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Models:
916, 917, 923, 925, and 926

900 Series Non-CFC
Ultra-Low Temperature Upright Freezers

Manual No. 7030916

Rev. 2

Read this Instruction Manual

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

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

Refer to the serial tag on the rear cover of this manual






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


This product is not intended for any use(s) other than the use(s) described in the labeling or this user's manual.

MANUAL NO. 7030916			
REV	ECR/ECN	DATE	DESCRIPTION
-		11/17/98	Section 4.7 Added recommended battery replacement ccp
-	16484	9/1/98	Section 4.7 Use re-chargeable batteries caution deg
-	FR-1223	5/27/98	Schematics changed deg
-	FR-1203	5/26/98	Added metric units to ref. drawing for IEC-1010 deg
-		1/20/98	Added Climatic Class T to Section 2.2 deg
-	SI-6703	12/31/97	Revised electrical schematics heg
-	SI-6658	11/24/97	Revised temp microprocessor board heg
-	FR-1160	11/24/97	Added operating range information heg
-	16498	9/9/97	Revised 230V specifications heg
-	FR-1146	7/29/97	Added alternate brand freezers heg
-	16483	6-29-97	Added recorder outlet section deg
-	FR-1116	6-23-97	Added arc supression per IEC heg
2	SI-5820	5/7/97	Added water cooled condenser option deg

General Safety Notes used in this Manual

	<p>Important operating and/or maintenance instructions. Read the accompanying text carefully.</p> <p>Ce symbole attire l'attention de l'utilisateur sur des instructions importantes de fonctionnement et/ou d'entretien. Il peut être utilisé seul ou avec d'autres symboles de sécurité. Lire attentivement le texte d'accompagnement.</p> <p>Wichtige Betriebs- und/oder Wartungshinweise. Lesen Sie den nachfolgenden Text sorgfältig.</p> <p>Importante instrucciones de operacion y/o mantenimiento. Lea el texto acompanante cuidadosamente.</p>
	<p>Potential electrical hazards. Only qualified persons should perform procedures associated with this symbol.</p> <p>Ce symbole attire l'attention de l'utilisateur sur des risques électriques potentiels. Seules des personnes qualifiées doivent appliquer les instructions et les procédures associées à ce symbole.</p> <p>Gefahr von Stromschlägen. Nur qualifizizierte Personen sollten die Tätigkeiten ausführen, die mit diesem Symbol bezeichnet sind.</p> <p>Potencial de riesgos electricos. Solo personas das capacitadas deben ejecutar los procedimientos asociadas con este simbolo.</p>

	<p>Equipment being maintained or serviced must be turned off and locked off to prevent possible injury.</p> <p>Risques potentiels liés à l'énergie. L'équipement en entretien ou en maintenance doit être éteint et mis sous clé pour éviter des blessures possibles.</p> <p>Geräte, an denen Wartungs- oder Servicearbeiten durchgeführt werden, müssen abgeschaltet und abgeschlossen werden, um Verletzungen zu vermeiden.</p> <p>El equipo recibiendo servicio o mantenimiento debe ser apagado y asegurado para prevenir danos.</p>
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	<p>Hot surface(s) present which may cause burns to unprotected skin or to materials which may be damaged by elevated temperatures</p> <p>Présence de surface(s) chaude(s) pouvant causer des brûlures sur la peau non protégée, ou sur des matières pouvant être endommagées par des températures élevées.</p> <p>Heiße Oberfläche(n) können ungeschützter Haut Verbrennungen zufügen oder Schäden an Materialien verursachen, die nicht hitzebeständig sind.</p> <p>Superficies calientes que pueden causar quemaduras a piel sin proteccion o a materiales que pueden estar danados por elevadas temperaturas.</p>
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- √ 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 Forma Scientific Products?

If you do, please contact us 8:00 A.M. to 7:00 P.M. (Eastern Time) at:

1-740-373-4763	Direct
1-800-848-3080	Toll Free, U.S. and Canada
1-740-373-4189	FAX
http://www.forma.com	Internet Worldwide Web Home Page

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

The Forma **Product Service Group** 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 Maintenance Program for your Forma products.

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

When more extensive service is necessary, we will assist you with the selection of a field service organization for on-the-spot repairs by a professional field technician. If your service need is covered by the Forma warranty, we will arrange for the unit to be repaired at our expense and to your satisfaction.

Regardless of your needs, Forma's professional telephone technicians are available to assist you Monday through Friday from 8:00 A.M. to 7:00 P.M. Eastern Time. Please contact us by phoning or faxing us at the above listed numbers. If you wish to write, our mailing address is:

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

International customers please contact your local Forma Scientific distributor.

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Section 1 - Receiving

1.1 Preliminary Inspection

This item was thoroughly inspected and carefully packed prior to shipment and all necessary precautions were taken to ensure safe arrival of the merchandise at its destination. Immediately upon receipt, before the unit is moved from the receiving area, carefully examine the shipment for loss or damage. Unpack the shipment and inspect both interior and exterior for any in-transit damage.

1.2 Visible Loss or Damage

If any loss or damage is discovered, note any discrepancies on the delivery receipt. Failure to adequately describe such evidence of loss or damage may result in the carrier refusing to honor a damage claim. Immediately call the delivering carrier and request that their representative perform an inspection. Do not discard any of the packing material or move the shipment from the receiving area.

1.3 Responsibility for Shipping Damage

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

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

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

Section 2 - Installation and Start-Up

2.1 Introduction

The 900 Series Forma Scientific non-CFC, Ultra-Low Temperature Freezers feature front-to-back air circulation for cooler compressor temperatures, increased performance and reliability and longer compressor life. In this unique system, ambient air enters the front grill of the freezer and passes through the filter, condenser and compressor housing, exiting out of the rear of the unit.

An enlarged condenser and two cooling fans also contribute to better efficiency and help extend compressor life. Cleaning the air filter and condenser fins is done from the front of the unit.

a. Non-CFC, non-HCFC and non-Flammable Refrigerants

Committed to a safer, healthier environment, Forma Scientific has phased out the use of ozone depleting CFC (chlorofluorocarbons) in all ultra-low temperature freezers. Forma also uses non-CFC foamed-in-place urethane insulation and all packaging materials used in shipping are non-CFC.

b. Peak Control System

Due to the increased demands on today's refrigeration systems, Forma Scientific has engineered a compressor protection system called PEAK Control. In this system, a pressure switch senses excessive compressor discharge pressure. When the discharge pressure exceeds the design limit, a solenoid valve opens allowing refrigerant to enter an expansion tank.

The refrigerant returns to the system through a capillary tube. The PEAK Control System continues to monitor system pressures, insuring they stay within design limits to help extend compressor life.

c. "Smart" Condenser Fans

For maximum compressor protection, all Forma ULT freezers include two tube axial fans in the compressor housing. When both compressors are running, both fans operate to pull ambient air through the condenser and over the compressors. When both compressors are off, one fan remains ready to cycle on when the thermostat senses a temperature rise above 32°C.

d. Built-In Automatic Voltage Compensation

A built-in, automatic voltage compensator is built into every Forma 900 Series non-CFC, Ultra-Low Temperature Freezer to detect and respond to high or low voltage situations. Voltage from the incoming power supply is monitored and adjusted by the automatic voltage compensator, ensuring compressor operation within design parameters. A light on the front of the control panel indicates when incoming voltage is being corrected.

2.2 Environmental Conditions

Forma 900 Series ULT Freezers are designed to operate in the following environmental conditions:

- Indoors
- Altitude - up to 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 ¹
- Pollution Category 2 ²
- Class of Equipment I
- Climatic Class T (Tropical) ³

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 2500 V for a 230 V supply and 1500 V for a 120 V supply.

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

³ Class T (Tropical) means that the freezers are electrically safe in a 43°C ambient.

2.3 Unpacking List

A small bag containing the following accessories is packed inside the freezer:

<i>Qty.</i>	<i>Stock #</i>	<i>Description</i>	<i>Purpose</i>
2	510016	1/4-20 x 5-1/2" Bolt	Wall Bumper
2	380520	Neoprene Cap	Cap Protector
1	430263	Cord Set	Electrical Connector

2.4 Location

Locate the freezer on a firm, level surface in an area of minimum ambient temperature fluctuation.

2.5 Installing the Wall Bumpers

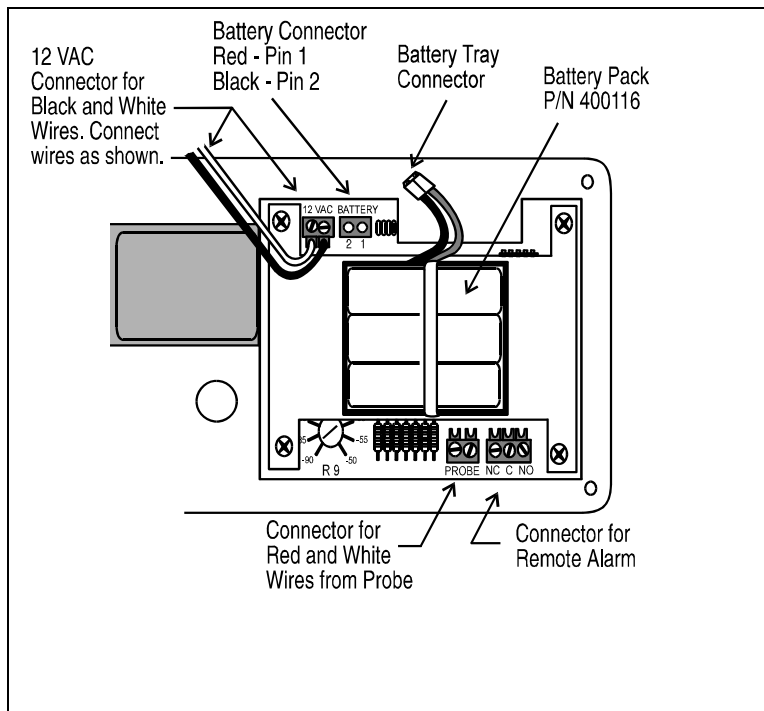
The parts bag contains two (2) 1/4-20 x 5-1/2" bumper bolts and two (2) neoprene caps. Install the bolts into the tapped holes on the back of the compressor section. Install a neoprene cap on each bolt.

To allow for proper ventilation and air flow, a minimum of 5" of clear space is required behind the freezer. An additional 5" (minimum) of clear space is also required on both sides of the freezer. When locating the back of the freezer toward a wall or obstacle(s), make sure that the wall bumpers are installed.

2.6 Connecting the Performance Monitor/Alarm Battery

Note: This section does not apply to factory-option S/N 400998.

1. To gain access to the battery, remove the four screws securing the Performance Monitor/Alarm panel.
2. Attach the battery tray electrical connector to the circuit board as shown in Figure 2-1. Both front panel lights will flash and the alarm will sound until the freezer is connected to electrical power and turned on. Turn the Normal/Standby Switch on the monitor control panel to Standby to silence the alarm.
3. Reinstall the Performance Monitor/Alarm panel.



**Figure 2-1
Performance
Alarm/Monitor Circuit
Board**

2.7 Connecting the Water Supply to the (optional) Water Cooled Condenser

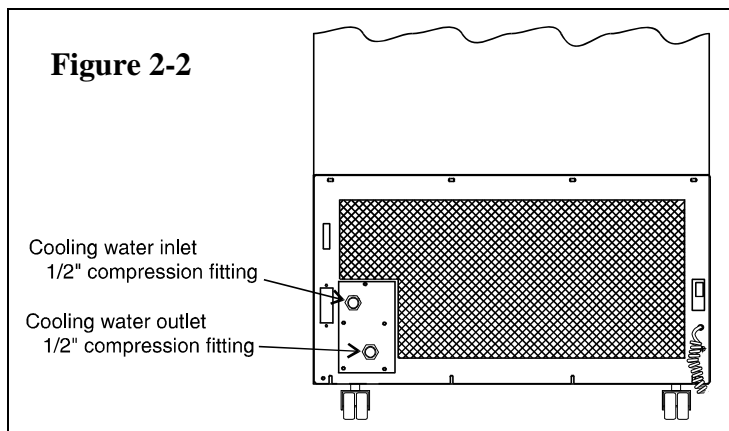


Figure 2-2

1. Insert a 1/2" OD copper water line into the cold water inlet (top) and tighten the compression fitting.
2. Insert a 1/2" OD drain line into the water outlet (bottom) and tighten the compression fitting. Direct the drain line to a suitable drain.

Note: The condensing units must be provided with enough water for adequate cooling. The units require approximately 1 GPM of 65°F (18.3°C) of tap water per horsepower, or 3 GPM of 85°F (29.4°C) water per horsepower.

2.8 Attaching the Power Cord

Plug the cord set (item C in the illustration at the right) into the back of the unit below the power switch. Secure it with the screw provided and identified by the circle. The line cord retainer (B) is secured to receptacle (A) by the factory with the two screws shown.

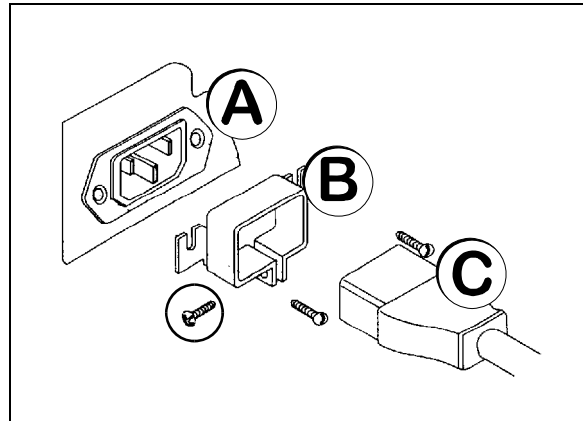


Figure 2-3

2.9 Connecting Power to the Freezer

Note: All optional equipment must be installed with electric power off and locked out and the freezer cabinet at ambient temperature.



Forma Scientific, Inc. recommends that the freezer be operated on a dedicated electrical circuit to avoid the possibility of a circuit overload and to ensure product safety.

With the power switch turned off, connect the freezer to a *grounded* electrical outlet. Refer to the data plate on the side of the unit, to the electrical schematics in Section 9, or to the Specifications Chart in Section 6.

2.10 Main Power Switch (mains disconnect)

The main power switch is located on the back of the refrigeration unit, directly above the line cord set.

Off = (o)

On = (I)

2.11 Setting the Operating Temperature

Note: Install all optional equipment before applying power to freezer.

1. After reading and completing Sections 1 through 3 (if unit has optional CoBex recorder), turn the power switch ON.

Note: The temperature inside of the freezing cabinet will be displayed in the LED window.

2. Pushing the Press-to-Set button displays the operating temperature set point.
3. If an operating temperature other than that displayed in the LCD window is desired, turn the temperature set point screw while pressing the Press-to-Set button. Use the adjustment screwdriver provided on the bottom frame of the freezer. Clockwise adjustment of the SET screw will lower set point temperature. Counterclockwise adjustment will raise set point temperature.

Note: Forma Scientific recommends setting the cabinet temperature no colder than necessary for product storage.

Avoid opening the door for extended time periods. Room air, which is higher in humidity, will replace chamber air and cause frost to develop.

This freezer is not a "quick-freeze" device. Freezing large quantities of liquid, or high-water content items, will temporarily increase the temperature and will cause the low stage compressor to operate for a prolonged time period.

2.12 Preparing the (Optional) CoBex Temperature Recorder

a. Installing the chart recorder battery

The seven-day circular chart recorder is located on the bottom front of the freezer cabinet and is protected by a glass door.

To prepare the recorder for operation, open the glass door and snap the connector onto the 9-volt battery as shown in Figure 2-4. If the freezer is operating, the green LED will show a steady light. If the freezer is not turned on, the LED will flash.

If the battery is weak or not connected, the green LED will flash. If power is lost to the cabinet, the LED will also flash as the freezer goes into the alarm state.

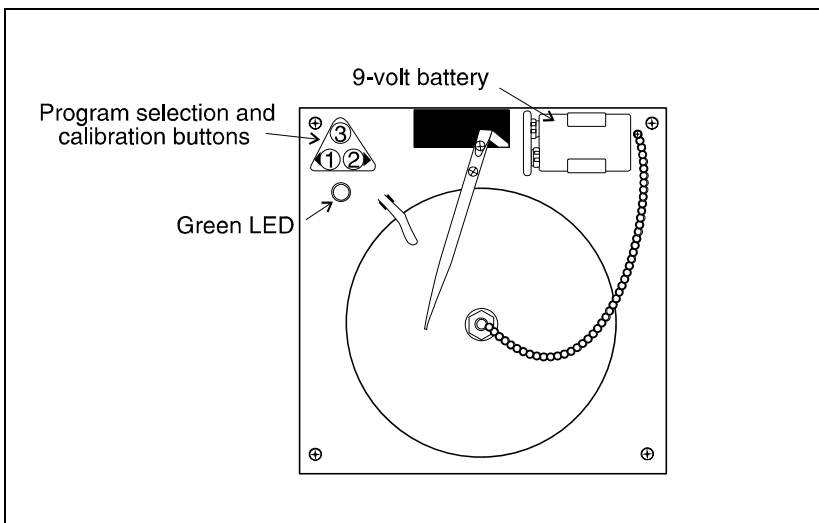


Figure 2-4

b. Installing the chart paper

(Refer to Figure 2-5) Press and hold button #3 for about one second until the pen begins to move to the left. Unscrew the knob at the center of the chart and install the paper, positioning the chart so the correct time line coincides with the time line groove on the chart plate.

Replace the knob and press the #3 button until the pen begins to move to the right.

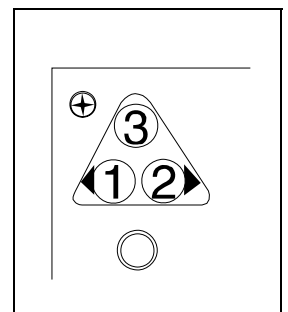


Figure 2-5

c. Changing the recorder range

The chart recorder contains eight temperature ranges and is factory-programmed for the freezer. To select another range, press and hold button #3 until the pen moves off of the chart paper. Press and hold for five seconds either button #1 or button #2. Release

the button and the green LED will begin to flash. The number of flashes corresponds to the temperature ranges as shown in the table below.

