Thermo Scientific Precision Model 815 Incubator

Refrigerated Incubator - Microprocessor Controlled

Operating and Maintenance Manual 7003721 Rev. 0



Thermo SCIENTIFIC

Units covered in this manual:

Catalog/Model Numbers	Volume (cu. ft.)	Voltage
3721	20	120
3722	20	230

Manual Number 7003721

Rev	ECR/ECN	Date	Description	By
0	--	1/25/10	Transfer to Marietta (was 3177879-LT2077X1)	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. ▲

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

Warning If the incubator is used in the manner specified in this operating manual, the protection provided by the equipment design may be impaired. ▲

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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.



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



Marking of electrical and electronic equipment, which applies to electrical and electronic equipment falling under the Directive 2002/96/EC (WEEE) and the equipment that has been put on the market after 13 August 2005.

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the WEEE symbol. Thermo Scientific has contracted with one or more recycling/disposal companies in each EU Member State European Country, and this product should be disposed of or recycled through them. Further information on Thermo's compliance with this directive, the recyclers in your country and information on Thermo products will be available at www.thermo.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?

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

1-740-373-4763	Direct
1-800-438-4851	Toll Free, U.S. and Canada
1-877-213-8051	FAX
http://www.thermofisher.com	Internet Worldwide Web Home Page
service.led.marietta@thermofisher.com	Service E-Mail Address

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

Our **Service Support** staff can supply technical information about proper setup, operation or troubleshooting of your equipment. We can fill your needs for spare or replacement parts or provide you with on-site service. We can also provide you with a quotation on our Extended Warranty for your Thermo 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
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 ±1°C for temperature, ±1% for gases, and ±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 CO_2 sensors, blower motors, water jackets, etc.**

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Section 1 Introduction

Your satisfaction and safety are important to Thermo and a complete understanding of this unit is necessary to attain these objectives.

Warning As a routine laboratory precaution, always wear safety glasses when working with this apparatus. ▲

This product is not intended, nor can it be used, as a sterile or patient connected device. In addition, this apparatus is not designed for use in Class I, II or III locations as defined by the National Electrical Code.

Unpacking and Damage

Save all packing material until unit is put into service. This merchandise was carefully packed and thoroughly inspected before leaving our factory.

Responsibility for safe delivery was assumed by the carrier upon acceptance of the shipment; therefore, claims for loss or damage sustained in transit must be made upon the carrier by the recipient as follows:

1. Visible Loss or Damage: Note any external evidence of loss or damage on the freight bill, or express receipt, and have it signed by the carrier's agent. Failure to adequately describe such external evidence of loss or damage may result in the carrier's refusing to honor your damage claim. The form required to file such claim will be supplied by the carrier.

2. Concealed Loss or Damage: Concealed loss or damage means loss or damage which does not become apparent until the merchandise has been unpacked and inspected. Should either occur, make a written request for inspection by carrier's agent within fifteen (15) days of the delivery date; then file a claim with the carrier since the damage is the carrier's responsibility.

If you follow the above instructions carefully, we will guarantee our full support of your claim to be compensated for loss or concealed damage.

Note Do not - for any reason - return this unit without first obtaining authorization. In any correspondence to Thermo, please supply the nameplate data, including catalog number and serial number. ▲

General Information

The incubator is commonly referred to as the standard model 815.

The Model 815 Refrigerated Incubator has been designed to provide the ultimate in temperature control. The user is assured of dependable and precise performance through the use of microprocessor technology in the temperature control circuitry. This incubator is operable in the range of -10° to 50°C. These temperature ranges will meet a wide variety of applications, such as BOD determination, general incubation, as well as the preservation of critical materials.

Performance Data

Heat-Up Time: From -10°C to 50°C; 120 minutes (Compressor "ON");

Cool-Down Time: From 50° to -10°C; 100 minutes.

Temperature Set Point (°C)	Uniformity (±°C)	Temperature Sensitivity
-10.0	±0.9	±0.1C
20.0	±0.5	
37.0	±0.5	
50.0	±0.	

Note The above performance figures are based upon the following operating conditions: Line Voltage ..... 110.5 to 112.5
Ambient Temperature ... 22.5° to 24°C

Theory of Operation

The refrigeration system, defrost heater, and air circulating fan are used in conjunction with a microprocessor controlled proportioning circuit to achieve sensitive temperature control. An RTD (Resistance Temperature Detector) located in the airstream senses any temperature deviation from the control point, and heat is provided proportionally to maintain the desired temperature. Regardless of what temperature is being maintained, the compressor operates continuously. This constant operation alleviates component failures associated with cycle type operation.

The circulating fan provides even air distribution throughout the chamber and ensures temperature uniformity.

Explanation of Front Panel Controls

Heater On Lamp - The "Heater On" lamp is illuminated when power is applied to the heater.

LED Display - Four digits are used to display the actual, set, calibrate, high limit and low limit values.

Indicator Lamps - There are five (5) green indicator lamps that are used to inform the user which parameter the display is indicating. The sixth indicator is for a high or low temperature alarm condition. An internal audible alarm will also operate when this alarm indicator illuminates.

On/Off Switch - The On/Off switch provides the main power to the incubator.

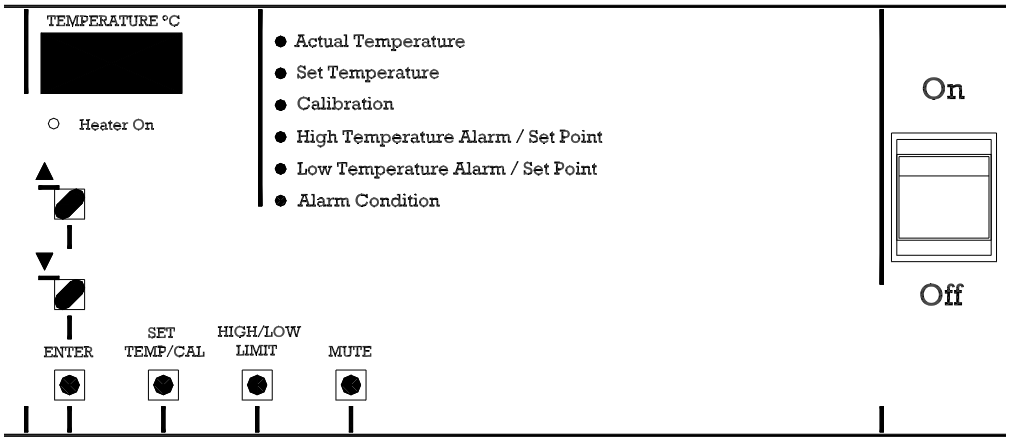
Mute Key - This key is used to silence the internal audible alarm and to also de-activate the external alarm device if one is being used.

High/Low Limit Key - This key is used to view the high or low temperature alarm setpoint The first depression of the key selects the high limit. The second depression selects the low limit. The respective green indicator lamp will light.

Set Temp/Cal Key - This key is used to view the operating setpoint temperature or calibrate the unit to a certified/traceable thermometer. The first depression of the key selects the operating setpoint and the second depression selects the calibration mode. The respective green indicator lamp will light.

