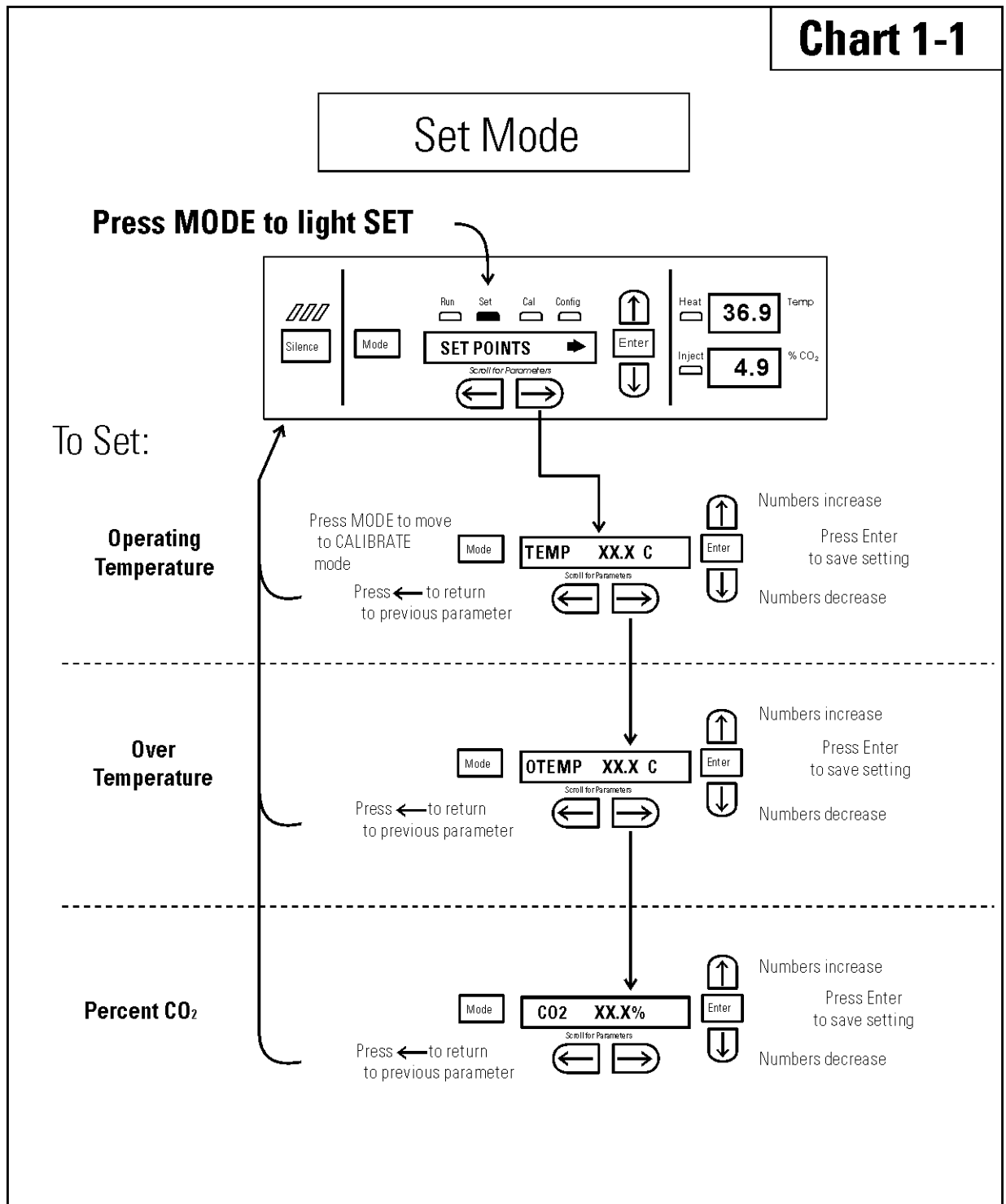
Setting the CO₂ Setpoint

All T/C CO₂ cells are calibrated at the factory at 37°C, high humidity, and 10% CO₂. Therefore, if a temperature setpoint of 37°C has been entered, the humidity pan has been filled and the CO₂ control is to run between 0-10% with a T/C CO₂ sensor, the CO₂ setpoint may be entered immediately. Otherwise, it is important to allow the unit 12 hours to stabilize at the temperature setpoint before entering the CO₂ setpoint.

All models of the incubator have a CO₂ setpoint range of 0.0% to 20.0%. The incubator is shipped from the factory with a CO₂ setpoint of 0.0%. At this setting, all CO₂ control and alarms are turned off. To change the CO₂ 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 arrows until the desired CO₂ 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 press the right/left arrow keys to go to next/previous parameter.

Chart 1-1



Section 2 Calibration

After the unit has stabilized, several different systems can be calibrated. In the calibration mode, the air temperature, CO₂ and RH levels can be calibrated to reference instruments. To access the 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 2-1 at the end of this section for more detail.

Calibration frequency is dependent on use, ambient conditions and accuracy required. A good laboratory practice would require at least an annual calibration check. On new installations, all parameters should be checked after the stabilization period.

Prior to calibration, the user should be aware of the following system functions. While the unit is in the calibration mode, all system control functions are stopped so the unit remains stable. Readout of the system being calibrated will appear on the message center. If no keys are pressed for approximately five minutes while in calibration mode, the system will reset to Run mode so control functions are reactivated.

Caution Before making any calibration or adjustments to the unit, it is imperative that all reference instruments be properly calibrated. It is the responsibility of the user to understand the interactive effects of temperature, CO₂%, O₂%, and RH% on each other and the independent reference instruments, especially a Fyrite® sensor. Read and understand all reference instrument operating manuals before use. Double-check all values entered into the incubator for accuracy before completing the calibration and returning the unit to service. ▲

Calibrating the Temperature

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

Temperature Stabilization Periods

Startup - Allow 12 hours for the temperature in the cabinet to stabilize before proceeding.

Already Operating - Allow at least 2 hours after the display reaches setpoint for temperature to stabilize before proceeding.

Calibrating Temp (continued)

1. Press the Mode key until Cal indicator lights.
2. Press the right arrow until "TMPCAL XX.XC" appears in the message center.
3. Press up/down arrow to match display to calibrated instrument.
4. Press Enter to store calibration.
5. Press the Mode key to return to Run or the right/left arrow to go to next/previous parameter.

Calibrating T/C CO₂ System

Models 310, 311, 350 and 351 have a thermal conductivity (T/C) CO₂ sensor. Thermal conductivity of the incubator atmosphere is not only effected by the quantity of CO₂ present, but also by the air temperature and water vapor present in the incubator atmosphere. In monitoring the effects of CO₂, air temperature and absolute humidity must be held constant so any change in thermal conductivity is caused by a change in CO₂ concentration.

Any changes to the temperature setpoint and/or humidity level control method (humidity pan location, capping ports, HEPA filter type) will necessitate a re-calibration of the CO₂ control.

T/C CO₂ Sensor Stabilization Periods

Some T/C CO₂ sensors go through an aging period, especially on new installations. Calibration should be checked on a weekly basis, and adjusted as necessary. When stabilization occurs, checks may become less frequent.

Start -Up - The CO₂ sensor has been calibrated at the factory for 37°C and elevated humidity. Allow the temperature, humidity, and CO₂ levels in the chamber to stabilize at least 12 hours before checking the CO₂ concentration with an independent instrument.

Presently Operating - Make sure the chamber doors are closed. Allow at least 2 hours after the temperature and CO₂ displays reach their setpoints for chamber atmosphere stabilization.

Calibrating T/C CO₂ System (continued)

1. Measure the CO₂ concentration in the chamber through the gas sample port with an independent instrument. Take several readings to ensure accuracy.
2. Press the right arrow until “CO₂CAL XX.X%” is displayed in the message center.
3. Press the up /down arrows to change the display to match the independent instrument.
4. Press Enter to store the calibration.
5. Press the Mode key to return to Run Mode or the right or left arrows to go to the next/ previous parameter.

Calibrating Infra-Red (IR) CO₂ System

Models 320, 321, 360 and 361 have an infrared (IR) CO₂ sensor. Infrared CO₂ sensors are not affected by chamber atmosphere, temperature or humidity. However, the light detector in the sensor is affected by wide temperature changes. Therefore, changing temperature setpoints could necessitate a recalibration of the IR CO₂ sensor before use. Chamber temperature should be allowed to stabilize before checking CO₂ concentrations with an independent instrument, especially on start-up.

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

Start-Up- Allow the temperature and the CO₂ of the cabinet to stabilize at least 12 hours before proceeding.

Presently Operating - Allow CO₂ to stabilize at least 2 hours at setpoint before proceeding.

To ensure accurate calibration, the unit will not allow CO₂ to be spanned below 3%. If the cabinet does not contain at least 3% CO₂, increase the setpoint and allow the unit to stabilize before completing this procedure.

Calibrating the IR CO₂ System (continued)

1. Measure the CO₂ concentration in the chamber through the gas sample port with an independent instrument. Take several readings 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 the 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 cycle.
7. Press the Mode key to return to Run mode.

Calibrating Relative Humidity

All 310 Series incubators can be equipped with an optional direct readout relative humidity (RH) sensor. This is a readout only of the chamber relative humidity level. It does not provide any control of the relative humidity in the cabinet.

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.

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

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

Calibrating Relative Humidity (continued)

1. Press the Mode key until the Cal indicator lights.
2. Press the right arrow key until “RH CAL XX%” appears in the message center.
3. Press the up/down arrow to match the display to the independent instrument.
4. Press Enter to store the calibration.
5. Press the Mode key to return to Run mode.

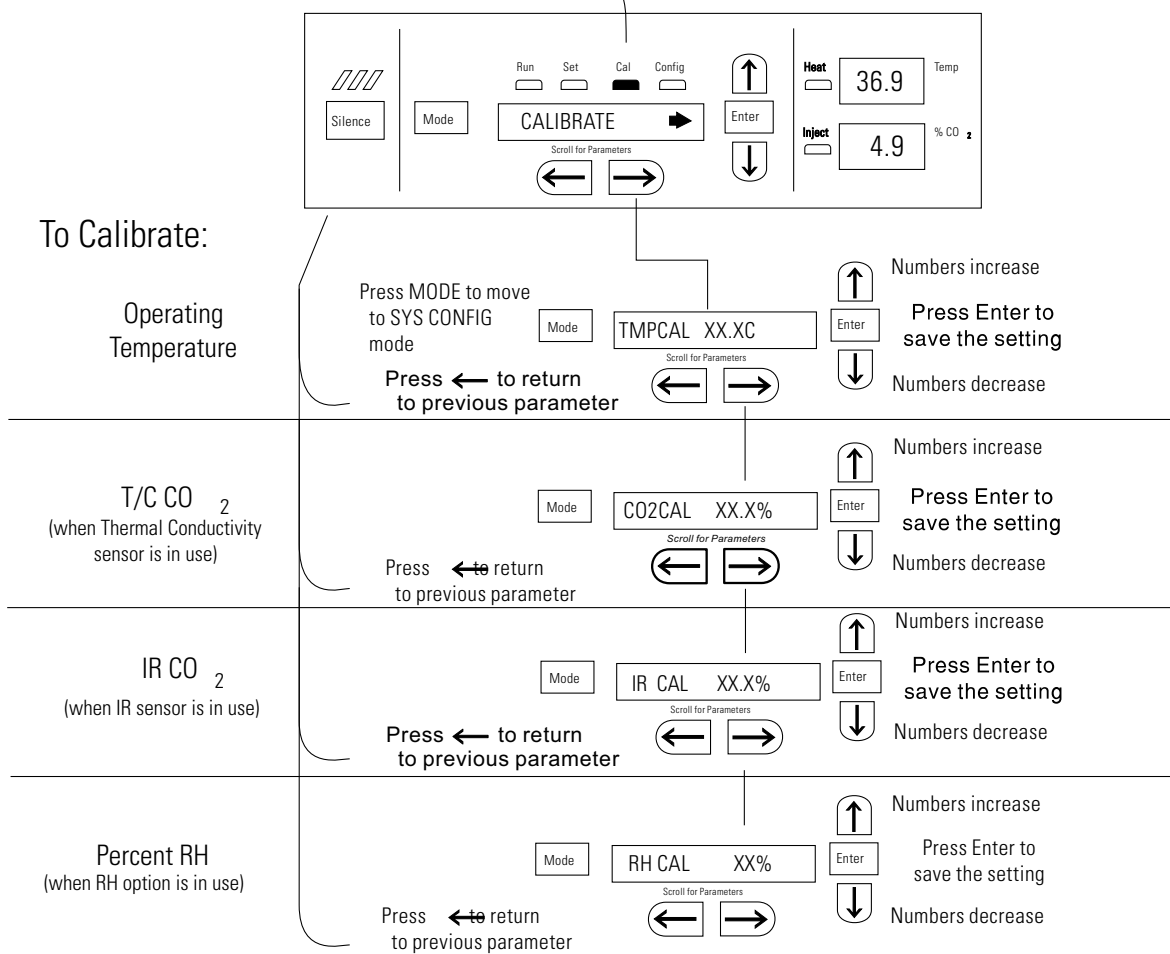
If a reliable RH measuring device is not available, the display may be calibrated to a typical level. This calibration method should be accurate to within 5%.

1. Follow the RH stabilization periods outlined previously.
2. With a full humidity pan and stable temperature, the relative humidity in the chamber will be 95%.
3. Using Step 3-5 of the relative humidity sensor adjustment, adjust the display to 95%.

Chart 2-1

Calibrate Mode

Press Mode to light CAL



Section 3 Configuration

Several features available in Configuration Mode 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 and/or left arrow until the appropriate parameter appears in the message center. See Chart 3-1 for more detail.

Turn 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 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.

Set an Access Code

A 3-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 up/down arrow to change the access code.
4. Press Enter to save the access code.
5. Press the Mode key to return to the Run mode or right/left to go to next/previous parameter.

Set a Low Temp Alarm Limit

The low temp alarm limit (tracking alarm) 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° below setpoint. The factory setting is 1° 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 TMP LO -X.XC is displayed in the message center.
3. Press 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.

Enable the Low Temp Alarm to Trip Contacts

The low temperature alarm can be programmed to trip the remote alarm contacts. A setting of ON allows it, a setting of OFF will not allow the temperature 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 TEMP RLY XXX is displayed.
3. Press the up/down key to toggle the setting ON/OFF.
4. Press Enter to save the setting
5. Press the Mode key to return to Run or the right/left arrow key to go to next/previous parameter.