Program No.	Range		
Program 1	-40°C	to	30°C
Program 2	0°C	to	60°C
Program 3	-100°C	to	38°C
Program 4	-5°C	to	50°C
Program 5	0°C	to	100°C
Program 6	-100°C	to	-200°C
Program 7	-115°C	to	50°C
Program 8	-10°C	to	70°C

d. Calibrating the chart recorder

Place an accurate thermometer in the chamber next to the recorder’s probe. After about three minutes, compare the thermometer with the chart recorder. If an adjustment is necessary, press either the #1 or #2 button to move the pen left or right. The button must be held about five seconds before the pen begins to move. Release the button when the pen matches the thermometer.

The felt-tip pen will require periodic replacement. Usually the ink will appear to fade before replacement becomes necessary. Additional pen tips may be purchased from Forma Scientific, Inc.

e. Recorder outlet

The 115 VAC recorder outlet is located at the end of the relay enclosure. Refer to Figure 2-6. The outlet is to be *only* used with the CoBex recorders that are supplied by Forma.

2.13 Remote Alarm Connector

For installations requiring the freezer to be connected to a remote alarm system, normally open and normally closed dry relay contacts are provided on all Forma 900Series Freezers. Figure 2-1 identifies the location of the remote alarm connector.

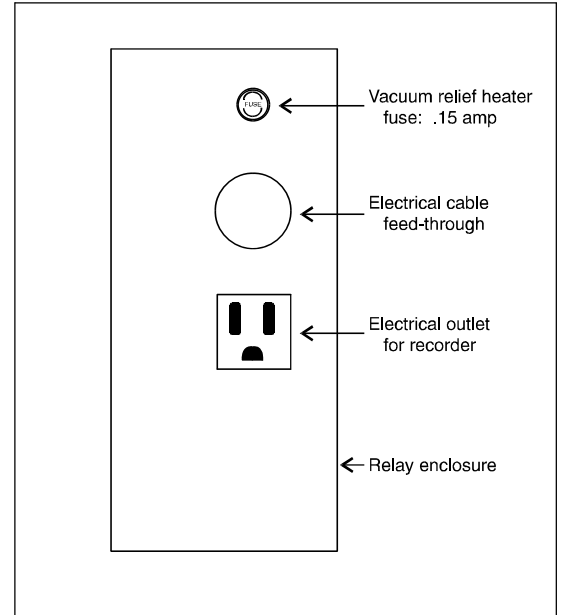


Figure 2-6

The NO and NC are dry contacts and require that 300 volt jacketed cable must be used, when wiring to an external alarm monitoring system. A cable exit hole is provided on the back of the freezer.

The alarm contacts are rated: .5A at 30 VDC, 15 watts maximum
.6A at 24 VAC, 14 watts maximum



IMPORTANT USER INFORMATION

Caution! Stored product should be protected by an activated alarm system capable of initiating a timely response 24 hours/day. Forma Alarms provide interconnect for centralized monitoring.

2.14 Chamber Temperature Probes and Vacuum Relief Assembly

The chamber temperature, temperature alarm, and temperature recorder (if installed) probes are located at the base of the left side wall and are protected by a stainless steel cover (Refer to Figures 2-7 and 2-8).

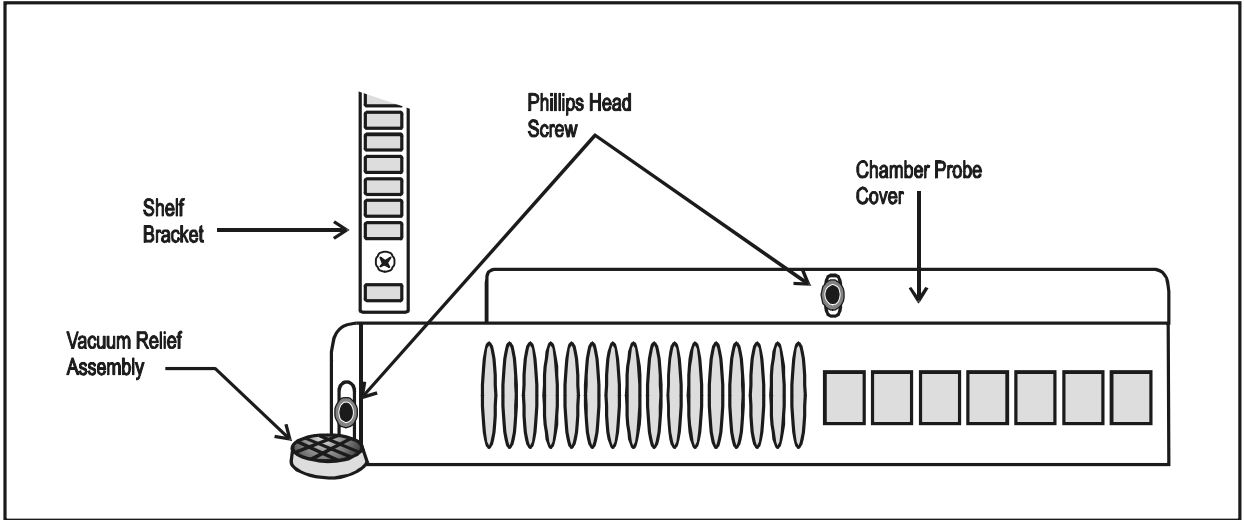


Figure 2-7
Chamber Probe Cover and
Vacuum Relief Assemblies

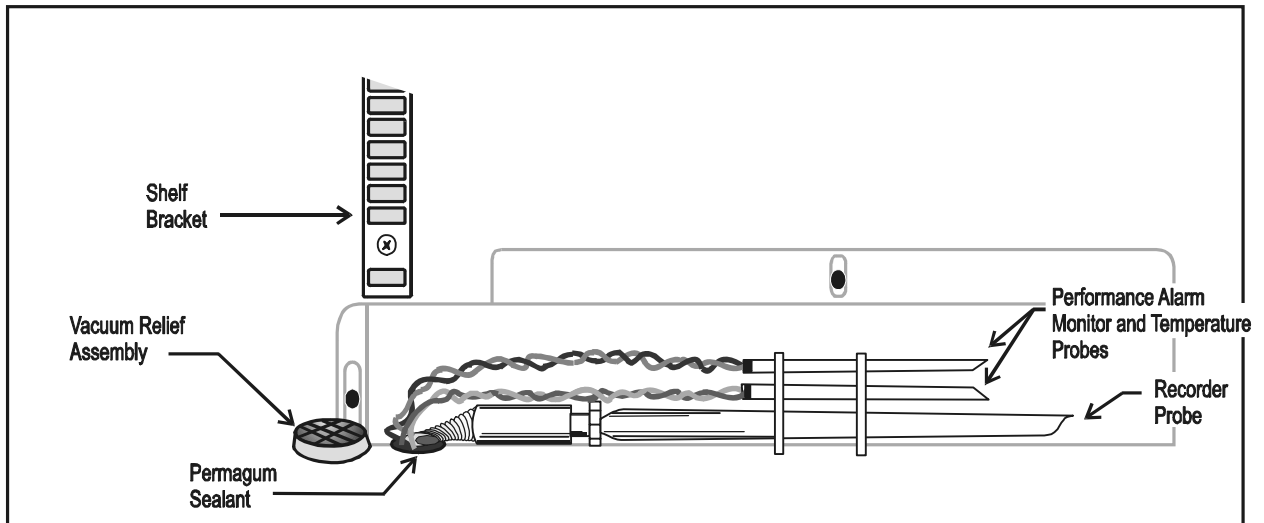


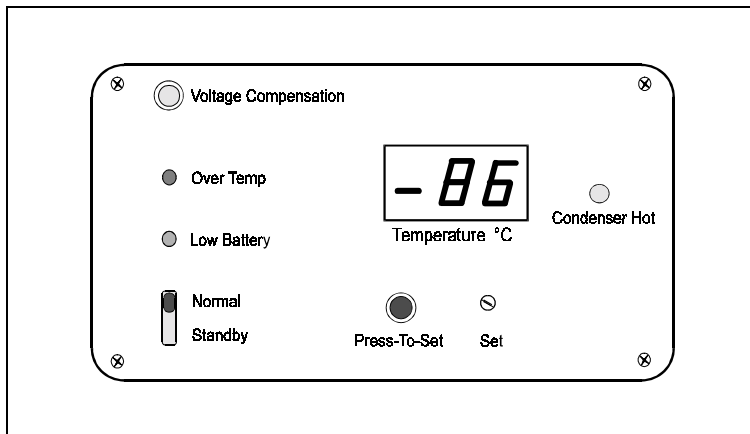
Figure 2-8
Installing the Performance Alarm
Monitor and Temperature Recorder Probes

Section 3 - Operation

3.1 The Control Panel

a. Temperature Controller/Monitor

The electronic Temperature Controller/Monitor provides a constant display of the freezer's temperature. The numerical LED display provides a readout of the actual freezer chamber temperature in increments of one Degree Celsius.



**Figure 3-1
Temperature Controller
with Performance
Monitor/Alarm**

The numerical LED display indicates the temperature set point when the Press-To-Set button is pressed. To adjust the temperature set point, press the Press-To-Set button and adjust the Set Point set screw using the adjustment screwdriver. Refer to Figure 3-3 for the screwdriver location.

The Condenser Hot indicator lights when the thermostat on the condenser reaches 40° C, which indicates typically a dirty air filter, a clogged condenser or a fan failure. Operating the freezer at high ambient temperatures will also cause the Condenser Hot indicator to light.

Note: It is important to maintain air filter cleanliness to prevent condenser clogging. Refer to Sections 4.2 and 4.3 for information for maintaining the air filter and cleaning the condenser.

The Voltage Compensation indicator lights when the voltage compensation system is in operation. Refer to Section 3.8 for information regarding this system.

The Temperature Controller/Monitor board controls power to the compressors and cooling fans.

The Temperature Controller/Monitor must be set and maintained within the normal temperature specifications of -50°C to -86°C . The Temperature Controller/Monitor must never be set below -86°C .



Adjustment of the temperature controller below the normal temperature specification (-86°C) will void the warranty.

b. Performance Monitor/Alarm

The electronic Performance Monitor/Alarm (Figure 3-1) provides a constant monitor of freezer operation. The Performance Monitor/Alarm is powered by three rechargeable AA Ni-Cad Batteries. The batteries are automatically charged when the freezer is connected to an electric power source.

The Performance Monitor/Alarm consists of:

1. **Normal/Standby** Switch
2. **Overtemp** Indicating Light
3. **Low Battery** Indicating Light
4. **Remote Alarm** Contacts
5. **Audible Alarm**

In the event of an over temperature condition, an audible alarm will sound and the red Over Temp light will flash. Refer to Section 3-5 for adjusting the Over Temp set point of the Performance Monitor/Alarm.

1. Normal/Standby Switch

A two position slide switch (Normal and Standby) activates the audible alarm system and indicating light.

Normal Position: If the chamber temperature rises above the Over Temp Alarm setting, the audible alarm will sound and the Over Temp light will flash.

Standby Position: This switch position silences the audible alarm during initial start-up and silences the audible alarm during an over temperature condition. The Over Temp light will continue to flash until the chamber temperature is below the Over Temp setting.

2. Over Temp Indicating Light

The red Over Temp light is normally off and will flash when the chamber temperature rises above the Over Temperature Alarm setting.

3. Low Battery Indicating Light

The red LOW BATTERY light flashes when the battery needs to be replaced.

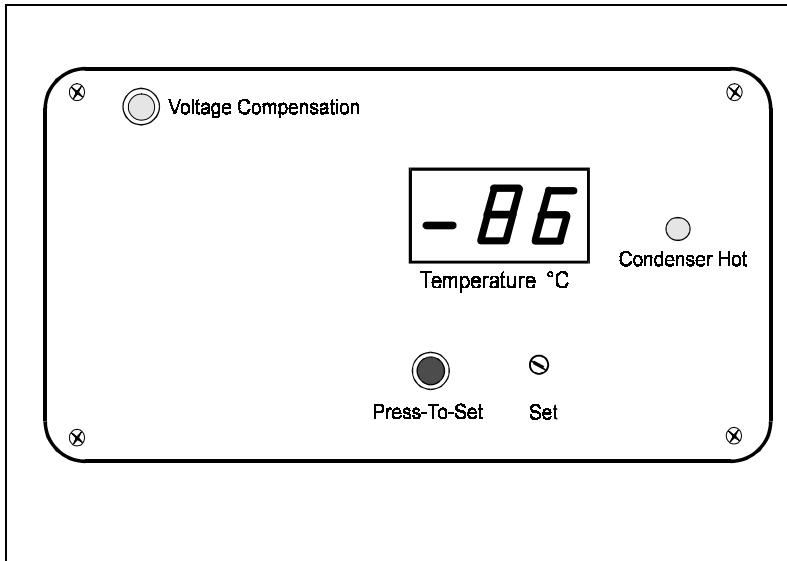
A replacement battery pack may be purchased through the Forma Scientific Service Department, telephone 1-800-848-3080. Ask for Part No. 400116. For battery location, refer to Figure 2-3. For the battery replacement procedure, refer to Section 4.7.

4. Audible Alarm

The audible alarm system operates with the Normal/Standby switch, OverTemp indicating light and Low Battery indicating light. The audible alarm system alerts the user when an abnormal condition has occurred.

3.2 The Control Panel (with factory-option S/N 400998)

The freezer may be ordered from the factory with the Performance Monitor/Alarm deleted. If this option was ordered, the control panel will appear as illustrated in Figure 3-2 and all manual references to the Performance Monitor/Alarm do not apply.



**Figure 3-2
Temperature
Controller/Monitor**

3.3 Main Power Switch (Mains Disconnect)

The main power switch is located on the rear of the refrigeration unit, directly above the line cord.

OFF Position= (o) and ON Position= (|).

3.4 Set Point Adjustment Screwdriver

A small screwdriver, located on the bottom left side of the freezer base is provided for setting the temperature set point. To remove the screwdriver from its holder, pull down on the black knob. The knob is the handle of the screwdriver. See Figure 3-3.

3.5 Adjusting the Performance Monitor/Alarm Over Temperature Set Point

1. Adjust the freezer temperature to the desired operating set point. Refer to Section 2.11. Allow the freezer temperature to stabilize.
2. Remove the four screws and lock washers securing the Performance Monitor/Alarm control panel.
3. Pull the control panel out and locate Set Pot R 9 on the bottom left corner of the Performance Monitor/Alarm circuit board. (See Figure 3-4)

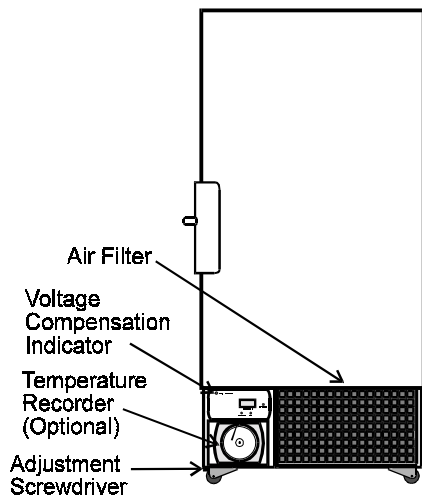


Figure 3-3
900 Series Freezers, Front View

4. Set the Normal/Standby switch to Normal. Turn R 9 counterclockwise to *lower* the over temp set point (Example: -75, -80) or clockwise to *raise* the over temp set point (Example: -60, -55) until the Performance Monitor alarm is activated. Then adjust R 9 the opposite direction until the alarm silences. The alarm should now be set a few degrees above the normal operating temperature set point of the freezer.

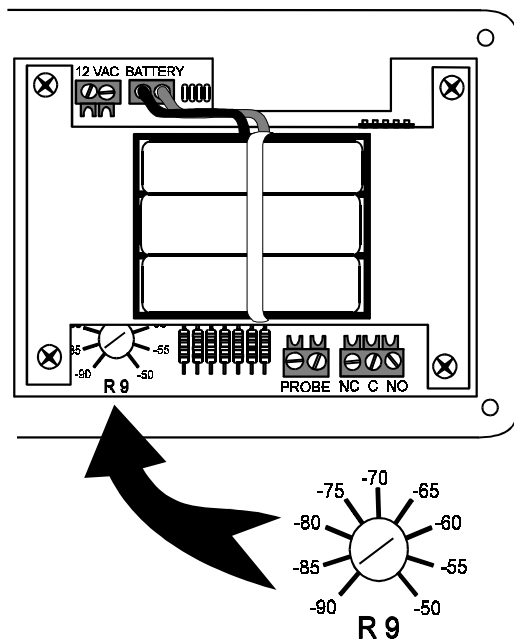


Figure 3-4
Performance Alarm/Monitor Circuit Board and R9 Control Location

3.6 Double Door Freezers (Factory-Built Option)

Double door models of the Forma ULT freezers are available as a factory-built option. These freezers reduce the amount of temperature loss by allowing longer term material to be stored in the bottom portion of the freezer, and more frequently accessed, short term material to be stored on the upper shelves. Operation of the double door freezers is the same as single door models.

Stock# 189758 - 13 cu. ft. and 17.3 cu. ft. Models, 120 VAC

Stock# 189760 - 13 cu. ft. and 17.3 cu. ft. Models, 220 VAC

Inventory rack ordering information is listed below.

Inventory Racks for 13 cu. ft. (368 Liters) freezers

Order No.	Description	Max Qty per Chamber
189771	Rack includes (9) 3" boxes for top chamber	8
189795	Rack includes (12) 2" boxes for top chamber Dimensions: 5.5" W x 9.7" H x 16.1" F-B (14.0cm x 24.6cm x 40.9cm)	8
820009	Rack includes (9) 3" boxes for bottom chamber	8
820015	Rack includes (15) 2" boxes for bottom chamber Dimensions: 5.5" W x 10.9" H x 16.5" F-B (14.0cm x 27.4cm x 41.9cm)	8

Inventory Racks for 17.3 cu. ft. (490 Liters) freezers

Order No.	Description	Max Qty per Chamber
189471	Rack includes (12) 3" boxes for top chamber	8
189495	Rack includes (16) 2" boxes for top chamber Dimensions: 5.5" W x 9.7" H x 22.1" F-B (14.0cm x 24.6cm x 56.1cm)	8
820017	Rack includes (12) 3" boxes for bottom chamber	8
820018	Rack includes (20) 2" boxes for bottom chamber Dimensions: 5.5" W x 10.9" H x 22.1" F-B (14.0cm x 27.7cm x 56.1cm)	8

Inventory racks for 23 cu. ft. (652 Liters) freezers

Order No.	Description	Max Qty per Chamber
189471	Rack includes (12) 3" boxes for top chamber	10
189495	Rack includes (16) 2" boxes for top chamber Dimensions: 5.5" W x 9.7" H x 22.1" F-B (14.0cm x 24.6cm x 56.1cm)	10
820017	Rack includes (12) 3" boxes for bottom chamber	10
820018	Rack includes (20) 2" boxes for bottom chamber Dimensions: 5.5" W x 10.9" H x 22.1" F-B (14.0cm x 27.7cm x 56.1cm)	10

3.7 CoBex Temperature Recorder (Optional)

Operation of the recorder chart drive is automatic when power is applied to the freezer. In the event of a power failure, the 9 Volt back-up battery will allow the recorder to sense and record temperature for about 24 hours. Refer to Section 2.12 and the CoBex booklet included with this manual.

