

Thermo Scientific Forma 7000 Series

-40C Upright Laboratory Freezer

Operating and Maintenance Manual 7048800 Rev. 14

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Important installer and user information:

A redundant temperature sensing device has been included in this freezer. This device is a type “T” thermocouple. For convenient access, the thermocouple (Figure 1-3) terminates in an interconnect jack (Figure 1-5) behind the base front cover. (May be located differently in chests. See Section 1.) It is strongly recommended that this thermocouple be attached to a redundant 24 hour 7 day monitoring system with alarm capabilities. Connecting the sensor to a monitoring and alarm system separate from the freezer provides the utmost in product safety, should the integral system fail. ▲

Packing List

Part Number	Description	Quantity
122005	Key	2
380520	Neoprene Cap	2
510016	1/4-20 x 5-1/2" Bolt	2
195763	Retaining Clip	1
370563	Remote Alarm Connector	1

Models covered by this manual

Catalog Number	Capacity in Cubic Feet	Voltage
7240A	13	120/60
7240V	13	230/50
7240D	13	208-230/60
7320A	17	120/60
7320V	17	230/50
7320D	17	208-230/60
7400A	23	120/60
7400V	23	230/50
7400D	23	208-230/60

MANUAL NUMBER 7048800

14	40634	11/03/17	Updated exploded drawings	bpg
13	41728	10/03/17	Added door operation info	bpg
12	31514	10/02/17	Updated schematics	bpg
11	41370	8/10/17	Updated BUS information	bpg
10	41159/41079/40543	5/15/17	Corrected D-volt rating, Updated manual, F-gas statement	bpg
10	41347/41348	5/12/17	Remove AS400 model, correct operating range	bpg
9	40474/FR-2881	6/17/16	Updated start component dwg on pgs 7-11 & 7-12, electrical schematics	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. ▲

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The -40C Freezers (see page i for specific list of models) described in this manual are high performance units which can be used for research and in situations that directly support medical applications. When these products are used to support a medical application, it is an accessory to a medical device and is therefore considered as a medical device in its own right by the regulatory body (e.g. FDA).

This product is intended for use:

- As cold storage in research use.
- As a medical device for diagnostic use (storage of samples not intended to be re-introduced to human body).

Registration: This medical application is considered a Class I medical device by the FDA. This product is classified as product code – JRM, regulation number 862.2050 and is considered a Class 1 device, 510(K) exempt.

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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.



Extreme temperature hazards, hot or cold. Use special handling equipment or wear special, protective clothing.



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



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

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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:

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Section 1 Installation and Start-Up

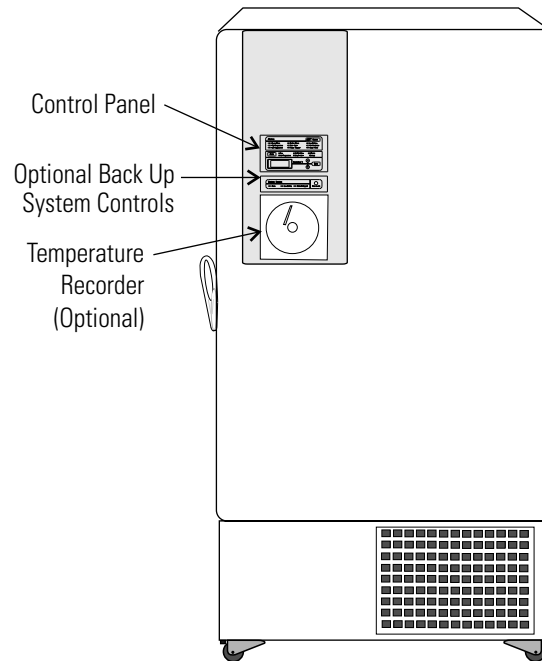


Figure 1-1. Front View

Figure 1-1

- Control Panel - keypad, displays and indicators.
- BUS (Optional Back Up System) panel.
- Optional temperature recorder - 7 day, one pen or Datalogger.

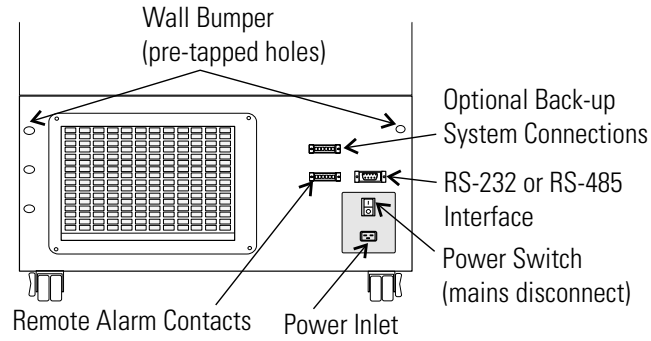


Figure 1-2. Rear View

Figure 1-2

- Remote alarm contacts.
- Power Inlet for power cord connection.
- Optional BUS connections for probe and solenoid.
- RS-232 or RS-485 Interface
- Power Switch (mains disconnect).

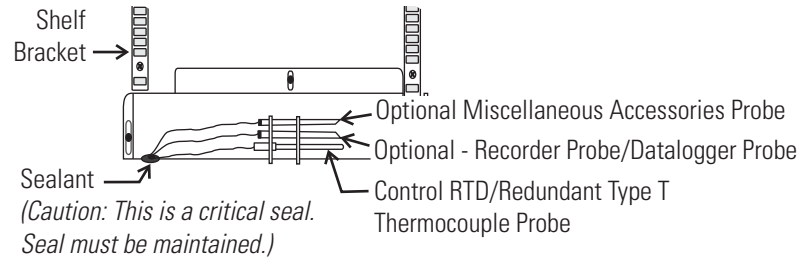


Figure 1-3. Chamber Probe

Figures 1-3 and 1-4

- Vacuum relief port: pressure equalization port.
- Probe cover: houses control, optional recorder, datalogger or miscellaneous accessory probes.

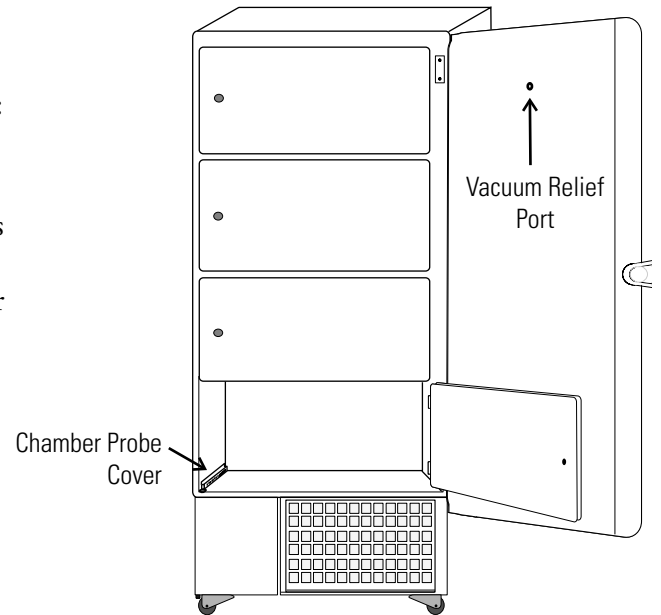


Figure 1-4. Vacuum Relief Port & Probe Cover Locations

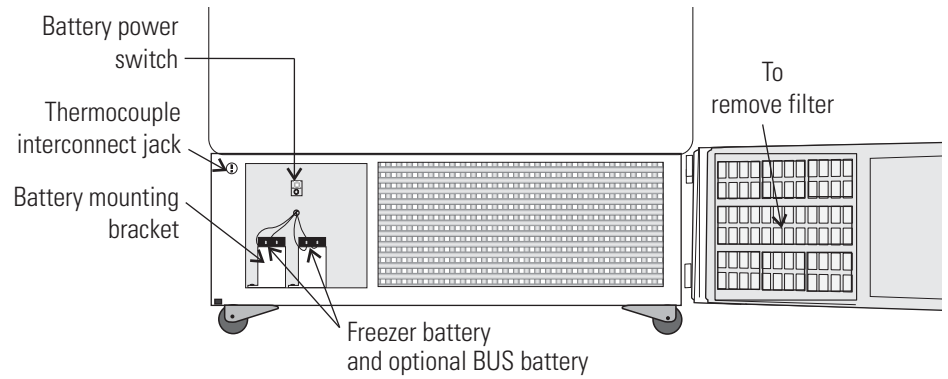


Figure 1-5. Battery(s) Location and Switch

Figure 1-5

- Battery mounting bracket(s)
- Battery power switch (freezer and BUS)
- Freezer battery
- Optional BUS battery
- Freezer filter location

Control Panel Keys, Displays & Indicators

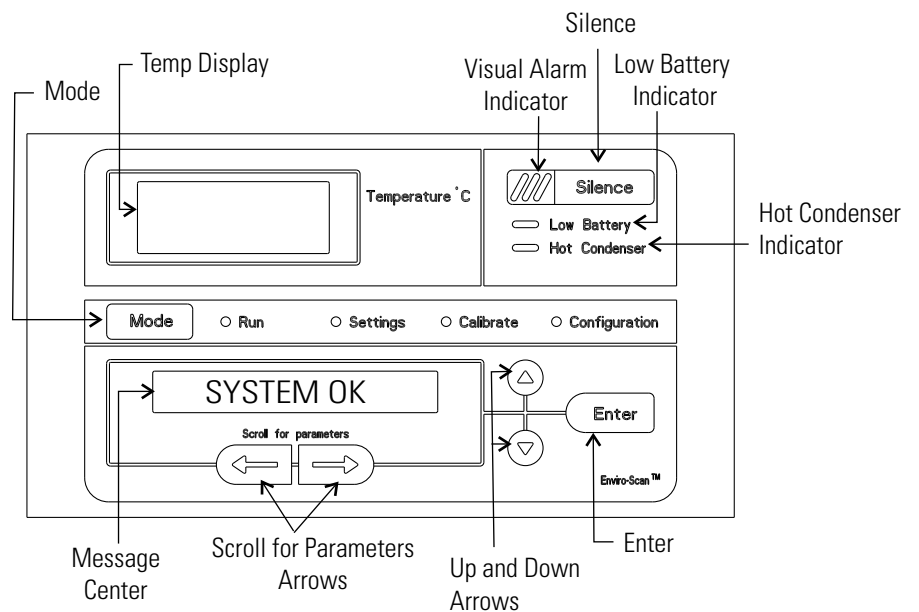


Figure 1-6. Control Panel, Display and Indicators

Section 1

Installation and Start-Up

Panel Keys, Display, Indicators (cont.)

Mode Select Switch - Used to select Run, Settings, Calibrate and System Configuration Modes.

Mode Select Indicators -

Run: Run Menu

Settings: Set Points Menu

Calibrate: Calibrate Menu

Configuration: Configuration Menu

Temperature Display - Displays temperature in degrees Celsius.

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

Silence - Mutes the audible alarm.

Low Battery - indicates a low battery condition of the freezer battery.

Hot Condenser - indicates a hot condenser condition.

Message Center - displays system status and alarms.

Scroll for Parameters Arrows - moves through the choices of the selected mode.

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

Enter - Stores the value into computer memory.

Freezers have four basic modes which allow freezer setup: Run, Settings, Calibrate and Configuration.

Run is the default mode which the freezer will normally be in during operation.

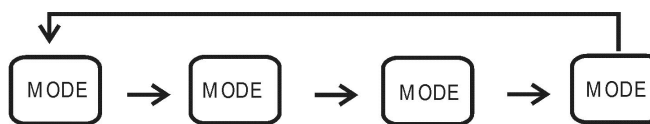
Settings is used to enter system set points for freezer operation.

Calibrate is used to calibrate various system parameters.

Configuration allows for custom setup of various options.

Panel Keys, Display, Indicators (cont.)

The chart below shows the selections under each of the modes. **Scroll for**



Run	Settings	Calibrate	Configuration
Default Mode System Ok	Control Set Point	Control Probe	High Alarm Test
Line Voltage	High Alarm Set Point	Optional Sample Probe	Low Alarm Test
Compensated Voltage	Low Alarm Set Point		System Battery Test
* HSHX Temperature	Optional Back Up System Set Point		BUS Battery Test
			Display Temperature
			* Clear High Stage Alarm
			Set Access Code
			RS485 Address
			BUS type CO2 or LN2
			Cold Excursion
			Warm Excursion
			Reset Excursion

Table 1-1. Modes of Operation

* -86C units only

Control Panel (continued)

Parameters Arrows: Steps the operator through the parameters of Settings, Calibrate and Configuration Modes. The right arrow goes to the next parameter, the left arrow returns to the previous parameter.

Up Arrow: Increases or toggles the parameter value that has been selected in the Settings, Calibrate, and Configuration Modes.

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

Down Arrow: Decreases or toggles the parameter values that have been selected in the Settings, Calibrate, and Configuration Modes.

Silence Key: Press to mute the audible alarm. See Section 4 for alarm ring-back times.

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

Displays

There are two displays on the control panel. The temperature display shows the temperature in degrees Celsius. The message center displays the system status (Mode) at all times. The message SYSTEM OK displays during normal operation. Alarm messages are displayed if the system detects an alarm condition. See Section 4 - Alarms.

Freezer Installation

Caution If tipped more than 45°, allow the unit to sit upright for 24 hours before start up. ▲

To remove the freezer from the pallet, use the 1/2" wrench to remove all bolts securing the shipping bracket to the pallet. Remove the shipping bracket.

Remove the ramp boards from the pallet and place the slotted ends over the ramp brackets on the pallet. The support blocks on the ramps will be facing down. Before moving the freezer, make sure the casters are unlocked and moving freely. Align the caster with the ramp boards. Use adequate personnel to roll the freezer off the pallet.

The freezer can be easily pushed to the desired approved location. If necessary, the doors and lower front panel may be opened to move the unit through tight openings. When the freezer is in position, set the front caster brakes.

Freezer Installation (continued)

Caution The freezer must not be moved with product load inside. ▲

Caution For proper ventilation and airflow, a minimum clearance of 5” at the rear and top and a clearance of 8” on the side of the freezer is required. Allow adequate space in the front of the freezer for door opening. ▲

Choose the Location

Locate the freezer on a firm, level surface in an area with an ambient temperature between 18°C and 28°C. Provide ample room to reach the mains disconnect switch (power switch) located on the rear of the freezer.

Door Operation

Upright freezer models are equipped with an advanced assembly specifically designed for ultra-low temperature freezers.

Features include:

- One-hand operation
- A front-accessible lock
- Hasps for a standard padlock to provide additional security. Length of the shackle must be between ¾ inch (1.9 cm) and 1½ inch (3.8 cm).
- Durable construction for reliable operation and safe product storage.