Enter Key - This key is used after any setpoint selection is made to enter the value into memory.

Up/Down Arrow keys - These keys are used to increase or decrease the desired setpoint value.

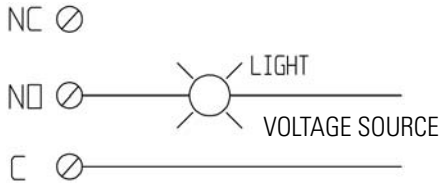


Explanation of Auxiliary Panel

On the left side of the incubator control panel, there is an auxiliary panel which has the items shown in the illustration below. They are described as follows:

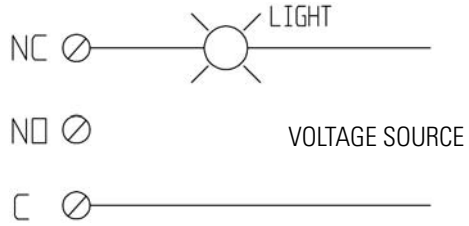
1) Fuse - This fuse is in line with the main power cord that comes into the incubator. The rating of this fuse is printed above the fuse holder. The physical size of this fuse is 5 MM x 20 MM.

2) Alarm Relay - This Alarm Relay output is provided to the user for the purpose of remotely monitoring the incubator in case of a high or low temperature alarm condition. This alarm relay will operate just as the audible alarm would. The contact itself is an isolated form C (normally open/normally closed) dry contact. This contact is to be used for low voltage class 2 connections only. The contact rating is 24 volts, 1.25 amps resistive. Typical usages of the output are shown below.



In the above configuration, the light will illuminate whenever the unit goes into an alarm condition...High or Low.

In the configuration below, the light will go off in a high or low temperature alarm condition.



Warning Wiring must conform to all local electrical codes. ▲

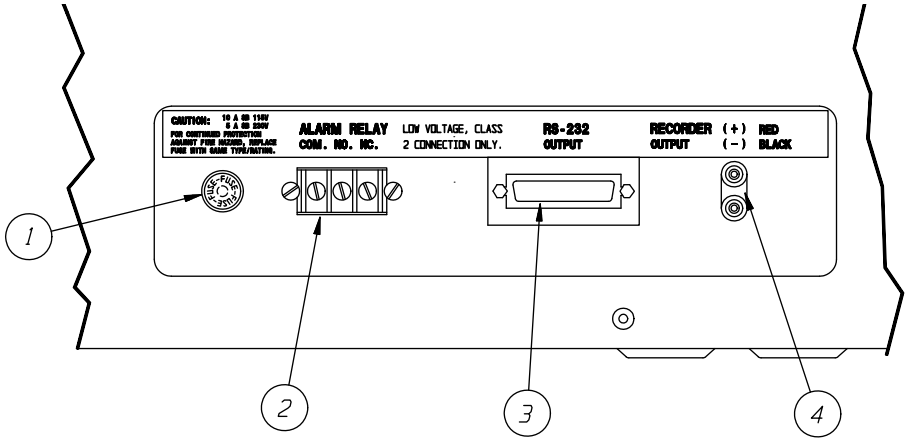
3) RS-232 Output (Optional Kit P/N 3166245) - This output is used for two way communications between the incubator and a personal computer. With the use of communications/modem software program, the user can record the temperature of the incubator at their selected time periods and store it in a file for use with a spreadsheet program. The user can also change the setpoint temperature from their personal computer and periodically monitor the actual temperature, setpoint temperature, and alarm status.

Explanation of Auxiliary Panel (continued)

4) Recorder Output - This is a DC millivolt output which represents the temperature of the incubator. The recommended main use of this is with a chart recorder having an input impedance of at least 1 megohm. The scaled temperature output change is 10 millivolt/degree C. When the incubator is operating at a negative temperature, the chart recorder output is still positive. Use the chart below to relate temperature to output voltage.

   Located on the chart recorder printed circuit board is an offset potentiometer R3. If, for some reason, the recorder output voltage does not match the temperature as shown in the chart, this potentiometer can be used to tune it in.

   When connecting a chart recorder to the recorder output connector, it is recommended to use a shielded cable with the shield grounded at the chart recorder and to keep the cable short as possible.



Temperature (Degree C)	Recorder Output (Millivolts)
-10	100
0	200
10	300
20	400
30	500
40	600
50	700

Instrumentation Port

Located on the rear side of the incubator is an instrumentation port for the user to insert sensor wires, external meter leads, etc. into the chamber. The rubber plug provided must always be used in this port to insure the uniformity specifications. An extra plug is supplied for the user's convenience. Be sure to seal any gaps around the wire(s) going through the plug.

Section 2 Installation

Use the proper lifting equipment when moving this unit. The unit weighs 315 lbs. ((142.9kg).

To assure proper ventilation, allow a minimum of 4" of clearance between the rear, top, and sides of the incubator and adjacent walls. If two or more incubators are positioned side by side, allow a minimum of 8" between cabinets. Adjust the front leveling feet of the incubator so that the front is higher than the rear. This will assist in door closing. Choose a site free from rapidly changing ambient temperature conditions.

Wall mount brackets are attached to the top rear of the cabinet. Remove any packaging materials from the brackets. Rotate the brackets so they point straight out from the back. Secure in place with the included hardware. Attach brackets to wall.

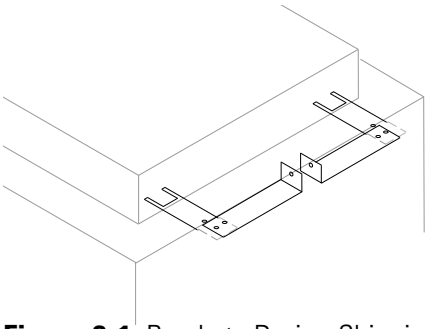


Figure 2-1. Brackets During Shipping

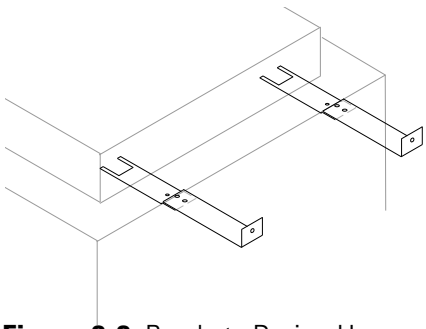


Figure 2-2. Brackets During Use

The power cord is the mains disconnect. Make sure the outlet and power cord are accessible at all times.

Caution The incubator should not be operated in an environment where the ambient temperature exceeds 90°F as the compressor thermo-overload will be tripped and will result in a wide band control cycle of approximately ±4°C. Such cycling should not be misinterpreted as a malfunction of the electronic controls. ▲

Radiators, air-conditioning outlets, other ventilating system outlets, and drafts can affect the operation of the incubator by a sudden inrush of air that is at a temperature different than operating conditions.