3.8 Automatic Voltage Compensation System

The Forma Biological Storage Freezer is equipped with an automatic line voltage compensation system located in the refrigeration compartment. The system monitors incoming electrical power and automatically adjusts the voltage directed to the freezer. This compensation system ensures that the compressor operates within specification and provides an additional margin of product protection.

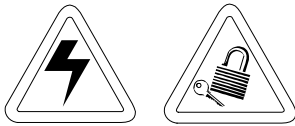
A green LED indicating light, labeled "Voltage Compensation", indicates when the system is in operation. The light is located on the front of the compressor section, lower left corner of the freezer cabinet. (See Figure 3-3)

Section 4 - Routine Maintenance

4.1 Cleaning the Cabinet Exterior

Clean the freezer exterior with soap and water and a general-use laboratory disinfectant. Rinse with water.

4.2 Cleaning the Condenser



De-energize all potential sources of energy to unit and lockout/tagout the de-energized controls.

The CONDENSER HOT light comes on when the thermostat in the refrigeration compartment reaches 40° C, which typically indicates a clogged condenser or a fan failure.

The efficiency of the refrigeration unit is directly related to the temperature of the air entering the air-cooled condenser. Dust in the condenser fins slows the rate of heat dissipation and increases compressor operating temperature (thereby decreasing compressor life). A dirty condenser reduce the overall performance of the refrigeration system in terms of recovery time and set point control accuracy, **or may ultimately cause compressor failure.**

The air-cooled condenser (the finned surface located in the center area of the refrigeration compartment) should be cleaned, as often as necessary, to ensure efficient compressor operation. **A minimum of twice a year** is recommended, depending upon laboratory cleanliness.

To clean the condenser, remove the front grille by grasping the assembly at the corners and gently pulling it away from the frame. Clean the compressor housings and condenser fins with a vacuum cleaner or air-hose. Other refrigeration system parts are cleaned by removing the back and side panels.

Before replacing the grille, inspect the air filter for cleanliness and clean or replace if necessary. Refer to Section 4.3.

Compressors and fan motors are permanently lubricated and do not require servicing.

After cleaning the refrigeration system, remove lockout/tagout devices and re-energize system per O.S.H.A. regulation, Section 1910-147.

4.3 Cleaning the Air Filter (Refer to Figure 4-1)

A foam type air cleaner is located at the front of the compressor panel. When the filter appears dirty it can be easily removed for cleaning. The filter and grill assembly are held in place by snap fasteners on each corner of the grill.

1. Remove the grill by grasping the assembly at the corners and gently pulling it away from the frame. Remove the filter.
2. Clean the filter by washing it with a mild detergent and dry by pressing it between two towels.
3. Should the filter become torn or excessively dirty, a replacement may be ordered from Forma Scientific, Inc.

4.4 Defrosting the Chamber

The type of frost formed in the chamber is generally very soft and may be easily removed with a soft cloth. *Do not* use any type of abrasive brushes. A complete defrosting may occasionally be required.

To completely defrost the chamber:

1. Remove the product and place it in another freezer.
2. Disconnect the freezer from the power supply.
3. Open all doors.
4. Place towels on chamber floor.
5. Allow frost to melt and become loose from the chamber interior.
6. Remove frost with a soft cloth.
7. After defrosting is complete, wipe interior chamber dry with a clean cloth.

4.5 Cleaning the Door Gasket

Routinely (monthly) check the door gasket for any perforations that will cause air leaks. Frost will form around all leakage areas. Frost accumulation on the door gasket may be removed with a soft cloth.

4.6 Cleaning the Vacuum Relief Port (Figures 4-1 and 4-2)

The vacuum relief port on the Model 900 Series is located in the lower left front of the chamber interior. Routinely check the vacuum relief port for frost accumulation and clean as necessary, using a soft cloth.

Caution: The vacuum relief port contains a small heating element to reduce frost build-up. If the freezer is not disconnected from the electrical supply or turned off at the power switch, the heating element continues to operate and may cause injury to personnel cleaning the freezer chamber.

4.7 Replacing the Performance Monitor/Alarm Battery Pack



For a consistent and dependable charge, replace the battery every 2-3 years. Replacement batteries must be of a re-chargeable type and are available from Forma Scientific, Inc. Refer to the parts list for stock number and description of the replacement batteries.

Dispose of the used batteries in a safe manner and in accord with good environmental practices.

1. Turn off electrical power to the freezer.
2. Remove the four screws and lock washers securing the Performance Monitor/Alarm panel.
3. Unplug the battery-to-circuit board connector and remove the battery pack. It is attached to the circuit board metal plate by a Velcro strip.
4. Align the replacement battery pack with the red and black wires toward the connector and press the pack onto the Velcro.
5. Plug in the battery pack and replace the Monitor/Alarm panel.

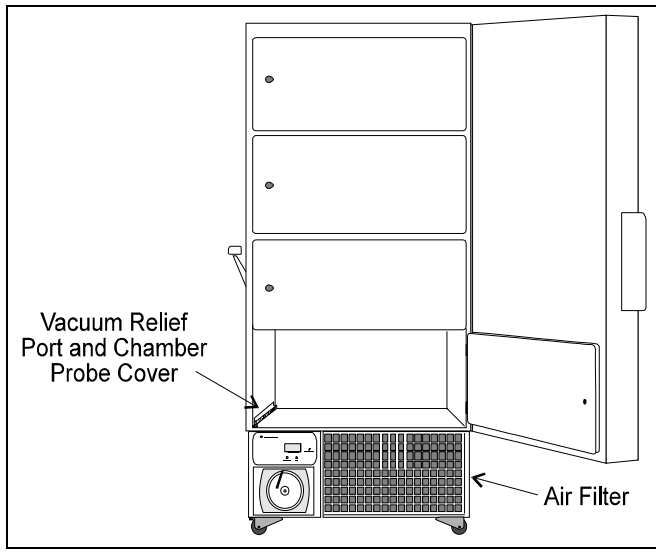


Figure 4-1
Detail View of the Vacuum Relief
Port and Chamber Probe Cover

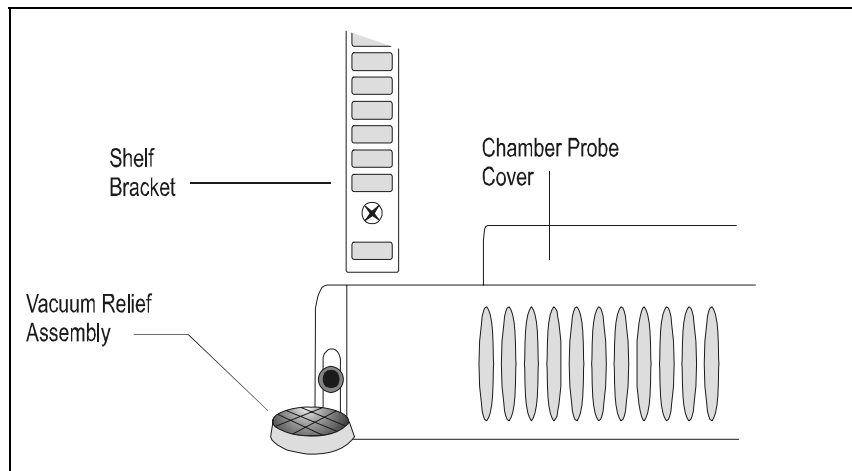


Figure 4-2
Detail View of the
Vacuum Relief Port and
Chamber Probe
Assembly

Section 5 - Service

Caution: *Servicing must be performed by qualified service personnel only!*



5.1 Servicing the Refrigeration System

In the event of a unit malfunction, check all electrical components including starting relays, thermal protectors, and starting capacitors for the compressors.

Electrical schematics and drawings with parts for the refrigeration system are included with this manual.

Caution: *Repair work should be performed only by personnel who have had prior experience with cascade refrigeration systems.*

Note: A service manual entitled "Ultra-Low Refrigeration System Service Guide" is available from Forma Scientific, Inc. Call or write for details.

5.2 Troubleshooting Guide

The following chart is intended as guide to troubleshooting the system. Servicing of the freezer must be performed by qualified service personnel only.

<i>Symptom</i>	<i>Possible Cause</i>
No Power Light.	<ul style="list-style-type: none"> • Power line cord disconnected. • Circuit breaker tripped/open. • Main power switch OFF. • Main fuses open.
Chamber Temp Deviates from Set Point.	<ul style="list-style-type: none"> • Too much warm product added. • Door open too long. • Insufficient voltage. • Inadequate air circulation. • Calibration. • Dirty condenser • High Ambient Temperature
Too Much Frost Build-Up.	<ul style="list-style-type: none"> • Door not properly sealed.
Freezer not Being Refrigerated (Unit is receiving Power).	<ul style="list-style-type: none"> • Compressor thermal overload open. • Defective temp control. • Defective high pressure cut-off. • Low stage compressor locked up. • Loss of refrigerate. • Main fuses open.
Display Problems in General.	<ul style="list-style-type: none"> • Defective temp control board.

Section 6 - Specifications

Upright -86°C Freezers

Specification	Models 916 and 917
Temperature	-50° C (-58°F) to -86° C (-123°F)
Exterior Dimensions	33.25" W x 79.0" H x 37.0" F-B (85 cm x 198 cm x 94 cm) Add 3" (7.6 cm) to width for handle/hinge Add 7" (17.8 cm) to F-B for control panel/wall spacer
Interior Dimensions	23.0" W x 51.5" H x 25.25" F-B (58 cm x 131 cm x 64 cm)
Capacity	17.3 Cu. Ft. (490 liters)
Refrigeration	Two, 1/2 HP Compressors (Cascade System)
Insulation	Type: Non-CFC foamed-in-place urethane Sides: 5" (12.7 cm) Door: 4.5" (11.3 cm)
Electrical	916: 120VAC, 1PH, 60 Hz, 15.5 FLA Operating Range: 108VAC - 130VAC 917: 230VAC, 1PH, 60 Hz, 12 FLA Operating Range: 208VAC - 240VAC
Breaker Requirements (Dedicated Circuit)	916: 20 Amp, 120 VAC 917: 15 Amp, 220 VAC 120V Dedicated Circuit 20 Amp Time Delay Breaker
Automatic Voltage Compensation	Low: Cut In: 110V, Cut Out: 115V, Volts Boost: 10 Cut In: 210V, Cut Out: 220V, Volts Boost 18 High: Cut In: 125V, Cut Out: 120V Volts Buck: 10 Cut Out: 235V, Cut Out: 225V, Volts Buck: 18
Shipping Weight (nominal)	Ocean: 925 lbs. (420 kg) Air/Container: 800 lbs. (363 kg) Motor: 675 lbs. (306 kg)

Specification	Models 925 and 926
Temperature	-50° C (-58°F) to -86° C (-123°F)
Exterior Dimensions	33.25" W x 79.0" H x 31.0" F-B (85 cm x 198 cm x 79 cm) Add 3" (7.6 cm) to width for handle/hinge Add 7" (17.8 cm) to F-B for control panel/wall spacer
Interior Dimensions	23.0" W x 51.5" H x 19.25" F-B (58 cm x 131 cm x 49 cm)
Capacity	13.0 Cu. Ft. (368 liters)
Refrigeration Type	Two, 1/2 HP Compressors (Cascade System)
Insulation	Type: Non-CFC foamed-in-place urethane Sides: 5" (12.7 cm) Door: 4.5" (11.3 cm)
Electrical	925: 208-230VAC, 1PH, 60 Hz, 12 FLA Operating Range: 208VAC - 240VAC 926: 120VAC, 1PH, 60 Hz, 15.5 FLA Operating Range: 108VAC - 130VAC
Breaker Requirements (Dedicated Circuit)	925: 15 Amp, 220 VAC 926: 20 Amp, 120 VAC 120V Dedicated Circuit 20 Amp Time Delay Breaker
Automatic Voltage Compensation	Low: Cut In: 110V, Cut Out: 115V, Volts Boost: 10 Cut In: 210V, Cut Out: 220V, Volts Boost 18 High: Cut In: 125V, Cut Out: 120V Volts Buck: 10 Cut Out: 235V, Cut Out: 225V, Volts Buck: 18
Shipping Weight (nominal)	Ocean: 935 lbs. (424 kg) Air/Container: 850 lbs. (386 kg) Motor: 724 lbs. (328 kg)

Specification	Model 923
Temperature	-50° C (-58°F) to -86° C (-123°F)
Exterior Dimensions	40.75" W x 79.0" H x 37.0" F-B (103.5 cm x 198 cm x 93.9 cm) Add 3" (7.6 cm) to width for handle/hinge Add 7" (17.8 cm) to F-B for control panel/wall spacer
Interior Dimensions	30.57" W x 51.5" H x 25.25" F-B (77.7 cm x 131 cm x 64 cm)
Capacity	23.0 Cu. Ft. (652 liters)
Refrigeration	Two 3/4 HP Compressors (Cascade System)
Insulation	Type: Non-CFC foamed-in-place urethane Sides: 5" (12.7 cm) Door: 4.5" (11.3 cm)
Electrical	230VAC, 1PH , 60 Hz, 12 FLA Operating Range: 208VAC - 240VAC
Breaker Requirements (Dedicated Circuit)	15 Amp, 220VAC
Automatic Voltage Compensation	Low: Cut In: 110V, Cut Out: 115V, Volts Boost: 10 Cut In: 210V, Cut Out: 220V, Volts Boost 18 High: Cut In: 125V, Cut Out: 120V Volts Buck: 10 Cut Out: 235V, Cut Out: 225V, Volts Buck: 18
Shipping Weight (nominal)	Ocean: 970 lbs. (440 kg) Air/Container: 880 lbs. (399 kg) Motor: 880 lbs. (379 kg)

Section 7 - Parts List

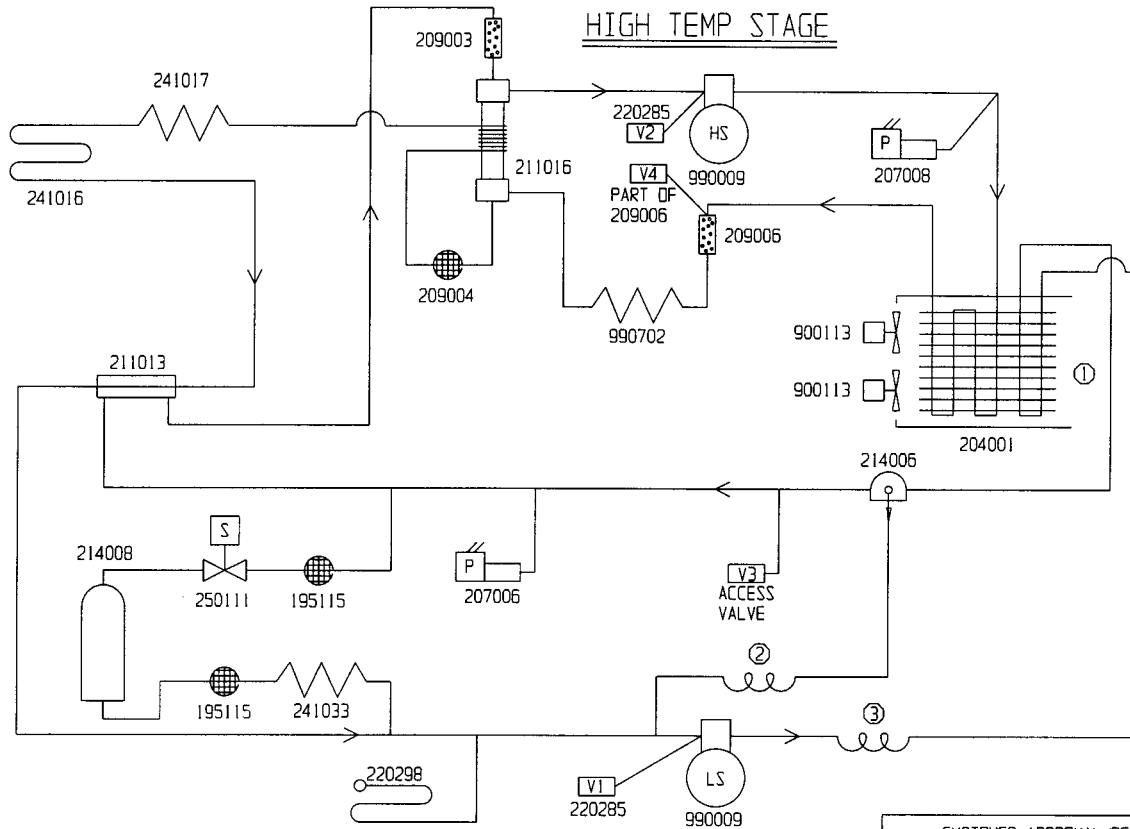
Stock #	Description
190764	Temperature Control Board
400101	Thermostat 40C
400116	Battery, Dryseal pk., 3.6V, AA (rechargeable)
400123	Performance Monitor, 900 Series
290041	Temperature Monitor Probe
214006	Oil Separator
209003	Dryer 3/8 ODF
209006	Dryer 1/4 ODS (Non-CFC)
250111	Solenoid Valve (120V Models)
250115	Solenoid Valve (220V Models)
207008	Pressure Switch, Cutout
900111 (2)	Tubeaxial Fan, 220V (923, 925 and 917)
900113 (2)	Tubeaxial Fan, 120V (916 and 926)
760163	Air Filter, 15.8" x 17.8"
195520	(5) 760163 Air Filters
132041	Door Heater, 115V, for (optional) Double Door Freezer
132042	Door Heater, 230V, for (optional) Double Door Freezer
420101	Transformer, 20 VA
230110	1Amp Fuse, Slo-Blow, (transformer)
285613	15Amp Fuse, Slo-Blow (230V)
285614	20Amp Fuse, Slo-Blow (120V)
230115	.15Amp Fuse, Slo-Blow (vacuum relief port heater)
290041	Control Probe