Wall Bumper Installation

The parts bag, located inside the cabinet, contains the following parts.

Qty	Stock #	Description	Purpose
2	510016	1/4-20 x 5-1/2” Bolt	Wall Bumper
2	380520	Neoprene Cap	Cap Protector

Install the bolts into the pre-tapped holes on the back of the compressor section. Install a neoprene cap on each bolt. Refer to Figure 1-2 for the locations of the pre-tapped holes.

Shelf Installation

Install the shelf clips into the shelf pilasters (front and back) at the desired shelf level. Install the shelves in the cabinet onto the clips.

Note Maximum shelf load is 100 lbs (45.4 kg) per shelf. ▲

RS-232 Communication

The Model 900 Series freezer has a data communications interface. The factory default setting is RS-232.

The wiring identification for the interface is shown in Figure 1-7. One nine pin, sub "D" style connector is located on the back of the freezer. See Figure 1-2 for the location of the connector on the freezer.

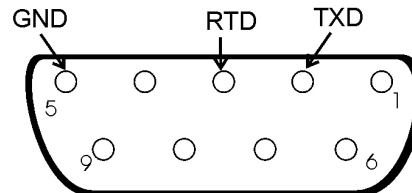


Figure 1-7. RS-232 Interface

The freezer transmits temperature information every 60 minutes. A standard DB9 serial extension cable can be used to connect the freezer to a serial device. Some serial devices may require a null modem adapter.

Data format:

Baud 1200
 Data bits 8 (7 bit ASCII with leading zero)
 Start bits 1
 Stop bits 2
 Parity none

The data transfer sequence is transmitted in the following format. X refers to numerical temperature data.

(NUL) (-) XXX (SP) C (SP) (Error Message) (SP) (LF) (CR) (EOT) (SP)

In the event of a CNTRLFAIL, Er07, or the control probe is out of range error, the numerical temperature data (XXX) in the transmission would be replaced by T_ERR.

If no alarm condition exists, spaces will be sent. A total of 20 characters will be sent.

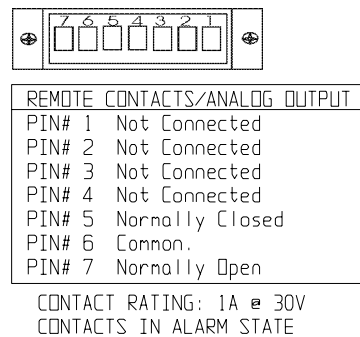
SP - Space	LF - Line feed
CR - Carriage return	EOT - End of text (4)
NUL - Null character (00)	

If an alarm condition does exist, "Error Message" in the protocol will be replaced by the following:

UNDERTEMP (temperature above the low alarm setpoint)
 OVERTEMP (temperature below the high alarm setpoint)
 PWRFAIL (AC power failure)
 CNTRLFAIL (Control probe failure)
 Er07 (micro failure)
 HSHX FAIL (Heat exchanger failure)
 HOT COND (Hot condenser)

Remote Alarm Contacts

See Figure 1-2 for the location of the remote alarm contacts. The remote alarm connector is located in the parts bag provided with the manual. It must be installed if connecting the freezer to an alarm system. After installing the wiring from the alarm system to the connector, install the connector to the freezer microboard and secure with the two screws provided. The remote alarm provides a NO (normally open) output, a NC (normally closed) output and COM (common). The contacts will trip on a power outage, and high or low temperature alarm. They will also trip on control probe or microboard failure. Figure 1-8 shows the remote contacts in alarm state.



IMPORTANT USER INFORMATION

CAUTION! Stored product should be protected by a redundant 24 hour/day monitoring system with alarm capability. An interconnect jack and thermocouple are installed for centralized monitoring, should on-board system fail.

Figure 1-8. Remote Alarms Contacts

Attach the Line Cord

Insert the power line cord into the power inlet module. Place the retaining bracket (P/N 195763) over the connector. Tighten retaining screws to secure.

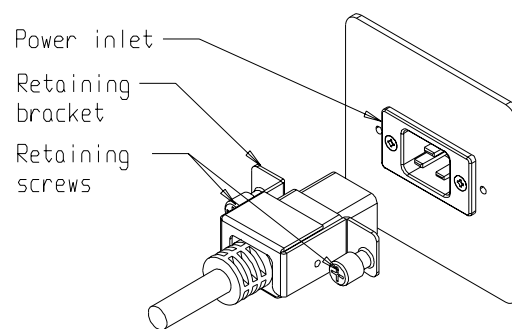


Figure 1-9. Line Cord

Connect Unit to Electrical Power

Note See the serial tag on the side of the unit for electrical specifications or refer to the electrical schematics in this manual. ▲

The freezer should be operated on a dedicated grounded service. Check the voltage rating on the serial tag of the unit and compare it with the outlet voltage. Then, with the power switch turned off, plug the line cord into the wall outlet.

First, turn on the freezer power switch. Then open the lower front door by grasping the bottom left corner. Locate the battery switch (Figure 1-5) and turn it to Standby mode (Ⓢ). During initial freezer start-up, the system battery may require charging and the Low Battery indicator may illuminate.

Caution Ensure the battery switch is turned to Standby mode (Ⓢ). The rechargeable batteries require 36 hours to charge at initial start-up. A “Low Battery” alarm may occur until the batteries are fully charged. Should a power failure occur during the initial start-up period, the electronics will have limited operation. ▲

Freezer Start-Up

With the freezer properly installed and connected to power, system setpoints can be entered. The following setpoints can be entered in Settings mode: Control temperature, high temperature alarm setpoint, low temperature alarm setpoint, and (optional) BUS setpoint. Default settings are shown in the table below.

Control Set Point	-40°C
High Temperature Alarm	-30°C
Low Temperature Alarm	-50°C
Optional BUS Set Point	-30°C

Note If the setpoint is changed and the low temperature and high temperature alarms are set 10° from the setpoint, the alarm setpoints will be adjusted automatically to maintain a distance of at least 10° from setpoint. ▲

Set Operating Temperature

Model 8800 Series -40°C freezers have an operating temperature range of -10°C to -40°C. The freezer is shipped from the factory with a temperature setpoint of -40°C. To change the operating temperature setpoint:

1. Press the Mode key until the Settings indicator lights.
2. Press right arrow until “SET PT = -XX” displays in message center.
3. Press the up/down arrow key until the desired temperature set point is displayed.
4. Press Enter to save the setpoint.
5. Press the Mode key until the Run indicator lights or press the right or left arrow to go to the next or previous parameter.

If no keys are pressed, the freezer will automatically return to RUN mode after 5 minutes.

Set High Temperature Alarm

The high temperature alarm activates an audible/visual warning when the freezer chamber temperature has reached or exceeded the high temperature alarm setpoint.

To set the high temperature alarm setpoint:

1. Press the Mode key until the Setting indicator lights.
2. Press right arrow until “HI ALM = -XX” displays in message center.
3. Press the up or down arrow key until the desired high temperature alarm setpoint is displayed.
4. Press Enter to save the setting.
5. Press the Mode key until the Run indicator lights or press the right or left arrow to go to the next or previous parameter.

If no control keys are pressed, the freezer will automatically return to RUN mode after 5 minutes.

Note The high alarm set point must be set at least 5°C from the control set point. ▲

Caution At initial start-up, the high temperature alarm is disabled until the cabinet reaches setpoint, or 12 hours elapse. ▲

Set Low Temperature Alarm

The low temperature alarm activates an audible/visual warning when the freezer chamber temperature reaches or decreases below the low temperature alarm setpoint.

To set the low temperature alarm set point:

1. Press the Mode key until the Settings indicator lights.
2. Press right arrow until “LO ALM = -XX” displays in the message center.
3. Press the up or down arrow key until the desired low temperature alarm setpoint is displayed.
4. Press Enter to save the setting.
5. Press the Mode key until the Run indicator lights or press the right or left arrow to go to the next or previous parameter.

If no control keys are pressed, the freezer will automatically return to RUN mode after 5 minutes.

Note The low alarm set point must be set at least 5°C from the control set point. ▲

Access Code

An access code can be set to prevent unauthorized change of settings in Calibrate, Configuration and Settings mode. (An access code of 000 is required to make changes.) If the access code is not at the default 000, you can not leave RUN mode without entering a code. See Section 3, Configuration for instructions on modifying the access code.

Run Mode

Run mode is the default mode for the freezer. Run mode displays the cabinet temperature on the temperature display under normal operating conditions. This information is scrolled by pressing the up or down arrow keys. The display will return to the operating temperature in 10 seconds if no keys are pressed.

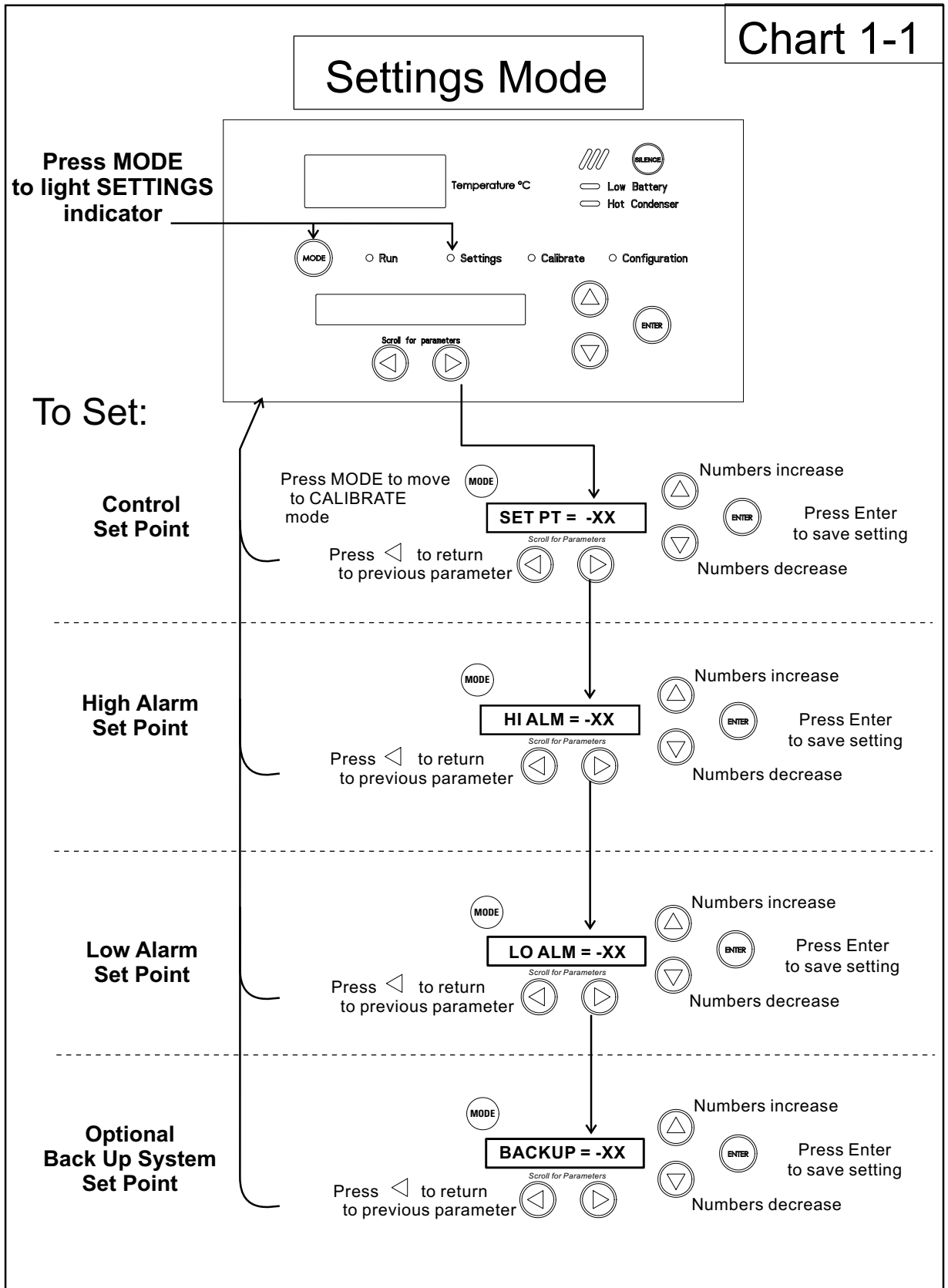
LINE VOLTAGE

COMPENSATED VOLTAGE

* HSHX TEMPERATURE (heat exchanger temperature); -86C units only

This information is scrolled individually by pressing the right arrow key. In each case, the message center returns to SYSTEM OK in 10 seconds if no keys are pressed.

Chart 1-1



Section 2 Calibrate

After the freezer has stabilized, the control probe may need to be calibrated. Calibration frequency is dependent on use, ambient conditions and accuracy required. A good laboratory practice would require at least an annual calibration check. On new installations, all parameters should be checked after the stabilization period.

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

Note At -20°C operation, the probe may need to be calibrated to ensure ambient temperatures are within the required range. Refer to the Calibration section for the procedure.▲

Plug a type T thermocouple reader into the receptacle located inside the lower door (Figure 1-5). Compare the control temperature setpoint to the temperature of the measuring device. See Chart 2-1 at the end of this section for more detail.

Calibrate the Control Probe

1. Press the Mode key until the Calibrate indicator lights.
2. Press the right arrow until “CONT T = -XX.X appears in the message center.
3. Press up/down arrow to match the display to calibrated instrument.
4. Press Enter to store calibration.
5. Press the Mode key to return to Run or the right/left arrow to go to next/previous parameter.

Probe Calibration for -20°C Operation

Note If the peak variation is within $\pm 5^{\circ}\text{C}$ of set value, then no calibration is required. ▲

1. Set temperature to -20°C.
2. Calibrate probe to -4°C (-2.5 for 13 ft units) per above procedure.
3. Allow unit to stabilize to -20°C per temperature stabilization period below.
4. Check peak variation after unit has achieved steady state operation. Probe may need to be calibrated a second time to achieve the required range.