Warning For personal safety, this apparatus must be properly grounded. ▲

The power cord of this instrument is equipped with a three-prong (grounding) plug which mates with a standard three-prong (grounding) wall receptacle to minimize the possibility of electric shock hazard from this apparatus. The customer should have the wall receptacle and circuit checked by a qualified electrician to make sure the receptacle is properly grounded.

Where a two-prong wall receptacle is encountered, it is the personal responsibility and obligation of the user to have it replaced with a properly grounded three-prong wall receptacle.

Warning Do not - under any circumstances - cut or remove third (ground) prong from the power cord. Do not use a two-prong adapter plug. ▲

Determine the total amount of current presently being used by other apparatus connected to the circuit that will be used for this unit. It is critical that the added current demand and other equipment on the circuit not exceed the rating of the fuse or circuit breaker in use.

Caution Be sure the power supply is the same voltage as specified on the nameplate. ▲

When loading the incubator, a space of 1/2" must be allowed between adjacent items. This will allow maximum air circulation, which is necessary for proper temperature uniformity. The uniformity will be adversely affected if air circulation is obstructed.

Liquid containers should never be placed in the incubator without covers. The evaporation of moisture within the chamber will only add frost and hasten the need for defrosting. This chamber is not self-defrosting.

Excessive frost buildup on the evaporator coil located on the lower rear wall will also affect temperature uniformity.

Safety Precautions

1. Do not place any explosive, combustible, or flammable materials in the chamber.
2. Do not place sealed containers in the chamber. Sealed containers, filled with materials do not provide room for expansion and can develop dangerous vapor pressure as the temperature increases.
3. Avoid spillage of liquids within the chamber.
4. Do not evaporate noxious fumes.

Caution Do not store containers filled with acidic or caustic solutions, as vapors from these materials will attack the evaporator and void the warranty. ▲

Section 3 Operation and Calibration

Power up by depressing the ON/OFF switch. Immediately after turning on power, all the segments of the display and all of the indicators will be on. After one second the display will show the actual temperature and the actual temperature indicator light will be lit. If the setpoint temperature is greater than the actual temperature, then the heater on lamp will be on or start to flash. If it flashes, then the actual temperature is near setpoint temperature.

To display any temperature value - With the use of either the SET Temp/Cal key or the HIGH/LOW LIMIT key, any temperature value can be displayed. To view the set temperature, press the set Temp/Cal key once. The green indicator for the set temperature will light. If no other keys are pressed, within 5 seconds, the display will automatically return to the actual temperature. To view the calibrate temperature, press the SET TEMP/CAL twice while the display is showing the actual temperature. The same sequence of key operation is true for the use of the HIGH/LOW LIMIT key.

To change the setpoint temperature - Press the SET TEMP/CAL key once. Then press the UP or DOWN arrow key until the desired temperature is displayed. When continuously pressing either the UP or DOWN keys, the display will begin to change rapidly. With a little practice, one will become accustomed to this. After the desired set temperature is achieved, then press the ENTER key. The display will then return to showing the actual temperature. If the ENTER key is not pressed, the expected new set temperature will not be accepted and the incubator will control at the previous set temperature.

The incubator is calibrated at the factory for use over a wide range of temperatures. Due to the slight non-linearities in the control system, it may be necessary to make the display match a calibrated thermometer's reading, even though the difference might be only a few tenth's of a degree.

The CALIBRATE key should be used ONLY to match a stable incubator's actual temperature to the calibrated thermometer.

Place a calibrated thermometer or the probe of one at the center of the third shelf of the incubator. Select the SETPOINT desired. Allow the unit to run for at least an hour after it reaches the setpoint, before calibration is performed.

Note If possible, place the thermometer into a liquid for stability. ▲

To perform calibration, press the SET TEMP/CAL twice. The green calibration indicator should be lit. Then press either the UP or DOWN arrow keys to make the display match the noted thermometer reading. After the satisfied display is achieved, press the ENTER key. The display will then return to showing the newly calibrated actual temperature.

To change the high temperature alarm/setpoint - After selecting a setpoint temperature, the HIGH TEMPERATURE ALARM SETPOINT automatically defaults to 1° higher than the setpoint that was entered. This 1° default difference can be overridden if desired. The following paragraph describes this.

Press the HIGH/LOW LIMIT key once. The green "High Temperature Alarm/Set Point" indicator should be lit. Use the UP or DOWN arrow keys to select your limit value. Then press the ENTER key. If the HIGH LIMIT value you have selected is below the operating SETPOINT TEMPERATURE, the incubators' alarm will activate

To change the Low temperature alarm/setpoint - After selecting a setpoint temperature, the LOW TEMPERATURE SETPOINT automatically defaults to 1° lower than the setpoint that was entered. This 1° default difference can be overridden if desired. The following paragraph describes this.

Press the High/Low Limit key twice. The green "Low Temperature Alarm/Setpoint" indicator should be lit. Use the UP or DOWN arrow keys to select your limit value. Then press the ENTER key. If the LOW LIMIT value you have selected is above the operating setpoint temperature, the incubators' alarm will activate.

Note Software version 2.00 and later has a 30 minute delay for the low and high alarm to avoid nuisance alarms caused by door openings. ▲

PREVENTIVE MAINTENANCE

Incubators

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.

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

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

Tips for all incubators:

- Do NOT use bleach or any disinfectant that has high chloros
- Use sterile, distilled or demineralized water.
- Do not use powdered gloves for tissue cultures.

Preventive Maintenance for Model 815/818 Incubators

Refer to Manual Section	Action	Daily	Weekly	Yearly
3	Check temperature display versus setpoints, w/ independent instrument		✓	
--	Inspect door latch, hinges and door gasket seal.			✓
3	Verify and document temp calibration, as applicable. See Calibration section.			✓
5	Perform a complete decontamination procedure. Wipe down interior, shelves and side panels with disinfectant. Rinse everything well with sterile distilled water.	Between experiments *More frequent decontamination may be required, depending on use and environmental conditions*		

Section 4 Service

Warning Service should be performed only by qualified service personnel. Exercise care as line voltage is present in the control compartment. ▲

If refrigeration service is required, after review of the Troubleshooting Section, contact Technical Services.

In any communication with Thermo, include the model and serial numbers from both nameplates.

Troubleshooting

Problems encountered with any constant temperature chamber will most frequently be related to temperature control. Before proceeding with detailed troubleshooting, be certain that the Low Limit and High Limit controls are adjusted properly. If the limit controls are set too close or beyond the operating temperature, the incubator may be consistently going into alarm. This will result in erratic temperature control. First, the symptoms and possible causes will be listed for quick reference. Solutions will be suggested later.

Warning Hazardous high voltage conditions exist inside the control panel. unplug line cord and turn "off" line switch before removing the cover. only qualified electrical instrument personnel are authorized to perform troubleshooting and/or servicing. ▲

Symptoms and Possible Causes

Freeze-up or gradual drop in chamber temperature:

No air circulation in chamber; inoperative fan (see Solution 1)

Heater (see Solution 2)

Power Supply PCB Assembly (see Solution 3)

RTD Temperature Probe (see Solution 3, Step D and/or Solution 4).