Refrigeration Replacement Parts

Stock #	Description
1990009	Low Stage Compressor with Zerol 150T, 115V, 1/2 HP (Models 916, 926)
2990009	High Stage Compressor with Ester Oil, 115V, 1/2 HP (Models 916, 926)
1990004	Low Stage Compressor with Zerol 150T, 230V, 1/2 HP (Models 917, 925)
2990004	High Stage Compressor with Ester Oil, 230V, 1/2 HP (Models 917, 925)
1990014	Low Stage Compressor with Zerol 150T, 230V, 3/4 HP (Model 923)
2990014	High Stage Compressor with Ester Oil, 230V, 3/4 HP (Model 923)
970023	Refrigerant R-134A, High Stage, 70# cylinder
970022	Refrigerant R-23, Low Stage, 70# cylinder
970009	Propane, 14.5 oz
970010	Propane Tank Adapter
143021	Zerol 150T, 1 gallon

Section 8 - Refrigeration Drawings

CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 26 gr (0.9 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 227 gr (8.0 OZ) (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 425 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE		5	FR-1203	04-10-98	RLM	KOG	HEG	ADDED METRIC UNITS FOR IEC-1010
APPROVED BY	_____	4	FR-1146	11-04-97	LDC	KOG	LDN	ADDED 700 & ALT. SELECT
APPROVING FIRM	_____	3	FR-1146	08-07-97	LDC	KOG	LDN	ADDED ALT. BRAND MODEL 5466
DATE OF APPROVAL	_____	2	FR-1025	10-04-96	AT	POK	LDN	IEC-1010 UP-DATES
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM FORMA SCIENTIFIC		1	FR-765	10-21-94	LDC	KOG	LDN	214008 WAS 993102
REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION		
		DATE 8-23-93	DWN AT	CAD AT	APPO JV	SCALE NONE		
CUSTOMER								
JOB TITLE 716, 916, 5416, 5466 & 8516 -86°C 17 CU FT U.R. FREEZER								
DWG TITLE REFRIGERATION SCHEMATIC								
LOCATION			JOB NUMBER			DRAWING NUMBER		
FREEZERS						8516-90-0-B		



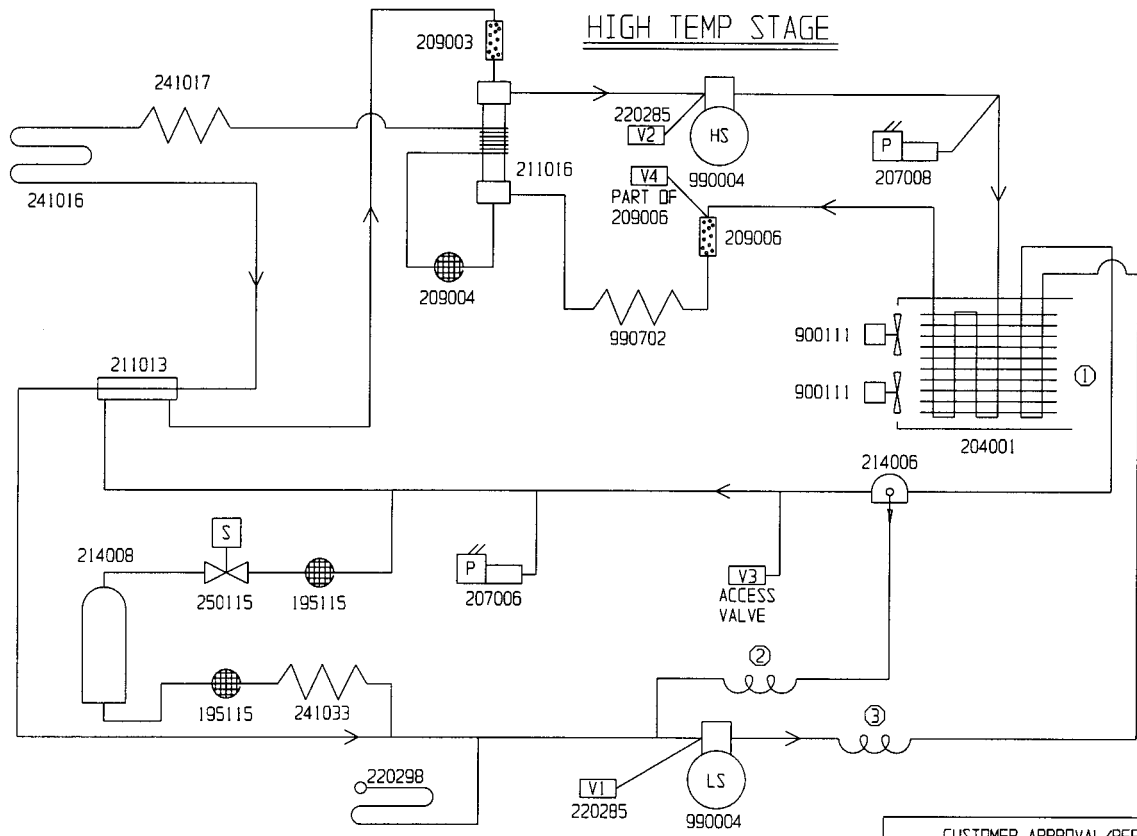
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CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 26 gr (0.9 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 227 gr (8.0 OZ) (0 PSIG - 85 PSIG)
 ZEROL ISOT: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 425 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE		6	FR-1203	04-10-98	RLM	KDG	HEG	ADDED METRIC UNITS FOR IEC-1010	
APPROVED BY	_____	5	FR-1146	11-04-97	LOC	KDG	LDN	ADDED 700 & ALT. SELECT	
DATE OF APPROVAL	_____	4	FR-1146	08-07-97	LOC	KDG	LDN	ADDED ALT. BRAND MODEL 5467	
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		2	FR-781	11-11-94	AT	KDG	LDN	250115 WAS 250111	
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		DATE 8-23-93	DWN	AT	CAD	AT	APPD	JV	SCALE NONE
CUSTOMER									
JOB TITLE 717, 917, 5417, 5457 & 8517 -86°C 17 CU FT U.R. FREEZER									
DWG TITLE REFRIGERATION SCHEMATIC									
LOCATION			JOB NUMBER		DRAWING NUMBER				
FREEZERS					8517-90-0-B				

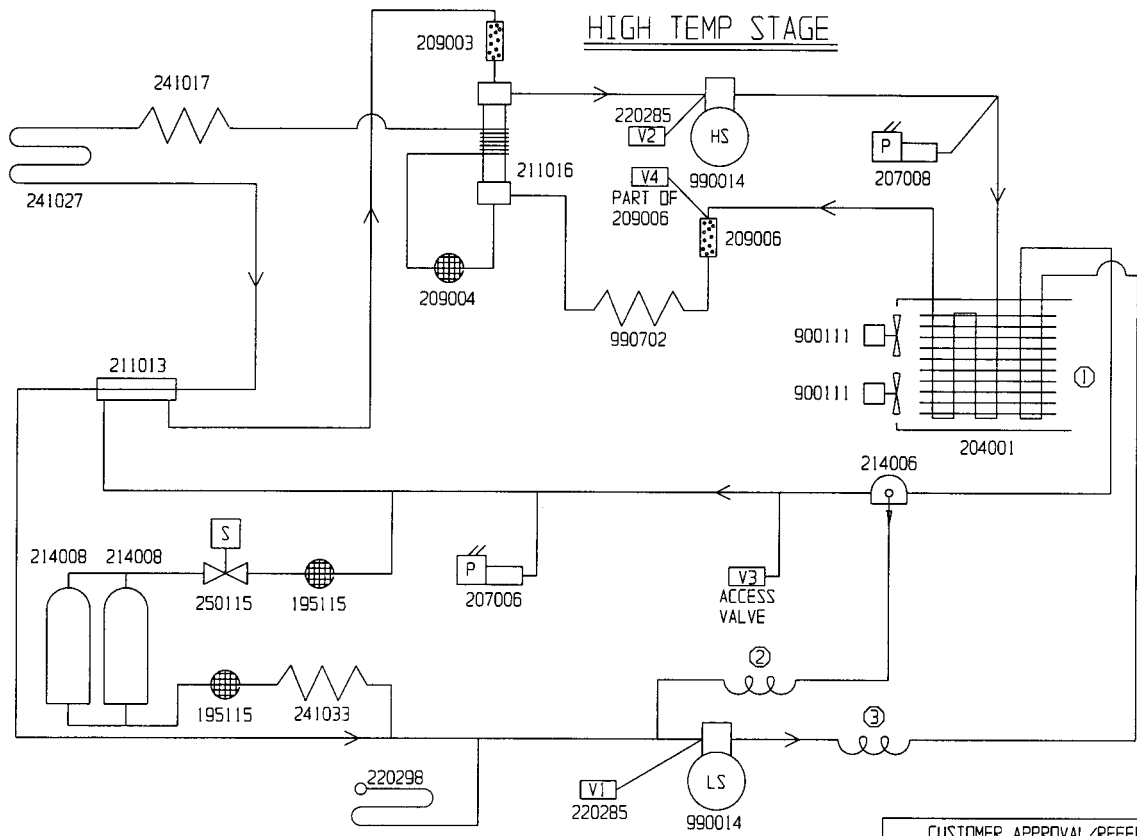


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CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 37 gr (1.3 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 405 gr (14.3 OZ) (0 PSIG - 100 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 425 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE		7	FR-1203	04-10-98	RLM	KDG	HEG	ADDED METRIC UNITS FOR IEC-1010		
APPROVED BY	_____	6	FR-1146	11-04-97	LDC	KDG	LDN	ADDED 700 & ALT. SELECT		
APPROVING FIRM	_____	5	FR-1146	08-07-97	LDC	KDG	LDN	ADDED ALT. BRAND MODEL 5463		
DATE OF APPROVAL	_____	4	FR-1025	10-04-96	AT	PKJ	LDN	IEC-1010 UP-DATES		
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CUSTOMER										
JOB TITLE 723, 923, 5423, 5463 & 8523 -86°C 23 CU FT U.R. FREEZER										
DWG TITLE REFRIGERATION SCHEMATIC										
LOCATION			JOB NUMBER			DRAWING NUMBER				
FREEZERS						8523-90-0-B				

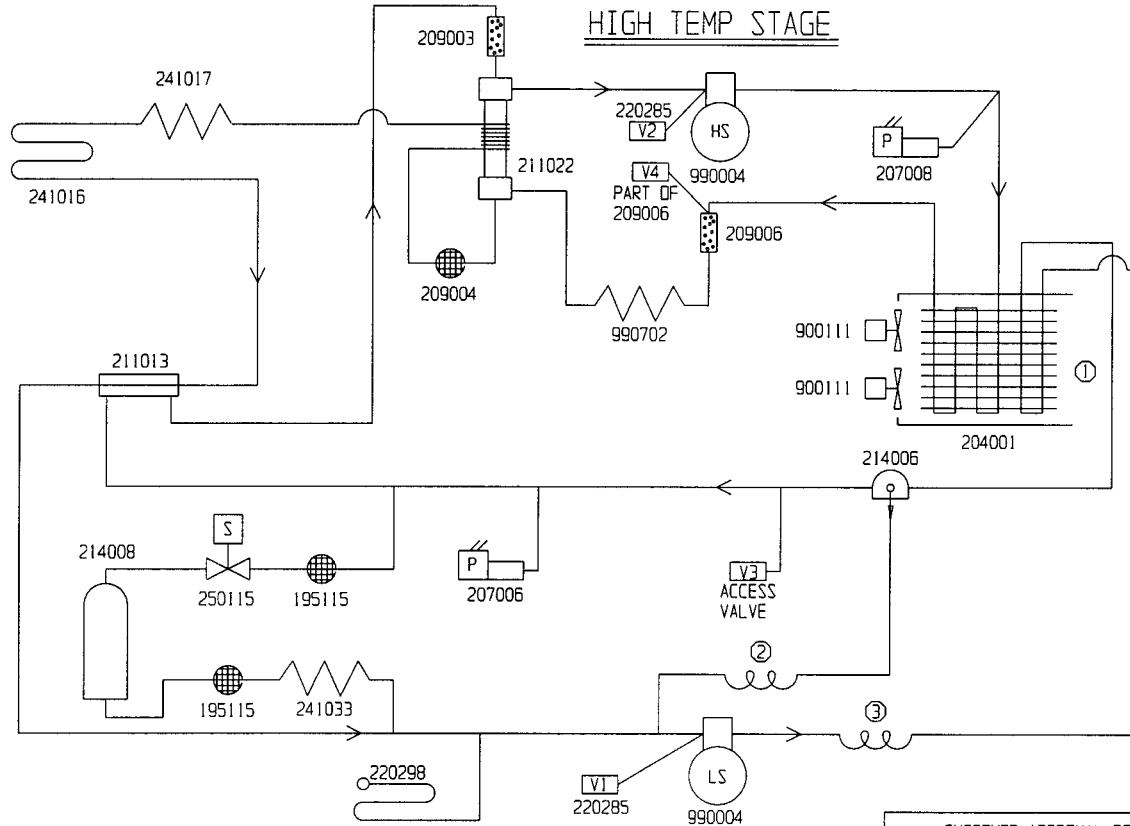


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CASCADE REFRIGERATION



HIGH TEMPERATURE STAGE:
 REFRIGERANT R-134a: 765 gr (27 OZ)
 MOBIL EAL-22: COMPRESSOR 1134 gr (40 OZ)

LOW TEMPERATURE STAGE:
 *REFRIGERANT R-290: 26 gr (0.9 OZ) (30" VAC. - 0 PSIG)
 *REFRIGERANT R-23: 224 gr (7.9 OZ) (0 PSIG - 85 PSIG)
 ZEROL 150T: (COMPRESSOR) 1134 gr (40 OZ)
 (OIL SEPARATOR) 426 gr (15 OZ)
 DESUPER HEAT COIL: ① TOP FOUR PASSES OF R-134a
 AIR-COOLED CONDENSER
 VIB. ISO. COIL ② 1 COIL 1/4" TUBING X 4" DIA.
 DESUPER HEAT/VIB. ISO. COIL ③ 2 COILS 5/16" TUBING X 6-3/4" DIA.

*WHEN SYSTEM IS AT 24°C

LOW TEMP STAGE

CUSTOMER APPROVAL/REFERENCE		7	FR-1203	04-10-98	RLM/KDG	HEG	ADDED METRIC UNITS FOR IEC-1010
APPROVED BY	_____	6	FR-1146	11-04-97	LDC/KDG	LON	ADDED 700 & ALT. SELECT
APPROVING FIRM	_____	5	FR-1146	08-07-97	LDC/KDG	LON	ADDED ALT. BRAND MODEL 5465
DATE OF APPROVAL	_____	4	FR-1025	10-04-96	AT	POK	IEC-1010 UP-DATES
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION IS NOT TO BE DISCLOSED TO OTHERS FOR ANY PURPOSE NOR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM FORMA SCIENTIFIC							
REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION	
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JOB TITLE 725, 925, 5425, 5465							
JOB TITLE 8525 & 8560 -86°C 13 CU FT UPRIGHT FREEZER							
DWG TITLE REFRIGERATION SCHEMATIC							
LOCATION		JOB NUMBER		DRAWING NUMBER			
FREEZERS				8525-90-0-B			



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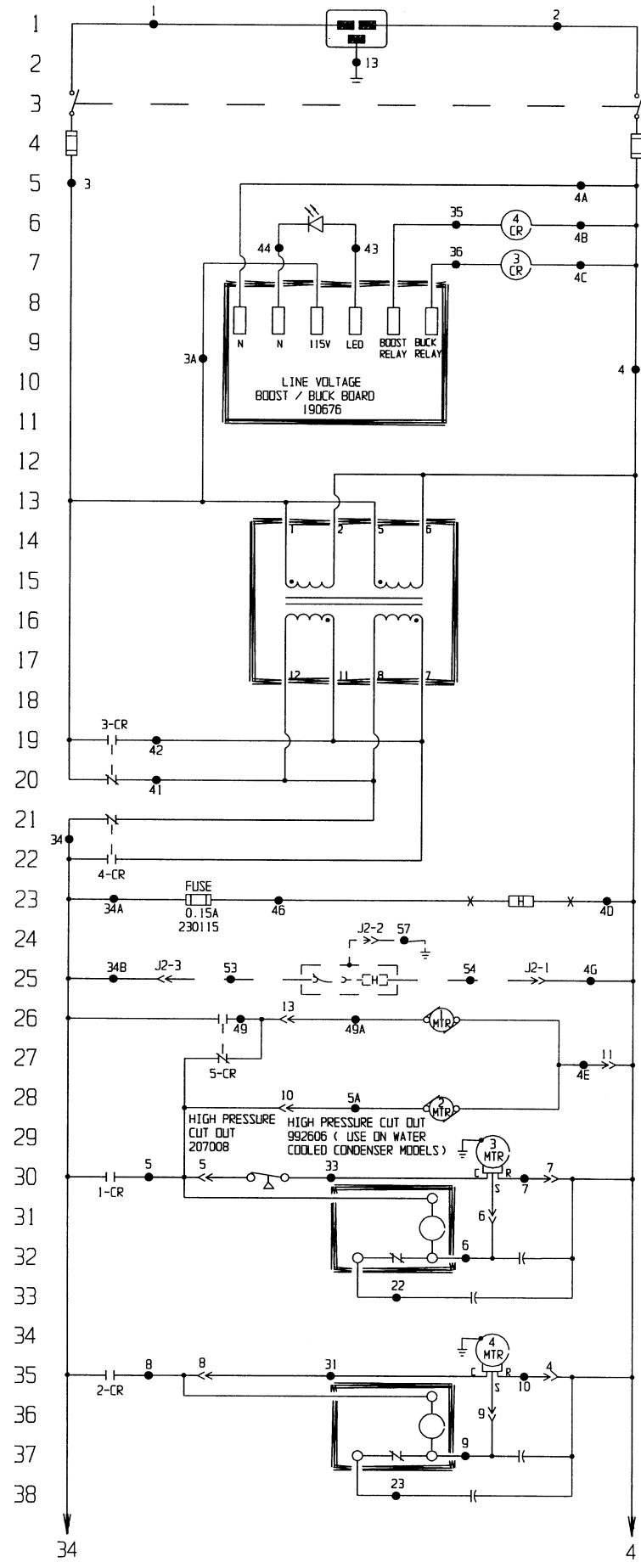
Bid on Equipment