Calibrate the Control Probe (continued)

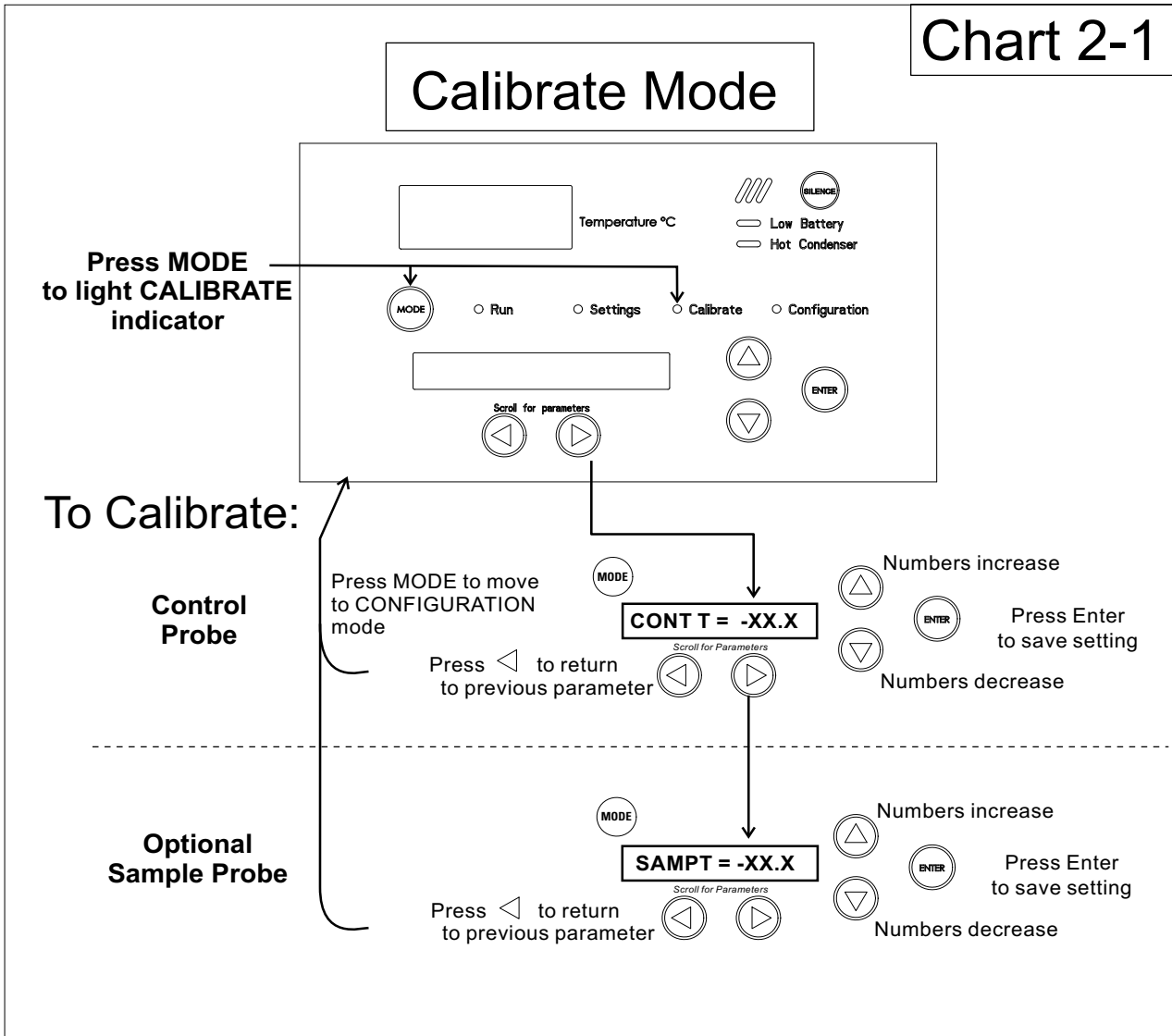
Temperature Stabilization Periods

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

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

Note During calibration, the temperature display is disabled. ▲

If no keys are pressed for approximately five minutes while in Calibration mode, the system will return to Run mode.



Section 3 Configuration

Configuration Mode is used for testing and custom setup of the freezer. The configuration functions listed and described below may not be necessary in all applications, but are available if needed. See Chart 3-1 for more detail.

High Alarm Test

The high alarm test is used to verify that the high alarm will activate, should the freezer temperature equal or exceed the high alarm set point.

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until HI ALRM TEST is displayed in the message center.
3. Press Enter to initiate the test.

The temperature on the display will begin to increase until the high alarm set point has been reached. The audible alarm will sound and the alarm indicator will flash. Press the Silence key to mute the alarm.

Low Alarm Test

The low alarm test is used to verify the that low alarm will activate, should the freezer temperature equal or become less than the low alarm set point.

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until LO ALRM TEST is displayed in the message center.
3. Press Enter to initiate the test.

System Battery Test

The temperature on the display will begin to decrease until the low alarm set point has been reached. The audible alarm will sound and the alarm indicator will flash. Press the Silence key to mute the alarm.

To test the charge of the freezer battery:

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until SYS BAT TEST is displayed in the message center.
3. Press Enter to initiate the test.

TESTING BATT will display during the testing period. Upon completion of the test the message center will display BATT GOOD or BATT FAIL. When a test is failed, the audible alarm will sound, the alarm indicator and the Low Battery indicator will light. Press the Silence key and the alarm indicator will go off. The Low Battery light will stay on until a future battery test is performed and passed.

BUS Battery Test

To test the charge of the BUS battery:

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until BUS BAT TEST is displayed in the message center.
3. Press Enter to initiate the test.

TESTING BATT will display during the testing period. Upon completion of the test the message center will display BBAT GOOD or BBAT FAIL. If this test fails, the audible alarm will sound, the alarm indicator and the Low Battery indicator will light. Press the Silence key. The audible alarm and alarm indicator will go off. The Low Battery light will stay on. If the test fails, it is recommended to replace the BUS battery.

Display Temperature

This function, only available on freezers with the optional sample probe, allows the user to select which temperature is displayed in the temperature display window. The options are CONTROL or SAMPLE.

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until DISP CONTROL or DISP SAMPLE is displayed in the message center.
3. Press up/down arrow to toggle between the two display selections.
4. Press Enter to save.

If control probe is selected, the temperature display will be on continuously. If sample probe is selected, the temperature display will be preceded with a letter 'S'.

Clear High Stage Alarm (-86C units only)

Should a high stage alarm have occurred, it may become necessary to clear the alarm condition after the condition has been corrected.

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until CLR HS ALARM is displayed in the message center.
3. Press Enter to clear the alarm.

Set Access Code

To set the Access Code:

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until "SET ACC CODE" is displayed in the message center.
3. Press Enter.
4. The message center will display ACC CODE = 000. Press the up or down arrow key until the desired access code is displayed (000 - 999). Press the left or right arrow key to select digit 1, 2, 3.

Note The left and right arrow keys are used to move from the first through the third digits within the access code. ▲

5. Press Enter to save the setting
6. Press the Mode key until the Run indicator lights. A 3-digit Access Code can be entered to avoid unauthorized personnel from changing the set points, calibration, or configuration. A setting of 000 will bypass the access code. The factory setting is 000.

RS485 Address

If the freezer is configured for RS-485 communications, it will need to have a unique identification address. This address is set through the Configuration mode.

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until RS485ADDR is displayed in the message center.
3. Press Enter. The message center will display **485 ADDR XX**.
4. Press up/down arrow to select the appropriate address for the freezer (1 - 24).
5. Press Enter to save.

Back Up System Type

This function, which is only available on freezers with the optional back up system (BUS), allows the user to select which type of gas is injected into the freezer chamber. The options are CO₂ and LN₂.

1. Press the Mode key until the Configuration indicator lights.
2. Press the right arrow until BUS TYPE CO₂ or BUS TYPE LN₂ is displayed in the message center.
3. Press up/down arrow to toggle between the two display selections.
4. Press Enter to save.

Cold Excursion

This function displays the coldest temperature recorded by the control probe.

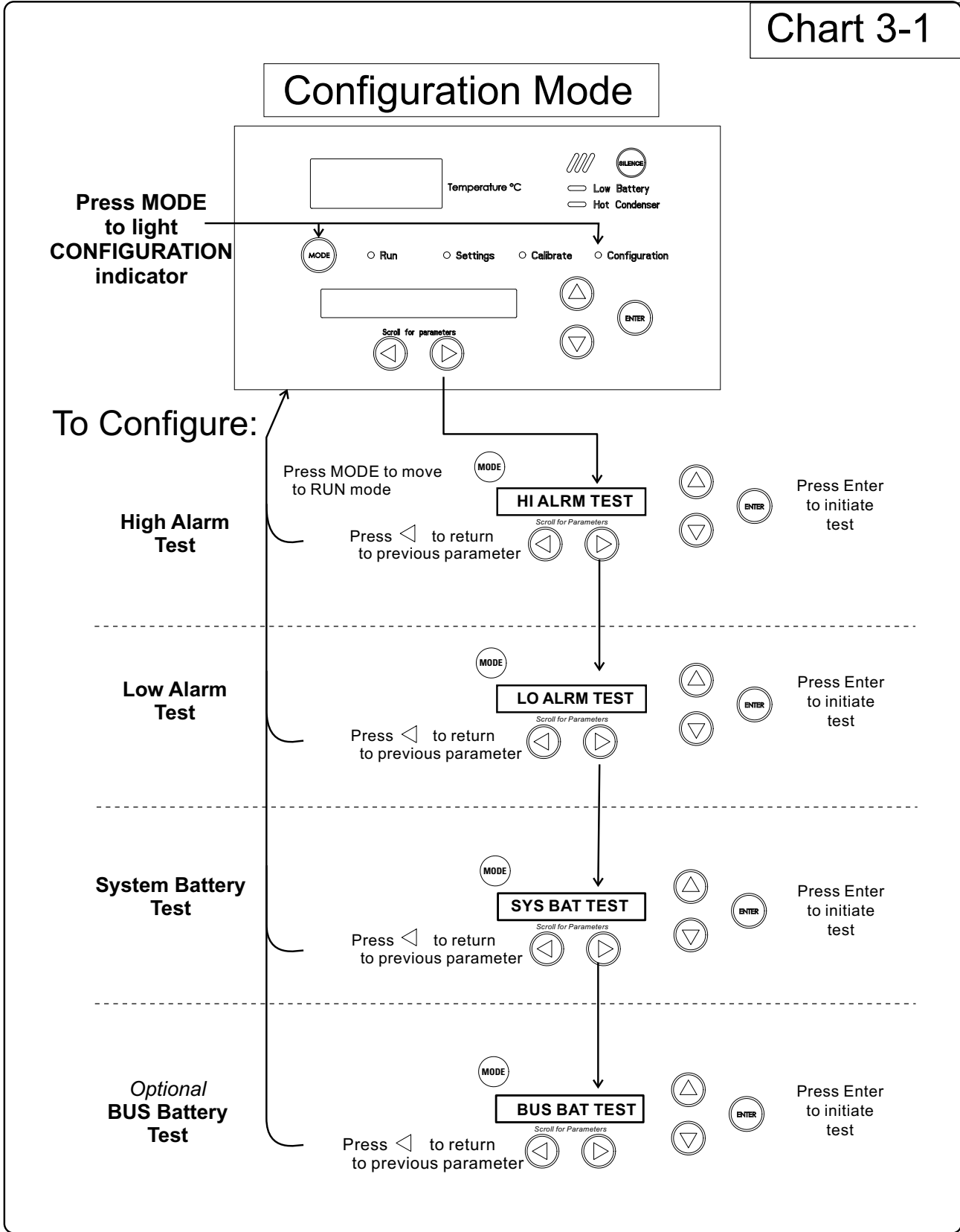
Warm Excursion

This function displays the warmest temperature recorded by the control probe.

Reset Excursion

This function resets the cold and warm excursions.

Chart 3-1



Configuration Mode, Chart 3-1, Page 2 of 3

refer to previous page

To Configure:

Display Temperature

MODE

DISP CONTROL

Scroll for Parameters

Press ◀ to return to previous parameter



CONTROL probe
Press Enter to save the setting
SAMPLE probe

ENTER

Clear High Stage Alarm

MODE

CLR HS ALARM

Scroll for Parameters

Press ◀ to return to previous parameter



Press Enter to clear the alarm condition

ENTER

Access Code

MODE

SET ACC CODE XXX

Scroll for Parameters

Press Mode to exit.
Press right or left arrow to move to next digit.



Numbers increase
Press Enter to save the setting
Numbers decrease

ENTER

RS-485 Address

MODE

RS485 ADDR

Scroll for Parameters

Press ◀ to return to previous parameter



Scroll through the various options.
Press Enter to save the setting

ENTER

Optional Back Up System Type

MODE

BUS TYPE CO2

Scroll for Parameters

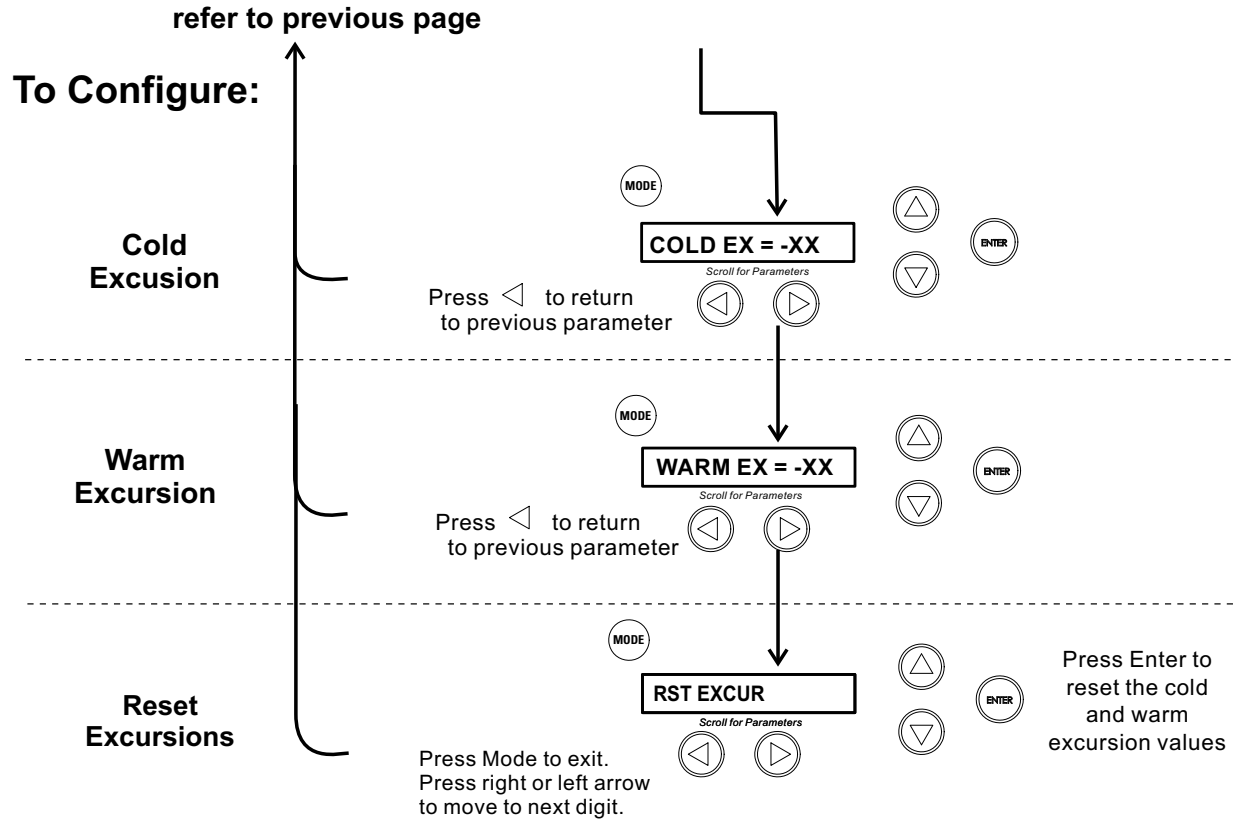
Press ◀ to return to previous parameter



Type CO2
Press Enter to save the setting
Type LN2

ENTER

Configuration Mode, Chart 3-1, Page 3 of 3



Section 4 Alarms

Model 8800 Series freezer alarms are displayed on the freezer control panel. When an alarm is active, a message appears in the LED message center. Press the Silence key to disable the audible alarm for the ringback period. The visual alarm will continue until the freezer returns to a normal condition. The alarms are momentary alarms only. If an alarm condition occurs and then returns to normal, the freezer automatically clears the alarm condition and the message center.