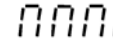
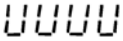
Symptoms and Possible Causes (continued)

Temperature variations at set point (poor control):
Excessive ambient temperature variations (see Solution 10)
Compressor Relay failure (see Solution 12)
No air circulation in chamber; inoperative fan (see Solution 1)
RTD Temperature Probe Location (see Solution 5)
Ice buildup on evaporator coils (see paragraph on "Defrosting")
RTD Temperature probe (see Solution 3, Step D and/or Solution 4).
Power Supply PCB Assembly (see Solution 3)

Does not reach a high set point temperature:
No air circulation in chamber; inoperative fan (see Solution 1)
Low line voltage, less than 110V (see Solution 9)
RTD Temperature Probe (see Solution 3, Step D and/or Solution 4).
Power Supply PCB Assembly (see Solution 3)
Overcharged compressor (see Solution 11)

Differences between Temperature Set and Digital Temperature Readout: (see performance figures, page 3)
RTD Temperature Probe (see Solution 3, Step D and/or Solution 4).
Malfunctioning Power Supply PCB assembly (see Solution 3)

Takes an extremely long time to reach high temperature set point:
No air circulation in chamber; inoperative fan (see Solution 1)
Low line voltage, less than 110V (see Solution 9)
Power Supply PCB assembly (see Solution 3)
Overcharged Compressor (see Solution 11)

Display indicates  **or** 
Malfunctioning RTD Temperature Probe (Solution 4)

Possible Solutions

1. **Inoperative Fan:**

   Open the door. Place your hand near the grill at the top rear of the chamber and check for air circulation. If there is no air circulation, the fan motor is malfunctioning. Contact Technical Services.

2. **Burned-out heater:**

   To check this, the control panel cover must be removed.

Warning Hazardous high voltage conditions exist inside control panel. Turn 'OFF' line switch on front panel and unplug line cord. ▲

Remove all screws that fasten the cover. Locate nylon connector J1 on the Limit/Alarm PCB Assembly. Depress both ears on the plug housing and gently pull out the connector.

With an Ohmmeter, measure the resistance between TB1-4 (Orange wire) and TB1-6 (Red wire).

The proper heater resistance is 24 ohms. If heater resistance is correct, then measure between one heater lead (RED or ORANGE) and incubator ground, it must be infinity (Open). If the heater resistance check indicates an open circuit, it may or may not be open. In series with the heater is a thermal overload switch. It might be that this thermal overload is open and not the heater. To check the heater and thermal switch directly, the shelfs of the incubator and the back wall cover must be removed. Unplug heater and measure its' resistance. If the resistance is correct, check resistance between heater terminal and the heater sheath. It must be an open circuit. If the heater is good, then check the thermal overload switch. At room temperature it should be closed (0 ohms). This switch should only open at 80°C and then close at 65°C. If the heater and thermal switch are good, then the problem is directed towards the heater wires in the harness. If heater is defective, contact Technical Services.

3. **Malfunctioning Power Supply PCB assembly:**

   The Power Supply PCB Assembly has the triac (solid state AC voltage switch) on it which supplies the power to heater. This triac is "told" to operate, when need be, by the microprocessor.

Possible Solutions (continued)

There is another device known as an Optoisolator which serves as the high/low voltage isolator between the triac and the microprocessor.

When the incubator starts experiencing temperature problems and/or variations, due to known controller malfunctions, these two components become prime suspects. The reason being they are under higher operating stress than other components.

If the incubator starts experiencing temperature problems such as no heat, constant heat, or "creeping" upward heat, then follow the troubleshooting instructions below. These instructions require the use of a voltmeter being able to measure DC and AC voltages and preferably a digital voltmeter.

Warning The following troubleshooting instructions require that power be on. only qualified service personnel should perform these procedures. ▲

A) Remove the control cover and familiarize yourself with the power supply assembly #3176814. Locate the Triac (Q2), the Opto-isolator (U1), resistor (R4). Also locate the test point #2 (TP2). The first measurements will be DC voltage measurement, so a DC scale of at least 10 volts should be selected. Connect the negative lead to TP2. This is DC ground. Also locate the terminal block (TB1).

B) This first section will be to verify the heater command is correct from the microprocessor, through the optoisolator, and through the Triac when the incubator is NOT requesting heat. The steps in this section must be followed in succession.

   1. Select a setpoint temperature at least 10° below what the actual temperature is. The incubator should not be requesting heat as indicated by the "Heater On" indicator lamp on the front panel. It should not be on continuously or even flashing.

   2. Measure the voltage at U1-Pin 2 with respect to TP2. It should be no less than 4 volts DC.

   3. Measure the DC voltage across R4, since the incubator is not requesting heat, there should be no current flowing through this resistor, making the voltage drop equal to zero volts.

   4. If the last two steps are not as stated, then most likely the CPU board is bad and should be replaced.

   5. Switch the voltmeter to an "AC Volts" scale capable of reading 120 volts.

Possible Solutions (continued)

6. Measure the voltage between U1-Pin 4 and U1-Pin 6. It should be line voltage. 110 VAC to 120 VAC.

7. If it is not, most likely the Optoisolator is bad and the power supply board will have to be replaced.

8. Measure the voltage TB1-4 (Orange wire) and TB1-6 (Red wire). It should be approximately 0 VAC.

9. If it is not, then most likely the triac is bad, and the power supply board should be replaced.

C) This next section will be to verify the heater command is correct from the microprocessor, through the optoisolator, and through the Triac when the incubator is requesting heat. The steps in this section must be followed in succession.

1. Select a setpoint temperature at least 10° above what the actual temperature is. The incubator should be requesting heat as indicated by the "Heater On" indicator lamp on the front panel. It should be on continuously, not flashing.

2. Measure the voltage at U1-Pin 2 with respect to TP2. It should be no greater than 4 volts DC.

3. Measure the DC voltage across R4, since the incubator is requesting heat, there should be current flowing through this resistor, making the voltage drop equal to 3 volts ±0.5 volts.

4. If the last two steps are not as stated, then most likely the CPU board is bad and should be replaced.

5. Switch voltmeter to "AC Volts" scale capable of reading 120 volts.

6. Measure the voltage between U1-Pin 4 and U1-Pin 6. It should be less than 1 VAC.

7. If it is not, most likely the optoisolator is bad and the power supply board should be replaced.

8. Measure the voltage between TB1-4 (Orange wire) and TB1-6 (Red wire). It should be line voltage. 110 VAC to 120 VAC.

9. If it is not, then most likely the triac is bad. The power supply board should be replaced.

Possible Solutions (continued)

D) Measure RTD temperature probe resistance at the connector after unplugging it from plug J302. The resistance between contacts, at various temperatures are as follows:

TEMPERATURE . . . . . .RESISTANCE
0°C . . . . . .100 OHMS
20°C . . . . . .108 OHMS
37°C . . . . . .114 OHMS
50°C . . . . . .119 OHMS

NOTE ONLY 2 OF THE 3 CONNECTORS POSITIONS ARE USED.