1-847-683-7720

www.bid-on-equipment.com

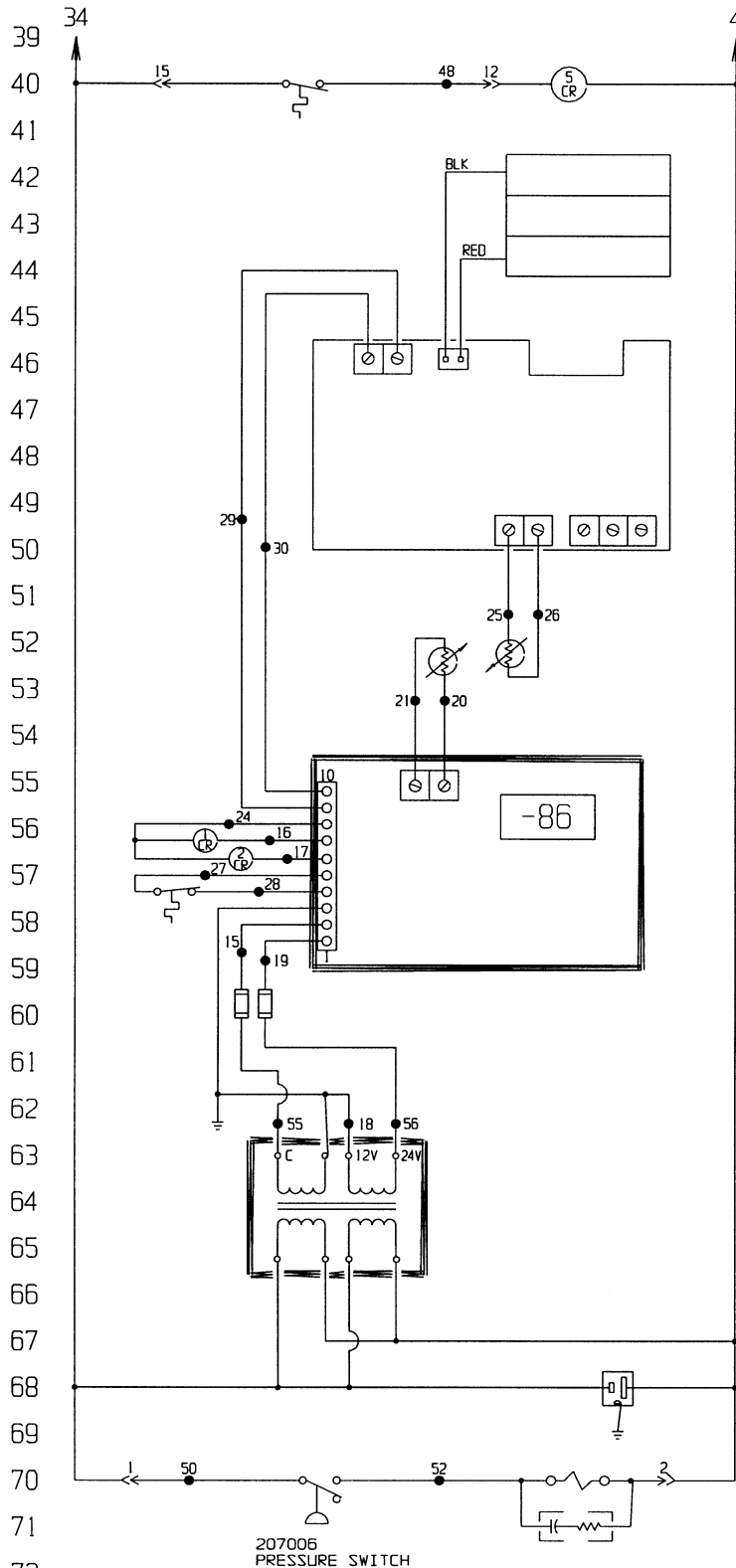
Section 9 - Electrical Schematics

POWER CONNECTION
 120V, 1Ø, 2W, 60HZ, 15.5 FLA
 (OPERATING RANGE 108-130V)



- 460169
POWER INLET
- 360188
POWER SWITCH
- 285614
FUSE 20A
- 280059
VOLTAGE CORRECTION LED
- 300073
BOOST RELAY
20, 21
- 300073
BUCK RELAY
18, 19
- 420065
175VA TRANSFORMER
- 133007
VACUUM RELIEF PORT HEATER
12.5W @ 120VAC
UPRIGHT FREEZERS ONLY
- 132041
SPLIT DOOR HEATER
10W @ 120VAC
SPLIT DOOR OPTION ONLY
- 900113
TUBEAXIAL FAN
- 900113
TUBEAXIAL FAN
- 990009
HIGH STAGE COMPRESSOR
1/2 H.P., 120V
- 300309
START RELAY
- 170108
RUN CAPACITOR
35UF, 370V
- 170012
START CAPACITOR
270-324UF, 125V
- 990009
LOW STAGE COMPRESSOR
1/2 H.P., 120V
- 300309
START RELAY
- 170108
RUN CAPACITOR
35UF, 370V
- 170012
START CAPACITOR
270-324UF, 125V

Electrical Schematic
 Forma Models:
 716, 726, 739, 759,
 916, 926, 939, 959,
 5466, 5461, 5472, and
 5479 ULT Freezers
 916-70-0-D Rev. 18
 Page 1 of 3



400105
 BASE THERMOSTAT
 300073
 BASE AIR FLOW RELAY
 23, 24

190404
 RECHARGEABLE ALARM

290041 PROBE
 1000 OHM PLATINUM
 290041 PROBE
 1000 OHM PLATINUM

190829 (CHEST)
 190764 (UPRIGHT)
 TEMP. CONTROL

300261
 HIGH STAGE RELAY
 300261
 LOW STAGE RELAY

400101
 AIR FLOW T-STAT
 OPEN ON RISE

420101 TRANSFORMER
 25 VA, 24V

460024
 RECORDER OUTLET

250111
 SOLENOID

270015
 ARC SUPPRESSOR

207006
 PRESSURE SWITCH

Electrical Schematic
 Forma Models:
 716, 726, 739, 759,
 916, 926, 939, 959,
 5466, 5461, 5472, and
 5479 ULT Freezers

WIRE REFERENCE CHART

	WIRE #	GAUGE	COLOR
77	1	14	BLK
	2	14	WHT
78	3	14	BRN
	3A	20	BRN
79	4	14	WHT
	4A	20	WHT
	4B	20	WHT
80	4C	20	WHT
	4D	18	BLU
	4E	18	BLU
81	4F	20	WHT
	4G	18	WHT
82	5	14	BRN
	5A	18	BRN
	6	14	RED
83	7	14	YEL
	8	14	BLK
84	9	14	PUR
	10	14	ORG
	13	14	GRN
85	15	22	RED
	16	22	YEL
86	17	22	ORG
	18	22	BLK
	19	22	WHT
87	20	22	RED
	21	22	WHT
88	22	14	GRY
	23	14	ORG
89	24	22	BLU
	25	22	RED
	26	22	WHT
90	27	22	BLK
	28	22	BLK
	29	22	BLK
91	30	22	WHT
	31	14	BLK
92	32	--	---
	33	14	BRN
	34	14	BLK
93	34A	18	BRN
	34B	18	BLK
94	35	20	ORG
	36	20	YEL
	41	14	RED
95	42	14	BLK
	43	20	RED
96	44	20	BLK
	45	14	GRY
	46	18	BLK
97	48	14	BRN
	49	14	BLK
98	50	18	BLK
	51	18	WHT
99	52	18	BRN
	53	18	BLK
	54	18	WHT
100	55	18	RED
	56	18	WHT
101	57	18	GRN/YEL

NOTES:

<input checked="" type="checkbox"/> Denotes Terminal Strip Connection	Ports List Reference Number
5-CR Last Relay Number	<input type="checkbox"/> Assembly
Last Terminal Number	<input type="checkbox"/> Panel
57 Last Wire Number	<input type="checkbox"/> Refrigeration
	<input type="checkbox"/> Wiring

CUSTOMER APPROVAL/REFERENCE

APPROVED BY _____
 APPROVING FIRM _____
 DATE OF APPROVAL _____

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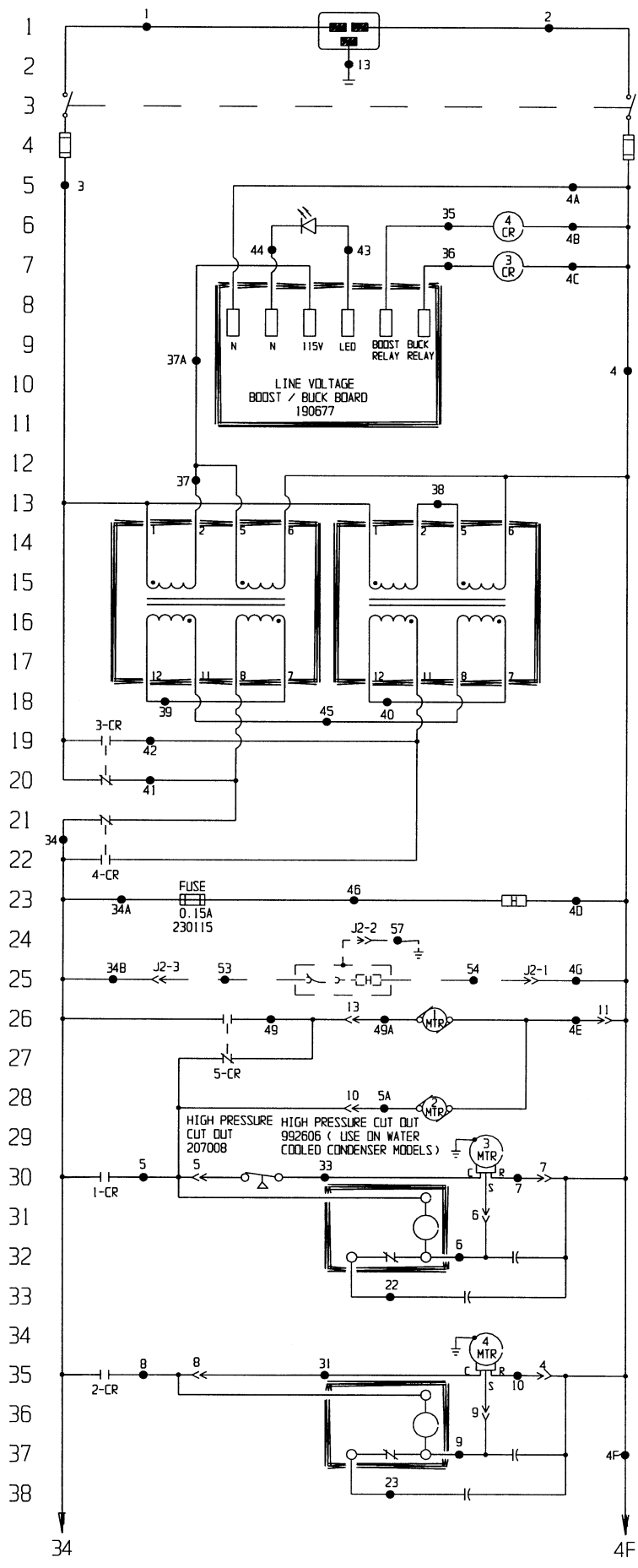


18	FR-1223	05-08-98	AT	KDG	HEG	ADDED 190629 TEMP. CONTROL (CHEST)				
17	SI-6703	12-17-97	AT	KDG	LON	ADD CONNECTORS FOR SPLIT DOOR OPT				
16	FR-1183	12-08-97	AT	KDG	LON	CHG. 190673 TEMP. BOARD TO 190784				
15	FR-1146	10-28-97	AT	KDG	LON	ADDED 700 SERIES				
14	FR-1160	10-28-97	AFC	KDG	LON	ADDED OPERATING RANGE				
REV	ECR NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION				
	DATE	8-17-93	OWN	AT	CAD	AT	APPD	JV	SCALE	NONE
JOB TITLE 716, 726, 739, 759, 916, 926, 939, 959										
JOB TITLE 5466, 5461, 5472 & 5479 FREEZERS										
DWG TITLE ELECTRICAL SCHEMATIC										
LOCATION					JOB NUMBER		DRAWING NUMBER			
FREEZERS							916-70-0-D			

Electrical Schematic
Forma Models:
 716, 726, 739, 759,
 916, 926, 939, 959,
 5466, 5461, 5472, and
 5479 ULT Freezers

916-70-0-D Rev. 18
 Page 3 of 3

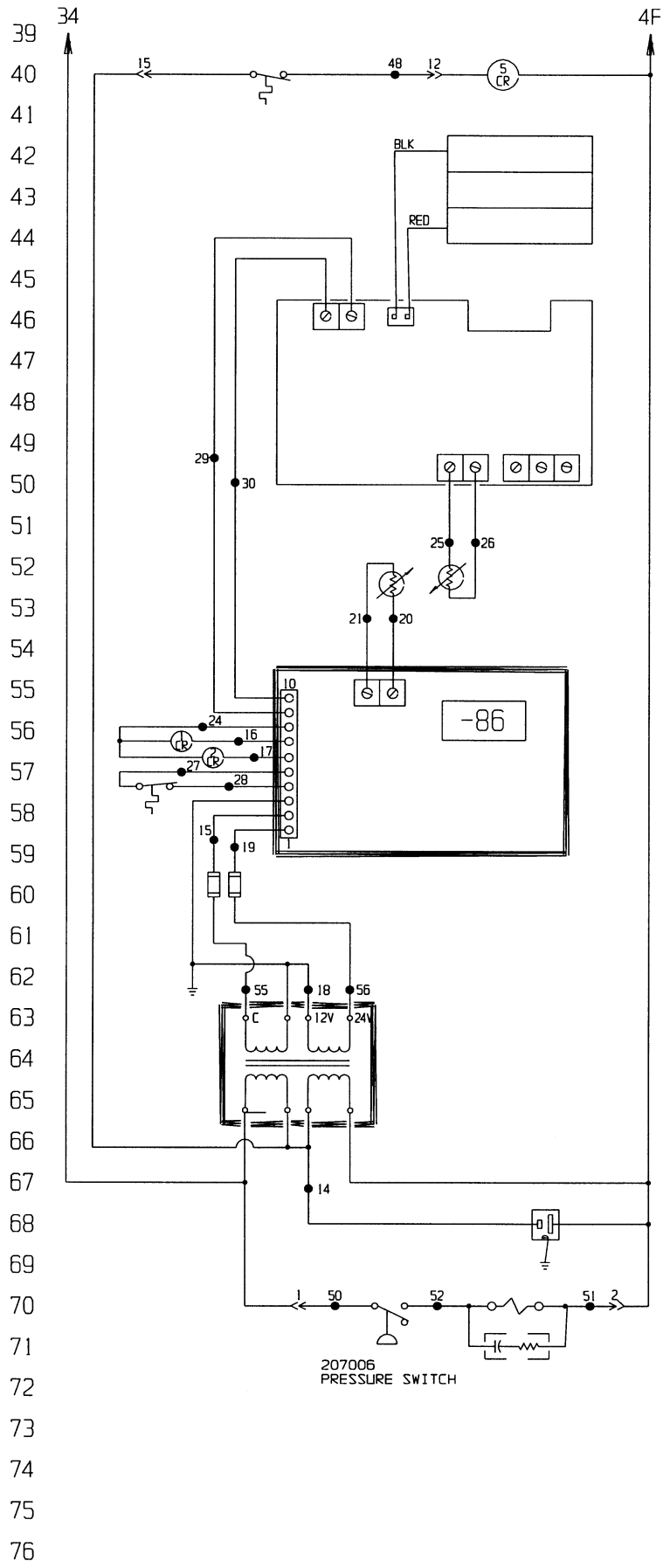
POWER CONNECTION
 230V, 1 ϕ , 2W, 50/60HZ, 12.0 FLA
 (OPERATING RANGE 208-240V)



- 460169
POWER INLET
- 360188
POWER SWITCH
- 285613
FUZE 15A
- 280059
VOLTAGE CORRECTION LED
- 300073
BOOST RELAY
20, 21
- 300073
BUCK RELAY
18, 19
- 420066
130VA TRANSFORMER, 2
- 133008
VACUUM RELIEF PORT HEATER
12.5W @ 220VAC
UPRIGHT FREEZERS ONLY
- 132042
SPLIT DOOR HEATER
10W @ 240VAC
SPLIT DOOR OPTION ONLY
- 900111
TUBEAXIAL FAN
- 900111
TUBEAXIAL FAN
- 990004
HIGH STAGE COMPRESSOR
1/2 H.P., 220V
- 300310
START RELAY
- 170101
RUN CAPACITOR
SUF, 370V
- 170010
START CAPACITOR
88-108UF, 250V
- 990004
LOW STAGE COMPRESSOR
1/2 H.P., 220V
- 300310
START RELAY
- 170101
RUN CAPACITOR
SUF, 370V
- 170010
START CAPACITOR
88-108UF, 250V

Electrical Schematic
Forma Models:
 717, 725, 738, 758,
 917, 925, 938, 958,
 5467, 5465, 5471, and
 5478 ULT Freezers

917-70-0-D Rev. 21
 Page 1 of 3



- 400105
BASE THERMOSTAT
- 300073
BASE AIR FLOW RELAY
24, 25

- 190404
RECHARGEABLE ALARM

- 290041 PROBE
1000 OHM PLATINUM
- 290041 PROBE
1000 OHM PLATINUM

- 190829 (CHEST)
190764 (UPRIGHT)
TEMP. CONTROL

- 300261
HIGH STAGE RELAY
- 300261
LOW STAGE RELAY
- 400101
AIR FLOW T-STAT
OPEN ON RISE

- 420101 TRANSFORMER
25 VA, 24V

- 460024
RECORDER OUTLET

- 250115
SOLENOID
- 270015
ARC SUPPRESSOR

Electrical Schematic
 Forma Models:
 717, 725, 738, 758,
 917, 925, 938, 958,
 5467, 5465, 5471, and
 5478 ULT Freezers