Set a Low CO₂ Alarm Limit

The low CO₂ alarm limit (tracking alarm) is the deviation from the CO₂ setpoint which will cause a low CO₂ alarm. The setpoint is variable from 0.5% CO₂ below setpoint to 5.0% CO₂ below setpoint. The factory setting is 1.0% CO₂ 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 CO₂ LO -X.X% is displayed in the message center.
3. Press up/down arrow to change the low CO₂ alarm limit.
4. Press Enter to save the low CO₂ alarm limit.
5. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

Setting a High CO₂ Alarm Limit

The high CO₂ alarm limit (tracking alarm) is the deviation from the CO₂ setpoint which will cause a high CO₂ alarm. The setpoint is variable from 0.5% CO₂ above setpoint to 5.0% CO₂ above setpoint. The factory setting is 1.0% CO₂ 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 up/down arrow to change the high CO₂ alarm limit.
4. Press Enter to save the high CO₂ alarm limit.
5. Press the Mode key to return to run mode or right/left to go to next/previous parameter.

Enable CO₂ Alarms to Trip Contacts

High and Low CO₂ alarms can be programmed to trip the remote alarm contacts. A setting of ON allows it, a setting of OFF will not allow the CO₂ alarms to trip the contacts. The factory setting is ON.

1. Press the Mode key until the Config indicator lights.
2. Press right arrow until CO₂ RLY XXX is displayed in message center.
3. Press 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.

Set Zero #, Span # for T/C CO₂ Sensors

If a new T/C CO₂ sensor is being installed, the two numbers on the factory installed sticker on the T/C cell must be entered to calibrate the CO₂ in the unit.

Note For the technician's convenience, a second label containing the two numbers is supplied with the new T/C cell and should be applied to cover the original label inside the electronics drawer.

Note The '-' symbol denotes the 'minus sign' which is displayed as required by scrolling the zero number through 0.

1. Press the Mode key until the Config indicator lights.
2. Press right arrow until T/C ZR# XXXX is displayed in message center.
3. Press up/down arrow to change the Zero number to match the sticker.
4. Press Enter to save the new setting.
5. Press right arrow until T/C SP# XXXX is displayed in message center.
6. Press up/down arrow to change the span number to match the sticker.
7. Press Enter to save the setting.

Note Pressing Enter will erase any CO₂ cal. offset value previously entered into the Calibration menu.

8. Press the Mode key to return to Run mode or right/left to go to next/previous parameter.

Set 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 which will cause a low RH alarm. The setpoint is variable from setpoint 0 to 90% RH. The factory setting is 0% RH which disables 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 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.

Enable 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 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.

Enable 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 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.

Select Primary Tank w/ 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 2. The factory setting is Tank1.

1. Press the Mode key until the Config indicator lights.
2. Press the right arrow until TANK SEL X is displayed in the message center.
3. Press 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.

Disable the Gas Guard System

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

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 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.

Communications Address for RS485

On units that have the RS485 option, direct communication with the Model 1535 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 485 ADDR is displayed in the message center.
3. Press up/down arrow to change 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

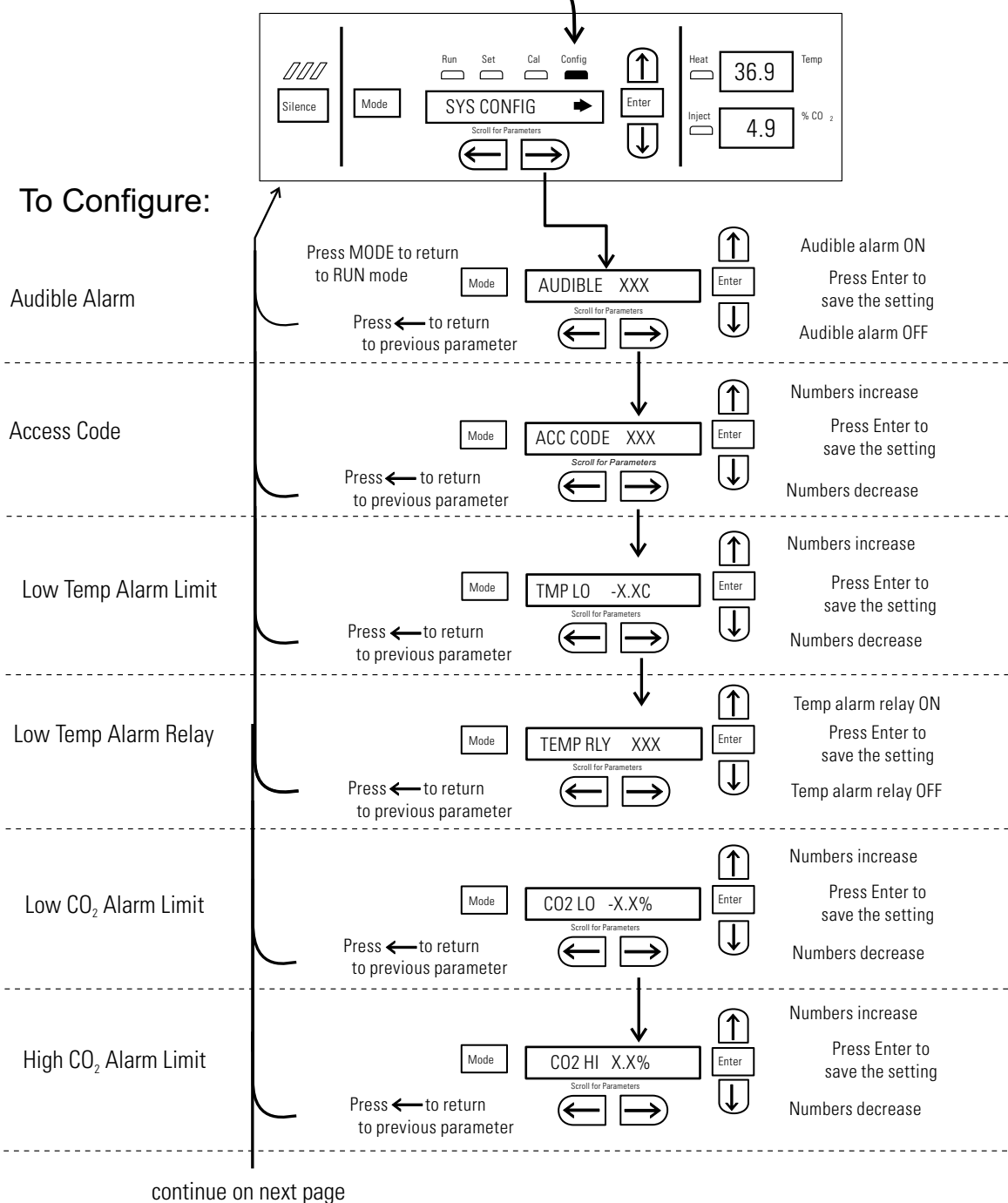
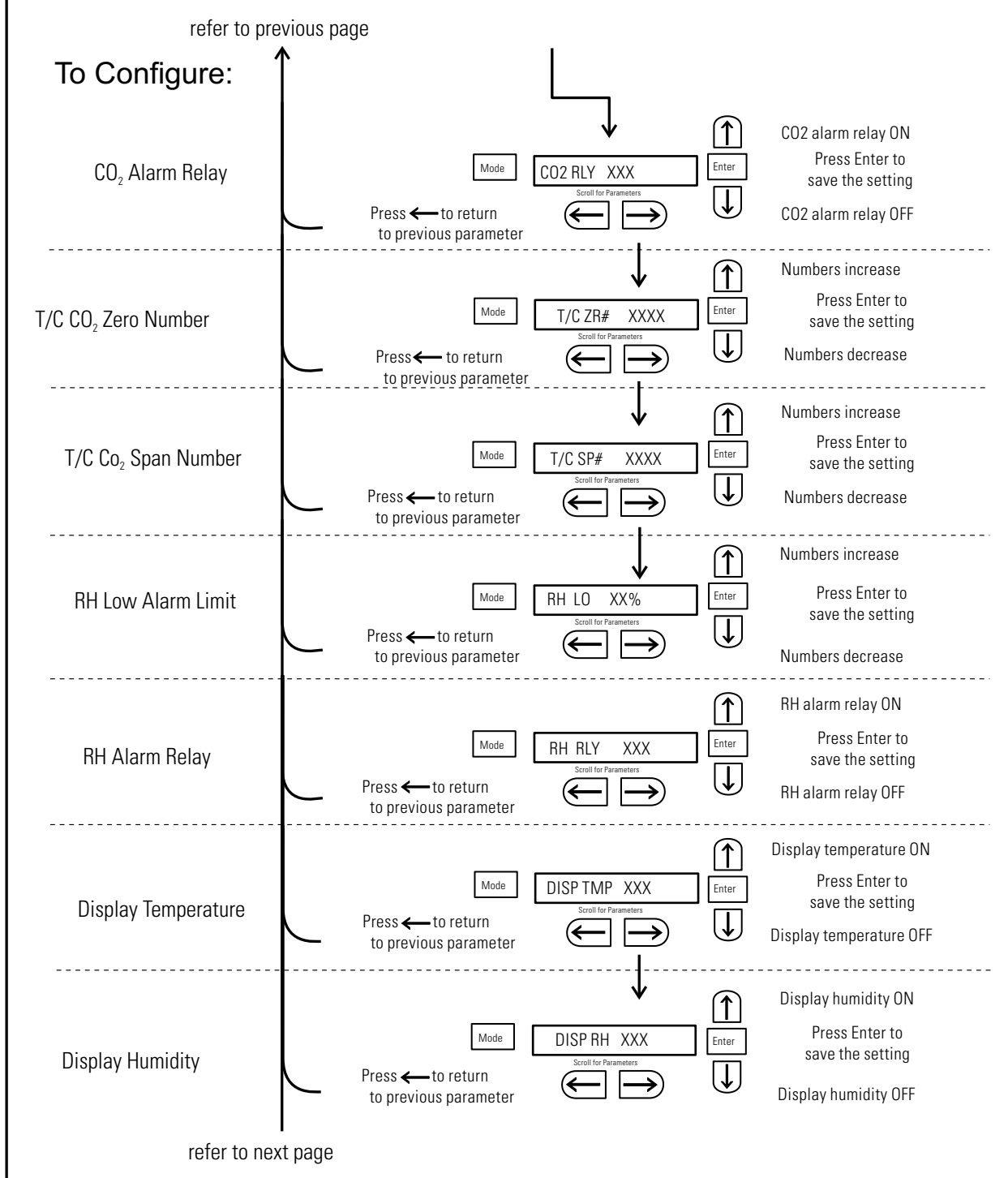


Chart 3-1
Page 2 of 3

Configure Mode

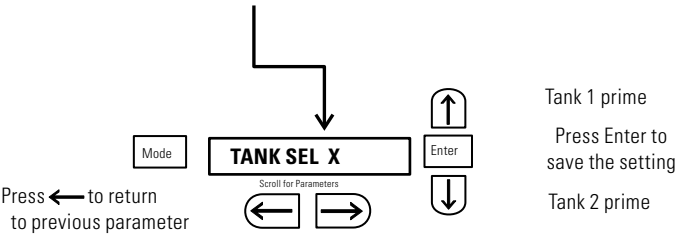


Configure Mode

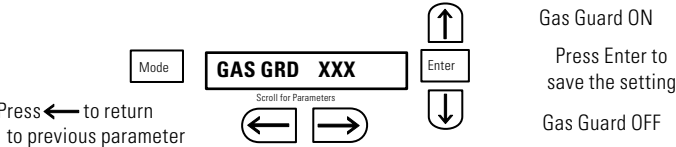
refer to previous page

To Configure:

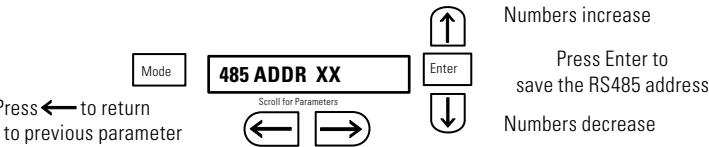
Tank Select



Gas Guard



RS485



Section 4 Alarms

The Model 310 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.

Table 4-1. Alarms and Descriptions

Description	Message	Delay	Ringback	Relay
No alarm condition exists	SYSTEM OK	----	----	----
CO2 System Auto Calibrating	CO2 AUTO CAL	----	----	----
Temp > Otemp Set point (see Section 1)	SYS IN OTEMP	0 min.	15 min.	Yes
Air Temp Sensor Fault (See Section 4)	TMP SNSR ERR	0 min.	15 min.	No
Temperature Controller Failure (See Section 4)	TMP CTRL ERR	0 min.	15 min.	YES
CO2 Sensor Fault (See Section 4)	CO2 SNSR ERR	0 min.	15 min.	No
CO2 Auto Zero Fault (IR option only, See Section 4)	IR AUTOZ ERR	0 min.	15 min.	No
CO2 Sensor Cannot be Calibrated (IR option only, See Section 4)	REPL IR SNSR	0 min.	15 min.	No
Inner Door is Open (see Section 4)	DOOR OPEN	15 min.	15 min.	No
CO2 is higher than CO2 High Tracking Alarm	CO2 IS HIGH	15 min.	15 min.	Programmable
CO2 is lower than CO2 Low Tracking Alarm	CO2 IS LOW	15 min.	15 min.	Programmable
TEMP is lower TEMP Low Tracking Alarm	TEMP IS LOW	15 min.	15 min.	Programmable
RH is lower than RH Low Limit Alarm (RH option)	RH IS LOW	30 min.	15 min.	Programmable
Tank 1 is low, switch to Tank 2 (Gas Guard only)	TANK1 LOW	0 min.	----	No
Tank 2 is low, switch to Tank 1 (Gas Guard only)	TANK2 LOW	0 min.	----	No
Both tanks are low (Gas Guard only)	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.

Temp Control Failure Alarm TMP CNTR ERR

In addition to other safety features designed into Model 310 Series incubators, a thermostat is also provided to monitor the cabinet's temperature. In the unlikely event of a temperature control failure, the thermostat will turn off all heaters at a cabinet temperature of 65°C, $\pm 10\%$. This is intended to be a safety feature to protect the incubator, and is not intended to protect the cell cultures or the equipment inside the chamber should a temperature control failure occur.

Sensor Fault Alarms

The microprocessor in Model 310 Series incubators continually scans all available sensors to ensure that they are operating properly. Should an error be detected, the incubator sounds an alarm and displays the appropriate message. If such an alarm occurs, contact your local distributor or the Technical Services department.

CO2 SNSR ERR

If the cables or connectors between the main microprocessor board and the CO₂ sensor or between the CO₂ board and the sensor head on the I/R CO₂ units become loose or disconnected, the CO₂ SENS ERR alarm occurs.

I/R Units

On I/R incubators, the red light on the I/R module (see Figure 5-8 for module circuit board location) will be lit continuously if communication is lost between the CO₂ board and the sensor head. The CO₂ display will also be locked at 00.0 without injection. Turning the incubator Off and On will not clear the alarm. Only proper connection of all components will correct the alarm.