4. **Malfunctioning RTD Temperature probe:**

The Control Board can detect if the temperature probe or the connection of the temperature probe to the circuit board is "OPEN" or "SHORTED". These two conditions are shown on the display as follows:

DISPLAY . . . . . .CONDITION
nnnn . . . . . .OPEN CIRCUIT
uuuu . . . . . .SHORT CIRCUIT

Before coming to the conclusion that the probe is bad when one of these displays appear, check the connection of the probe to the circuit board.

5. **RTD Temperature Sensor Probe Location:**

The Proper RTD location is important. The RTD is supported by the stainless steel bracket attached on the rear wall and near the top of the chamber. Two tube shaped clips securely support the RTD probe into place. The RTD must be inserted fully into its support bracket.

6. **Constantly Experiencing Low temperature Alarm:**

If the incubator is constantly going into low temperature alarm, then most likely the setpoint temperature setting is too close to the low temperature alarm/setpoint setting. The setpoint temperature setting should be a minimum of 2° above the low temperature alarm setting. If the problem persists, then see Solution 3.

7. **Constantly experiencing high temperature alarm:**

If the incubator is constantly going into high temperature alarm, then most likely the setpoint temperature setting is too close to the high temperature alarm/setpoint setting. The setpoint temperature setting should be a minimum of 2° below the high temperature alarm setting. If the problem persists, then see Solution 3.

Possible Solutions (continued)

Note Software version 2.00 and later has a 30 minute delay for the lowe and high alarm to avoid nuisance alarms caused by door openings. ▲

8. **Ice buildup on evaporator coils:**

   Excessive frost buildup is the result of the introduction of outside moisture. This may be caused by the evaporation of liquids placed in the chamber, or it may be the result of excessive opening of the door during high humidity conditions. The door gasket should also be examined for proper seal. If repairs are necessary, contact Technical Services.

9. **Excessive line voltage variation:**

   Incubator will operate satisfactorily over full temperature range (-10°C to 50°C) when line voltages vary from nominal voltage by -5% or +10%. Larger voltage variations may impair the Temperature Control. Correct as required.

10. **Excessive ambient temperature variation:**

    If the incubator is placed close to the air-conditioning outlet, hot radiators, or direct sunlight, or if the ambient temperature changes drastically, the chamber temperature will be affected. Correct as necessary.

Caution The incubator should not be operated in an environment where the ambient temperature exceeds 90°F, as the compressor thermo-overload will be tripped and will result in a wide band control cycle of approximately ±4°C. Such cycling should not be misinterpreted as a malfunction of the electronic controls.

11. **Overcharged compressor:**

    This would happen only if compressor was overcharged after installation. For correct charge, see nameplate located behind lower portion of door. If unit has more charge than shown, it will not reach 50°C. Compressor must be discharged and recharged correctly.

12. **The circuit design calls for continuous compressor operation.** If compressor cycles "On-Off", it is an indication that the starting relay is overriding the control circuit. This may be the result of excessive (90°F) ambient temperature adjacent to the compressor, excess dirt on the compressor, or a relay malfunction. Provide additional wall clearance and/or circulation around the unit, clean compressor, or contact Technical Services.

Section 5 Maintenance

The design of the incubator is such that periodic maintenance is kept to a minimum. No lubrication is required. The following paragraphs cover the few minor procedures necessary for continuous operation.

Warning Turn off power switch and unplug line cord from power source before starting any maintenance procedure. ▲

If the chamber needs to be cleaned, a mild soap and water solution, or bicarbonate of soda (1tbsp./gallon of water), is recommended.

When the incubator is used frequently below ambient temperatures, or in any manner that increases moisture buildup within the chamber, an appropriate defrosting schedule must be determined. Defrosting is accomplished by turning the incubator off for 24 hours. Moisture will collect in the drip pan beneath the incubator.

General Cautions

1) Overcharging a refrigeration system can cause excessive system pressure and can be dangerous.

2) The compressor terminal protective cover must be properly in place before applying electric power to the compressor.

3) Caution should be exercised by service personnel when servicing refrigeration system.

4) Service should be performed by a certified refrigeration technician only.

Section 6 Options

RS232

Instructions to install and operate the RS232 option follow.

1. Remove the eight (8) screws securing the control panel. There are four (4) on the top and 2 on each of the sides. Then remove the cover by sliding it towards the front of the incubator.

2. Slide open the auxiliary panel door and locate the mounting area of the RS232 board as shown on page 4.

3. Mount the RS232 printed circuit board assembly using the screws or standoffs provided. See Figure below.

4. Connect one end of the cable to J304 located on the left edge of the left printed circuit board (p/n 3176707). Be careful of alignment.

5. Connect the other end of the cable to the cable connector on the RS232 PCB assembly (see sketch).

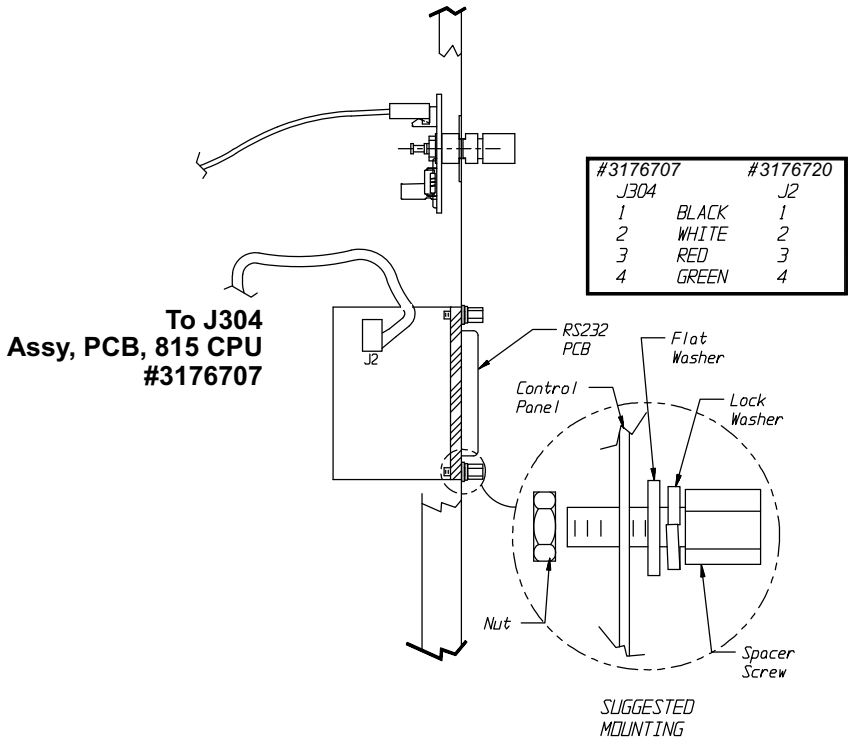
6. Replace the control panel and secure with the eight (8) screws.

The RS232 PCB provides a bi-directional communication port that will allow the user to monitor the performance or the change the operating valves of the incubator from a remote computer. RS232 Communication will require a communication program such as a modem program installed in your computer which will allow the storage of data within your files.