917-70-0-D Rev. 21
 Page 2 of 3

WIRE REFERENCE CHART

	WIRE #	GAUGE	COLOR
77	1	14	BRN
78	2	14	BLU
	3	14	BRN
79	4	14	BLU
	4A	20	BLU
80	4B	20	BLU
	4C	20	BLU
81	4D	18	BLU
	4E	18	BLU
82	4F	20	BLU
	4G	18	WHT
83	5	14	BRN
	5A	18	BRN
84	6	14	RED
	7	14	YEL
85	8	14	BLK
	9	14	PUR
86	10	14	ORG
	13	14	GRN/YEL
	14	14	BLK
87	15	22	RED
	16	22	YEL
88	17	22	ORG
	18	22	BLK
89	19	22	WHT
	20	22	RED
90	21	22	WHT
	22	14	GRY
91	23	14	ORG
	24	22	BLU
92	25	22	RED
	26	22	WHT
93	27	22	BLK
	28	22	BLK
94	29	22	BLK
	30	22	WHT
	31	14	BLK
	32	--	---
95	33	14	BRN
	34	14	BRN
96	34A	18	BRN
	34B	18	BLK
97	35	20	ORG
	36	20	YEL
98	37	14	PUR
	37A	20	PUR
99	38	14	PUR
	39	14	ORG
100	40	14	YEL
	41	14	RED
101	42	14	BLK
	43	20	RED
102	44	20	BLK
	45	14	GRY
103	46	18	BLK
	48	18	BRN
	49	14	BLK
104	49A	18	BLK
	50	18	BLK
105	51	18	WHT
	52	18	BRN
	53	18	BLK
106	54	18	WHT
	55	18	RED
107	56	18	WHT
	57	18	GRN/YEL

NOTES:	
⊗ Denotes Terminal Strip Connection	Parts List Reference Number
5-CR Last Relay Number	○ Assembly
Last Terminal Number	∧ Panel
57 Last Wire Number	○ Refrigeration
	□ Wiring

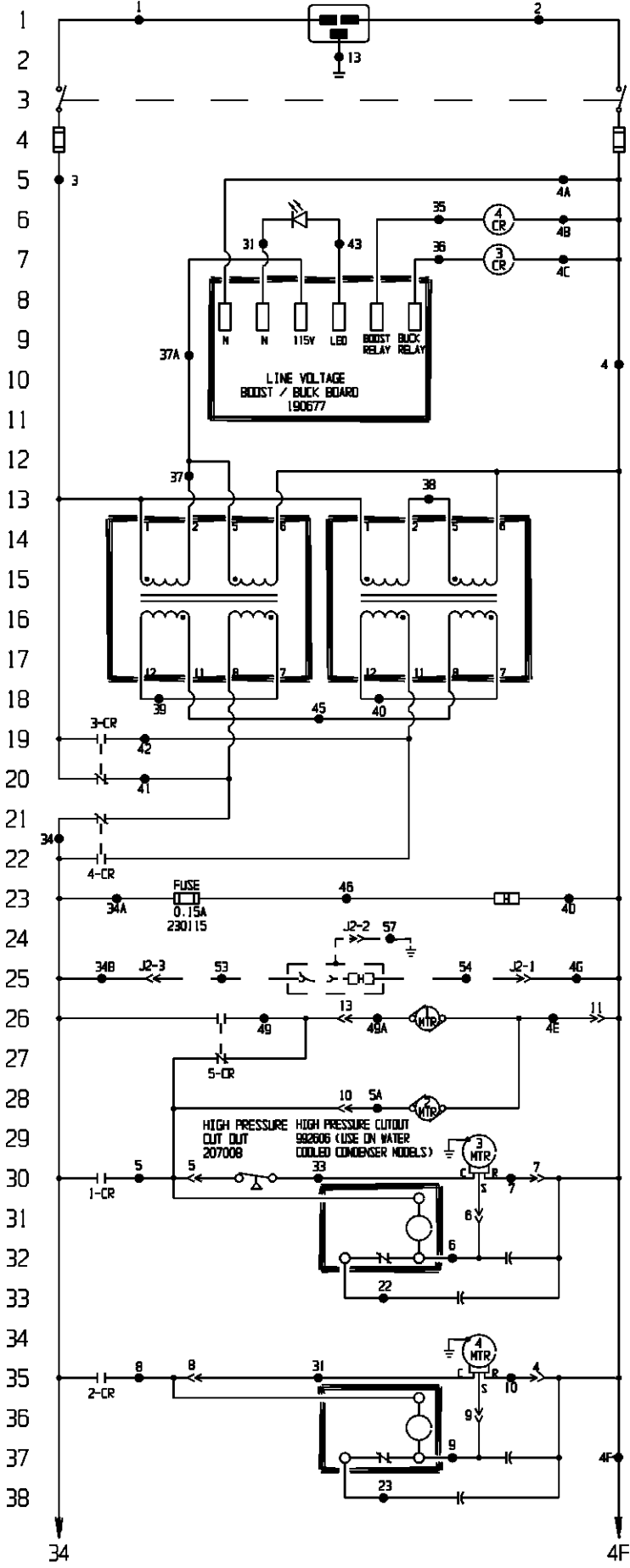
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APPROVED BY	APPROVING FIRM	20 SI-6703 12-17-97 AT KDG LDN ADD CONNECTORS FOR SPLIT DOOR OPT.
DATE OF APPROVAL		19 FR-1183 12-08-97 AT KDG LDN CHG. 190673 TEMP. CONTROL TO 190764
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REV	ECR NO. DATE	BY CAD APPD DESCRIPTION OF REVISION
	DATE 8-17-93	DWN AT CAD AT APPD JV SCALE NONE
JOB TITLE 717, 725, 738, 758, 917, 925, 938, 958		
JOB TITLE 5467, 5465, 5471 & 5478 FREEZERS		
DWG TITLE ELECTRICAL SCHEMATIC		
LOCATION	JOB NUMBER	DRAWING NUMBER
FREEZERS		917-70-0-D

Electrical Schematic
Forma Models:
717, 725, 738, 758,
917, 925, 938, 958,
5467, 5465, 5471, and
5478 ULT Freezers

917-70-0-D Rev. 21
Page 3 of 3

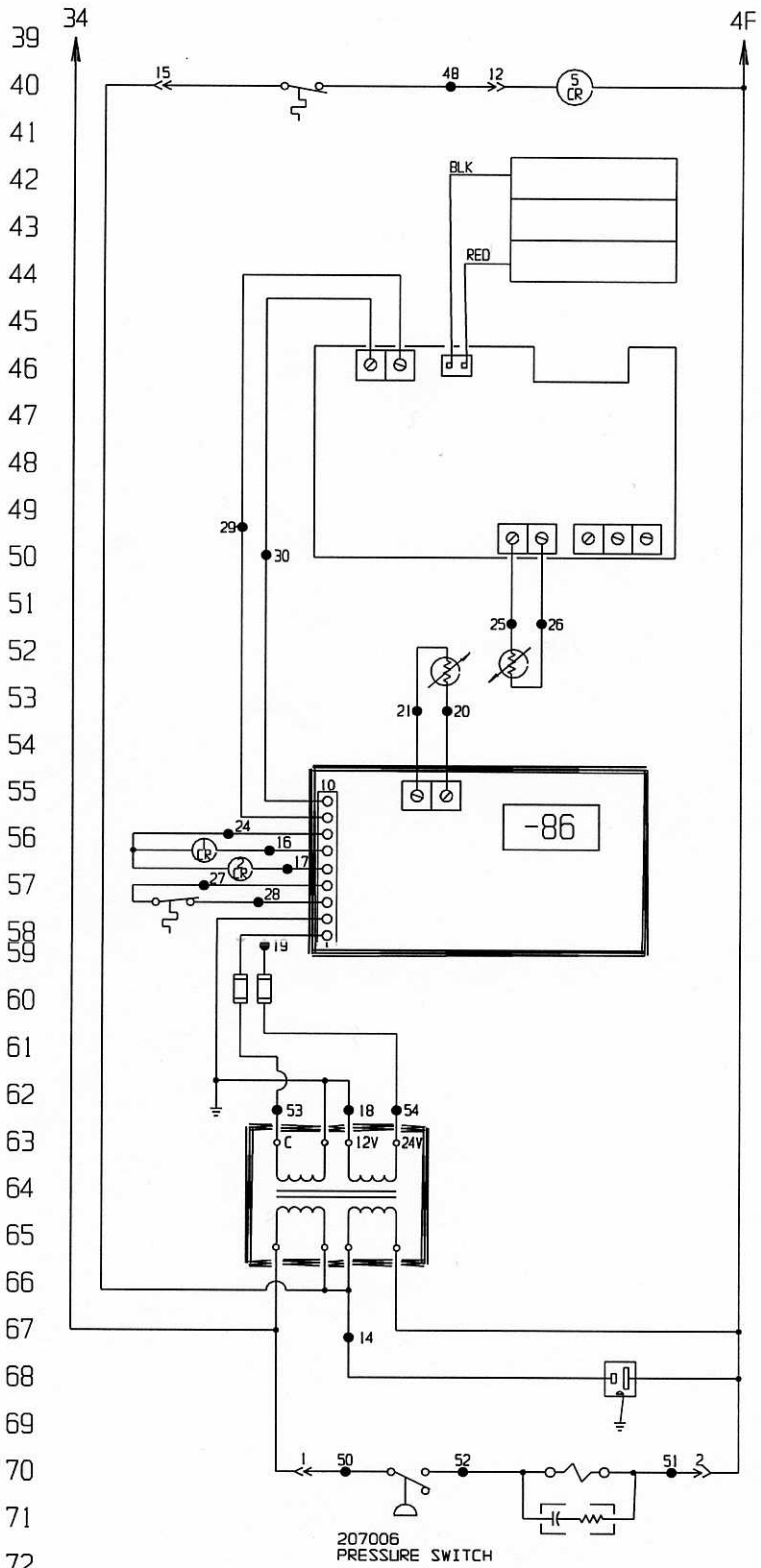

Forma Scientific
BOX 649 MARIETTA, OHIO 45750 TELEX 24-5304
 TOLL FREE USA 800-848-3080, OHIO 614-373-4763

POWER CONNECTION
 230V, 1Ø, 2W, 50/60HZ, 14.0FLA
 (OPERATING RANGE 208-240V)



- 460169
POWER INLET
- 360188
POWER SWITCH
- 295613
FUSE 15A
- 280059
VOLTAGE CORRECTION LED
- 300073
BOOST RELAY
20, 21
- 300073
BUCK RELAY
18, 19
- 420066
130VA TRANSFORMER, 2
- 133008
VACUUM RELIEF PORT HEATER
12.5W @ 220VAC
UPRIGHT FREEZERS ONLY
- 132043
SPLIT DOOR HEATER
13W @ 240VAC
SPLIT DOOR OPTION ONLY
- 900111
TUBEAXIAL FAN
- 900111
TUBEAXIAL FAN
- 990014
HIGH STAGE COMPRESSOR
3/4 H.P., 220V
- 300308
START RELAY
- 170101
RUN CAPACITOR
5UF, 370V
- 170036
START CAPACITOR
145-175UF, 250V
- 990014
LOW STAGE COMPRESSOR
3/4 H.P., 220V
- 300308
START RELAY
- 170101
RUN CAPACITOR
5UF, 370V
- 170036
START CAPACITOR
145-175UF, 250V

Electrical Schematic
 Forma Models:
 723, 923, and 5463
 ULT Freezers
 923-70-0-D Rev. 19
 Page 1 of 3



400105
 BASE THERMOSTAT
 300073
 BASE AIR FLOW RELAY
 24, 25

190404
 RECHARGEABLE ALARM

290041 PROBE
 1000 OHM PLATINUM
 290041 PROBE
 1000 OHM PLATINUM

190764
 TEMP. CONTROL

300261
 HIGH STAGE RELAY
 300261
 LOW STAGE RELAY

400101
 AIR FLOW T-STAT

420101 TRANSFORMER
 25 VA, 24V

460024
 RECORDER OUTLET

250115
 SOLENOID

270015
 ARC SUPPRESSOR

207006
 PRESSURE SWITCH

Electrical Schematic
 Forma Models:
 723, 923, and 5463
 ULT Freezers

WIRE REFERENCE CHART

	WIRE #	GAUGE	COLOR
77	1	14	BRN
78	2	14	BLU
	3	14	BRN
79	4	14	BLU
	4A	20	BLU
80	4B	20	BLU
	4C	20	BLU
81	4D	18	BLU
	4E	18	BLU
82	4F	20	BLU
	4G	18	WHT
83	5	14	BRN
	5A	18	BRN
84	6	14	RED
	7	14	YEL
85	8	14	BLK
	9	14	PUR
	10	14	ORG
86	13	14	GRN/YEL
	14	14	BLK
87	15	22	RED
	16	22	YEL
88	17	22	ORG
	18	22	BLK
89	19	22	WHT
	20	22	RED
90	21	22	WHT
	22	14	GRY
91	23	14	ORG
	24	22	BLU
92	25	22	RED
93	26	22	WHT
	28	22	BLK
	29	22	BLK
94	30	22	WHT
	31	14	BLK
95	32	--	---
	33	14	BRN
96	34	14	BRN
	34A	18	BRN
97	34B	18	BLK
	35	20	ORG
98	36	20	YEL
	37	14	PUR
99	37A	20	PUR
	38	14	PUR
	39	14	ORG
100	40	14	YEL
	41	14	RED
101	42	14	BLK
	43	20	RED
102	44	20	BLK
	45	14	GRY
103	46	18	BLK
	48	18	BRN
	49	14	BLK
104	49A	18	BLK
	50	18	BLK
105	51	18	WHT
	52	18	BRN
106	53	18	BLK
	54	18	WHT
	55	18	RED
107	56	18	WHT
	57	18	GRN/YEL

NOTES:	
⊗ Denotes Terminal Strip Connection	Parts List Reference Number
5-CR Last Relay Number	<input type="radio"/> Assembly
Last Terminal Number	<input type="radio"/> Panel
57 Last Wire Number	<input type="radio"/> Refrigeration
	<input type="checkbox"/> Wiring

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

BOX 949 NARIETTA, OHIO 45750 TELE 614-534-4304
TOLL FREE USA 800-949-3000, OHIO 614-373-4763

19	SI-6703	12-17-97	AT	KDG	HEG	ADD CONNECTORS FOR SPLIT DOOR OPT
18	FR-1183	12-08-97	AT	KDG	LON	CHG. 190673 TEMP. CONTROL TO 190764
17	FR-1146	10-28-97	AT	KDG	LON	ADDED 700 SERIES
16	FR-1160	10-28-97	AFC	KDG	LON	ADDED OPERATING RANGE
15	SI-6658	08-07-97	AT	KDG	LON	CHG. 190403 TEMP. CONTROL TO 190673
REV	ECR NO.	DATE	BY	CAD	APPO	DESCRIPTION OF REVISION
DATE	8-17-93	DWN	AT	CAD	AT	APPO JV SCALE NONE
CUSTOMER						
JOB TITLE	723, 923 & 5463 23 CU. FT. UPRIGHT FREEZER					
DWG TITLE ELECTRICAL SCHEMATIC						
LOCATION	JOB NUMBER	DRAWING NUMBER				
FREEZERS		923-70-0-D				

Electrical Schematic
Forma Models:
723, 923, and 5463
ULT Freezers

923-70-0-D Rev. 19
Page 3 of 3

INSTALLATION, OPERATION AND SERVICE INSTRUCTIONS

FOR CIRCULAR CHART RECORDERS

CoBEX RECORDERS, INC.

CAUTION: IT IS IMPORTANT THAT THESE INSTRUCTIONS BE READ BEFORE INSTALLING THE INSTRUMENT. KEEP THESE INSTRUCTIONS ON FILE FOR FUTURE REFERENCE.

RECEIVING INSPECTION

As soon as the recorder is received, visually inspect the shipping container for signs of damage. If there is evidence of rough handling, inspect the recorder immediately to make certain that it is intact and has not been damaged in shipment.

TRANSIT LOSS

All COBEX instruments are insured against transit loss by breakage. To make this insurance effective, all claims must be filed with the carrier at the destination within one week of receipt of merchandise. No claims, regardless of the nature of same, will be accepted beyond this period.

UNPACKING

Each recorder is shipped with the standard accessory items listed below. When unpacking the recorder make certain that all of the items are accounted for.

1. Charts: One box (where applicable).
2. Battery (for optional battery backed-up units).
3. Installation manual.

CoBEX RECORDERS, INC.

6601 LYONS ROAD, F-7
COCONUT CREEK, FL 33073
TEL. (954) 425-0003
FAX. (954) 425-0509
www.cobexrecorders.com

Packaging - Processing

Bid on Equipment

1-847-683-7720

www.bid-on-equipment.com

RECORDER CASE LOCATION

Upon unpacking, find a suitable location to mount the unit before plugging it in. After the recorder has been connected to the main AC power supply, connect the battery to the battery strap and place the battery in its holder (if your unit is equipped with an optional battery back-up).

Select a location that is well lighted, free from dust, dirt and corrosive fumes. The instrument should not be located near any sources of heat or be subjected to sudden or extreme temperature changes. It should be mounted on a rigid support that is not subject to vibration. Refer to Figures 7 and 8 for recorder case dimensions.

POWER SUPPLY

The recorder uses AC power when the unit is operating normally. If the AC power were to fail and the battery back-up option is installed, then the green LED light will begin "flashing" to indicate that there is an interruption in the main power. Otherwise, the green LED light glows continuously.

The recorder will have either an AC power cord or a wall mounted transformer for connection to the main AC power supply. If a permanent connection to the main AC power supply is to be accomplished in the field, then refer to Figures 6A, 6B, 6C and 6D for diagrams showing the connection to a 115VAC 50-60Hz or a 230VAC 50-60Hz main power supply.

CONNECTING A PROBE

Most of the temperature recording units will already have a temperature indicating probe installed. If the recorder has a Temperature/Humidity type probe, make sure to remove the protective cap when the recorder is in use and replace the cap whenever the environmental chamber is to be rinsed.

If you will be supplying your own probe input device, then this next section will contain some important

information concerning the connection of the probe to the recorder.

This recording unit is capable of accepting input from either a CURRENT source (such as 4-20mA), a VOLTAGE source (such as 0-1 Volt, 0-5 Volts, 1-5 Volts or 0-10 Volts) or a 100 ohm RTD probe. **Note:** The recorder is programmed (at the factory) to accept a specific probe input range. Connecting a probe that supplies the recorder with a current or voltage that is not within the specified range will give unpredictable results and may damage the recorder. If you are not sure of the probe type or input range for your recorder, please contact COBEX Recorders before continuing.

In order to connect the probe input device to the recorder, you must first gain access to the main microprocessor PC board that is mounted to the back of the chart plate.