Description	Message	Delay	Ringback	Relay
No alarm condition exists	SYSTEM OK	----	----	----
Power Failure	POWER FAIL	1 min.	15 min.	Yes
High Temperature Alarm	TEMP IS HIGH	1 min.	15 min.	Yes
Low Temperature Alarm	TEMP IS LOW	1 min.	15 min.	Yes
Door Ajar	DOOR IS OPEN	1 min.	15 min.	No
Low Battery*	LOW BATTERY	1 min.	8 hours	No
Low BUS Battery (optional)	LOW BUS BATT	1 min.	15 min.	No
Control Probe Failure	CNT PRB FLT	1 min.	15 min.	Yes
Heat Exchanger Probe Failure **	HSHX PRB FLT	1 min.	15 min.	No
Condenser Probe	COND PRB FLT	1 min.	15 min.	No
Sample Probe Failure (optional)	SMPL PRB FLT	1 min.	15 min.	No
High Stage System Failure **	HS SYST FAIL	1 min.	15 min.	YES
Condenser Hot Condition	HOT CONDENSER	1 min.	none	No
Wrong Power	WRONG POWER	0 min.	none	YES
Micro Board Failure	MICRO FAIL	0 min.	15 min.	YES

All alarm delays and ringback times are +30 seconds.

**The automatic battery test runs immediately on power-up, then every 8 hours thereafter.*

*** -86C units only*

High Stage System Failure Alarm (-86C units only)

This condition is created when the high stage compressor and fans run for 30 minutes and are not capable of cooling the interstage heat exchanger to the proper temperature. Under this condition, the high stage compressor and fans will turn off after 30 minutes and an audible and visual alarm will occur along with the "HS SYST FAIL" message in the LED message center.

Multiple Alarms

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

Micro Board Failure Alarm

An internal communication failure has occurred with the micro board. During this alarm, the compressor(s) attempt to run continuously. However, with this type of failure, freezer operation becomes undependable.

Lost Communication

Communication between the micro board and the display board has been lost. Under this condition, the visual alarm flashes along with dashes in the temperature display (---). Contact Technical Services.P

Section 4

Alarms

Error	Notes
Er00	<p>Name: Improper model selected.</p> <p>Description: Indicates that DIP SW3 has not selected a proper model or can't be accessed properly.</p> <p>Response: Display shows "Er00" and will not start-up until a proper model is selected. Contact Technical Services.</p>
ErA1	<p>This error condition will prevent peripherals (fans, compressors, etc.) from powering up with the incorrect voltage.</p> <p>Name: Voltage/Frequency failure</p>
ErC1	<p>Description: Indicates the measured RMS line voltage did not agree with the logic level sensed by the micros provided by the installed high voltage PCB; or the measured RMS voltage is not within a tolerable range (<180VAC < 270 for 230VAC unit / < 85VAC < 160 for 115VAC unit); or the frequency measured over 10 cycles was not within a tolerable range (55 Hz < Freq < 70 Hz for 60 Hz units / 40 Hz < Freq < 55 Hz for 50 Hz units)</p>
Erd1	<p>Response: This condition is checked at power on reset and if it is active, the unit will NOT power up. The unit will indefinitely display "Er_1" in the display and continue to monitor the frequency and voltage. Furthermore, the audible alarm will sound. Other startup error messages may be displayed prior to this message; however, the system will stop the startup sequence for this condition.</p>
ErE1	
ErF1	<p>ErA1 .. No pulses (zero crossings) detected to determine frequency (50 / 60 Hz)</p> <p>ErC1 .. Frequency detected is below 50 Hz</p> <p>Erd1 .. Frequency detected is above 60 Hz (Possible noise spikes on supply voltage)</p>
Erg1	<p>ErE1 .. Unit is 230V and the voltage detected is below the low limit (180VRMS)</p> <p>ErF1 .. Unit is 230V and the voltage detected is above the high limit (260VRMS)</p> <p>Erg1 .. Unit is 115V and the voltage detected is below the low limit (85VRMS)</p>
ErH1	<p>ErH1 .. Unit is 115V and the voltage detected is above the high limit (160VRMS)</p>
Er02	<p>Name: Control (Cabinet) Sensor Failure</p> <p>Description: This condition indicates that the control sensor has failed to produce a valid reading for ≥12 consecutive reads (~60 seconds).</p> <p>Response: The unit will stage both compressors on (if necessary) and the unit will attempt to head to bottom out. If the sensor recovers, the system will begin to operate normally and respond to the temperature feedback. The remote alarm contacts will become active. 'Er02' will be added to the main display queue and the last valid cabinet temperature value will not be displayed.</p>

Error (cont.)	Notes
Er05	<p>Name: Display Firmware Integrity Failure Description: The display firmware has failed to pass its CRC CCITT checksum integrity test. Response: The display performs this check at startup and the display board will fail to startup without any error indication if it does not pass this at power on.</p>
Er06	<p>Name: Micro Firmware Integrity Failure Description: The micro firmware has failed to pass its CRC CCITT checksum integrity test. Response: This is checked at power on reset and the "Er06" will be displayed for ~10 seconds at startup if this condition exists.</p>
Er07	<p>Name: Micro Fail - CS5521 SPI Failure / UISR Failure Description: This condition indicates a micro board failure due to either the SPI bus is unable to communicate with the ADC device or a UISR event caused the microcontroller to be in an unstable state. Response: The unit will try to recover from this fault three times by a hardware reset of the micro board. In the event that the system couldn't rectify the issue, the following sequence of events will occur:</p> <ol style="list-style-type: none"> 1. Remote alarm contacts will become active. 2. Buzzer will annunciate audibly and will have a ringback of 15 minutes. 3. "Seven segment" display will show "Er07". 4. The compressor will activate. 5. The system will go to bottom out temperatures.
Er09	<p>Name: Stuck Button Description: This condition indicates that the display board has a stuck button. Response: The Er09 will show on the display periodically.</p>
Er11	<p>Name: Condenser Probe Sensor Failure Description: This condition indicates that the condenser probe sensor has failed to produce a valid reading for ≥ 12 consecutive reads (~60 seconds). Response: The display shows "Er11".</p>
dErr	<p>This is a general display error in which value being displayed can not be represented within characters provided.</p>
(Four dashes) ---- in display	<p>Name: Lost Communication Description: Communication between the micro board and the display board has been lost. Under this condition, the visual alarm flashes along with dashes in the temperature display (----). Contact Technical Services.</p>

Section 5 Maintenance

Warning Avoid the excessive use of water around the control area due to the risk of electrical shock. Damage to the controls may also result. ▲

Wipe down the freezer exterior using soap and water and a general-use laboratory disinfectant. Rinse thoroughly with clean water and dry with a soft cloth.

Clean the Air Filter

The procedure for cleaning the air filter (minimum of four times a year) follows.

1. Open the front lower door by grasping the bottom left corner.
2. Locate the grille on the door. See Figure 4-1. Grasp the middle of the grille material and gently pull out to remove.
3. Wash the filter material using water and a mild detergent.
4. Dry by pressing between two towels.
5. Install the filter back into the grille and attach the grille.

Depending upon environmental conditions, the filter may need to be cleaned or replaced more frequently. If the filter becomes torn or excessively dirty, a replacement can be purchased from Thermo. See the exploded parts list for the filter part number. A filter kit (set of 5) is also available.

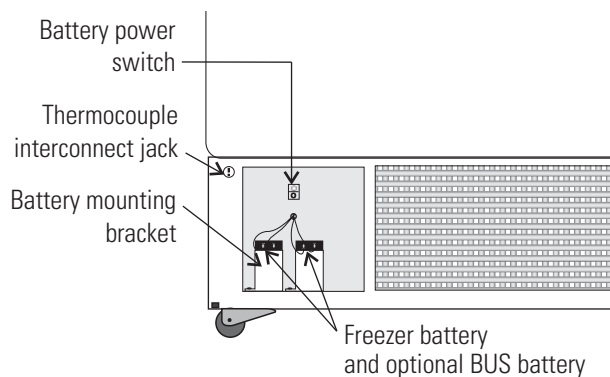


Figure 5-1. Component Locations

Clean the Condenser

The procedure for cleaning the condenser (minimum yearly) follows.

1. Open the front lower door by grasping the bottom left corner. See Figure 4-1.
2. Using a vacuum cleaner, exercising care to not damage the condenser fins, clean the condenser.

Depending upon environmental conditions, the condenser may need to be cleaned more frequently.

Caution Do not use liquids that are corrosive to stainless steel or the brazing material (copper or nickel). ▲

Defrost the Chamber

The procedure for defrosting the chamber follows.

1. Remove all product and place it in another freezer.
2. Turn the unit off and disconnect it from the power source.
3. Turn off the battery switch (O). See Figure 4-1.
4. Open all of the doors and place towels on the chamber floor.
5. Allow the frost to melt and become loose.
6. Remove the frost with a soft cloth.
7. After defrosting is complete, clean the interior with a non-chloride detergent. Rinse thoroughly with clean water and dry with a soft cloth.
8. Plug unit in and turn power switch on.
9. Turn the battery power switch to Standby mode (Ⓞ).
10. Allow the freezer to operate empty overnight before reloading the product.

Prepare the Unit for Storage

Defrost the unit as described previously. This prepares the unit for storage. Turn off the battery power switch (O). Turn off the freezer power switch. Disconnect power to the battery(s) and to the freezer.

Caution If the unit has been in service, turn it off and disconnect the power cord connector before proceeding with any maintenance. ▲

Clean the Door Gasket

The procedure for cleaning the door gasket (minimum monthly) follows.

Using a soft cloth, remove any frost build-up from the gasket and door(s). The door gasket may need to be cleaned more frequently if dirt or excessive frost build-up prevents the door from closing properly.

Clean the Vacuum Relief Port

The exterior door gasket provides an excellent seal that protects product, provides an energy efficient thermal barrier to keep cold air in and room temperature air out and reduces frost build up on the inner doors.

Because the door gasket seals so well, a vacuum can be created after a door opening. Warm air enters the cabinet, cools and contracts, creating a vacuum that pulls the door in tightly against the seal.

To equalize the pressure inside the cabinet after a door opening requires 1.5-3.0 cu.ft. of ambient air to be drawn into the cabinet. The amount of air required to equalize the pressure varies depending on the cabinet size, cabinet temperature, duration of door opening, inventory volume and the temperature/humidity of the ambient air. The unit is designed with a 'vacuum relief port' to allow the pressure to be equalized.

The time required to draw 1.5-3.0 cu.ft. of air into the cabinet depends on two factors,

- a) size and number of paths available for the air to enter the cabinet,
- b) pressure difference between the internal cabinet and the ambient room.

Cabinets with the vacuum relief port operating normally, (i.e. vacuum relief port is not iced over) will require a minimum of 30 seconds up to a maximum of 120 seconds for the cabinet to equalize. This is also a good indication that the exterior door is well sealed.

The vacuum relief port requires routine maintenance. It will ice over unless preventive measures are taken. If the vacuum relief port becomes iced over, the freezer will take several hours to equalize pressure.

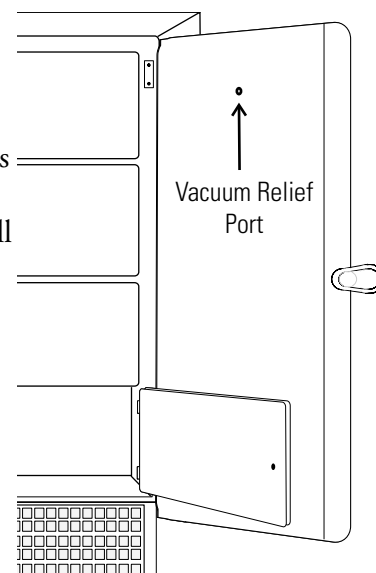


Figure 5-2. Port Location

Clean the Vacuum Relief Port (cont.)

Caution Do not leave the freezer unattended with the door unlatched. The vacuum could release, resulting in a door opening and possible product loss. ▲

Observe the inner side of port with each door opening for frost and ice build-up. Remove any frost with a soft dry cloth. If the tube should become clogged with ice, it must be cleaned. **Make sure during cleaning that the vacuum relief tube is completely free of ice to prevent rapid ice formation.**

Other factors that can affect the performance of the vacuum relief port include: high ambient temperature, high humidity conditions and frequent door openings. Maintenance should be performed weekly, or as needed.

Caution Failure to maintain the vacuum relief port may result in excessive ice build-up inside the tube, clogging the port, resulting in an inability to open the door. The vacuum relief port may need to be cleaned more often with frequent door openings and high humidity environments. ▲

Replace Battery(s)

1. To gain access to the battery, open the lower door by grasping the bottom left corner. The battery is rectangular in shape, located on the front left corner of the compressor compartment and is secured in place by a mounting bracket.
2. Directly above the battery(s) is the battery power switch. Turn the battery power switch to the Off position (O).
3. Disconnect the battery connections.
4. Remove the old battery and install the new battery.
5. Reconnect the battery (red to positive and black to negative).
7. Turn the battery power switch to Standby mode (⏻).
8. Close lower panel door.