The RS232 PCB utilizes one of the users computer serial ports, such as COM1 or COM2. The communication software must be configured to the selected port. The serial port is an IBM PC AT-style port. The cable that connects to it must end in a DB-25 (25-pin) male connector. The cable is a one-to-one wiring format. The pin assignments for the serial port are:

PIN	SIGNAL	DESCRIPTION
2	TXD	Serial Transmitted Data
3	RXD	Serial Received Data
7	GND	Signal Ground (0 V)

TOP VIEW OF CONTROL PANEL



Setting Up the Incubator for Communication

Your incubator requires the selection of 3 parameters for communications:

A) Baud Rate - This is the speed of communication between the incubator and computer. Whatever is selected for the incubator must also be selected in the communication software selected to be used.

B) Status Update Time Interval - This is the time between information being sent from the incubator until it is received by the computer.

C) Status Display Type - Selection of the format of data to be sent to your computer.

Please read the following steps before performing any of them. It will allow you to familiarize yourself with the procedure and to determine the values you want beforehand.

Note In the following setup mode, there is a five (5) second time-out feature that is active following each entry. If the five (5) seconds is exceeded, the unit will return to the normal operation mode. If the time-out occurs before the value was entered, start over. ▲

Set Up the Incubator for Communications (cont.)

1. With the incubator ON, simultaneously press and hold the UP and DOWN keys, then press the ENTER key. The letters will be shown in the display. A number other than 96 might be shown in the display:



   Choose the number appropriate for the Baud Rate desired.

   3 = 300
   6 = 600
  12 = 1200
  24 = 2400
  48 = 4800
  96 = 9600

   Press the UP or DOWN key until the display shows your selection. Press ENTER. The baud rate has been entered.

2. The display should change to the following. Again, the number in the display might be different than 0.1, but it will have a decimal point.



   Choose the number appropriate for the Status Update Time Interval desired.

   0.0 Minutes . . . . . .No report
   0.1 Minutes . . . . . .Between reports
   0.5 Minutes . . . . . .Between reports
   1.0 Minutes . . . . . .Between reports
   2.0 Minutes . . . . . .Between reports
   5.0 Minutes . . . . . .Between reports
  10.0 Minutes . . . . . .Between reports
  30.0 Minutes . . . . . .Between reports
  60.0 Minutes . . . . . .Between reports

   Press the UP or DOWN key until the setpoint display shows your selection. Press ENTER. The value is entered.

Set Up the Incubator for Communications (cont.)

3. The display should have changed to the following. Again, the number in the display might be different than 1. This selection is for Status Display Type.



Listed are the numbered selections with explanations and examples of the values displayed on your computer's monitor when the incubator transmits information.

0 = Used for a raw, one-line status output suitable for importing into a spreadsheet.

1 = Used for a multi-line format with English headings with continuous screen.

2 = Used for the format as "1" but preceded by a clear screen command used by terminals or computers running terminal software. This mode overwrites the previous transmission.

With Status Display Type = 0:

10 -5.0 0

Where:

10 = Actual Temperature

-5.0 = Setpoint Temperature

0 = Normal

With Status Display Type = 1 or 2:

Actual Temperature: 10

Setpoint Temperature: -5.0

Alarm Status: Normal

LOW

HIGH

4. Allow the setup to time out.

The incubator is now ready to communicate with your computer.

Setting up the Computer for Communication

Your communications software will most likely have a setup routine to set the parameters listed below. These are the values the incubator is using, so the computer parameters must match accordingly. Also, you will probably have to select the "COM" serial port you chose when you connected the cable from your computer to the incubator. The software may ask what format the data is in. You should choose "ASCII".

Parameter	Settings
Baud Rate:	Baud Rate value selected earlier in Step 1.
Parity:	None (0)
Data Bits:	Eight (8)
Stop Bits:	One (1)
COM Port:	Selected by user
Format:	ASCII

Using the Communication

The incubator transmits information on its RS232 port as long as the status update time interval is not "0.0."

If you start your communication software with the incubator on, most likely you will see the error(s) messages as follows:

ERR

? VALUE IS READ ONLY

? ILLEGAL COMMAND

Wait for the Status Update Time duration you selected to complete, and the communications will correct itself.

Besides having the incubator transmit information in one of the three formats, the user can monitor other values or even change some of these from their computer.

Using the Communication (continued)

The following table lists the available commands for monitoring or controlling your unit.

View Command:	Description:	Unit:	Range:	Change Command
A?	Actual Temperature	Degrees	-10 to 50	Read Only
T?	Setpoint Temperature	Degrees	-10 to 50	T10 thru T50
R?	Baud Rate	-	0 - 5	R0 thru R5
S?	Status Update Time	-	0 - 8	S0 thru S8
V?	EPROM Version Number	-	Current Rev.	Read Only
D?	Status Display Type	-	0 - 2	D0 thru D2
O?	Display the Alarm Status	-	0 - 2	Read Onl

To View Data: If Status Update Time is “0.0” no data will automatically be displayed. To view data within a particular command code, type that command code followed by the question mark (?) symbol and then ENTER (Return).

Example: To view Setpoint Temperature type: T? <CR>

To Change Data: To change the value within the command type the command code followed by the new value and ENTER (Return).

Example 1: To change Setpoint Temperature to 25.0°C type: T25.0 <CR>

Example 2: To change Setpoint Temperature to -.8°C type: T-.8<CR>

(**A**) **Actual Temperature:** The actual temperature within the incubator.

(**T**) **Setpoint Temperature:** The temperature at which the user has selected the incubator to operate.

Using the Communication (continued)

(R) **Baud Rate:** The rate at which data is transmitted between the incubator and your computer.

0 = 300 Baud

1 = 600 Baud

2 = 1200 Baud

3 = 2400 Baud

4 = 4800 Baud

5 = 9600 Baud

(S) **Status Update Time Interval:** The time between data messages sent from the incubator to your computer.

0 = 0 Minutes, No report

1 = 0.1 Minutes (6 seconds)

2 = 0.5 Minutes (30 seconds)

3 = 1.0 Minutes

4 = 2.0 Minutes

5 = 5.0 Minutes

6 = 10.0 Minutes

7 = 30.0 Minutes

8 = 60.0 Minutes

(V) **EPROM Version Number:** The incubator software version level.

(D) **Status Display Type:** Selection of format that data is sent to your computer

0 = Used for a raw, one-line status output suitable for importing into a spreadsheet

1 = Used for a multi-line format with English headings

2 = Used for the format as “1” but preceded by a clear screen command used by terminals or computers running terminal software.