CAUTION! DO NOT TOUCH the terminals of the transformer while the unit is connected to the main AC power supply. To avoid the risk of possible electric shock, unplug or disconnect the recording unit from the main power supply before attempting to open the recorder. If the recorder is installed with the battery back-up option, disconnect the 9 Volt battery to avoid damaging the recorder and draining the battery.

On 6" inch recording units mounted in a metal enclosure, the chart plate on the recorder case is held by four (4) screws. Unscrew and gently remove the chart plate to expose the main microprocessor PC board of the recording unit. Otherwise, your recording unit will have a hinged chart plate held in place by two (2) screws located in the upper and lower right hand corners of the chart plate. Remove these two screws and open the hinged chart plate. On 8" enclosures, there is a single screw along the right hand edge that secures the chart plate inside of the enclosure. Loosen this screw and open the hinged chart plate.

If you are not sure how to access the back of the chart plate, please contact COBEX Recorders before continuing.

Next, you will need to determine the *type* of microprocessor controller PC board that is installed in your recorder. Refer to Figures 1A, 1B and 1C and compare these figures to the microprocessor controller PC board that is installed in your recorder.

TYPE "A" CONTROLLER PC BOARD

If your recorder has a **Type A** microprocessor controller PC board installed, then locate screw terminal blocks J6 and JP5. Screw terminal block J6 is normally used when connecting an RTD temperature probe and JP5 is normally used to supply a signal input to the recorder from a VOLTAGE or CURRENT type probe. JP5 may also be used when connecting a second RTD temperature probe (on a two pen recorder). Refer to Figure 1A for the location of J6 and JP5 on the microprocessor PC board.

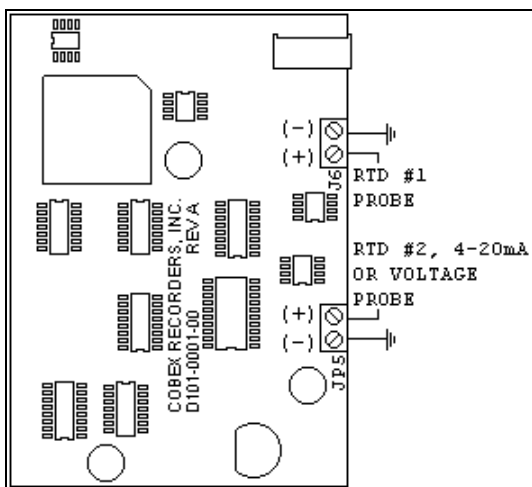


Figure 1A: Microprocessor PC Board (Type "A").

TYPE "B" CONTROLLER PC BOARD

If your recorder has a **Type B** microprocessor controller PC board installed, then locate screw terminal blocks J3 and J4 on the microprocessor PC board. These screw terminal blocks are used to provide signal input to the recorder for up to two pens. Refer to Figure 1B for the location of J3 and J4 on the micro-controller PC board. VIN (located on screw terminal block J4) is used to provide a signal input to the recorder from a VOLTAGE type probe, +5V can be used to power an external probe.

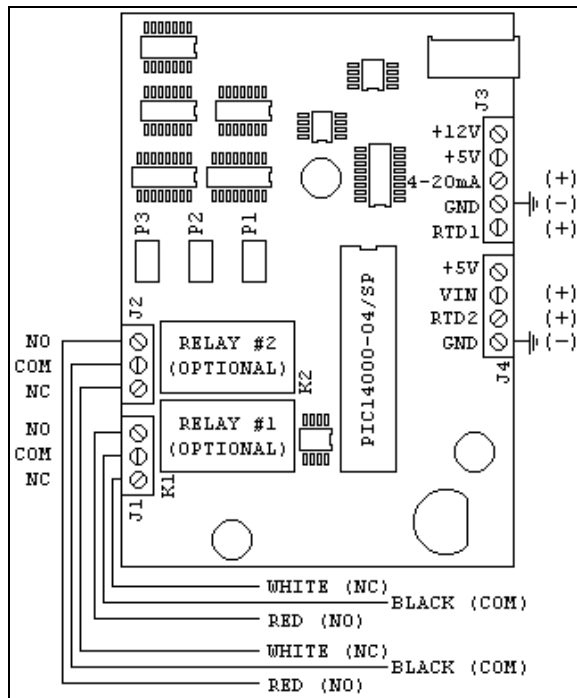


Figure 1B: Micro-Controller PC Board (Type B).

TYPE "C" CONTROLLER PC BOARD

If your recorder has a **Type C** microprocessor controller PC board installed, then locate screw terminal block J3 on the microprocessor PC board. This screw terminal block is used to provide a signal input to the recorder for one pen. Refer to Figure 1C for the location of J3 on the micro-controller PC board.

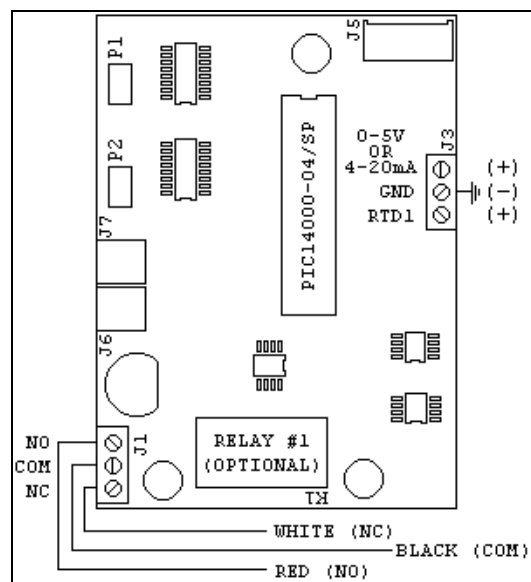


Figure 1C: Micro-Controller PC Board (Type C).

CHANGING THE CHART PAPER

Press and hold the "change chart" button (#3) for approximately one (1) second until the pen begins to move to the left of the chart and then release the button. Wait until the pen has moved completely off of the chart. To remove the chart paper, unscrew (counter-clockwise) the chart "hub" knob at the center of the chart. Remove the old chart paper and position the new one so that the correct time line coincides with the time line groove on the chart plate. Refer to Figure 5 for the location of the time line groove.

Re-attach the chart "hub" knob and screw securely (by hand) against the chart. Press and hold the "change chart" button (#3) again for approximately one (1) second until the pen begins to move back onto the chart and then release the button. Check to make sure that the pen is marking on the chart paper. If it is not, then carefully adjust the pen arm to establish contact with the paper.

MARKING SYSTEMS: MARK-A-MATIC II INKING SYSTEM

This type of pen consists of a self contained ink reservoir with a porous plastic stylus which is snapped around the outer edge of the metal pen arm.

A pen cap is provided to extend the life of the ink pen during shipping or when the recording unit is not in service. To remove the pen cap, gently lift the pen arm away from the chart paper. Remove the black plastic pen cap to expose the fiber tip of the ink pen and gently place the pen back onto the chart paper. Do not let the pen arm "snap" back onto the chart paper. This will flatten the fiber tip of the pen and will no longer give you a fine line marking on the chart paper. Place the pen cap in a safe place for future use.

If the stylus does not touch the chart, adjustment can be made by slightly bending the metal pen arm in the center towards the chart paper. Do not use more pressure than is necessary to create a fine line marking on the chart paper. **Note:** As the pen ink supply runs

out, the pen color will become lighter. This indicates that the pen should be replaced.

REPLACEMENT OF PEN

Note: In non-inking units, (that is, when using pressure sensitive recording chart paper) replacement of the pen is not necessary.

Recorders that are equipped with fiber tipped cartridge pens will have a cartridge that is color coded "red" to designate pen number one (1) and an optional cartridge that is color coded "blue" to designate pen number two (2). The pen cartridge is securely fastened to the metal pen arm using a special "U" clip tab.

For ease of replacement, it is suggested that the two (2) screws that hold the pen arm be loosened and the pen cartridge and metal pen arm be removed as an assembly. Refer to Figure 5 for the location of the pen arm screws. Unsnap the plastic "U" clip tab of the pen cartridge from the metal pen arm, remove and discard the old pen cartridge. Replace the new cartridge by opening the hinge and snapping it securely around the metal pen arm. Refer to the following figure.

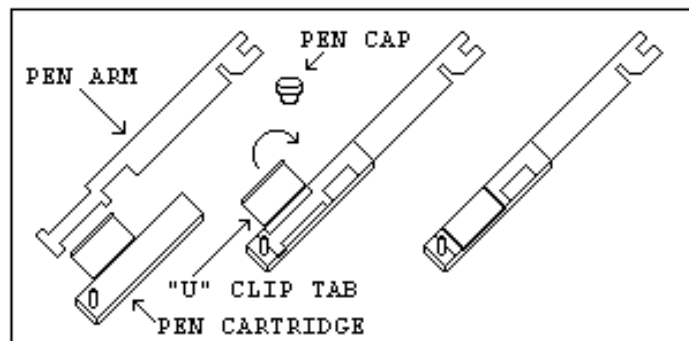


Figure 2: Pen Arm Assembly.

PEN ARM CALIBRATION

To check and/or adjust the recording pen(s) calibration to the outer most temperature graduation of the chart, press and hold the "change chart" button (#3) until the pen begins to move off of the chart. Once the pen(s) has moved off of the chart, again press and hold the "change chart" button (#3) until the pen begins to move back onto the chart. The pen

should briefly stop at the outer most temperature graduation of the chart before continuing onto the chart to begin recording. If the pen does not stop exactly at this location on the chart, it can be adjusted or "calibrated" by using the left (#1) or right (#2) arrow buttons (refer to Figure 3).

When the pen moves back onto the chart and briefly stops, you will have approximately five (5) seconds in which to adjust the pen's position using the left and right arrow buttons of Figure 3.

On multiple pen recorders, each pen will move (one-at-a-time) onto the chart briefly stopping at the outer most temperature graduation of the chart at which time the pen's position can be adjusted by using the left (#1) or right (#2) arrow buttons. When the time to adjust the position of the first pen has expired, the second pen will move onto the chart briefly stopping at the outer most temperature graduation of the chart at which time the second pen's position may be adjusted.

Each time the chart paper or fiber tip pen cartridge is changed, you should make sure that each pen stops at the outer most temperature graduation of the chart paper. Otherwise, this pen *offset* will cause the unit to record an incorrect temperature on the chart.

TEMPERATURE RECORDER CALIBRATION CHECK

This recorder has been accurately calibrated at the factory. Before making any adjustments, this instrument should be in service for 24 hours. Thereafter, if any adjustment is required, perform the following procedure. **Important: DO NOT immerse a Temperature/Humidity probe in any solution.**

1. Place a Certified Test Thermometer(s) in a solution bottle(s) alongside the recorder's sensor probe(s).
2. Once the temperature has leveled out, compare the position of the pen on the recorder to the test thermometer's reading.

- 2a. For two (2) pen recorders, also compare the second thermometer's reading to the second pen of the recorder.
3. If an adjustment is required, use the left (#1) and right (#2) arrow push buttons on the recorder to calibrate (or move) the pen's position on the chart to correspond to the temperature of the solution. The arrow buttons must be held for approximately five (5) seconds before the pen will begin to move.
- 3a. For two (2) pen recorders, you must first select the pen that you wish to calibrate. This is done by pressing the left (#1) arrow button to select the red pen or the right (#2) arrow button to select the blue pen. The arrow button must be held down until the green LED light goes out. After the green LED light goes out, follow the instructions in step #3 above. (Refer to the following figure for a diagram of the push buttons).

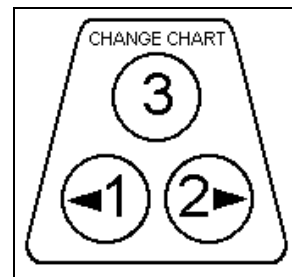


Figure 3: Push buttons.

OPTIONAL FEATURES

BATTERY BACK-UP

The green LED light remains a constant green color indicating that both the battery and the main power to the unit are good. Refer to Figure 5 for the location of the green LED indicating light. If the AC power were to fail or the battery becomes weak, then the green LED light will begin "flashing" indicating that either you have lost the main power to the unit or it is time to replace the battery. Having a 9 volt DC battery back-up in place, will allow the recorder to continue to function normally for approximately 24 hours in the event of a power failure.

BATTERY LOCATION AND REPLACEMENT

4", 6" AND 10" RECORDERS

To replace the battery, first open the recorder door. The battery will be located in the upper right hand corner of the unit. Refer to Figure 5 for the location of the battery. **Note:** Use only NEW 9 volt alkaline replacement batteries.

8" RECORDERS



CAUTION! DO NOT TOUCH the terminals of the transformer while the unit is connected to the main AC power supply. To avoid the risk of possible electric shock, unplug or disconnect the recording unit from the main power supply before changing the battery.

To replace the battery on an 8" recorder, first open the recorder case door. Next, loosen the single screw located on the right hand side of the chart plate and open the hinged chart plate. The battery strap and battery holder are located on the back of the chart plate. **Note:** Use only NEW 9 volt alkaline replacement batteries.

OPTIONAL ALARM/CONTROL RELAY CONNECTION TO THE RELAY



CAUTION! DO NOT TOUCH the terminals of the transformer while the unit is connected to the main AC power supply. To avoid the risk of possible electric shock, unplug or disconnect the recording unit from the main power supply before attempting to access the terminals of the relay. If the recorder is installed with the battery back-up option, disconnect the 9 Volt battery to avoid damaging the recorder and draining the battery.

On 6" inch recording units mounted in a metal enclosure, the chart plate on the recorder case is held by four (4) screws. Unscrew and gently remove the

chart plate to expose the relay that is mounted to the back of the chart plate. Otherwise, your recording unit will have a hinged chart plate held in place by two (2) screws located in the upper and lower right hand corners of the chart plate. Remove these two screws and open the hinged chart plate. On 8" recording units, there is a single screw along the right hand edge that secures the chart plate inside of the enclosure. Loosen this screw and open the hinged chart plate to expose the relay terminals. If you are not sure how to access the relay terminals of your recording unit, please contact COBEX Recorders before continuing.

The relays that are used in this recording unit are *latching* type relays. That is, the contacts of the relay will remain either closed or open (even when there is no power applied to the recorder) until the relay is pulsed with a signal from the recorder to change the position of the contacts.

Refer to Figures 1B, 1C and 6B for the location of the screw terminal connections for the relays. **Note:** A RED, BLACK and WHITE set of wires may already be provided as an external connection to the relay's terminal block. The terminal position NC will be *closed* when the pen is positioned to the right of the control point and will be *open* when the pen is positioned to the left of the control point.

The relays are rated for the following maximum values:

2.0 AMP at 30V DC
0.6 AMP at 125V AC
0.6 AMP at 110V DC

Warning: Damage to the recording unit may result if the ratings for the relays are exceeded.

SETTING THE CONTROL POINT FOR THE RELAY

To set the position of the pen on the chart that will determine when the relay contacts will open or close, follow these instructions:

Press and hold the "change chart" button (#3) until the pen arm begins to move off of the chart and then release the button. Wait until the pen has moved completely off of the chart. When the "change chart" button (#3) is pressed again, the pen will begin to move back onto the chart briefly stopping at the outermost graduation of the chart.

The pen arm will then move to the first control point position and the green LED light will turn off. The pen will remain at this position for a period of approximately five (5) seconds during which time the control point can be adjusted using the left arrow (#1) or the right arrow (#2) push buttons. Refer to the following figure for a diagram of the push buttons. When the time has expired for adjusting the control point, the green LED light will turn back on and the unit will begin recording.

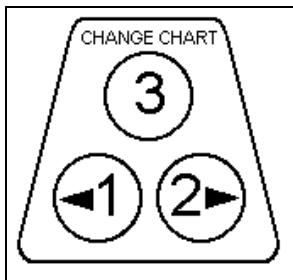


Figure 4: Push buttons.

When the pen has two control points, the pen then moves to the second control point at which time the second control point may be adjusted. Having two control points (per pen) allows you to define HIGH and LOW temperatures that will open or close the relay contacts. Approximately five (5) seconds after you have finished adjusting the control point(s), the LED light will turn solid green and the pen arm will move to indicate the probe's temperature and the unit will begin recording.

CHART "RANGE" SELECTION

If the recorder that you are using has a *range sticker* (that lists several temperature ranges) mounted on the front of the chart plate, then the following section will apply to you.

This recording unit has the option for the user to select from several temperature "ranges" that are programmed into the recorder. **Note:** The chart paper that is used on the recording unit must match the *range* that is selected for the recorder. Otherwise, the pen's position on the chart paper will not correspond to the temperature that is measured.

Also, if the pen moves to the center or outer edge of the chart and remains there while the unit is powered on, then this maybe an indication that the current range that is selected for the unit is not correct. The recorder has a built-in safety mechanism that will always move the pen to the highest temperature on the chart when the current temperature that is measured is not within the selected range.

The recording unit can have up to eight (8) user selectable ranges programmed into the unit. To select from one of the available ranges, follow these instructions:

After the recording unit has been powered-on and is operating normally (recording temperature), press and hold the "change chart" button (#3) until the pen arm begins to move off of the chart. Once the pen has moved off of the chart, press and hold the left arrow (#1) or right arrow (#2) button for approximately eight (8) seconds and then release the button. Refer to Figure 4 for a diagram of the buttons.

Note: If your recorder has a **Type A** microprocessor controller PC board installed, then the current range that the recorder is operating in will be altered when this *change range* mode is entered. For example, if the recorder is currently operating in range #1 and the left arrow (#1) button is pressed for the eight second period as described above and then released, the current range will be advanced to range #2 and the LED light will begin flashing two (2) times. Refer to Figure 1A to determine if you have a **Type A** microprocessor controller PC board installed.

The green LED light will begin flashing one (1) time if range #1 is selected or will flash two (2) times if range #2 is selected and so on. Press the left arrow button (#1) to increase the range number or press the

right arrow button (#2) to decrease the range number that is selected for the recorder. When you have finished selecting the range, press and hold the "change chart" button (#3) until the pen begins to move back onto the chart and the selected range will be saved into the recorder's permanent memory.

RECORDER SPECIFICATIONS

INPUT

Nominal Input Voltage: Single Phase 115/230VAC.

Nominal Input Current: 40mA/20mA

Nominal Input Frequency: 50-60 Hz.