Caution The % of charge can vary depending on the age, usage and condition of the battery. For a consistent and dependable charge, replace the battery every 2 years. Replacement batteries must be rechargeable and are available from Thermo. Refer to the parts list for stock number and description of the replacement batteries. Dispose of used batteries in a safe manner and in accordance with good environmental practices. ▲

Check Battery(s)

1. To gain access to the battery, open the lower door by grasping the bottom left corner. The battery is rectangular in shape, located on the front left corner of the compressor compartment and is secured in place by a mounting bracket.
2. Directly above the battery(s) is the battery power switch. Turn the battery power switch to the off position (O).
3. Cut the tie wrap securing the battery to the mounting bracket. Lift the battery out of the bracket.
4. Disconnect the red and black wires from the battery.
5. Use a voltmeter set to DC volts. Matching the wire colors, connect the meter to the battery.
6. If the voltage reads less than 10.8 volts, replace the battery. If above 10.8, re-install as previously.
7. Turn the battery power switch to Standby mode (Ⓢ).
8. Close lower panel door.

PREVENTIVE MAINTENANCE

Freezers

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 that the unit be checked and calibrated periodically by a qualified service technician.

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

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 below.

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

Tips:

- Fill an upright by starting at the bottom near the probe and add racks to one shelf at a time. Allow freezer to recover to set point between shelves.
- Fill a chest by starting at the left side near the probe. Filling with room temperature racks will result in a long pull-down time.
- Fill unit with frozen product to help overall performance; frozen water jugs, for example.
- Always make certain the vacuum relief port is free of frost and ice, to allow for timely re-entry into the freezer after a door opening.

• 401 Millcreek Road, Box 649 • Marietta, Ohio 45750 USA • 740-373-4763

• USA and Canada 800-438-4851 • Telefax: 740-373-4189 • email: service.led.marietta@thermo.com/forma

Preventive Maintenance for 7000 Series Freezers

Refer to Manual Section	Action	Monthly	Yearly	Every 2 Years
--	Verify ambient temperature, <90°F	✓		
--	* Adjust door handle for firm latching, as needed	✓		
Figure 1-4 for probe location 4.5, 4.6	Check and clean probe cover, gaskets, hinges, and vacuum relief port of ice and snow	✓	More frequent cleaning may be required, depending on use and environmental conditions	
4.2	Check air filter. Clean or replace as needed		✓ 4X	
1.5.f, 4.7	Check alarm back-up battery	✓		** Replace
--	Check condenser fan motor for unusual motor noise or vibration		✓	
2	* Verify and document calibration, at the minimum, annually		✓	
4.3	* Clean condenser compartment and wipe off condenser		✓	

* Qualified service technicians only

** Dispose of properly, according to all state and federal regulations

To minimize ice build-up inside of freezer:

- Locate the freezer away from drafts or heating/cooling vents
- Keep the number of door openings to a minimum
- Minimize the length of time door is open
- Make sure door latches securely after opening

Section 6 Factory Installed Options

Described below are the factory installed options which are available, or may be already installed, on your unit.

Back-Up System (BUS) - P/N 1960445, 1960447

Warning Before installation of BUS components, make sure the power to the freezer is disconnected, the battery switch is turned off (O) and the freezer has warmed to ambient temperature. ▲

The built-in BUS (back up system) will keep the freezer chamber temperature below the critical level in the event of a power or equipment failure. If power to the freezer fails, or temperature increases to the back up alarm set point, the BUS injects liquefied gas into the chamber to keep the chamber temperature within the specified range.

The BUS operates on an internal 12-volt, rechargeable battery which is kept charged during normal operation by the integral battery charger.

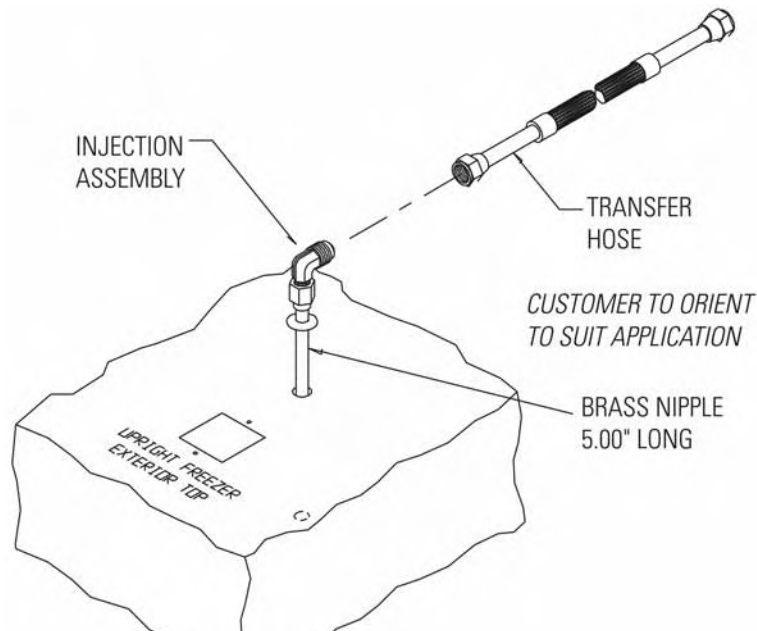


Figure 6-1. Injection Assembly

Vent Stack, Solenoid and Injection Assembly

1. Install the injection assembly (Figure 5-1) through the 1/2" pre-punched hole, directly behind the 2" vent stack hole in the center of the chamber ceiling.

Note Cover the open end of injection assembly with tape to keep insulation from entering the nipple. ▲

2. Slide 3/8" flatwasher over open end of nipple.
3. Insert the covered end of the injection assembly through the exterior hole.
4. Remove the tape covering from the end of the nipple and install the 1/8" NPT brass tee on the open end of the nipple. Place Permagum sealant between the brass tee and the interior top.
5. Remove the two Phillips head screws securing the metal bracket on the vent stack assembly.
6. Install the vent stack (Figure 5-2) through the opening and secure it to the top of the freezer, using screws.
7. On the cabinet interior, seal around the end of the vent stack with Permagum.
8. Install the transfer hose connecting one end to the injection assembly, the other end to the solenoid valve. Install the solenoid valve to the supply source. The solenoid mounting bracket is not required and may be discarded.

Caution When selecting a CO₂ supply cylinder, it must be equipped with a siphon tube. ▲

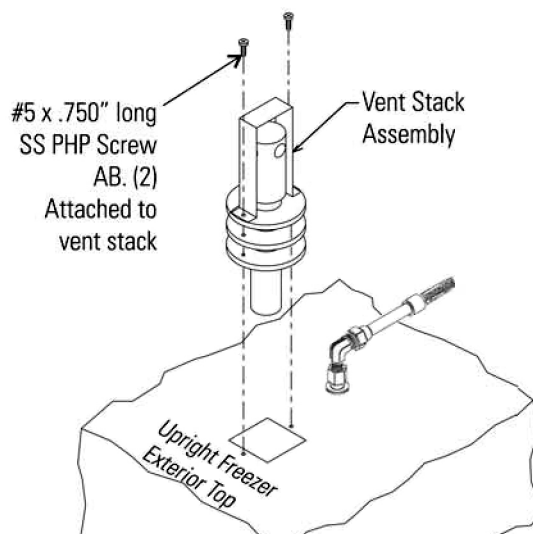


Figure 6-2. Vent Stack Assembly

Temperature Probe

1. Locate the 0.500" pre-punched hole in the upper left hand back corner of the chamber ceiling. Remove the tie wrap securing the coiled probe/solenoid harness. Uncoil the probe lead and run the probe tip (approximately 12") down through 0.500" porthole (Figure 5-4).
2. As shown in Figure 5-3, thread the small tie wrap through the openings in the front of the bracket. Secure the probe on the back of the bracket with the tie wrap.
3. Tap #8-32 the two pre-punched holes located on the interior left wall of the freezer. Mount the bracket. Figure 5-4 shows the Back-Up probe mounted on the interior left side wall of the freezer.

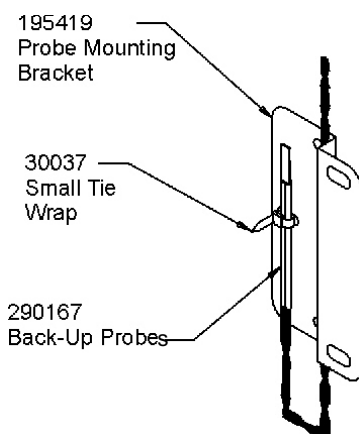


Figure 6-3. Probe

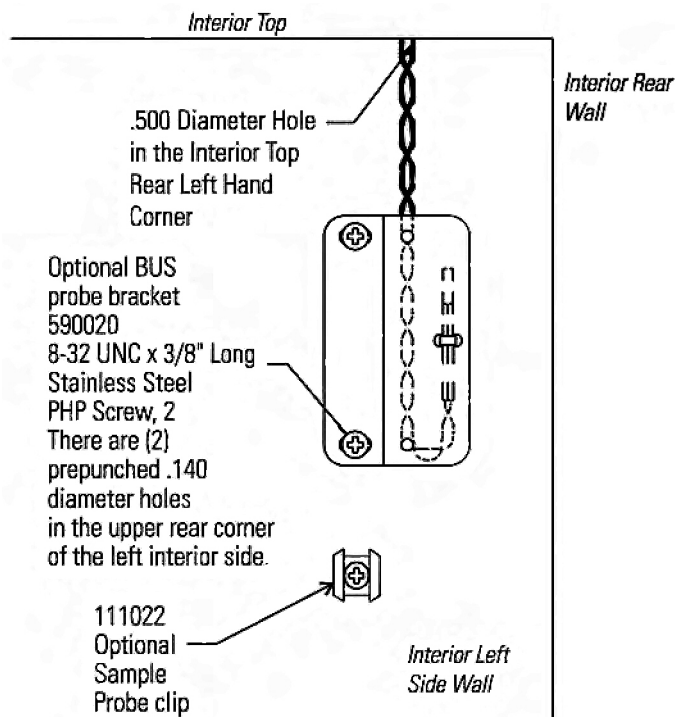


Figure 6-3. Bracket

Connect the Probe/ Solenoid Harness

1. Remove the four screws on the freezer back panel and use them to mount the tie wrap anchors as shown in Figure 5-5. Secure the probe wire with tie wraps.
2. Plug the solenoid/probe connector into the BUS connection and secure with a screw on the right and left side. The connector is keyed.
3. Loosen the terminal screws on the solenoid. Slide the spade lug connectors under the screws and tighten to secure.
4. Connect power to the freezer. Turn the freezer On, with battery switch Off (O).
 - a. **Arming on Power On**

The arming function occurs only one time at initial power-on. It may occur in 3 ways; BUS timeout arming, both sensors fail and BUS temperature sensor arming.

At power-on, the BUS will perform a Hold-off period check. The BUS will not inject the refrigerant for a Hold-off period, calculated as follows:

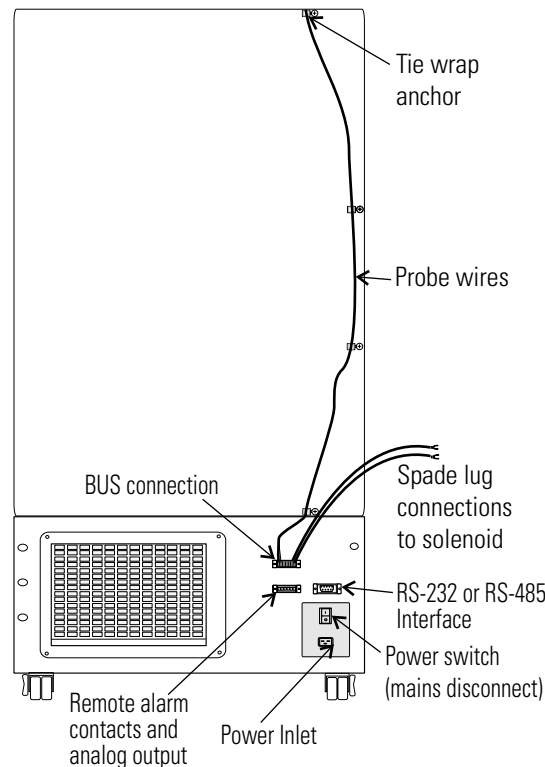


Figure 6-5. Routing

Connect the Probe/ Solenoid Harness (cont.)

Hold-off period:

- 12 hour is between 0 and +70C
- 12 hour is between 0 and (BUS Setpoint - Hysteresis)
- 0 hours is below (BUS Setpoint - Hysteresis)
- 0 hours is temperature Out Of Range or both probes fail.

b. The Low Battery indicator may also illuminate.

5. Turn the battery switch to Standby mode (⏻) to charge both batteries.

BUS Operation and Maintenance

Warning When activated, this unit injects liquid nitrogen or carbon dioxide. Liquid nitrogen can cause serious freezing (frostbite) if it comes in contact with unprotected skin or eyes. Nitrogen suppresses oxygen levels and may cause suffocation if area is not well ventilated. Refer to Appendix A for the proper handling of liquid LN₂. ▲

Caution Make sure the pressure relief valve on any LN₂ tank is adjusted to 30 PSI maximum blow-off. ▲

Warning Carbon dioxide gas suppresses oxygen levels and may cause suffocation if area is not well ventilated. Refer to “Handling Liquid CO₂” in Appendix B of this manual. ▲

Power - indicates the unit has AC power.

1. Normal Operation

- Low Battery: Illuminates only after a battery test which occurs every 8 hours. The battery test is a loaded test and during the test, the battery voltage is monitored. When the battery voltage is less than a certain threshold, this light will illuminate and stay illuminated until the next battery test.
- Solenoid Engaged: Illuminates any time the controller is activating the solenoid. Illumination will only occur when the controller senses the solenoid is active and calling for injection.

2. Fault Code

This same user interface will also permit fault codes to be easily viewed when the user presses and releases the Press to Test button in less than 2 seconds. When this occurs, both the Low Battery LED and Solenoid Engaged LED will blink twice ON/OFF quickly indicating that fault code display mode is active. For the next ~10 seconds, the fault codes will be displayed as shown in the table below. The display shows only the lower number fault code until that fault is resolved.

BUS Operation and Maintenance (cont.)

Low Battery LED	Solenoid Engaged LED	Fault Code Number	Fault Code Definition
OFF	OFF	0	Normal Operation
OFF	Blinks 1 time	1	Primary Probe Failure
OFF	Blinks 2 times	2	Secondary Probe Failure
OFF	Blinks 3 times	3	Solenoid Driver Failure
OFF	Blinks 4 times	4	Low Tank

Table 6-1. BUS Fault Codes

Each blink will take one second, with half of the second interval being ON (illuminated) and the other half of the second interval being OFF. After the sequence concludes, both the Low Battery LED and the Solenoid Engaged LED will flash four times ON/OFF quickly to indicate a return to normal display.

3. BUS Injection Test

The user must press and hold the Press-to-Test button for ≥ 2 seconds before injection occurs. After the Press-to-Test button is pressed for >30 seconds, the solenoid will turn off. This will avoid a button or button signal becoming stuck in an active condition.