Using the Communication (continued)

(O) **Display the Alarm Status:** The alarm has three (3) possible values:

0 = Normal, no alarms

1 = Low alarm

2 = High alarm

Section 7 Specifications

Temperature
- Range . . . . . .-10°C to +50°C
- Uniformity . . . . .±0.9°C @ -10°C, ±0.5°C @ 37°C
  . . . . . .±0.5°C @ 20°C, ±0.6°C @ 50°C

Temperature Sensitivity . . . . . .±0.1°C

Recovery time after 30 second door opening
. . . . . .10 minutes at 20°C

Shelves
- Interior Shelf Area: . . . . . .15.8 sq. ft (1.47 sq. m)
- Supplied: 6

Electrical
- 115VAC . . . . . .60Hz, 1 phase, 800 watts, 7 FLA
- 230VAC . . . . . .50Hz, 1 phase, 800 watts, 3.5 FLA

BTU Output 2730

Dimensions
- Exterior . . . . . .32.0” W x 75.0” H x 29.0” L
  . . . . . .(82 cm x 191 cm x 74 cm)
- Chamber . . . . . .26.5” W x 57.0” H x 20.0” L
  . . . . . .(67.3 cm x 144 cm x 50.8 cm)

Weight . . . . . .315 lbs. (142.9 kg)

Volume . . . . . .48.5 cu. ft. (1.37 cu. m.)

Safety Specifications

Indoor use

Altitude: . . . . . .2,000 meters

Temperature: . . . . . .5°C to 40°C

Humidity . . . . . .80% RH at or below 31°C, decreasing linearly to 50% RH at 40°C

Mains Supply Fluctuations . . .Operating Voltage Range

Installation Category II

Pollution Degree 2

Class of Equipment I

---

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.

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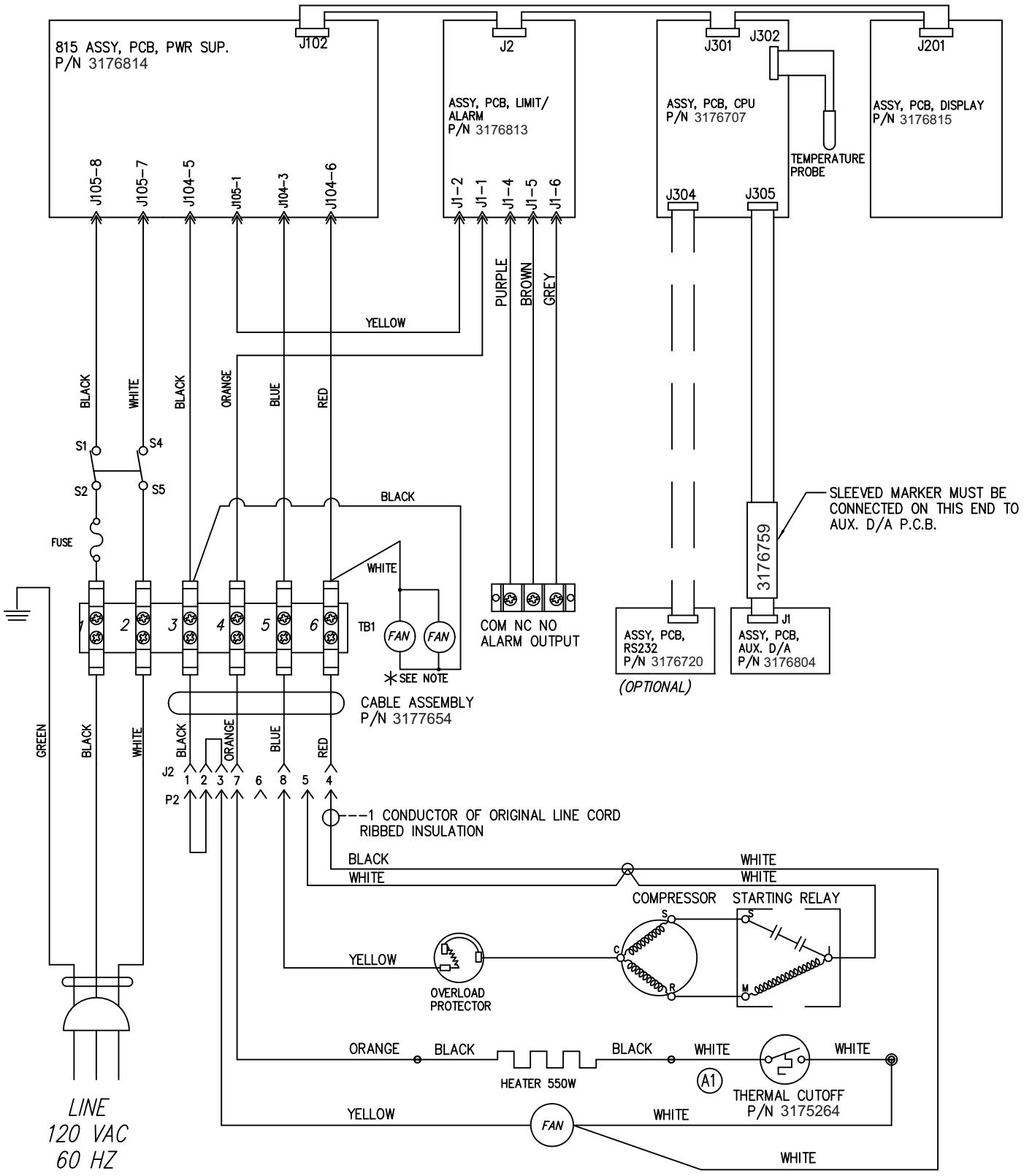
2 Pollution degree describes the amount of conductive pollution present in the operating environment. Pollution degree 2 assumes that normally only non-conductive pollution such as dust occurs with the exception of occasional conductivity caused by condensation.