BATTERY (Optional)

Battery Type: 9 Volt Alkaline

Low Battery Signaling: Flashing LED

OPERATING ENVIRONMENT

0°C-40°C (32°F-104°F); 0-95% RH, Non-condensing

Pollution Degree: 2

Installation Category: II

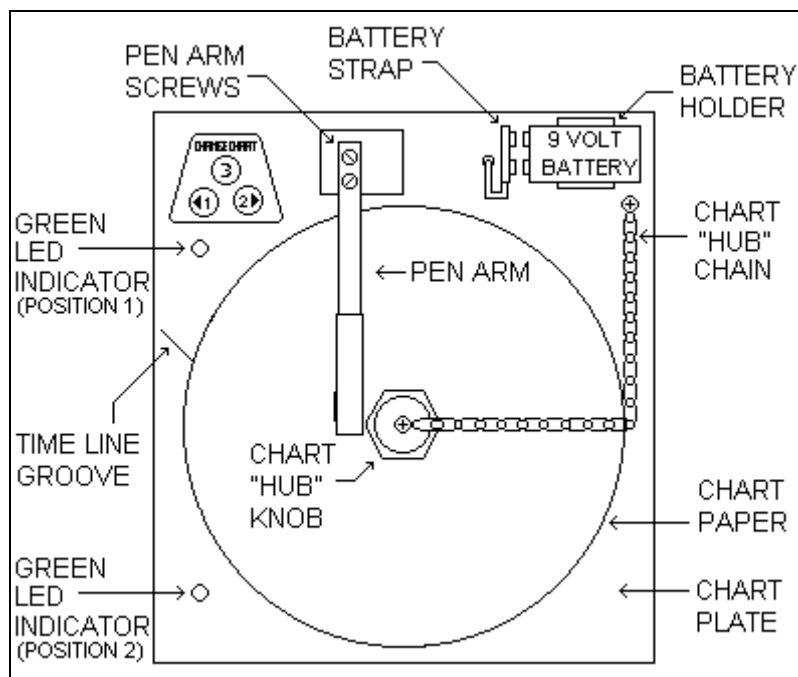


Figure 5: Recorder Assembly (Front View).

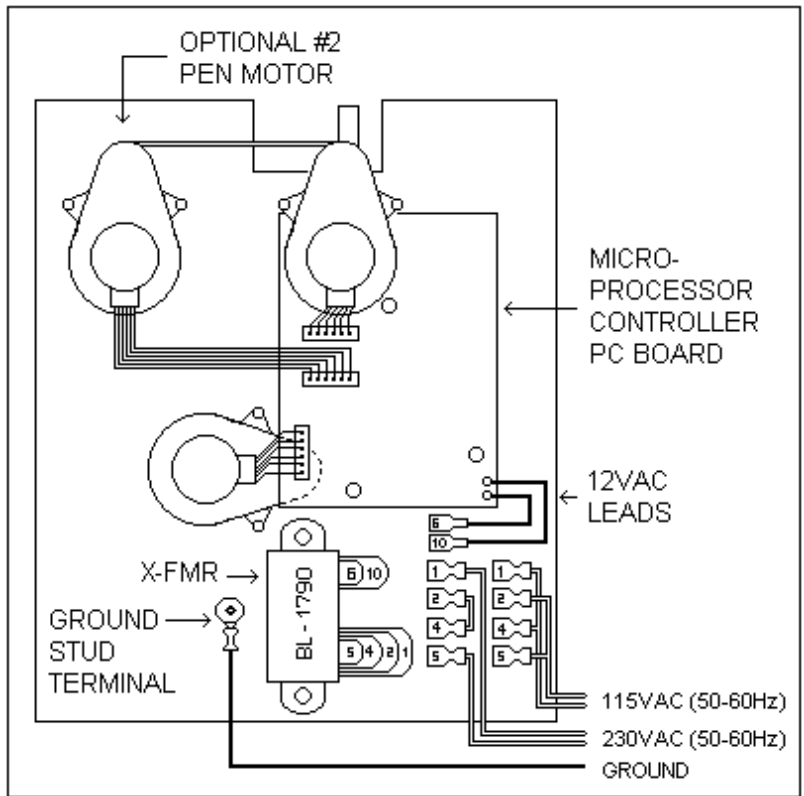


Figure 6A: Recorder Assembly “Type A” (Rear View).

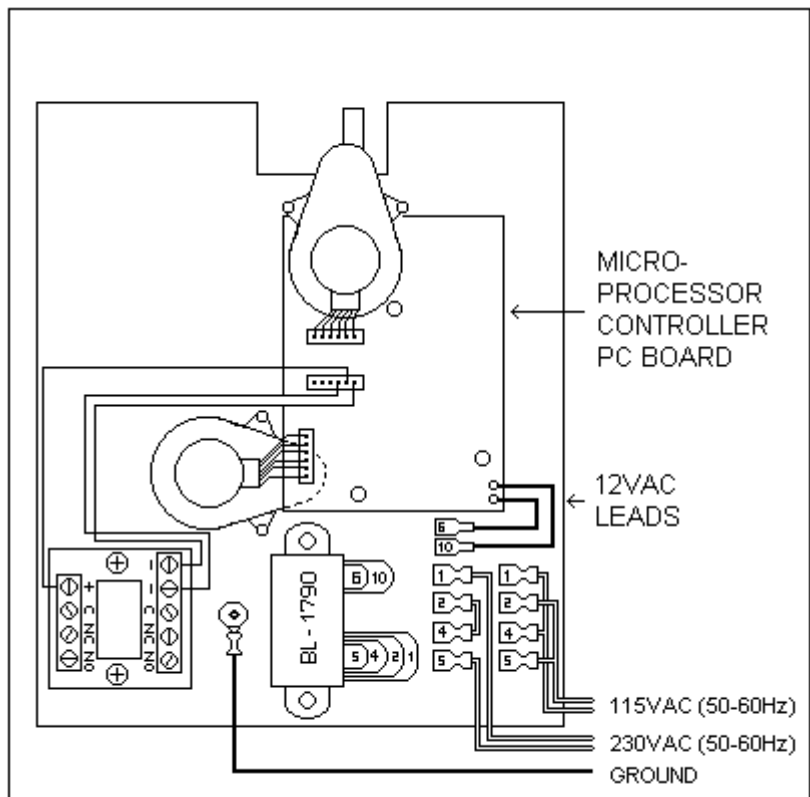


Figure 6B: Recorder Assembly “Type A” with Electric Contact Option (Rear View).

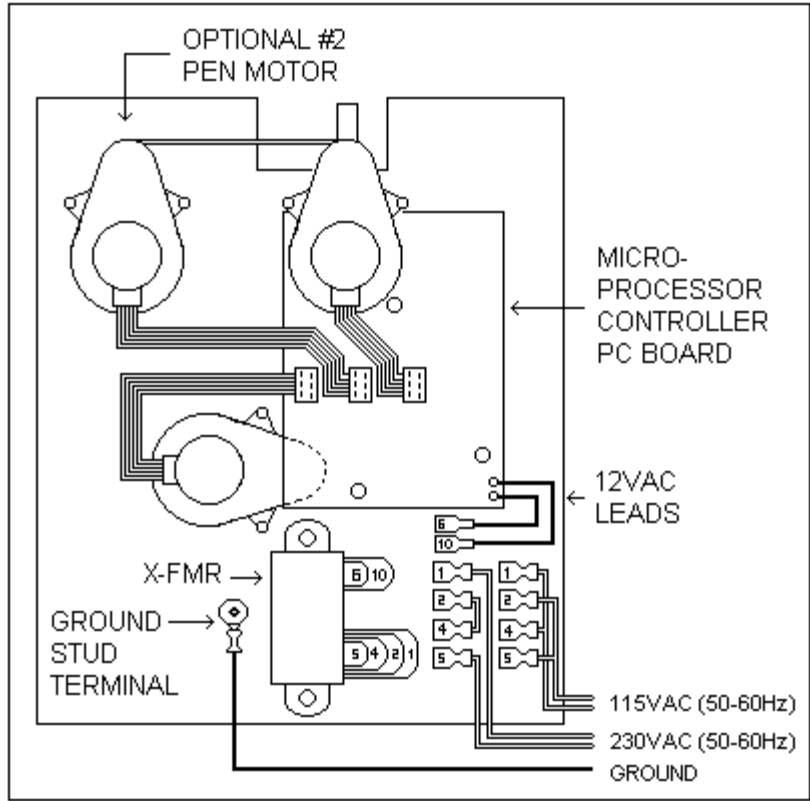


Figure 6C: Recorder Assembly Type "B" (Rear View).

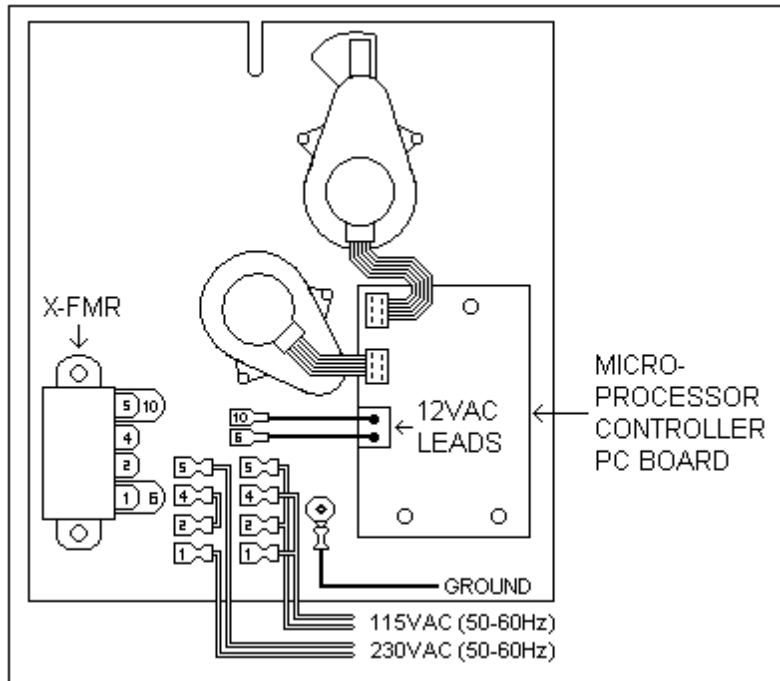


Figure 6D: Recorder Assembly Type "C" (Rear View).

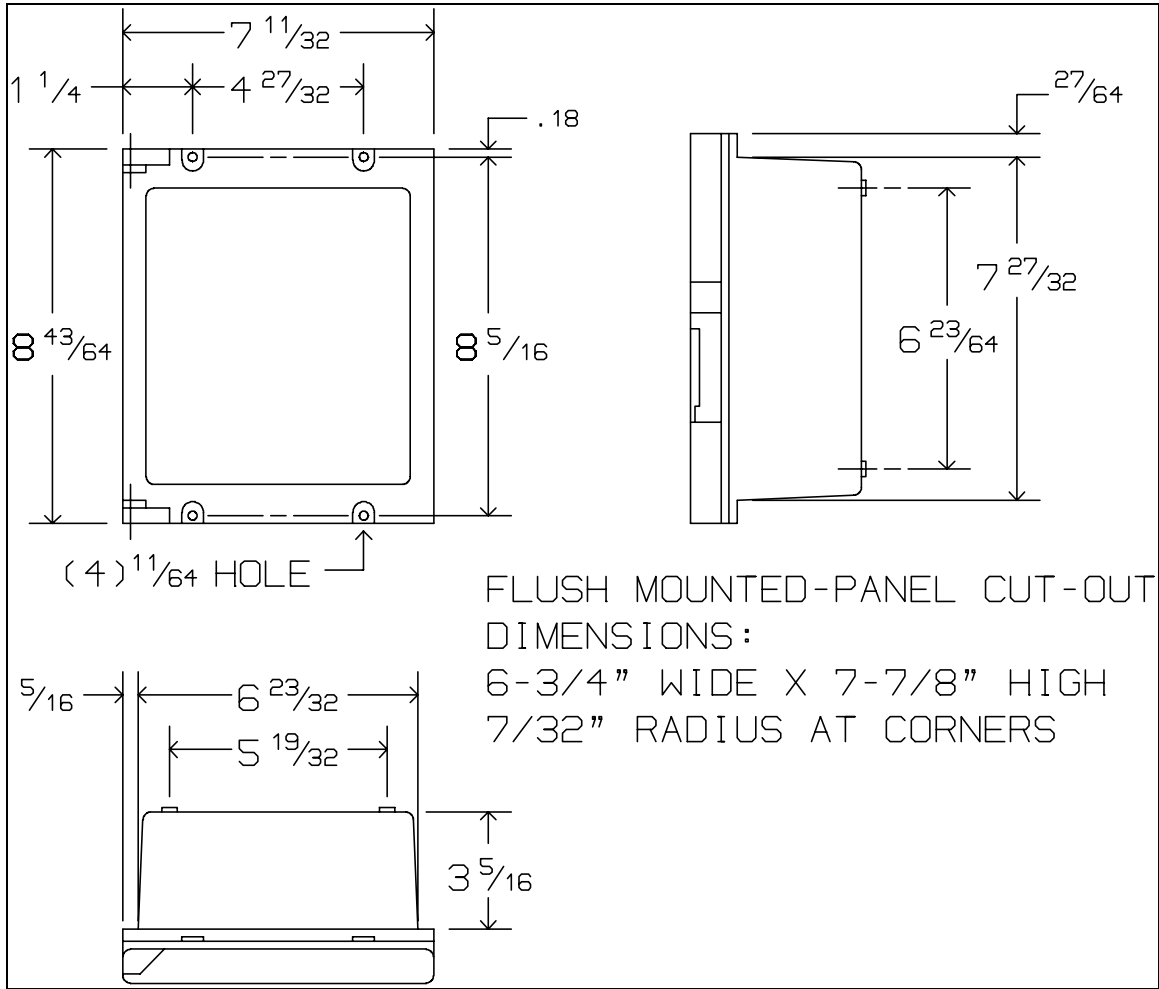


Figure 7: 6" Recorder Case Dimensions.

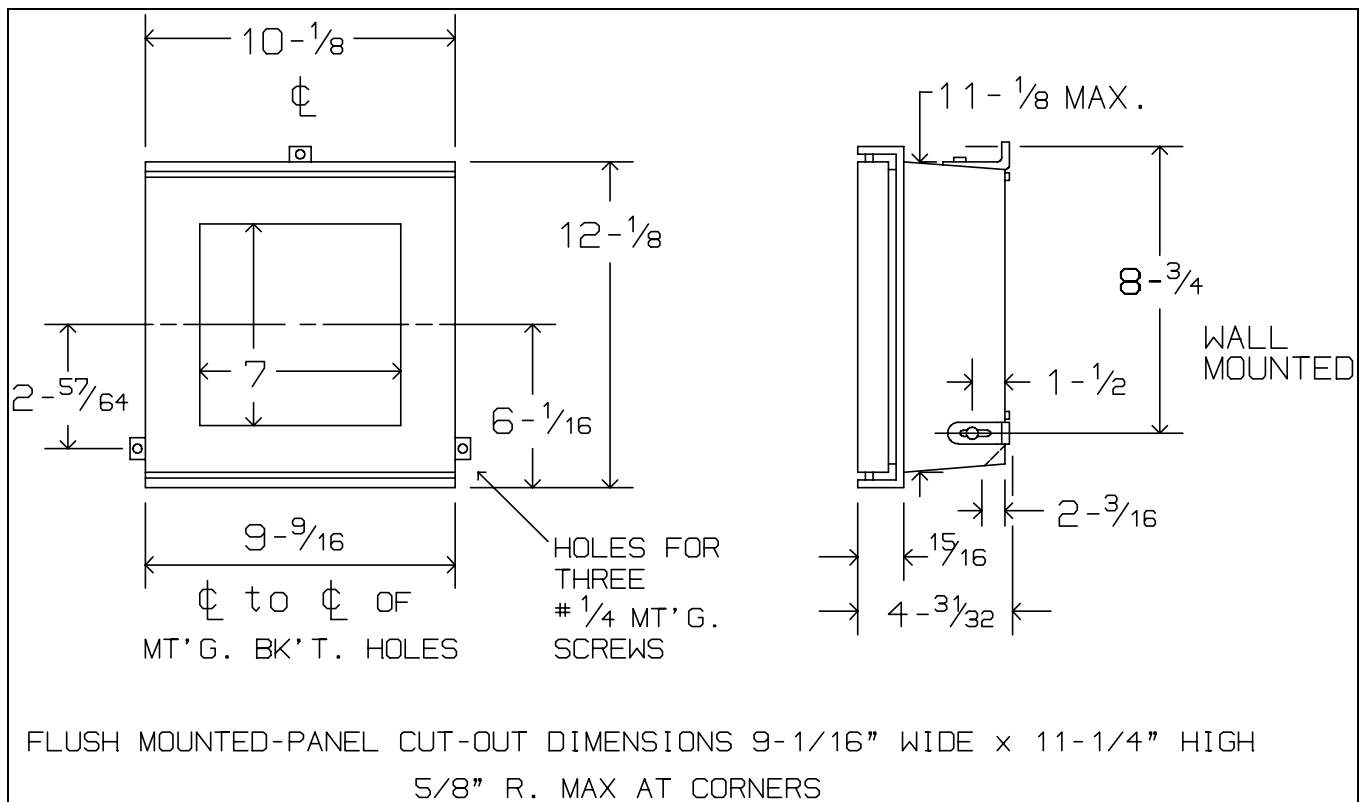


Figure 8: 8" Recorder Case Dimensions.

For all physical dimensions and panel cut-out dimensions for *skeleton* and *skeleton with door* recorders, please contact COBEX Recorders, Inc.

GUARANTEE: COBEX products are warranted to be of good workmanship and quality and free from defects under normal use and service. This warranty is limited to repairing such defects, provided return is made prepaid to COBEX Recorders, Inc., Coconut Creek, Florida within one (1) year after delivery to the original purchaser. COBEX shall not be liable for consequential damages. This warranty is in lieu of all other warranties, guarantees, liabilities or obligations, statutory, expressed or implied to the original purchaser or to any other person. No agent is authorized to assume for COBEX Recorders, Inc., any liability, except as set forth above.

Orders submitted on customer's own purchase order forms, which forms may contain statements, clauses, or conditions modifying, adding to, repugnant to or inconsistent with the terms and provisions of the Seller herein contained will be accepted by the Seller only upon condition and with the express understanding that notwithstanding any such statements, clauses, or conditions contained in any order forms of the customer the liabilities of the Seller shall be determined solely by its own terms and conditions of sale, and in accepting and consummating any such order the Seller shall be deemed not to have in anyway changed, enlarged or modified its liabilities or obligations as fixed by such terms and conditions of sale as stated by the Seller herein.