IR AUTOZ ERR

On incubators equipped with an IR CO₂ control system, calibration is performed automatically once every 24 hours using the Auto Zero feature. If a CO₂ correction of more than 0.45% is detected then the Auto Zero cycle is aborted and the IR AUTOZ ERR appears in the display, the visual alarm flashes, and the audible alarm sounds. The unit will continue to function using the last valid CO₂ correction value. The error may be cleared by performing the IR CO₂ control system calibration (see Section 2) or waiting 24 hours for the next Auto Zero cycle.

IR AUTOZ ERR (continued)

Warning Do not disassemble the IR CO₂ sensor as there are no user-serviceable adjustments. ▲

Possible problems which cause this alarm are:

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

Possibilities are:

Defective or electrically disconnected air pump

Kinked auto zero vinyl tubing

Disconnected tubing between the air pump and the sensor

Plugged filter or orifice on the 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 example, calibrating the CO₂ will correct the alarm.
- High background CO₂ in the laboratory. This could be from leaks in the tank, regulator or vinyl CO₂ tubing.
- High CO₂ sensor calibration drift. This will require replacement of the sensor.
- Calibration of the CO₂ system to less than 3% actual CO₂. If this has occurred, contact the Technical Services Department.

REPL IR SNSR

If the Auto Zero feature cannot properly calibrate the sensor, then REPL IR SNSR appears in the display, the visual alarm flashes, the audible alarm sounds, and the chamber CO₂ control disabled. The CO₂ control and alarms can be disabled by changing the setpoint to 0.0% (see Section 1) or the IR CO₂ sensor must be replaced. Call Technical Services.

PREVENTIVE MAINTENANCE

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

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

Thermo Fisher Scientific has qualified service technicians, using NIST traceable instruments, available in many areas. For more information on Preventive Maintenance or Extended Warranties, please contact Technical Services.

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 chlorine content.
- Use water as described in Fill Humidity Pan.
- Avoid spraying cleaner on the CO₂ sensor.
- Do not use powdered gloves for tissue cultures.

Action	Daily	Weekly	Monthly	6 Months	Yearly	2 Years
Inspect the inner and outer door latches and hinges for proper operation and excessive mechanical wear; inspect the line cord insulation and inner door silicone gasket for chips and cracks. Replace as required.					✓	
Check water level in the humidity pan, ½” from top. See “Filling the Humidity Pan”.		✓				
Check proper blower motor operation (air flow, noise, and vibration)		✓				
Verify and document CO ₂ humidity and temperature calibration, as applicable. See Calibration section.					✓	
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 water. See “Clean the Interior,” “Clean Humidity Pan”.	<i>Before first use, after every service call, and between experiments to prevent cross-contamination.</i> <i>More frequent decontamination may be required, depending on use and environmental conditions.</i>					
Change HEPA and gas filters, if applicable (<i>or as needed</i>). See “Installing Access Port Filter”, “Installing Air Sample Filter”, “Installing HEPA Filter”.				✓		

Section 5 Routine Maintenance

Caution 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. ▲

Warning It is the responsibility of the user to immediately clean up after all accidental spills of hazardous materials. Be certain to follow local EHS policies with regards to personal protective equipment, cleaning, and disposal. ▲

Disinfecting the Incubator Interior

Use an appropriate disinfectant, such as quaternary ammonium. All articles and surfaces to be disinfected must be thoroughly cleaned, rinsed with sterile water, and rough dried.

Warning 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. ▲

Warning Do not spray T/C sensor with flammable solutions. The internal temperature of the CO₂ sensor is approximately 150°C when the unit is in operation. Allow sufficient time for the sensor to cool before cleaning. ▲

Caution 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. ▲

Note If condensation is visible on the ceiling of the chamber, yet the message center does not display ADD WATER, then the liquid level switch could be faulty. Call Technical Services.

1. Remove the shelves, HEPA filter (a factory installed option), access port filter, sample air filter, left and right duct sheets and the top duct. The top duct requires the two wing nuts to be removed.

Warning If the unit has been in service, disconnect the power cord from both the unit and the power source, turn off all gas regulators, and allow the unit to cool before disinfecting. ▲

2. Set the HEPA filter aside. Wash the shelves, ducts, wing nuts and stopper with disinfectant. Optional: The shelves, ducts and wing nuts may be autoclaved.

Disinfecting the Interior (continued)

3. Remove the blower scroll held on by four screws. Remove the blower wheel and the access port filter. If a new blower wheel and scroll are going to be used, discard the old ones per local EHS policies and procedures.. If the old ones are being reused, wash and rinse all parts with disinfectant.
4. The CO₂ sensor may be lowered by unscrewing the retaining ring around the sensor. This will allow the sensor gasket to be removed, cleaned and replaced. WIPE the CO₂ sensor, do not spray or soak.
5. Wash the inner door gasket with disinfectant. The inner door gasket may be removed and/or replaced.
6. Wash the cabinet interior with disinfectant, starting at the top and working down. Refer to the disinfectant directions for length of time needed before rinsing. 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.
7. If the CO₂ sensor gasket was removed, spray it with 70% alcohol and install it. Install the sample filter.
8. Install the top duct, left and right ducts, inner door gasket, and access port stopper spraying each with 70% alcohol.
9. Install new HEPA Filter.
10. Install the shelves and spray with 70% alcohol.

Cleaning the Cabinet Exterior

Use a lint-free cloth to clean the exterior, especially the door handle. Do not use any liquids (including spray cleaners) on the control panel. Instead clean with a dry microfiber cloth.

Wipe the surfaces (except control panel) twice using a clean cloth dampened in clear water. Wipe dry with a clean cloth.

Cleaning the Glass Doors

The chamber glass door and the optional independent inner glass doors may be cleaned using the same disinfectant used on the incubator interior. It is imperative that they be rinsed with sterile distilled water to remove the disinfectant residue. The doors should then be dried with a soft cloth.

Cleaning the Glass Doors (continued)

Precautions in the cleaning and care of the incubator glass doors:

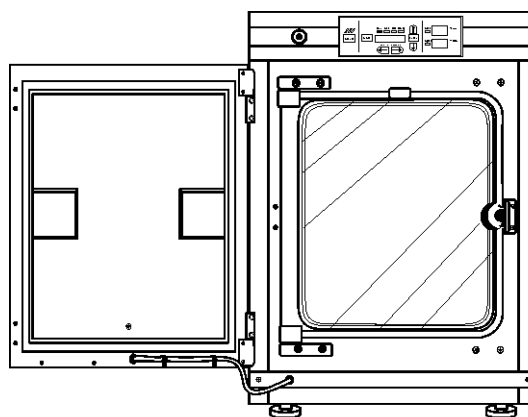
Moisture leaches alkaline materials (sodium, Na) from the surface of the glass. Evaporation of the moisture concentrates the alkaline and may produce a white staining or clouding of the glass surface. Cleaning chemicals with a pH above 9 and heat (autoclaving) accelerate the corrosion process. Therefore, it is very important to rinse and dry the glass doors after cleaning. Autoclaving the glass doors should be avoided.

There is no simple method for repairing corroded glass. In most cases, the glass must be replaced.

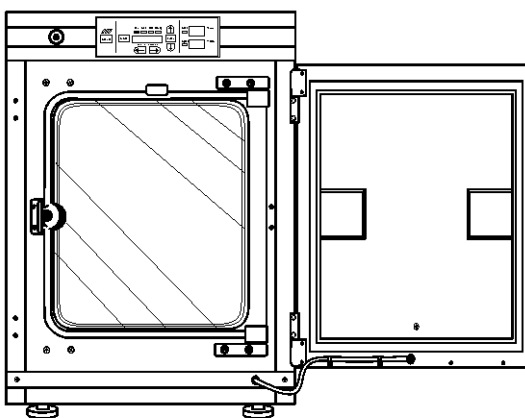
Cleaning the Humidity Pan

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.

Reversing the Door Swing



Left hand door swing



Right hand door swing

Figure 5-1. Door Swings

Reversing the Door Swing (continued)

For side-by-side operation or changing lab layouts, the inner and outer doors are field reversible. The procedure is written from the perspective 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 screwdriver, a flatblade screwdriver and an 1/8" Allen wrench. The door reversing procedure takes about 30 minutes.

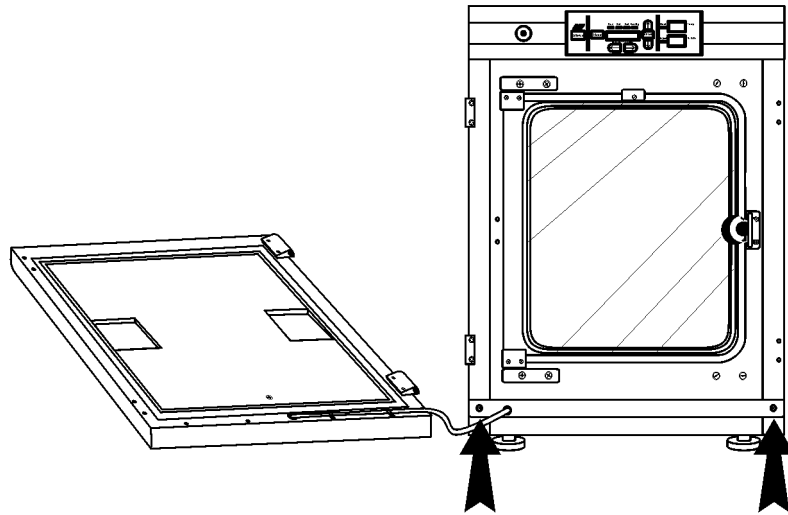


Figure 5-2. Remove Two Screws

Warning The electronics drawer contains hazardous voltages. If the unit has been in service, disconnect the power cord from both the unit and the power source, turn off all gas regulators, disconnect all tubing and any other connections from the rear of the electronics drawer, and allow the unit to cool before reversing the door swing. ▲

1. Remove the kick plate at the bottom of the cabinet by removing the two Phillips screws indicated by the black arrows in the illustration. Disconnect the cable inside the cabinet.
2. Open the outer door and remove it by lifting it off its hinge pins. Place the door on a padded surface to prevent scratches (Figure 5-2).

Note The hinge pins are not connected to the brackets and may fall out when the door is lifted off. ▲

3. Refer to the illustration of the outer door in Figure 5-2. With a Phillips screwdriver, remove and save the four nylon screws from the door hinge mounting holes. The black arrows identify the screw locations.
4. Remove the door hinges, rotate them 180° and secure them on the left side of the door. Install the nylon screws into the newly exposed holes.

Reversing the Door Swing (continued)

5. Remove the two plastic clips securing the door heater cable. These clips will be rotated 180° when installed on the left lower edge of the door frame.

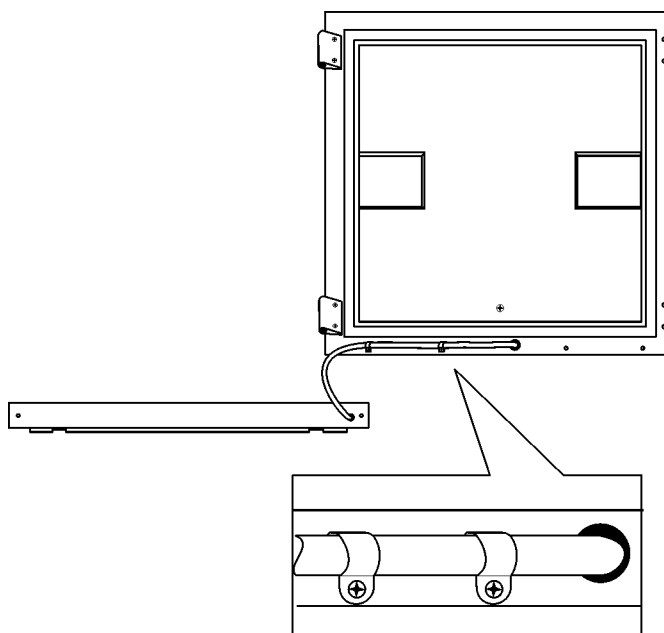


Figure 5-3. Rotate Kickplate

6. Rotate the kick plate and attach the door heater cable with the clips as shown in Figure 5-3. The insert in the illustration shows the proper positioning of the clips.

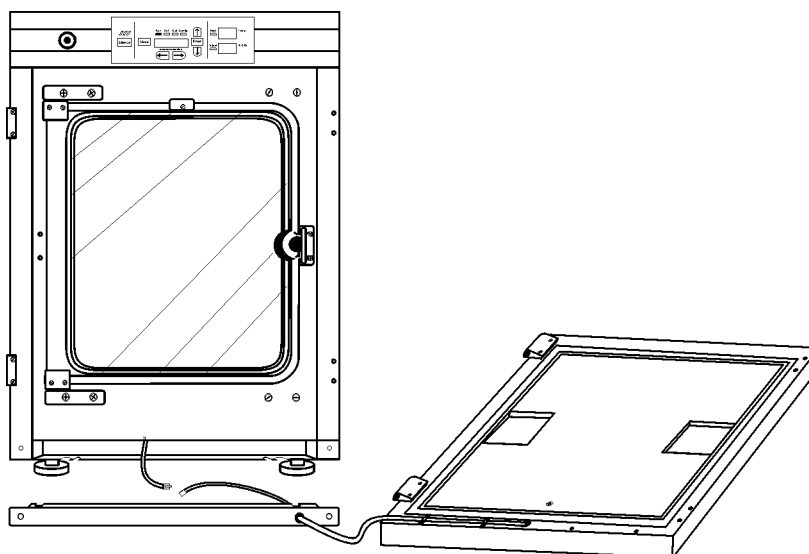


Figure 5-4. Unit with Detached Door

7. The incubator and door should look similar to Figure 5-4.

Reversing the Door Swing (continued)

8. Refer to Figure 5-5 for the next steps. Remove the nylon screws along the right side of the cabinet. Remove the outer door hinges. Rotate them 180° and install them on the right side of the cabinet. Install the nylon screws in the holes vacated by the hinges.
9. With a 1/8" Allen wrench, remove the door open switch target plate on the top of the inner door.

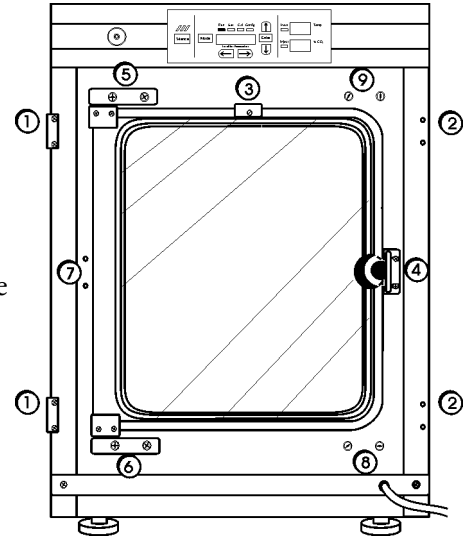


Figure 5-5. Component Locations

10. Remove the door latch striker plate.
11. Hold the door securely and remove the upper hinge bracket on the cabinet. This hinge bracket will be rotated 180° and be placed in the lower right corner of the cabinet where indicated.
12. Lift the glass door from the lower hinge and set it aside. Then remove the lower hinge from the cabinet. This hinge bracket will be rotated 180° and be placed in the upper right corner of the cabinet where indicated.
13. Remove the screws and washers from the new striker plate location. These screws and washers can be threaded into the holes vacated by the striker plate where indicated.
14. Rotate the striker plate 180° from its original position and attach it to the cabinet where indicated.
15. Using a flatblade screwdriver, remove the threaded nylon plugs from the new hinge bracket locations. Install the lower hinge bracket where indicated.
16. Rotate the door 180° and place it in the lower hinge bracket. Install the upper hinge bracket where indicated.
17. Screw the threaded plugs into the holes vacated by the door hinge brackets where indicated in Figure 5-6.