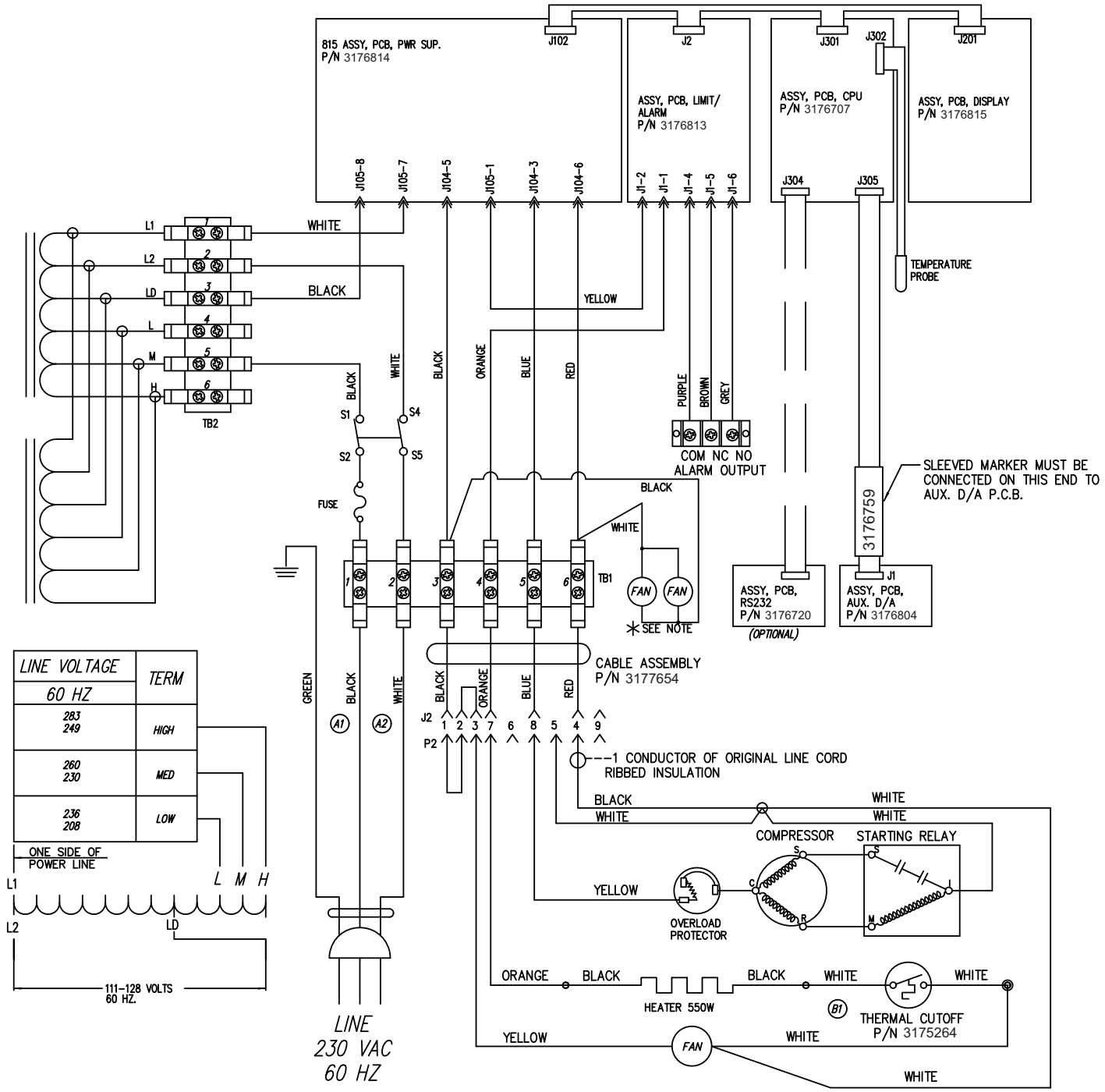
Section 8 Spare Parts

DESCRIPTION	PART NO.
ASS'Y, PCB, DISPLAY, 815	3176815
ASS'Y, PCB, 815 CPU	3176707
ASS'Y, PCB, 815 PWR SUP	3176814
ASS'Y, PCB, 815 HI LIMIT	3176813
ASS'Y, RTD TEMP. PROBE, 100	3176738
SWITCH, ON/OFF	3175318
ASS'Y, CABLE, INTERFACE	3176759
FUSE KIT, 10 AMP, 115V	3167218
FUSE HOLDER KIT, 115V	3167216
FUSE HOLDER KIT, 230V	3167217
CORD W/PLUG, 115V	3178034
HARNESS, 815/818, 115V	3177651
CORD W/PLUG, 230V	3176551
HARNESS, 815/818, 230V	3177652
FUSE KIT, 5 AMP, 230V	3167219
RS232 COMMUNICATIONS OPTION	3166245
THERMAL CUTOFF SWITCH	400141
STOPPER KIT	3167215
BULB KIT	3167220
MOTOR, FAN- REAR	130630
AUTO TRANSFORMER (230V)	3174991
INS. TEMP SENSOR BRACKET	316129
BACK HARNESS	3177654
REAR COMPRESSOR COVER	1900381

Accessories

Name	Part Number
Glass Thermometers	3173710
RS232 Interface Kit	3166245
Digital Chart Recorder	3166207
Chart Paper (100 sheets)	3174255
Access Port Stopper	3167215
Shelf	


815 ASSY, PCB, PWR SUP.
P/N 3176814
J102
J2
J301
J302
J201
ASSY, PCB, LIMIT/
ALARM
P/N 3176813
ASSY, PCB, CPU
P/N 3176707
ASSY, PCB, DISPLAY
P/N 3176815
TEMPERATURE
PROBE
J105-8
J105-7
J104-5
J105-1
J104-3
J104-6
J1-2
J1-1
J1-4
J1-5
J1-6
J304
J305
PURPLE
BROWN
GREY
YELLOW
BLACK
WHITE
BLACK
ORANGE
BLUE
RED
S1
S4
S2
S5
FUSE
BLACK
WHITE
SLEEVED MARKER MUST BE
CONNECTED ON THIS END TO
AUX. D/A P.C.B.
3176759
1
2
3
4
5
6
TB1
FAN
FAN
SEE NOTE
COM NC NO
ALARM OUTPUT
ASSY, PCB,
RS232
P/N 3176720
(OPTIONAL)
J1
ASSY, PCB,
AUX. D/A
P/N 3176804
CABLE ASSEMBLY
P/N 3177654
GREEN
BLACK
WHITE
BLACK
ORANGE
BLUE
RED
J2
1 2 3 7 6 8 5 4
P2
1 CONDUCTOR OF ORIGINAL LINE CORD
RIBBED INSULATION
BLACK
WHITE
WHITE
WHITE
COMPRESSOR
STARTING RELAY
S
C
R
S
M
YELLOW
OVERLOAD
PROTECTOR
ORANGE
BLACK
HEATER 550W
BLACK
WHITE
A1
WHITE
THERMAL CUTOFF
P/N 3175264
YELLOW
FAN
WHITE
WHITE
LINE
120 VAC
60 HZ


815 ASSY, PCB, PWR SUP.
P/N 3176814
J102
J2
J301
J302
J201
ASSY, PCB, LIMIT/ ALARM
P/N 3176813
ASSY, PCB, CPU
P/N 3176707
ASSY, PCB, DISPLAY
P/N 3176815
J105-8
J105-7
J104-5
J105-1
J104-3
J104-6
J1-2
J1-1
J1-4
J1-5
J1-6
J304
J305
TEMPERATURE PROBE
L1
L2
LD
L
M
H
TB2
WHITE
BLACK
YELLOW
S1
S2
S4
S5
FUSE
PURPLE
BROWN
GREY
COM NC NO
ALARM OUTPUT
SLEEVED MARKER MUST BE CONNECTED ON THIS END TO AUX. D/A P.C.B.
3176759
TB1
FAN
FAN
SEE NOTE
ASSY, PCB, RS232
P/N 3176720
(OPTIONAL)
J1
ASSY, PCB, AUX. D/A
P/N 3176804
CABLE ASSEMBLY
P/N 3177654
GREEN
A1
A2
J2
P2
1 2 3 7 6 8 5 4 9
1 CONDUCTOR OF ORIGINAL LINE CORD
RIBBED INSULATION
LINE VOLTAGE
60 HZ
TERM
283
249
HIGH
260
230
MED
236
208
LOW
ONE SIDE OF
POWER LINE
L1
L2
L M H
LD
111-128 VOLTS
60 HZ.
LINE
230 VAC
60 HZ
COMPRESSOR
STARTING RELAY
OVERLOAD
PROTECTOR
ORANGE
HEATER 550W
B1
THERMAL CUTOFF
P/N 3175264
FAN

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