During a Press-to-Test injection, if either RTD #1 or RTD #2 reads a temperature less than 20°C below BUS set point and it is determined to be a valid input, then injection will terminate immediately.

4. BUS Set point “Validation” Feedback

Whenever the BUS set point or working fluid changes, the BUS acknowledges the set point acceptance by causing the Low Battery LED and Solenoid Engaged LED to blink three times ON/OFF quickly. This does not imply that the BUS error-checked the values, other than that the value received was within the range of the BUS working correctly with prior programming.

Note Solenoid will not engage if door is open. ▲

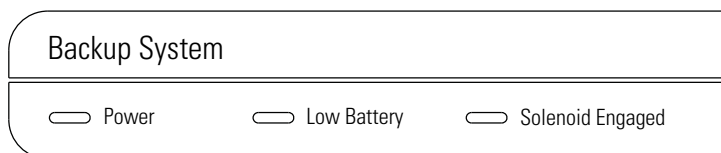


Figure 6-6. BUS Control Panel

BUS Operation and Maintenance (cont.)

For Hysteresis & Dual probe fault mode settings (Figure 15), locate Jumper J17 near to solenoid/sensor connector (J1), refer to the following table for operation details:

Jumper PIN	Status	Hysteresis	Dual Probe Fault Mode
J17 PIN 1 & PIN 2	Short Together/ Jumper Cap Installed	5°C	Non-PWM Mode
J17 PIN 1 & PIN 2	Open/No-Jumper Installed	9°C	PWM Mode

Table 6-2. Probe Fault Modes

PWM mode: If both probes fail, the solenoid will activate periodically, allowing the flow of refrigerant (CO₂ or LN₂).

Non-PWM mode: If both probes fail, the solenoid remains OFF and no refrigerant will flow.

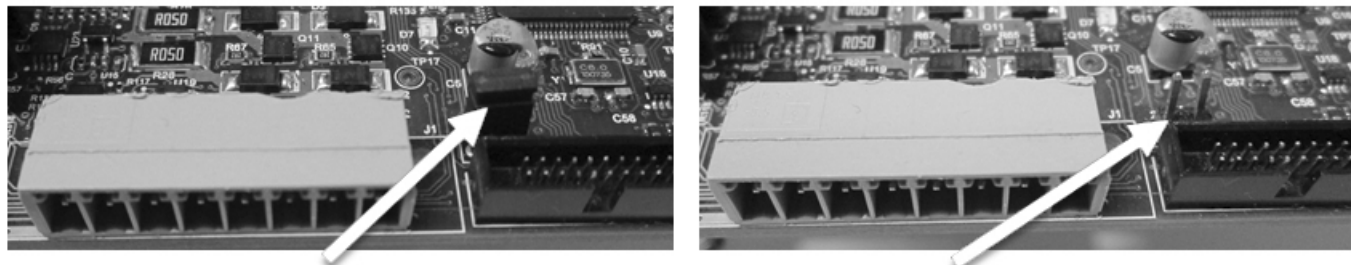


Figure 6-7. Jumper Cap for Hysteresis & Dual Probe Fault Mode Selection

Configure Optional Back-Up System

The optional BUS can be configured for LN₂ or CO₂ supply. Section 3-Configuration contains instructions for setting the BUS type.

Set the Optional Back-Up Setpoint

The optional back up system is designed to inject CO₂ or LN₂ into the freezer compartment if the temperature rises above back up system set point. To set the BUS set point:

1. Press Mode key until the Settings indicator light.
2. Press right arrow until “BACKUP = -XX” displays in message center.
3. Press up or down arrow key until desired BUS set point is displayed.
3. Press Enter to save the setting.
4. Press the Mode key until the Run indicator lights, or press the right or left arrow to go to the next or previous parameter.

If no control keys are pressed, the freezer will automatically return to Run mode after 5 minutes.

Set the Optional Back-Up Setpoint (cont.)

Caution Changing the operating temperature set point can affect the BUS set point. The BUS set point will self adjust to maintain a temperature of at least 10°C above the operating temperature set point. ▲

Caution The BUS set point cannot be set any colder than the high temperature alarm set point (see Section 1). If the back-up system is installed with CO₂, then -65°C is the coldest BUS set point that can be used (if the cabinet set point is -75°C or colder). ▲

Test BUS Operation

After the freezer has stabilized and both batteries are fully charged, the BUS can be tested to verify proper operation.

1. Disconnect AC power to the freezer by turning the power switch off.
2. As the freezer warms up, verify the BUS injects at the desired temperature. Displayed temperature may vary by a few degrees from inject temperature due to the differences in probe locations.
3. **Preventive Maintenance** - Monthly maintenance action to check CO₂ or LN₂ back-up system operation, and battery voltage.
 - Check for fault codes on the BUS probe per Table 6-1. Also verify solenoid operation by performing a Press-To-Test.

Clean Vent Stack

Routinely check the vent stack for frost or ice build-up. The type of frost that forms in the vent stack is generally very soft and may be easily removed with a bristle brush or soft cloth. If ice build-up has occurred, a complete defrost may occasionally be required. See Section 4 for freezer defrost instructions.

Disconnect the Fitting Assembly & Transfer Hose

To disconnect the freezer back-up from the gas supply:

1. Close the supply valve.
2. Depress test button on BUS control box to remove gas from the line.
3. Slowly disconnect the fitting assembly from the supply (in the event that any gas remains in the line).

Chart Recorder

Procedures concerning the use and maintenance of the optional recorder follow.

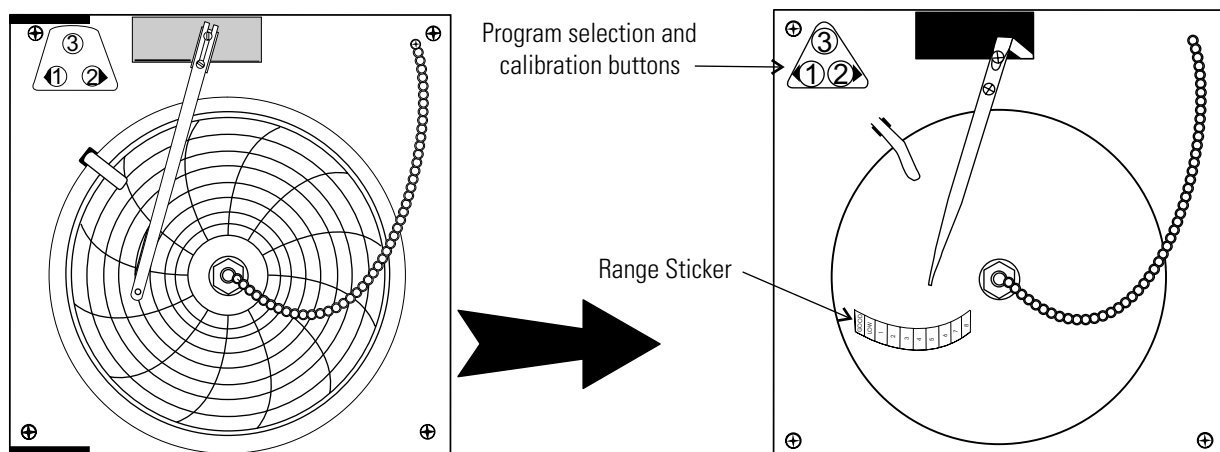


Figure 6-8. Recorder Details

- ### Install the Chart Paper
1. Open the glass door of the recorder and press button #3 until the pen begins to move outward.
 2. Unscrew the knob at the center of the chart and remove the paper.
 3. Install the new chart paper, position the paper to the correct time line and replace the knob.
 4. Remove the cap from the felt pen and press button #3.



Figure 6-9.
Buttons

Change the Recorder Range

The chart recorder contains eight temperature ranges and is factory-programmed for the freezer.

1. Press and hold button #3 for one second, then let the pen move off the chart paper.
2. Press and hold for five seconds either button #1 or button #2.
3. Release the button and the green LED will begin to flash. Count the number of flashes to determine the present program setting.
4. To change the program setting, press the left or right arrows to increase or decrease the count.
5. When the desired program number is flashing, press button #3 to bring the pen arm back onto the chart. Recording will begin in the new program.

Program	From	To
1	-40	30°C
2	0	60°C
3	-100	38°C
4	-5	50°C
5	0	100°C
6	-100	200°C
7	-115	50°C
8	-10	70°C

Table 6-3. Recorder Temp Range

Calibrate the Chart Recorder

Caution The recorder must be in service for 24 hours before performing the following calibration procedure. ▲

1. Place an accurate thermometer in the chamber next to the recorder probe.
2. Temperature probes for the recorder are located in the left front corner of the freezer chamber (Figure 1-4).
3. After about three minutes, compare the thermometer reading with the chart recorder reading.
4. If an adjustment is necessary, press the #1 button to move the pen to the left or the #2 to move the pen to the right. The button must be held about five seconds before the pen begins to move. Release the button when the pen position matches the thermometer.

Note The felt-tip pen on the recorder requires periodic replacement. Usually the ink will appear to fade before replacement becomes necessary. Additional pen tips may be purchased from Thermo. ▲

Five Inner Door Option

The five inner door option (P/N 189405, 189406, 189407, 195652) is factory installed. The freezer is converted to accommodate four adjustable specimen shelves with the fifth “shelf” as the bottom of the freezer chamber.

Section 7 Specifications

Number	7240A	7240V	7240D	7320A
Temperature Range	-10°C (14°F) to -40°C (-40°F)			
Exterior Dimensions	33.3"W x 77.9"H x 32.9" 84.6 x 197.9 x 83.6cm	33.3"W x 77.9"H x 32.9" 84.6 x 197.9 x 83.6cm	33.3"W x 77.9"H x 32.9" 84.6 x 197.9 x 83.6cm	33.3"W x 77.9"H x 38.9" 84.6 x 197.9 x 98.8cm
Interior Dimensions	23.0"W x 51.5"H x 19.3" 58.4 x 130.8 x 49.0cm	23.0"W x 51.5"H x 19.3" 58.4 x 130.8 x 49.0cm	23.0"W x 51.5"H x 19.3" 58.4 x 130.8 x 49.0cm	23.0"W x 51.5"H x 25.3" 58.4 x 130.8 x 64.3cm
Capacity	13.0 cu. ft. (368.1 liters)	13.0 cu. ft. (368.1 liters)	13.0 cu. ft. (368.1 liters)	17.3 cu. ft. (489.9 liters)
Refrigeration	One 1 HP (2545 BTUH each)			
Insulation	Non-CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 4.5" (11.4 cm) door			
Electrical - nominal voltage ±10%	120V, 60Hz, 10.0 FLA Operating Range: 108-130VAC	230V, 50 Hz, 6.5 FLA Operating Range: 208-230VAC	208-230V, 60Hz, 6.5 FLA Operating Range: 208-240VAC	120V, 60Hz, 10.0 FLA Operating Range: 108-130VAC
Breaker Requirements	20 Amp Dedicated Circuit, 20 Amp Time Delay Breaker	15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker	15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker	20 Amp Dedicated Circuit, 20 Amp Time Delay Breaker
Shipping Weight: Motor	696 lbs. (316 kg)	696 lbs. (316 kg)	696 lbs. (316 kg)	810 lbs. (367 kg)

Number	7320V	7320D	7400A
Temperature Range	-10°C (14°F) to -40°C (-40°F)		
Exterior Dimensions	33.3"W x 77.9"H x 38.9" 84.6 x 197.9 x 98.8cm	33.3"W x 77.9"H x 38.9" 84.6 x 197.9 x 98.8cm	40.8"W x 77.9"H x 38.9" 103.6 x 197.9 x 98.8 cm
Interior Dimensions	23.0"W x 51.5"H x 25.3" 58.4 x 130.8 x 64.3cm	23.0"W x 51.5"H x 25.3" 58.4 x 130.8 x 64.3cm	30.6"W x 51.5"H x 25.3" 77.7 x 130.8 x 64.3 cm
Capacity	17.3 cu. ft. (489.9 liters)	17.3 cu. ft. (489.9 liters)	23.0 cu. ft. (651.3 liters)
Refrigeration	One 1 HP (2545 BTUH each)		
Insulation	Non-CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 4.5" (11.4 cm) door		
Electrical - nominal voltage ±10%	230V, 50 Hz, 6.5 FLA Operating Range: 208-230VAC	208-230V, 60 Hz, 6.5 FLA Operating Range: 208-230VAC	120V, 60Hz, 10.0 FLA Operating Range: 108-130VAC
Breaker Requirements	15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker	15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker	20 Amp Dedicated Circuit, 20 Amp Time Delay Breaker
Shipping Weight: Motor	810 lbs. (367 kg)	810 lbs. (367 kg)	920 lbs. (417 kg)

Section 7
Specifications

Number	7400V	7400D
Temperature Range	-10°C (14°F) to -40°C (-40°F)	
Exterior Dimensions	40.8"W x 77.9"H x 38.9" 103.6 x 197.9 x 98.8 cm	40.8"W x 77.9"H x 38.9" 103.6 x 197.9 x 98.8 cm
Interior Dimensions	30.6"W x 51.5"H x 25.3" 77.7 x 130.8 x 64.3 cm	30.6"W x 51.5"H x 25.3" 77.7 x 130.8 x 64.3 cm
Capacity	23.0 cu. ft. (651.3 liters)	23.0 cu. ft. (651.3 liters)
Refrigeration	One 1 HP (2545 BTUH each)	
Insulation	Non-CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 4.5" (11.4 cm) door	
Electrical - nominal voltage \pm 10%	230V, 50Hz, 6.5 FLA Operating Range: 208-240VAC	208-230V, 60Hz, 6.5 FLA Operating Range: 208-240VAC
Breaker Requirements	15 amp Dedicated Circuit, 15 Amp Time Delay Breaker	15 amp Dedicated Circuit, 15 Amp Time Delay Breaker
Shipping Weight: Motor	920 lbs. (417 kg)	920 lbs. (417 kg)

Certifications

2004/108/EC Electromagnetic Compatibility Directive

2006/95/EC Low Voltage Directive

2011/65/EL RoHS

Declaration of Conformity and Directives available on request

Safety Specifications

Indoor Use Only

Altitude - Up to 2,000 meters

Temperature - 5°C to 43°C

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

Mains Supply Fluctuations - Mains supply voltage fluctuations not to exceed \pm 10% of the nominal voltage

Installation Category II ¹

Pollution Degree 2 ²

Class of Equipment I

Intended Use

This product is intended for use as a General Purpose Laboratory Freezer for storing samples or inventory between -10 and -40°C.

Unintended Use

This unit is not intended for use in an explosive environment, nor to be used for the storage of flammable inventory. This unit is not intended for use in a Class II medical application as defined by Title 21 of the Federal Code of Regulations.