Reversing the Door Swing (continued)

18. Install the door open switch target plate. Refer to Figure 5-6 and 5-7. The plate must be positioned exactly 12.5 inches from the outside edge of the cabinet to the leading edge of the plate. Do not overtighten.
19. Connect the door heater cable and install the kick plate with the door heater cable on the right side.
20. Installing the outer door onto the hinge pins completes the door reversal procedure.

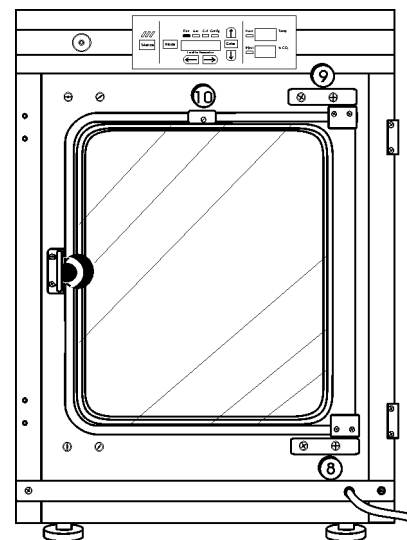


Figure 5-6. Reversed Components

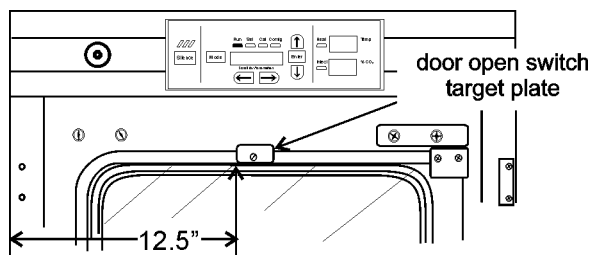


Figure 5-7. Plate Position

HEPA Filter (Factory Installed Option)

Replace the HEPA filter routinely on an annual basis, or more often if it changes color. The filter should also be changed when the chamber is cleaned.

Replacing the Power Fuses



Warning The electronics drawer contains hazardous voltages. Replacing the fuses should be performed by qualified personnel only. If the unit has been in service, disconnect the power cord from both the unit and the power source, turn off all gas regulators, disconnect all tubing and any other connections from the rear of the electronics drawer. ▲

There are only two replaceable fuses in the incubator. To access the fuses:

1. Open the outer door to the chamber.
2. Remove the two screws located below the control panel.
3. Lift up on the control panel, then pull it out.

Replacing the Power Fuses (continued)

- 5. Refer to Figure 5-8 for the location of the two fuses.
- 6. Slide the control panel back in, replace the screws and return the unit to service. If the fuse(s) blow after restoring power to the incubator, contact Technical Services.

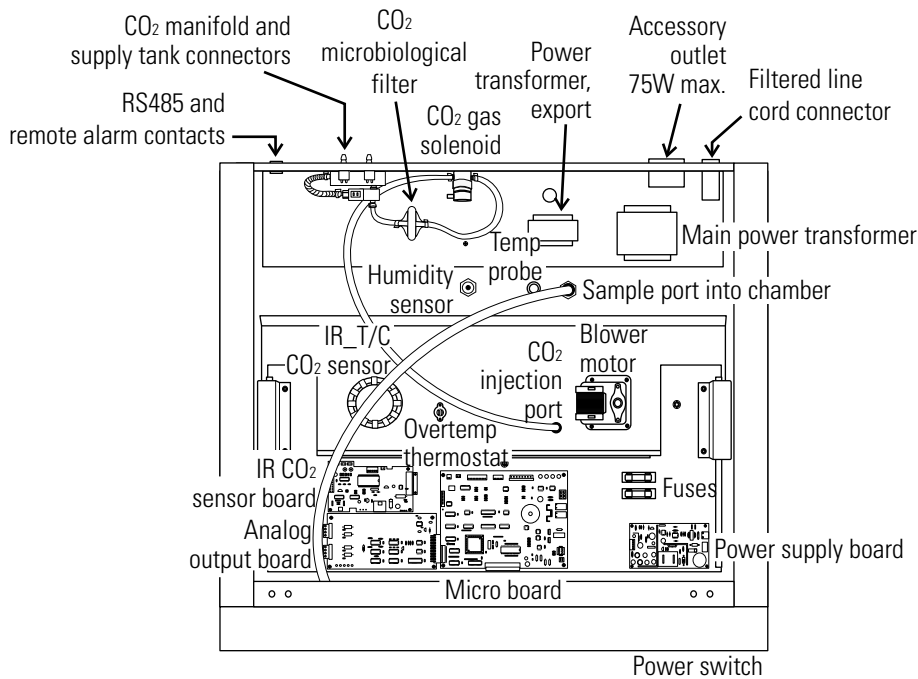


Figure 5-8. Major Components in Electronics Drawer

Table 5-1. Fuses

Fuse Voltage	Manufacturers Part #	Amperage Rating	Rupture Speed	IEC Letter Code
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
24 VAC Door Heat	Schurter 034.3124	5.0 Amp	Time-Lag	T

Major Components

Expanded descriptions for some of the components indicated in Figure 5-8 follow.

Power Switch - Located beneath the control panel. The outer door must be open to access the switch.

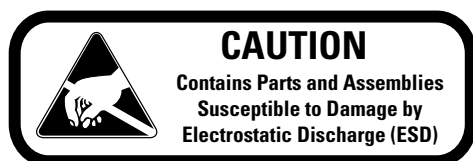
RS 485 and Remote Alarm Contacts - Connectors and auxiliary wire through port

CO₂ manifold and supply tank connectors - Part of the Gas Guard system, a factory installed option.

Humidity sensor (optional)

Analog output board - 4-20 mA, 0-1 Volt, 0-5 Volt

Electronics Section



1. Turn off the incubator's power switch and unplug the power cord.
2. Remove the two screws from the front of the cabinet top and the two screws in the uppermost corners of the back panel.
3. Slide the top about an inch to the rear and lift it off.

Note There are small locking tabs in the back which will be bent if the top is lifted off without sliding it first to the back. ▲

Replacing the Sample Air Filter

1. Connect one end of the sample port filter to the ceiling port.
2. Connect the other end of the filter to the back of the blower fan inlet.

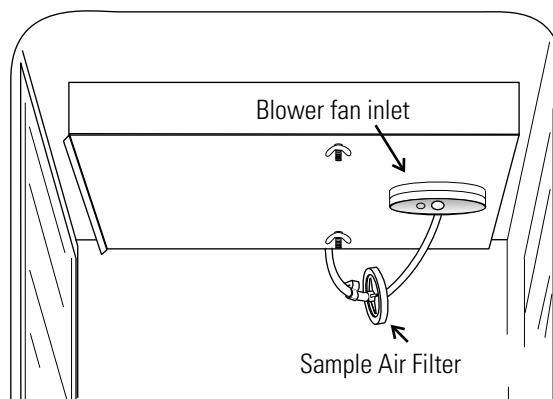


Figure 5-9. Air Sample Filter

Section 6 Factory Options

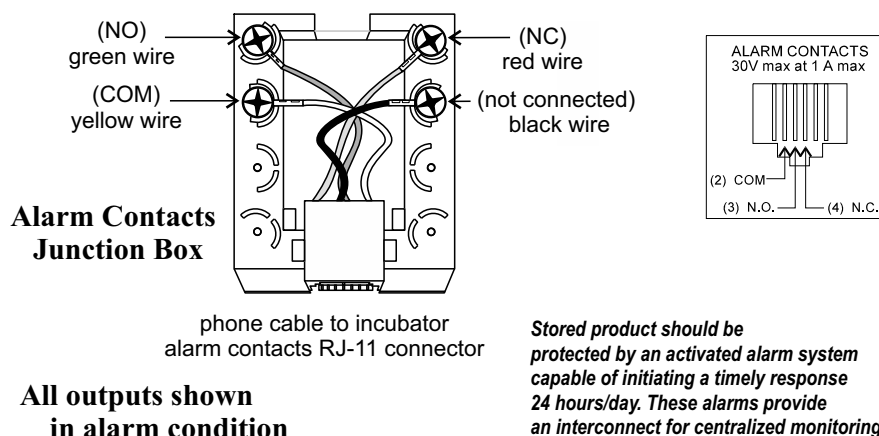
Descriptions for connections to external equipment follow.

Connect Remote Alarm Contacts

A set of relay contacts is provided to monitor alarms through an RJ11 telephone style connector on the back of the cabinet. Refer to Figure 6-3 for the location of the alarm connector. The 12-foot telephone cord (P/N 190388) and RJ11-to-screw terminal conversion box (190392) are available through Technical Services.

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

The contacts will trip on a power outage or an overtemperature condition. The contacts may also be programmed to trip or not trip on temperature alarms, CO₂ alarms, and RH alarms. See Section 3, Configuration Mode.

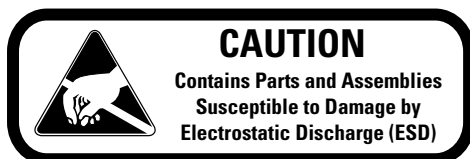


**All outputs shown
in alarm condition**

Figure 6-1. Remote Alarm Output

Note After connecting the incubator to the external alarm system, verify proper alarm operation by simply placing the incubator power switch to its off position to simulate a power outage condition.

Connect the RS485 Interface



All incubator models can be purchased with the RS485 communications option (P/N 190523). This option allows the incubator to be directly connected to a Model 1535 alarm system without the use of a communications module. A junction box is provided with each RS485 option. See Figure 6-2 for wiring details. Figure 6-3 shows the RS485 connector location on the back of the incubator cabinet.

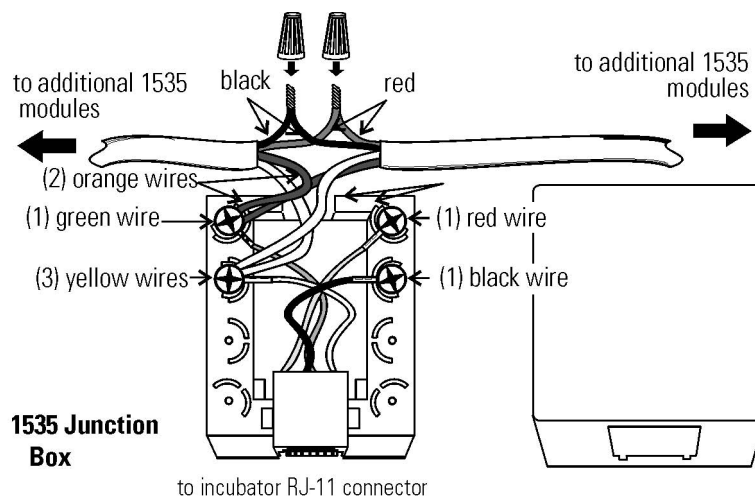


Figure 6-2. RS485 Wiring

To allow the incubator and the 1535 to communicate, an address must be allocated on the 1535. Refer to the 1535 operating manual. The same address number must be assigned to the incubator. Refer to Section 3 of this manual.

Note After connecting the Model 1535 Alarm System to the incubator, verify that there are no RS485 communication errors per the Model 1535 operating manual. Simulate incubator failures of each module to verify proper Model 1535 operation.

Connect the Analog Output Boards



The analog output board option (P/N 190512, 190543, 190544) allows the incubator to output analog signals representing the air temperature of the cabinet, CO₂ content, and 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. Refer to Table 6-1 for output specifications of the three boards.

For the 0-1V and 0-5V boards, the recording device must supply a load ≥ 1000 ohm. For the 4-20mA board, the recording device must supply a load of ≤ 100 ohm. The outputs do not have isolated grounds.

Connect Analog Output Boards (cont.)

Table 6-1. Analog Output Boards

	190512 4-20 mA Output Scaling 4-20 mA Equals	190544 0-1V Output Scaling 0-1 V Equals	190543 0-5V Output Scaling 0-5V Equals
Temperature	0.0-100.0°C	0.0-100.0°C	0.0-100.0°C
RH	0-100 %RH	0-100 %RH	0-100 %RH
CO2	0.0-100.0 %CO2	0-100.0 %CO2	0-100.0 %CO2

To wire in the analog output board, a shielded 22 gauge, 3-conductor cable (P/N 73041) is recommended, with the maximum length being 50 feet (15.2m).

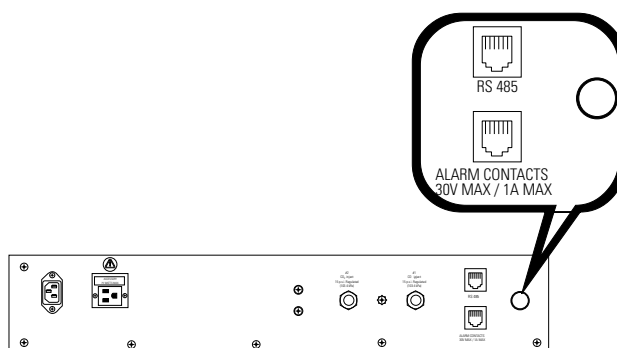


Figure 6-3. Auxiliary Through-Port in Back Panel

Warning The electronics drawer contains hazardous voltages. Opening the drawer and/or wiring in an analog board should be performed by qualified personnel only. If the unit has been in service, disconnect the power cord from both the unit and the power source, turn off all gas regulators, and disconnect all tubing and any other connections from the rear of the electronics drawer. ▲

To install the analog board:

1. Remove the top of the electronics section. Refer to Section 5 of this manual.*
3. Locate the Analog Output board, Figure 6-4 and Figure 5-8.

* Alternate access to the electronics is to open the outer door and remove the two screws in the upper corners of the cabinet just under the display top. Lifting up the top section, the electronics drawer can be pulled out to the limit of the internal wiring.

Connect Analog Output Boards (cont.)

- Each system monitored (Temp, CO₂, RH) requires two conductors (refer to Figure 6-4). Feed the wires through the auxiliary wire through-port on the back panel. This port is a circular fitting adjacent to the remote alarm and RS485 connectors as illustrated in Figure 6-3. The wire routing is shown by the black arrows in Figure 6-5.