Fluorinated Greenhouse Gases

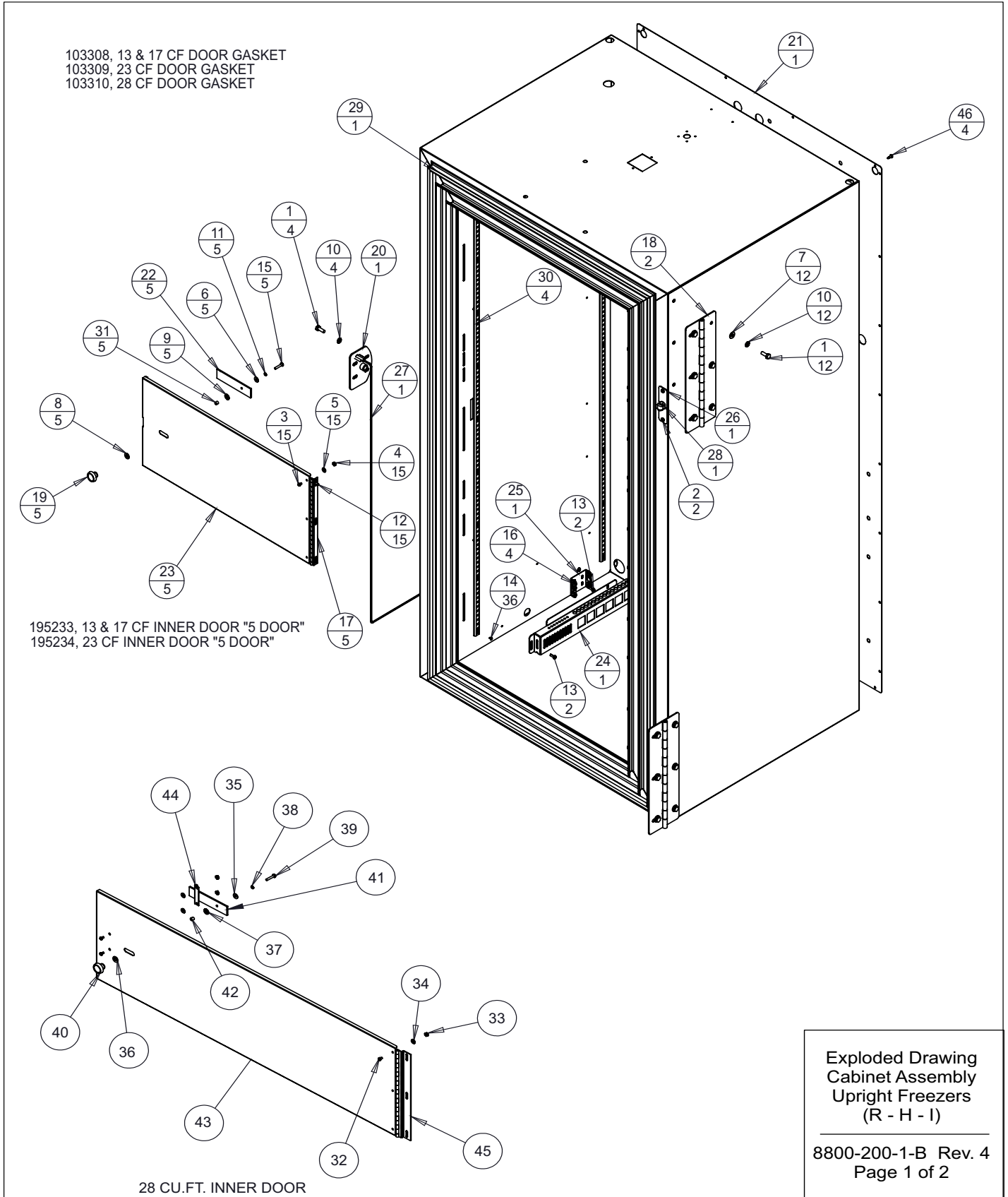
Compliant with REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on fluorinated greenhouse gases. This product contains fluorinated greenhouse gases in a hermetically sealed system. This product contains foam blown with fluorinated greenhouse gas, R-245fa. If a leak in the sealed system is detected, the operator shall repair without undue delay.

For ULT models rated 230V/50Hz, intended for import into the EU, the following sizes are designed for use with the following amounts of fluorinated greenhouse gases:

	1st Stage		
Size (ft ³)	Refrigerant	Amount (kg)	GWP
13	R-404a	0.595	3 922
17	R-404a	0.624	3 922
23	R-404a	0.624	3 922

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

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



Section 8
Parts List

REV	ECN NO.	DATE	BY	CAD	APPD	DESCRIPTION OF REVISION
0	FR-2202	06-16-11	KDG	KDG	DRP	RELEASED FOR PRODUCTION/LIB. CAP
1	FR-2409	10-11-12	AJC	KDG	DRP	RELEASE 8, CHANGE 121087 TO 121099
2	FR-2574	01-03-14	MAM	KDG	DRP	PILASTER MOUNTING, SCREWS TO POP RIVETS
3	FR-2833	05-01-17	KMB	KDG		420308 TO 103308, 420309 TO 103309 & 103104 TO 103310
4	FR-2941	05-01-17	KMB	KDG		195874 TO 195830 & 330010 TO 30033

BILL OF MATERIALS

ITEM NO.	PART NO.	PART DESCRIPTION
1	20003	1/4-20 X 3/4 SS HH CAP SCREW
2	22053	#8-32 X 1/2 SS PHP SCREW
3	22115	#6-32 X 1/4 SS PHP SCREW
4	23009	#6-32 SS HEX NUT
5	23020	#6 SS FLAT WASHER
6	23021	#8 SS FLAT WASHER
7	23023	1/4 SS FLAT WASHER
8	23043	NYLON FLAT WASHER
9	23044	1/4" NYLON SHOULDER WASHER
10	23062	1/4 SS EXT TOOTH LOCKWASHER
11	23080	#8 SS SPRING LOCKWASHER
12	24032	#8-32 X 3/8 SS PHP SCREW F POINT
13	24042	#8-32 X 1/2 SS PHP SCREW F POINT
14	25018	1/8 X 1/4 SS POP RIVET
15	59008	#8-32 X 7/8 SS PHP SCREW
16	114020	5/8" X 1/2" ID GROMMET
17	116069	FRONT PANEL HINGE
18	116092	EXTERIOR FREEZER DOOR HINGE
19	120400	BLACK PLASTIC KNOB
20	121099	FRZ CAM LATCH STRIKE
21	189921	EXTERIOR BACK 13 & 17
22	195169	LATCH TAB
23	195233	13/17 CU. FT. INNER DOOR
24	195866	PROBE GUARD
25	195867	PROBE MOUNT
26	195830	UR DOOR WIREWAY COVER PLATE
27	195900	MAGNETIC SWITCH
28	30033	RT. ANGLE STRAIN RELIEF
29	103308	13/17 CU.FT. SINGLE DOOR FRAME GASKET
30	500177	PILASTER STRIPS
31	515083	1/4 DIA. X 1/4L SS SPACER
32	22115	#6-32 X 1/4 SS PHP SCREW
33	23009	#6-32 SS HEX NUT

34	23020	#6 SS FLAT WASHER
35	23021	#8 SS FLAT WASHER
36	23043	NYLON FLAT WASHER
37	23044	1/4" NYLON SHOULDER WASHER
38	23080	#8 SS SPRING LOCKWASHER
39	59008	#8-32 X 7/8 SS PHP SCREW
40	120400	BLACK PLASTIC KNOB
41	195169	LATCH TAB
42	515083	1/4 DIA. X 1/4L SS SPACER
43	1950221	28 CU. FT. INNER DOOR
44	1950218	28 CU. FT. INNER DOOR LATCH GUIDE
45	116091	FRONT PANEL HINGE
46	24030	8 X 1/2 ZP PHP SCREW TEKS

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ThermoFisher
SCIENTIFIC

BOX 649, MARIETTA, OHIO 45750

MODEL/PART NAME: UP-RIGHT FREEZER

DWG TITLE: UP-RIGHT FREEZER ASSEMBLY (R-H-I)

DWN: KDG CAD: KDG APPD: MAH DATE: 06-15-11 SCALE: 0.094

MATERIAL: N/A

PAINT: N/A

TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX±
.xxx±

DRAWING NUMBER

8800-200-1

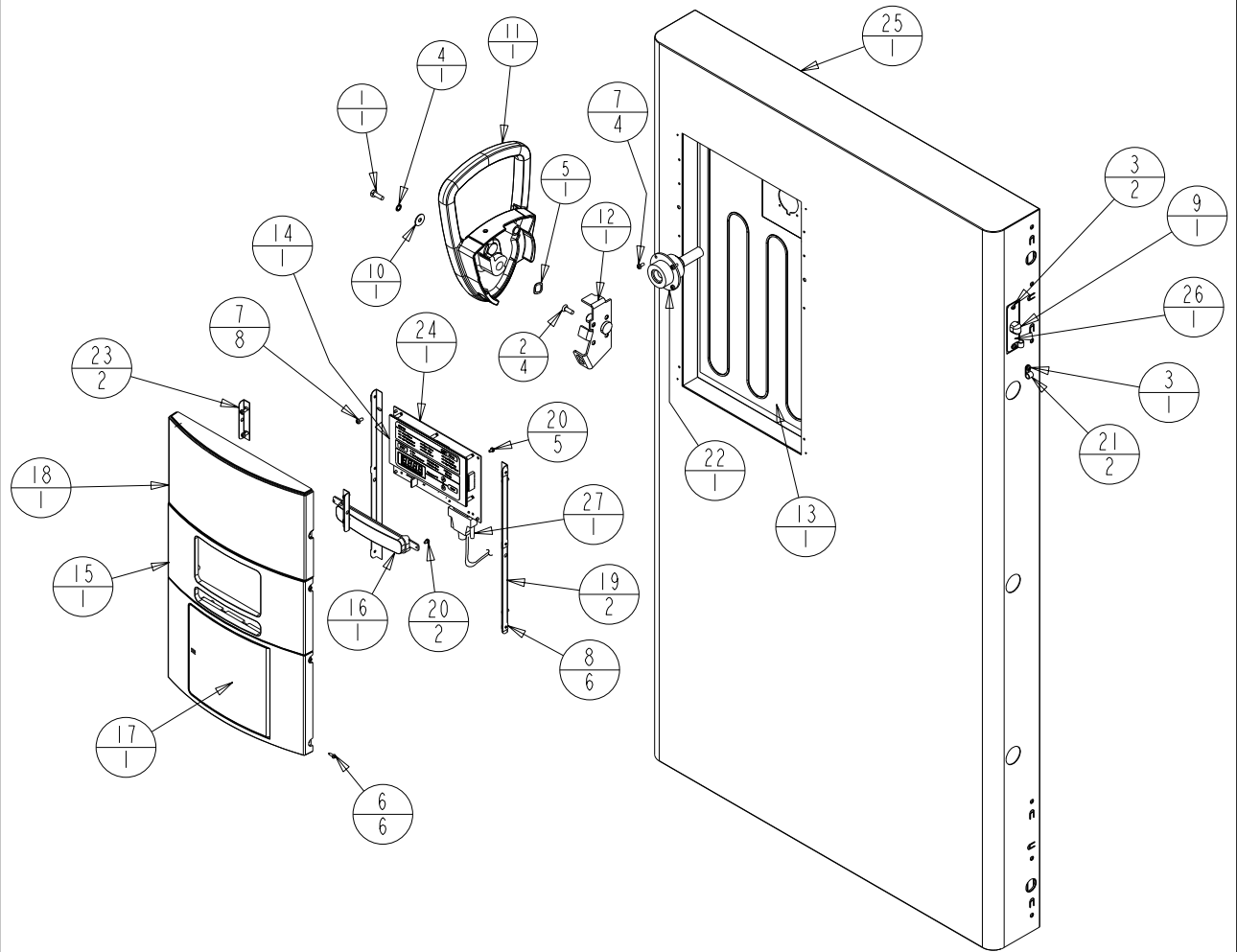
SIZE

B

Exploded Drawing
Cabinet Assembly
Upright Freezers
(R - H - I)

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195774, 23 CU. FT. UPRIGHT FREEZER DOOR
195775, 28 CU. FT. UPRIGHT FREEZER DOOR



900 Single Door BOM Assembly
(F - TS -86)

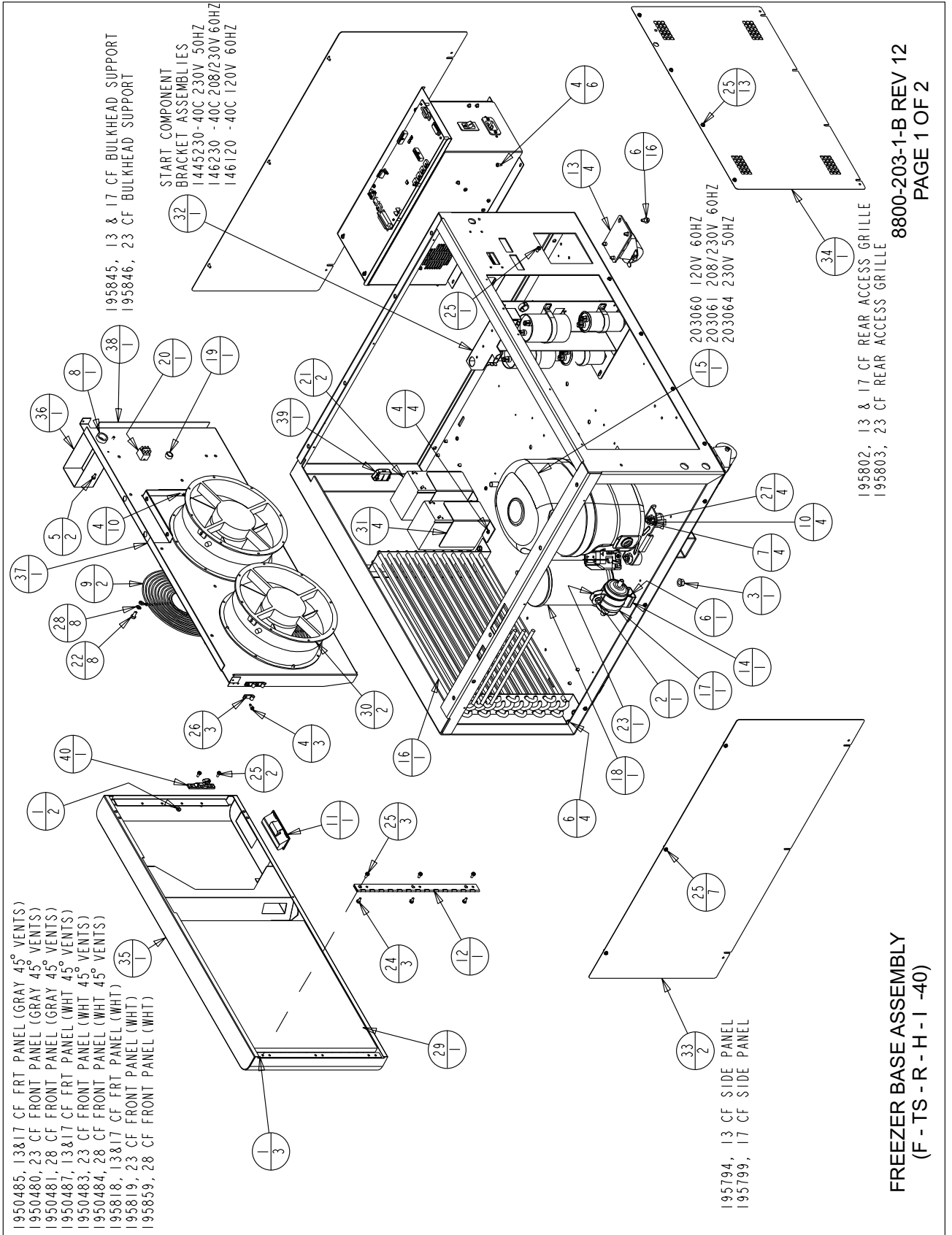
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Section 8
Parts List