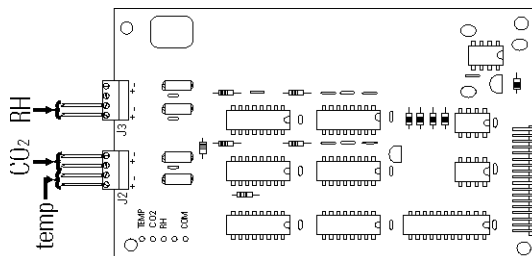


Figure 6-4. Connector Terminals

- Strip the ends of each conductor and wire it to the appropriate terminals of connectors J2 and/or J3 on the analog board. Refer to Figure 6-4.

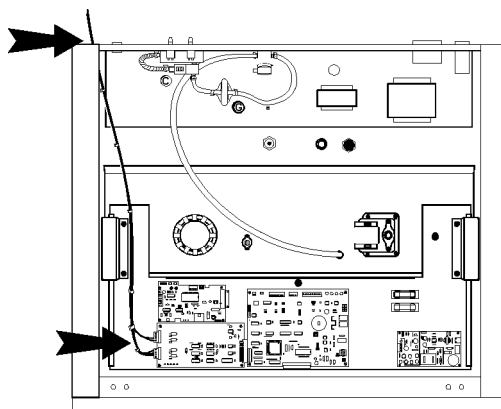


Figure 6-5. Wire Routing

- When wiring is completed, slide in the electronics drawer or the replace the sheet metal cabinet top.
- Replace the screws removed earlier.

Note Accuracy of the analog outputs measured at the circuit board terminal strip with respect to the incubator display is ± 1 unit. There is no calibration of the analog outputs by the incubator, so the instrument(s) connected to the analog outputs must be calibrated to match the incubator display before returning to service.

CO₂ Gas Guard

Warning CO₂ can be lethal in high concentrations. Refer to warnings in Section 1 of this manual. ▲

The Model 310 Series incubators can be equipped with a built-in Gas Guard system (P/N 190640) that will operate with a CO₂ gas supply. The Gas Guard uses two pressure switches to continuously monitor the pressures of two independent CO₂ supplies and automatically switches from one supply to the other when the supply pressure drops below 10 psig (68.95 kPa). The Gas Guard's design does not facilitate use by multiple incubators.

The CO₂ gas supplies must be equipped with two-stage pressure regulators with gauges. 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 (103.4 kPa), maximum. Gas pressures below 15 psig may cause nuisance alarms to occur on incubators equipped with the built-in Gas Guard.

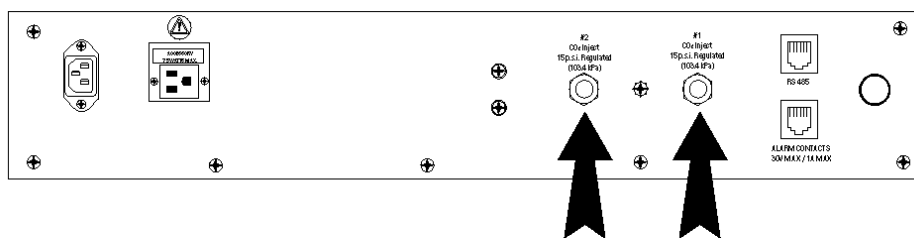


Figure 6-6. Connect Gas Supplies

Connect the CO₂ Gas Supplies

The CO₂ inlets for the Gas Guard are located on the back of the cabinet. Using 1/4" ID tubing, connect one of the CO₂ supply tanks to the fitting labeled CO₂ Inlet #1. Connect the second CO₂ supply tank to the fitting labeled CO₂ Inlet #2. Install 3/8" hose clamps to secure the 1/4" ID tubing to the barbed fittings on the regulator and back of the electronics drawer. (Refer to Figure 6-6.)

Warning Check for leaks at all connections. ▲

De-activate the Gas Guard

The built-in Gas Guard is turned ON when shipped from the factory. In addition, the Tank Sel for the Gas Guard is specified as Tank 1 when shipped. Refer to Section 3, Configuration, to de-activate the Gas Guard or change the Tank Sel from #1 to #2. If the Gas Guard system is not used, the incubator will function normally by supplying CO₂ from the supply tank connected to Inlet #1.

Operation of CO₂ Gas Guard

With the Gas Guard in operation, the incubator will use the gas supplied by the tank connected to Inlet #1 until the pressure drops below 10 psig (68.95 kPa). At this time, the Gas Guard automatically switches to gas supplied through CO₂ Inlet #2.

In addition, the incubator automatically changes the Tank Sel in Configuration Mode from 1 to 2 to indicate that the incubator is now using gas supplied through Inlet # 2. If the gas supply to Inlet #1 is replenished, the incubator will continue to operate using the gas supplied through Inlet #2 unless the operator changes the Tank Sel from #2 to #1 through Configuration Mode. Refer to Section 3, Configuration.

Audible and visual alarms occur on the control panel when the gas guard switches from one supply to the other. The audible alarm sounds until the operator presses the Silence key on the control panel. The visual alarm in the Message Center reads Tank 1 Low while the audible alarm is sounding, but the message is removed when the operator presses the Silence key. However, the 'Tank Low' indicator on the control panel stays lighted until the condition is resolved. The unit operates normally.

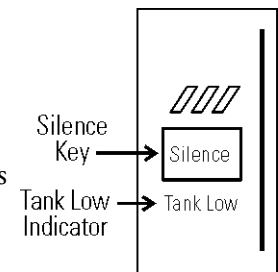


Figure 6-7. Silence Key

Both the audible and visual alarms described above do not ring back once the Silence key is pressed. If the Gas Guard system does not detect an adequate gas supply at CO₂ Inlet #1 or Inlet #2, 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 (68.95 kPa).

Humidity Readout

The 310 Series incubators can be equipped with a humidity sensor (P/N 190643) to monitor the relative humidity 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. Humidity level factors are listed below.

- Water level in the humidity pan
- Frequency of door openings
- The humidity pan located on bottom of chamber versus a shelf.

Humidity Readout (continued)

Incubators equipped with a Thermal Conductivity CO₂ sensor rely on a constant level of relative humidity in order to accurately measure and control the CO₂ concentration in the incubator. s

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

Uninterruptible Power Supply Connections

Warning The Uninterruptible Power Supply is not rated for life-support applications. ▲

The optional Uninterruptible Power Supply ([UPS] P/N 270078 and 270082) provides a back-up power source for the incubator. When the batteries are fully charged and the incubator operating at 37°C in an 18°C ambient temperature, the UPS provides approximately one hour of uninterrupted power during a power failure. A higher operating temperature decreases this back-up time, a higher ambient temperature increases it. This estimated time assumes that the incubator will be already at its operating temperature and that the incubator door will not be opened during the back-up period.

The remote alarm contacts will not trip during a power failure while connected to the UPS until battery power is exhausted. There is however, an audible and visual alarm when the unit switches to battery operation.

The UPS batteries are fully charged when the unit has been connected to utility power for a minimum of four hours. The UPS power switch does not have to be on for the batteries to charge. When battery replacement becomes necessary, refer to the UPS user's manual.

Caution Use only factory recommended UPS units which produce a pure sine wave output. Other UPS units could damage the incubator and void the warranty. Typical facility back-up systems will not effect the efficiency of the incubator. ▲

Connecting UPS P/N 270078, 115V, 50/60Hz

1. Plug the incubator line cord into one of the receptacles on the back of the UPS. Then plug the UPS line cord into a suitable wall outlet.
2. Turn the UPS power switch on.

Connecting UPS **P/N 270082, 230V, 50/60Hz**

Use the line cord supplied with the incubator to connect the UPS to a suitable wall outlet, and the UPS coupler to connect the incubator to the UPS.

Warning The Uninterruptible Power Supply contains potentially hazardous voltages even when not connected to line voltage. Do not attempt to disassemble UPS as it contains no user-serviceable parts. Repairs must be performed by factory trained service personnel. ▲

Section 7 Specifications

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

Temperature

Control	±0.1°C Microprocessor PID Control
Setpoint	Digital - Touch pad, 0.1°C
Range	+5C above ambient to +55C (models 310, 311)
.....	+5C above ambient to +50C (models 320, 321)
.....	+5C above ambient to +45C (models 330, 331, 340, 341)
Uniformity	±0.3°C @ +37°C
Tracking alarm	User programmable (low) indicator
Overtemp	Tracking, user programmable, action, indicator
Display	Digital, LED, 0.1°C increments

Overtemperature Safety

Type	Extreme temperature safety, action, and indicator
Sensor . . .	Thermostat, independent of temperature control system
Indicator	Message center, audible and visual alarms

Relative Humidity

Control	Humidity pan - natural vaporization
Humidity with pan	95% RH at 37°C
Optional display	1% increments
Alarm	Low RH with optional RH monitor

$$\text{CO}_2$$

Control	±0.1%	microprocessor PID control
Sensor		T/C or IR
Readability	0.1%	
Range	0 to 20%	
Inlet pressure	15 psig, ±5 psig	
Display	Digital LED, 0.1% increments	

Shelves

Dimensions 18.5" x 18.5" (47cm x 47cm)
Construction . . Stainless steel (belt sanded, both sides)
Surface area 2.4 sq. ft. (0.22 sq. m) per shelf
Max. per chamber 38.4 sq ft (3.6 sq. m)
Loading35 lbs (16kg) slide in and out, 50 lbs (23kg) stationary
Standard # 4 (shipped with unit)
Maximum # 16

Construction

Interior volume 6.5 cu. ft.
Interior Type 304 stainless steel shiny finish
Exterior 18 gauge cold roll steel
Outer door gasket . . Four-sided molded, magnetic vinyl
Inner door gasket Feather-edge, removable
Insulation Fiberglass

Fittings

Access port 1-1/4 inch removable silicone plug
CO₂ inlet 1/4" barbed
Sample port Front mounted barbed

Electrical

115 Volt models -
115VAC, 50/60 Hz, 1PH, 2.4 FLA (3.0 FLA, using 75W accessory outlet)
230 Volt models -
230VAC, 50/60 Hz, 1 PH, 2.0 FLA
Power switch/circuit breaker 2 Pole, 6.0 Amp
Accessory outlet . . Voltage equal to the cabinet input, 75 Watts maximum, 0.6A maximum, 0.5ma leakage current
Remote alarm contacts . . Overtemperature deviation of temp, CO₂, power, NO and NC

Unit BTU Output (typical @ +27°C)

115/230V 344 BTUH (100 watt)
(597 BTUH, using 75W accessory outlet)

Dimensions

Exterior . 26.0" W x 38.5" H x 25.0" F-B (66.0cm x 97.8cm x 63.5cm)
Interior . 21.4" W x 26.8" H x 20.0" F-B (54.1cm x 68.1cm x 50.8cm)

Weight

Net Weight Stainless Steel 205 lbs (93kg)
Net Weight Copper 230 lbs. (104.3kg)

Options/Accessories

HEPA filter, Factory installed: Stock no. 190858
Battery back-up, Free Standing:
Stock # 270078, 120VAC, 60Hz, Stock # 270082, 220VAC, 50Hz
Humidity, Factory installed:
. . Stock no. 190463 - provides humidity readout and low alarm
Inner door kit, Customer installed:
. . . . Stock no. 190650 - independent eight separate glass doors
Built-in Gas Guard, Factory installed:
Stock no. 190640-CO₂ only, automatically switches supply tanks
Recorders, Customer installed:
. Standard recorders used on water-jacket incubators
Decontamination kits
HEPA filter, blower assembly, inner door gasket, etc. -
Stock # 190868 (w/ HEPA filter), Stock # 190869 (w/o HEPA filter)

Copper Options

Interior ductwork Solid copper: Stock no. 190725
Perforated shelf, Customer Installed: . . . Stock no. 224166 - solid copper
Humidity Pan, Customer Installed: . . . Stock no. 237015 - solid copper
Copper interior kit, Factory installed: . . Stock no. 190870 - Replace stainless steel duct work, shelves, and . humidity pan with solid copper

Optional Data Outputs

Analog Factory installed: Stock no. 190544 - 0-1 volt
Analog Factory installed: Stock no. 190543 - 0-5 volt
Analog Factory installed: Stock no. 190512 - 4-20mA
Digital Factory installed: Stock no. 190523 - RS-485

..... (Compatible with Model 1535 Alarm Monitor only)

Certifications

CE Declarations are available upon request from the factory.

Safety Specifications

Indoor Use Only

Altitude - Up to 2,000 meters

Temperature - 5°C to 40°C

Humidity - Maximum 80% RH for temperatures up to 31°C, decreasing linearly to 50% RH at 40°C (non condensing)

Mains Supply Fluctuations - Not to exceed $\pm 10\%$ of nominal voltage

Installation Category II ¹

Pollution Degree 2 ²

Class of Equipment 1

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

Fluorinated Greenhouse Gases

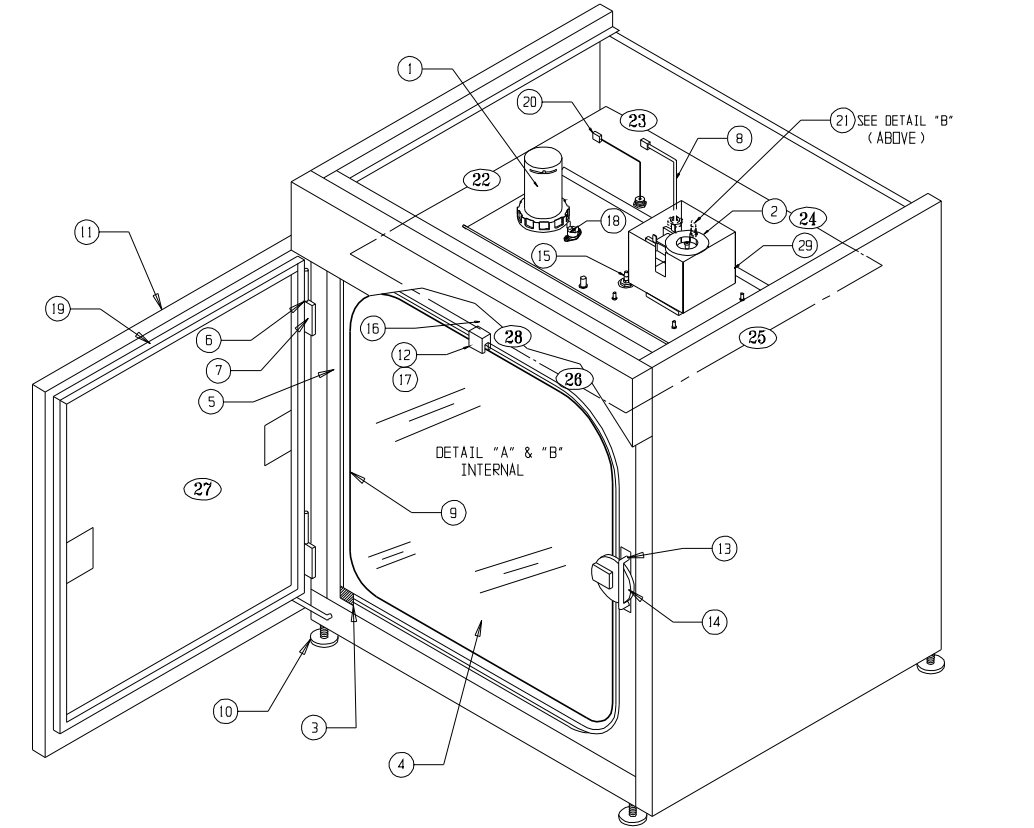
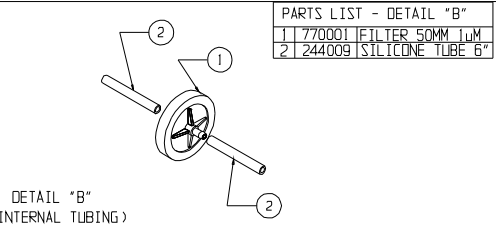
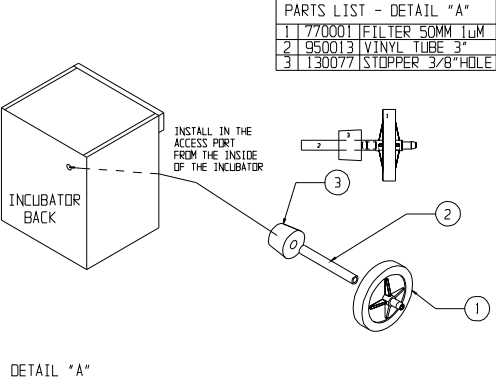
Compliant with REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on fluorinated greenhouse gases.

This product contains foam blown with fluorinated greenhouse gas, R-245fa.

Section 8 Spare Parts

Part Number	Description
190699	Removable feather gasket
190670	Duct sheet and shelf channel kit
190772	Micro board, (main control)
230135	Fuse, 1A, TD, 5 x 20mm
230120	0.5A fuse, TD, 5 x 20mm (accessory outlet)
230161	Fuse, 5A, 5 x 20mm
156126	Motor, 2-pole, 115VAC, 50/60 Hz
190793	Display board
290184	Probe, 2252 Ohm/25°C, 1/8 x2
770001	Disposable filter, 99.97 (CO ₂ line, air sample)
760175	HEPA filter, 5.5" diameter
760199	HEPA2 VOC Filter Replacement Kit (includes 760200 HEPA2, 117036 silicone plug, 101018 o-ring)
1900067	Filter Replacement Kit (includes [2] 770001 filter and 760175 HEPA)
1900094	HEPA2 VOC Filter Replacement Kit (760200 HEPA2, 190985 access port filter, 770001 filter)
224175	Shelf
190868	Decontamination kit with HEPA filter
190869	Decontamination kit without HEPA filter
130077	Stopper with 3/8" hole
290090	Thermal conductivity type CO ₂ sensor
190885	Infrared type CO ₂ sensor w/ auto zero
250087	CO ₂ valve with fittings
290154	RH sensor assembly (RH display option)
190883	Sample port filter assembly
190661	IR sensor filter
190985	Filtered air exchange assembly
230153	6A, DPDT circuit breaker switch (power)
400201	40W Switcher kit
420096	130VA transformer 12/24V
1194021	34 position control to display ribbon cable
420097	43VA transformer (230VAC units only)
360213	Pressure switch (Gas Guard option)
250121	Gas valve (Gas Guard option)
190512	4-20mA output board
190543	0-5V output board
190544	0-1V output board

10#	STK #	DESCRIPTION
1	310-201-0-0	IR/TC SENSOR ASSEMBLY
2	310-202-0-0	MOTOR/BLOWER ASSEMBLY
3	116022	HINGE, 1/4" GLASS
4	105060	DOOR, TEMPERED GLASS
5	180174	FACE FRAME, PVC
6	190611	HINGE PIN, STN STEEL
7	190612	HINGE BLOCK, ALUMINUM 2.0"
8	190643	TEMPERATURE PROBE ASSEMBLY
9	191534	REMOVEABLE FEATHER GASKET
10	113002	ADJUSTABLE FOOT
11	190788	OUTER DOOR W/ HEATER
12	190795	MAGNET MOUNT, DOOR
13	190833	LATCH MOUNT, INNER DOOR
14	180210	KNOB, BLACK
15	XXXXX	GAS INJECT PORT
16	360283	SWITCH, MAGNETIC ACTUATED
17	360231	MAGNET, DOOR
18	400133	THERMOSTAT, SNAP ACTION
19	990033	MAGNETIC GASKET, MOLDED
20	290184	"OPTIONAL" RH SENSOR
21	840020	SAMPLE PORT BULKHEAD FITTING
22	132054	LEFT HEATER, 13 WATTS
23	132050	BACK HEATER, 30 WATTS
24	132051	BOTTOM HEATER, 24 WATTS
25	132055	RIGHT HEATER, 22 WATTS
26	132053	COLLAR HEATER, 9 WATTS
27	NA	DOOR HEATER, 69 WATTS
28	132056	FACE HEATER, 27 WATTS
29	1900252	MOTOR GUARD



310-200-0-0



CUSTOMER APPROVAL/REFERENCE		5	11N-40027-10-16-14	DRAGAGE/CS	BRAND NO. 360270
APPROVED BY		15	151-40277-09-27-04	REWORK/CLON	CHG. 190289 GLASS DOOR TO 190300
DATE OF APPROVAL		4	11N-3180102-24-04	REWORK/CLON	CHG. 190289 MOTOR & GUARD
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REVISION NO. DATE BY DESCRIPTION OF REVISION		2	11N-2755107-24-00	REWORK/CLON	CHG. 250137 PROBE TO 250184
DATE 11-4-00		1	11N-3180102-24-04	REWORK/CLON	CHG. 190289 MOTOR & GUARD
CUSTOMER		11N-3180102-24-04			
JOB TITLE MAIN CABINET		11N-3180102-24-04			
CHG. TITLE ILLUSTRATED PARTS DRAWING		11N-3180102-24-04			
LOCATION		LINE NUMBER		DRAWING NUMBER	
INCUBATOR		310-200-0-0		310-200-0-0	

CHAMBER TOP

TC SENSOR ASSEMBLY

IR SENSOR ASSEMBLY

* FIELD REPLACEMENT: REPLACE (3) ITEMS ANY TIME SENSOR IS REPLACED.

ID#	STK #	DESCRIPTION
1	110081	1.875" DIAMETER CAP
2	200125	2" BLUE NUT
3	190875	SENSOR CAP ADAPTER
4	103099	GASKET
5	640046	DOWEL PINS (2)
6	190781	CO2 MOUNT
7	190820	IR ADAPTER WASHER
8	190885	IR SENSOR ASSEMBLY (MATCHED SET)
9	103101	GASKET
10	190661	SENSOR COVER (REPLACEMENT PART)
*	11	103100 GASKET
*	12	190782 TC ADAPTER
*	13	290090 THERMAL CONDUCTIVITY SENSOR
*	14	O-RING, Buna-N, 1 1/8" ID X 1/8"

CUSTOMER APPROVAL/REFERENCE			
APPROVED BY:	3	1N-3816104-10-01	ALD/CLS
DATE OF APPROVAL:	2	1N-288102-02-00	GLE/CLS
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REVISED PARTS LIST	1	12-7-98	GLE/CLS
RELEASED FOR PRODUCTION	0	11-8-98	GLE/CLS
REVISION NO. DATE	BY	DESCRIPTION	SCALE
DATE 11-8-98	DMV	1	1
CUSTOMER:			
JOB TITLE: MAIN CABINET			
DWG. TITLE: TC/IR SENSOR ILLUSTRATED PARTS DRAWING			
LOCATION:	JOB NUMBER:	DRAWING NUMBER:	
INCUBATR		310-201-0-D	

Exploded view diagram of the 310/3110 Series CO₂ Incubator motor/blower assembly. The diagram shows the motor (12) at the top, followed by the motor shield & guard (9), the blower scroll (10), and the blower wheel (7). Various screws, nuts, washers, and spacers are shown in their assembly positions, labeled with callouts 1 through 15. A separate view of the motor (12) is shown at the bottom right.

BILL OF MATERIALS			
ITEM NO.	PART NO.	PART DESCRIPTION	QTY
1	23007	#10-32 SS HEX NUT	1
2	22002	#4-40 X 1/2 SS PHP SCREW	4
3	640047	#8-32 x .750" LONG STN STL SELF-CLINCHING STUD	5
4	22142	#8-32 x 3/4 FHP SCREW	4
5	23002	#8-32 ZP LKWASH HEX NUT	4
6	730068	.310 ID TEFLON FLAT WASHER	1
7	100113	3.500 X 1.500 BLOWER WHEEL POLY.	1
8	190790-31-1	310 INCUBATOR BLOWER SUPPORT	1
9	1900252	BLOWER MOTOR SHIELD & GUARD	1
10	190846	BLOWER SCROLL -RESTRICTED, 310/3110	1
11	190831	BLOWER SCROLL- NO HEPA, 310	1
12	156126	MOTOR	1
13	190832	MOTOR SPACER	1
14	730034	NYLON WASHER 1.500"OD X .500"ID	1
15	730069	SILICONE WASHER	1

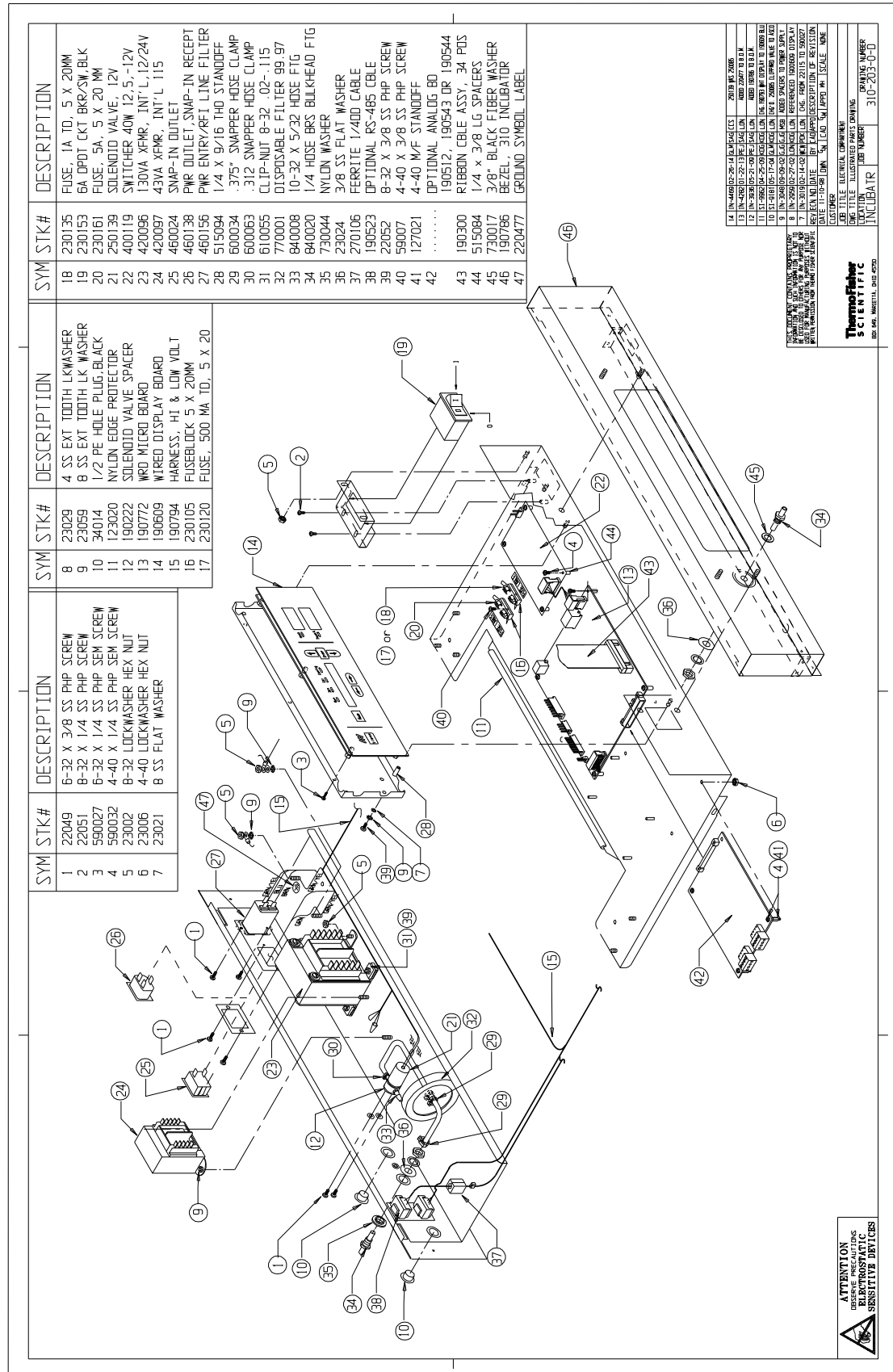
6	1N-4310	03-27-13	GJG	SAG	CCS	23007 HEX REPLACED 23052 WING NUT			
5	1N-3180	03-18-04	GJG	MSB		REVISED MOTOR & BLOWER WHEEL			
4	1N-2958	08-10-01	MLM	PDK	LDN	CHANGED TO INJECTED MOLDED SCROLL			
3	SI-1987	06-28-00	GJG	LDN		REVISED BLOWER SCROLL #13			
2	1N-2759	12-20-99	GJG	LDN		REVISED SEAL WASHER INFO			
1	1N-2759	10-21-99	GJG	MSB		REVISED SEAL WASHER INFO			
REV ECN NO.						DATE	BY	CAD APPD	DESCRIPTION OF REVISION
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MODEL/PART NAME: 310/3110 SERIES INCUBATOR									
DWG TITLE: MOTOR/BLOWER ILLUSTRATED PARTS DRAWING									
OWN: PDK CAD: PDK APPD: MH DATE: 11-08-98 SCALE: 0.625									
MATERIAL: N/A									
PAINT: N/A									
TOLERANCE UNLESS OTHERWISE SPECIFIED									
ANGLES: DECIMAL: .XX± FRACTION: XXX±									
DRAWING NUMBER 310-202-1									
SIZE D									

ThermoFisher
SCIENTIFIC

BOX 649, MARETTA, OHIO 45750

Assembly Drawing
Model:
310/3110 Series
CO₂ Incubator

310-202-1-D Rev. 6
Page 1 of 1



Exploded view diagram of a Thermo Scientific Direct Heat Incubator. The diagram shows the internal components of the incubator, including the heating element, temperature sensor, and wiring harness. The components are numbered 1 through 18, corresponding to the parts list on the right.

SYM	STK#	DESCRIPTION
1	22052	8-32 X 3/8" SS PHP SCREW
2	22115	6-32 X 1/4" SS PHP SCREW
3	110081	CAP, MODIFIED
4	190856	IR SENSOR HARNESS (2PC)
5	190885	IR CO2 SYSTEM (SENDER & BOARD)
6	246008	VINYL TUBING 1/16ID X 1/8 OD X 30"
7	246019	WIRE RNF TUBING 1/4"OD X 3-3/4"
8	250121	SOLENOID VALVE, 3 WAY 12VDC
9	270140	FERRITE PLATE
10	270141	FERRITE END CLIP
11	350006	BRASS ADAPTER, 1/8 HOSE X 10-32
12	360213	PRESSURE SWITCH
13	840057	1/4" HOSE TO 1/8" NPT BRASS 90°
14	440030	FLAT CABLE MOUNT, ADHESIVE
15	600034	HOSE CLAMP .375"
16	600044	SWAPPER HOSE CLAMP 1/2"
17	840027	NYLON FITTING 1/16 TUBE X 10-32
18	1900089	HARNESS, GAS GUARD

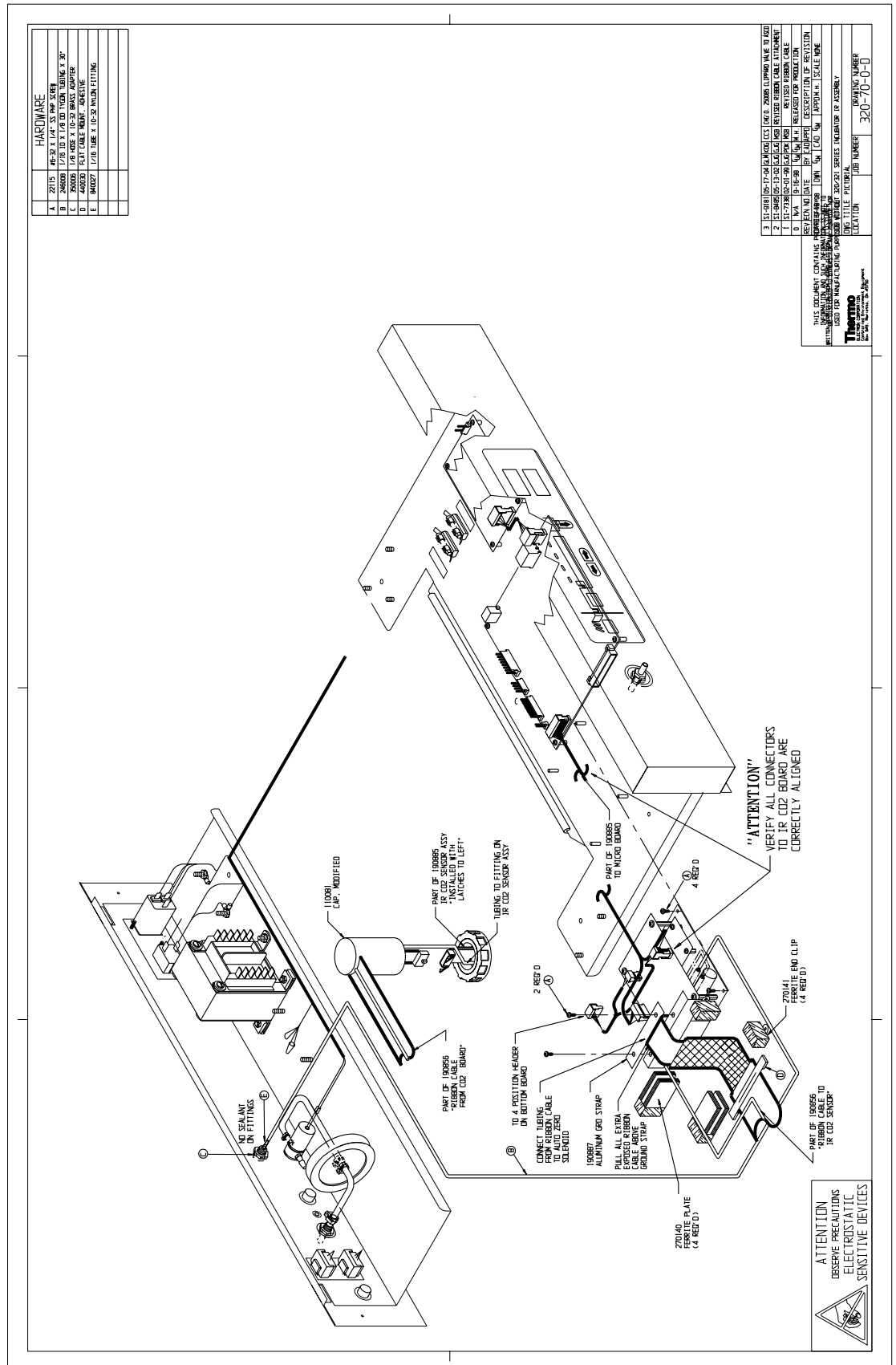
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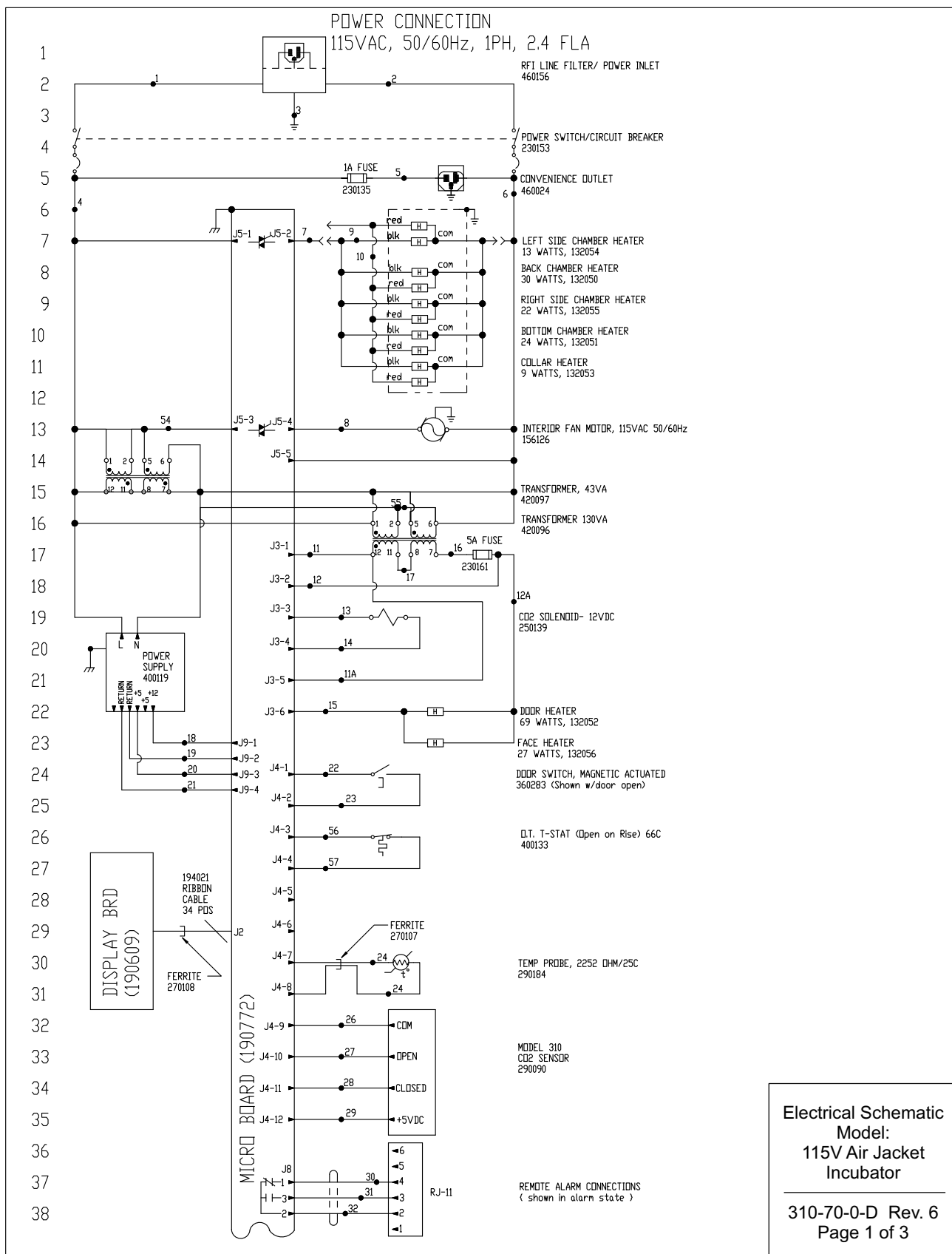
Thermo Scientific
Life Sciences Group
7000 University Ave.
Rockville, MD 20850-1218
USA
Phone: 1-800-541-1811
Fax: 301-987-7300
Email: techsupport@thermo.com

DATE: 11-11-08
DRAWN: JAY
CHECKED: JAY
SCALE: NONE

CUSTOMER: _____
JOB TITLE: _____
JOB NUMBER: _____
LOCATION: _____
INCUBATOR: 310-204-0-0

REVISIONS:
1. 10-4-2001 (05-12-04) BUREAU (CS) REWAVE WIRE HARNESS
2. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
3. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
4. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
5. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
6. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
7. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
8. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
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12. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
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15. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
16. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
17. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS
18. 11-11-2001 (05-12-04) BUREAU (JAY) REWAVE WIRE HARNESS



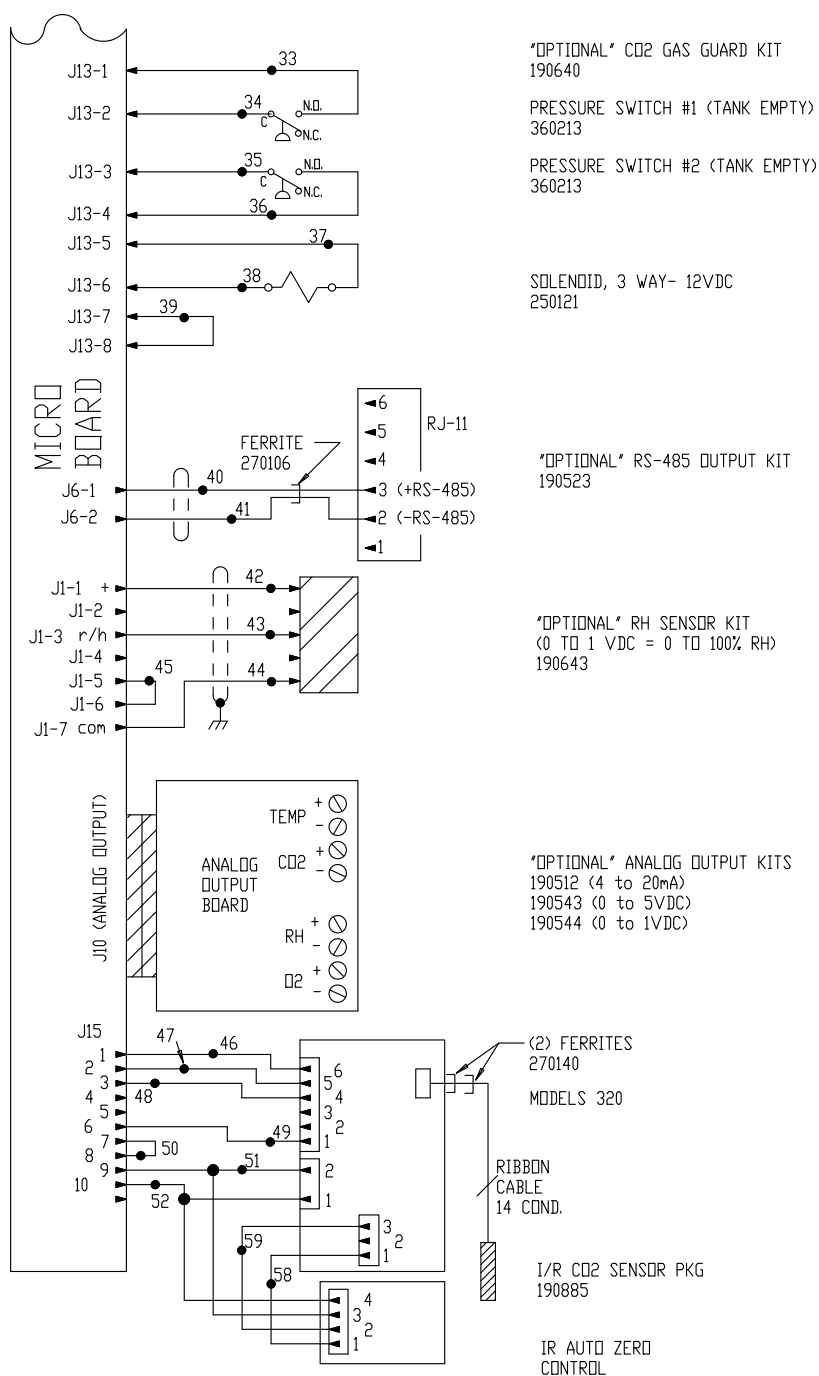


Electrical Schematic
Model:
115V Air Jacket
Incubator

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Section 9
Electrical Schematics

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Electrical Schematic
Model:
115V Air Jacket
Incubator

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Page 2 of 3

REVISIONS						
REV	DESCRIPTIONS	DRN	APPR	EFFECTIVE DATE	ECR #	
0	RELEASED FOR PRODUCTION	GLM	MAH	6/03/98	N/A	
1	CHG. 290137 TEMP. PROBE TO 290184	KDG	MAH	08-04-03	IN-3124	
2	REVISED MOTOR PART NUMBER	GJG	MSB	03-01-04	IN-3180	
3	REVISED DISPLAY BRD. PART NUMBER	DEM	DRP	01-09-14	IN-4446	
4	REVISED DISPLAY BRD. PART NUMBER	DEM	DRP	01-29-14	IN-4446	
5	250139 WAS 250085	SAG	DRP	03-17-14	IN-4469	
6	360283 WAS 360230	SAG	DRP	10-16-14	IN-4592	

WIRE REFERENCE CHART								
NO.	GA.	COLOR	NO.	GA.	COLOR	NO.	GA.	COLOR
1	16	BROWN	22	22	BLUE	47	22	ORANGE
2	16	BLUE	23	22	BLUE	48	22	YELLOW
3	16	GRN/YEL	24	22	RED	49	22	BROWN
3B	16	GREEN	25	22	RED	50	22	RED
4	18	BLACK	26	22	GREEN	51	22	GREEN
4A	18	BLACK	27	22	GRAY	52	22	BLACK
5	18	BLACK	28	22	PURPLE	53	18	RED
6	18	WHITE	29	22	ORANGE	54	18	YELLOW
7	18	ORANGE	30	22/3	BLACK	55	18	YELLOW
8	18	BLUE	31	22/3	RED	56	22	BROWN
9	18	BLACK	32	22/3	WHITE	57	22	BROWN
10	18	RED	33	20	RED	58	22	BROWN
11	18	BROWN	34	20	RED	59	22	WHITE
11A	18	BROWN	35	20	BLUE			
12	18	RED	36	20	BLUE			
12A	18	RED	37	20	ORANGE			
13	18	YELLOW	38	20	ORANGE			
14	18	YELLOW	39	20	BLACK			
15	18	BLUE	40	22/2	RED			
16	18	RED	41	22/2	BLACK			
17	18	ORANGE	42	22/3	BLACK			
18	18	RED	43	22/3	RED			
19	18	GREEN	44	22/3	GREEN			
20	18	ORANGE	45	22	BLACK			
21	22	GREEN	46	22	BLUE			

SENSOR REFERENCE VALUES

CD2 (290090) DIFFERENCE VOLTAGE OF 3-6MV/%CD2
J4-9 & J4-10 TO J4-9 & J4-11

RH (190643) J1-7 & J1-1 = 12VDC
J1-7 & J1-3 = 10MV/%RH

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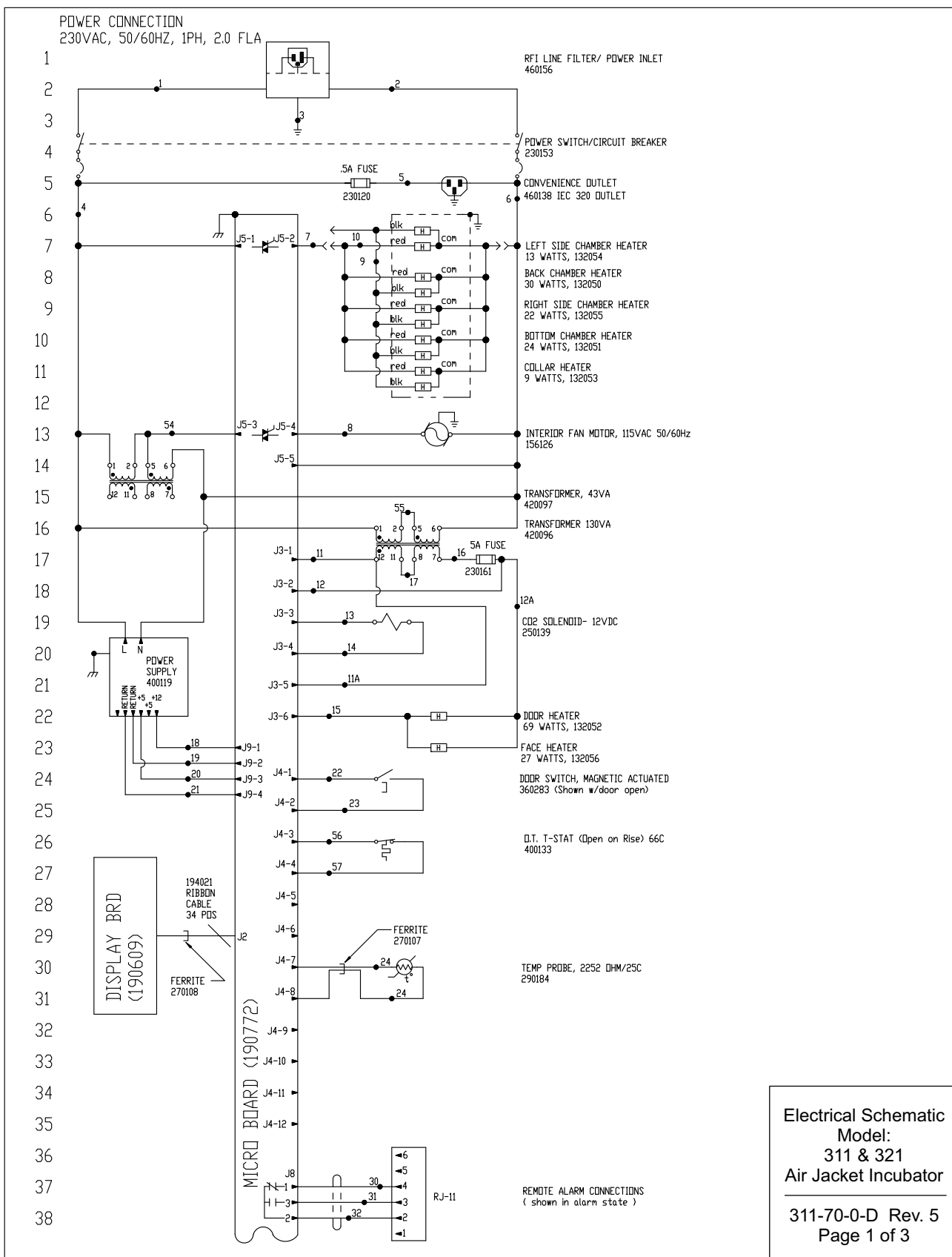
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TOLERANCES ON: 1 PL DECIMAL: ± 2 PL DECIMALS: ± 3 PL DECIMALS: ± ANGLES: ± FRACTIONS: ± SURFACES:	SIGNATURES	DATE
	DR'N GLM	3-18-98
	CHK'D	
	APPR M.H.	
	RED'N	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.	DO NOT SCALE DRAWING	
	SSF0742 1-08	

TITLE ELECTRICAL SCHEMATIC 115 VOLT (DOM.)		
MATERIAL		
SIZE D	SCALE	DWG. NO. 310-70-0-D
EP\SERIES NO.		PAGE OF
ThermoFisher SCIENTIFIC		
THERMO FISHER SCIENTIFIC BOX 649 MARIETTA, OH 45750 U.S.A.		

Electrical Schematic
Model:
115V Air Jacket
Incubator

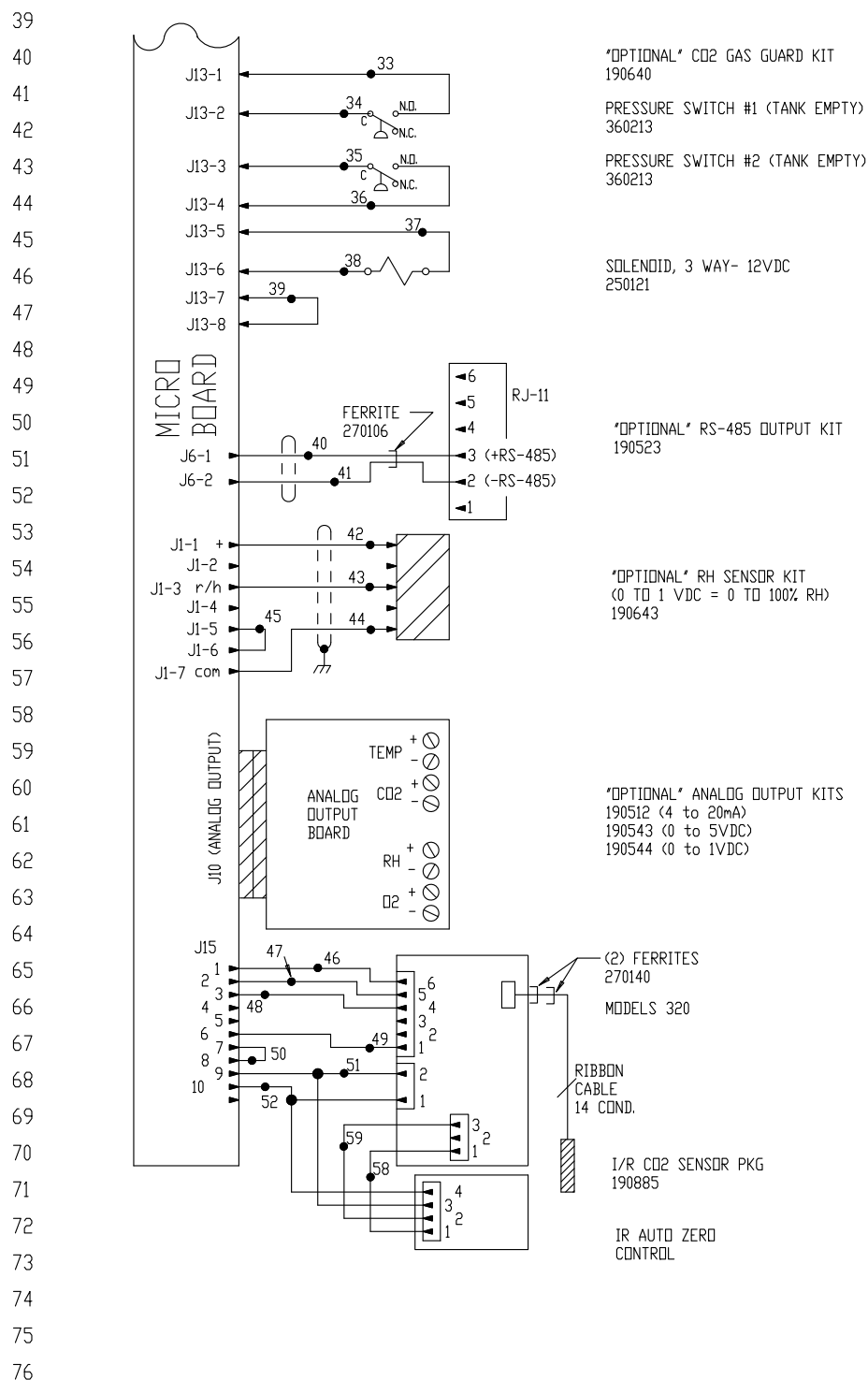
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Page 3 of 3

Section 9
Electrical Schematics



Electrical Schematic
Model:
311 & 321
Air Jacket Incubator

311-70-0-D Rev. 5
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Electrical Schematic
Model:
311 & 321
Air Jacket Incubator

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REVISIONS						
REV	DESCRIPTIONS	DR'N	APPR	EFFECTIVE DATE	ECR #	
0	RELEASED FOR PRODUCTION	GLM	MAH	6/03/98	N/A	
1	CHG. 290137 TEMP. PROBE TO 290184	KDG	LDN	08-04-03	IN-3124	
2	CHANGED MOTOR PART NUMBER	GJG	MAB	03-01-04	IN-3180	
3	CHANGED DISPLAY BRD. PART NUMBER	DEM	DRP	1-29-14	IN-4446	
4	250139 WAS 250085	SAG	DRP	03-17-14	IN-4469	
5	360283 WAS 360230	SAG	CCS	10-16-14	IN-4592	

WIRE REFERENCE CHART								
NO.	GA.	COLOR	NO.	GA.	COLOR	NO.	GA.	COLOR
1	16	BROWN	22	22	BLUE	47	22	ORANGE
2	16	BLUE	23	22	BLUE	48	22	YELLOW
3	16	GRN/YEL	24	22	RED	49	22	BROWN
3B	16	GREEN	25	22	RED	50	22	RED
4	18	BLACK	26	22	GREEN	51	22	GREEN
4A	18	BLACK	27	22	GRAY	52	22	BLACK
5	18	BLACK	28	22	PURPLE	53	18	RED
6	18	WHITE	29	22	ORANGE	54	18	YELLOW
7	18	ORANGE	30	22/3	BLACK	55	18	YELLOW
8	18	BLUE	31	22/3	RED	56	22	BROWN
9	18	BLACK	32	22/3	WHITE	57	22	BROWN
10	18	RED	33	20	RED	58	22	BROWN
11	18	BROWN	34	20	RED	59	22	WHITE
11A	18	BROWN	35	20	BLUE			
12	18	RED	36	20	BLUE			
12A	18	RED	37	20	ORANGE			
13	18	YELLOW	38	20	ORANGE			
14	18	YELLOW	39	20	BLACK			
15	18	BLUE	40	22/2	RED			
16	18	RED	41	22/2	BLACK			
17	18	ORANGE	42	22/3	BLACK			
18	18	RED	43	22/3	RED			
19	18	GREEN	44	22/3	GREEN			
20	18	ORANGE	45	22	BLACK			
21	22	GREEN	46	22	BLUE			

SENSOR REFERENCE VALUES

CO2 (290090) DIFFERENCE VOLTAGE OF 3-6MV/%CO2
J4-9 & J4-10 TO J4-9 & J4-11

RH (190643) J1-7 & J1-1 = 12VDC
J1-7 & J1-3 = 10MV/%RH

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RoHS		FAC.ID.	TITLE MODEL S 311, 321 AIR JACKET INCUBATOR			
TOLERANCES ON: 1 PL DECIMAL: ± 2 PL DECIMALS: ± 3 PL DECIMALS: ± ANGLES: ± FRACTIONS: ± SURFACES: UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.		SIGNATURES	DATE	MATERIAL ELECTRICAL SCHEMATIC 230 VOLT (EXP.)		
		DR'N GLM	3-18-98	SIZE D	SCALE	DWG. NO. 311-70-0-D
		CHK'D		EP\SERIES NO.	PAGE	OF
		APPR M.H.		ThermoFisher SCIENTIFIC		
		REDR'N				
		DO NOT SCALE DRAWING				
		SSF0742 1-08				

Electrical Schematic
Model:
311 & 321
Air Jacket Incubator
311-70-0-D Rev. 5
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THERMO FISHER SCIENTIFIC DIRECT HEAT INCUBATOR WARRANTY USA*

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

During the first year, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, including labor. In addition, after the initial warranty period of one year the CO₂ sensor (IR) will be warranted for a second year, parts only. The CO₂ sensor (T/C) will be warranted for four additional years for a total of five years, parts only. Installation and calibration is not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters and gaskets are excluded from this warranty.

Replacement or repair of components parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original warranty period. The Technical Services Department must give prior approval for return of any components or equipment. At Thermo's option, all non-conforming parts must be returned to Thermo postage paid and replacement parts are shipped FOB destination.

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

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

If equipment service is required, please call your Technical Service Department at 1-800-438-4851 (USA and Canada) or 1-740-373-4763. We're ready to answer your questions on equipment warranty, operation, maintenance, service and special applications. Outside the USA, contact your local distributor for warranty information.



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THERMO FISHER SCIENTIFIC INTERNATIONAL DIRECT HEAT INCUBATOR WARRANTY*

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

During the first year component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, excepting labor. In addition, after the initial warranty period of one year the CO₂ sensor (IR) will be warranted for a second year, parts only. The CO₂ sensor (T/C) will be warranted for four additional years for a total of five years, parts only. Installation and calibration is not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to performance of any repairs. Expendable items, glass, filters and gaskets are excluded from this warranty.

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Thermo Fisher Scientific (Asheville) LLC

401 Millcreek Road
Marietta, Ohio 45750
United States

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