BILL OF MATERIALS		
ITEM NO.	PART NO.	PART DESCRIPTION
1	20003	1/4-20 X 3/4 SS HH CAP SCREW
2	20058	#1/4-20 X 3/4 SS FHP UC SCREW
3	22053	#8-32 X 1/2 SS PHP SCREW
4	23033	1/4 SS INTERNAL TOOTH LOCK WASHER
5	23057	5/8 WAVE WASHER
6	24016	#6 X 1/2" SS PHP SCREW AB POINT
7	24032	#8-32 X 3/8 SS PHP SCREW F POINT
8	25040	#6 U SPEED NUT STL. STL.
9	30033	RIGHT ANGLE STRAIN RELIEF
10	121092	.856" OD FLAT WASHER
11	121098	FINISHED HANDLE/LATCH ASSEMBLY "WHT"
12	121102	CAM LATCH MOUNT
13	132114	HEATER, 3W, 14VDC
14	140444	CONTROL PANEL ASSEMBLY
15	180305	CONTROL CENTER DISPLAY BEZEL "SID BLU"
16	180306	THERMO BACK-UP SYSTEM BLANK PANEL "SID BLUE"
17	180308	CONTROL CENTER RECORDER BLANK "SID BLU"
18	180360	CONTROL BLANK PANEL "SID BLUE"
19	195837	MOUNTING ANGLE FOR 180305
20	590027	#6-32 X 1/4 SS PHP EXT SEMS SCREW
21	600085	5/16 NYLON CABLE CLAMP
22	1950069	HEATED VACUUM RELIEF PORT
23	1950492	MOUNTING ANGLE
24	191956_	FREEZER DISPLAY BOARD
25	195773	13 & 17 CU. FT. UPRIGHT FREEZER DOOR
26	195830	UPRIGHT DOOR WIREWAY COVER PLATE
27	430336	15 FT, RS-232 CABLE 25 POS.

900 Single Door BOM Assembly
(F - TS -86)

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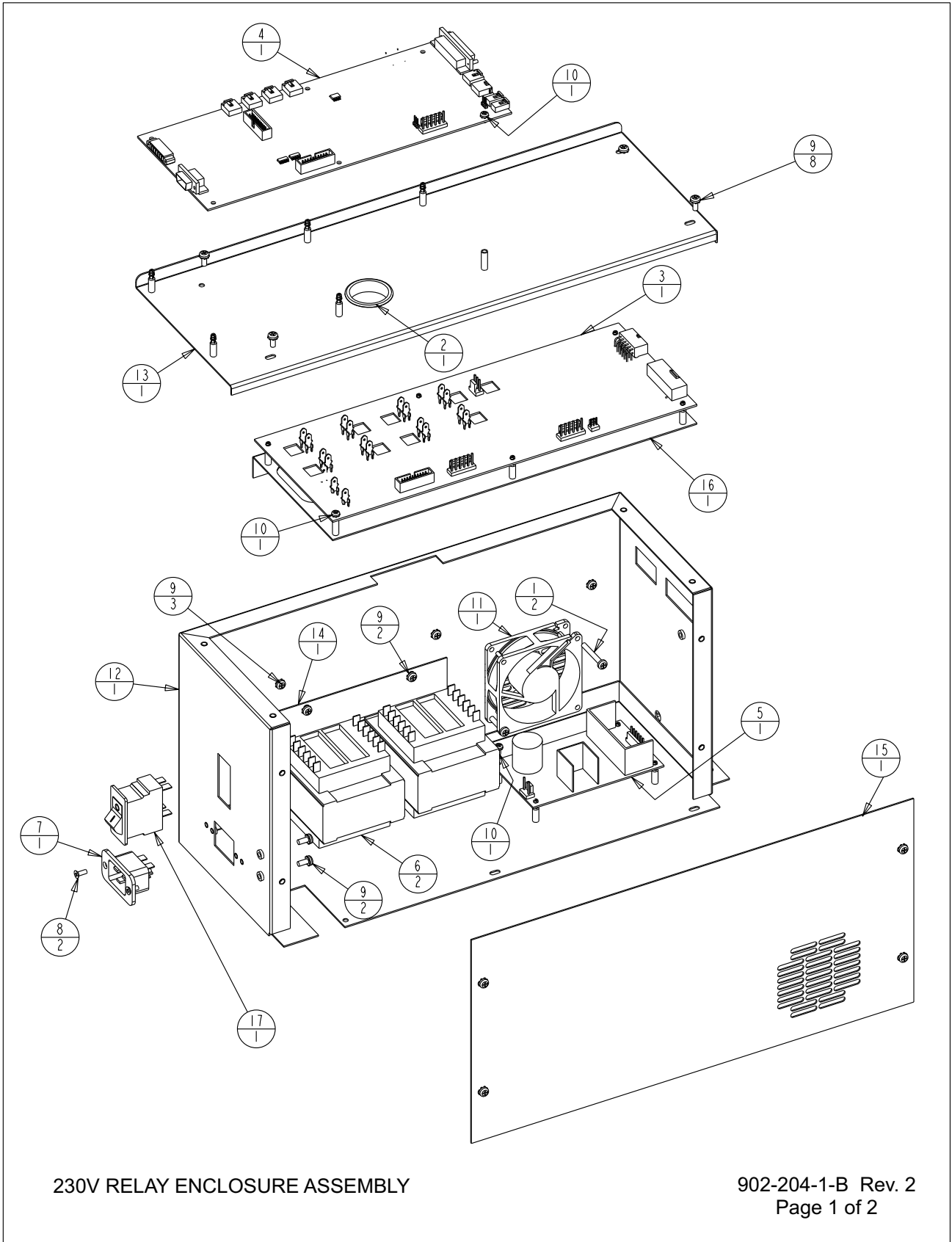


BILL OF MATERIALS		
ITEM NO.	PART NO.	PART DESCRIPTION
1	23002	#8-32 ZP LKWASH HEX NUT
2	23011	1/4-20 ZP LKWASH HEX NUT
3	23013	3/8-16 ZP LKWASH HEX NUT
4	24030	#8 X 1/2" TEKS SCREW
5	24032	#8-32 X 3/8 SS PHP SCREW F POINT
6	24038	1/4-20 X 1/2 SELF TAPPING SCREW
7	24049	1/4 ZP FLAT WASHER
8	30016	1" SNAP BUSHING
9	108020	10" WIRE FAN GUARD
10	114034	COMPRESSOR MOUNTING SLEEVE
11	115032	BLACK ABS PLASTIC PULL
12	116115	FRONT PANEL HINGE
13	120011	DUAL WHEEL CASTER
14	200126	2" RIGID HANGER
15	203060	BRISTOL HIGH/LOW STAGE COMPRESSOR
16	204009	REFRIGERATION CONDENSER
17	209020	LIQUID LINE FILTER DRYER WITH ACCESS PORT
18	214023	OIL SEPARATOR
19	330002	5/8" SNAP BUSHING
20	360248	MINI SNAP-IN POWER SWITCH

BILL OF MATERIALS (CONTINUED)		
ITEM NO.	PART NO.	PART DESCRIPTION
21	400159	SEALED LEAD ACID BATTERY - 12 VOLT - 7.2 Ah
22	510035	#12-24 X 1/2 SS HH CAP SCREW
23	550043	1/4-20 X 1" ZP CARRIAGE BOLT
24	590020	#8-32 X 3/8 SS PHP EXT SEMS SCREW
25	590029	#8-32 X 3/8 SS PHP EXT SEMS SCREW W/PATCH
26	600080	1/4 ALUM CLAMP W/LINER
27	680008	1/4-20 X 1-3/4 SELF TAPPING SCREW
28	730087	#12 SS EXT TOOTH LOCKWASHER
29	760203	AIR FILTER
30	900113	10" TUBEAXIAL FAN, 115V
31	1950074	BATTERY MOUNTING BRACKET
32	120230-01-2	UPLIGHT FREEZER START COMPONENT BRACKET ASSY.
33	195799	SIDE PANEL 17, 23 AND 28 CU. FT. UPRIGHT
34	195802	13/17 REAR ACCESS GRILLE
35	195818-16-1	13&17 CU. FT. UR FRZ BASE FRONT PNL
36	195829	MULLION/DOOR SWITCH WIRE COVER
37	195844	UR FRZ FAN BULKHEAD
38	195845	13&17 CU. FT. FAN BULKHEAD SUPPORT
39	319388	LATCH CATCH, PART OF 319388 ASSEMBLY
40	319388	LATCH KEEPER, PART OF 319388 ASSEMBLY

FREEZER BASE ASSEMBLY
(F-TS-R-H-I-40)

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230V RELAY ENCLOSURE ASSEMBLY

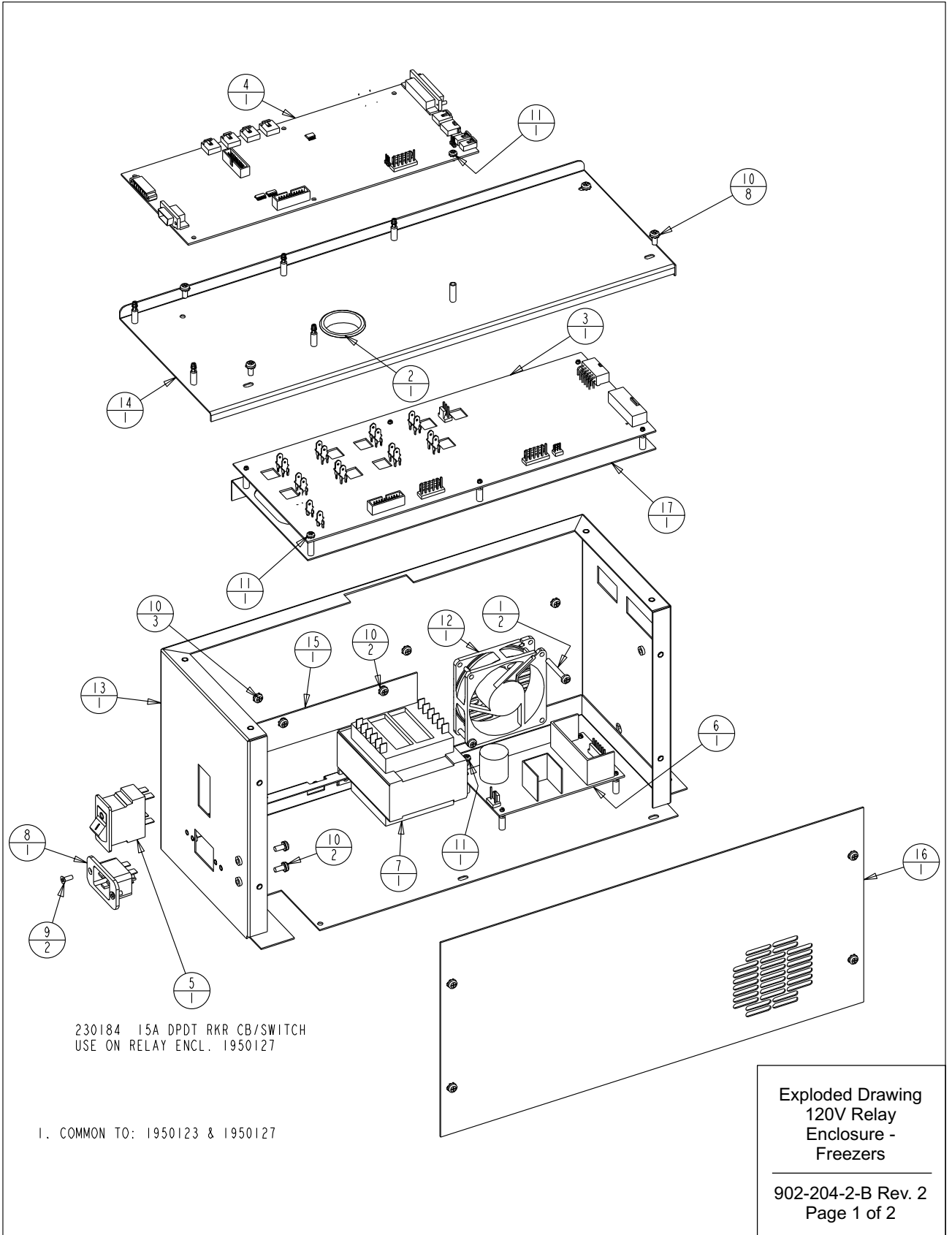
Section 8
Parts List

BILL OF MATERIALS		
ITEM NO.	PART NO.	PART DESCRIPTION
1	22143	#8-32 x 1-1/4 SS PHP SCREW
2	30077	1-1/2" SNAP BUSHING
3	191923	HIGH VOLTAGE BOARD 230V
4	191989	MICRO BOARD (HIGH END)
5	400165	SWITCHER BOARD
6	420090	175V TRANSFORMER
7	460169	POWER INLET, 16/20A
8	490009	#6-32 X 3/8 SS FHP UC SCREW
9	590020	#8-32 X 3/8 SS PHP EXT SEMS SCREW
10	590027	#6-32 X 1/4 SS PHP EXT SEMS SCREW
11	900134	TUBEAXIAL FAN, 30 CFM, 12V
12	195631-16-1	RELAY ENCLOSURE SPOTWELD SUB-ASSEMBLY
13	195631-16-4	RELAY ENCLOSURE COVER/191656 SUPPORT
14	195631-31-3	TRANSFORMER HOLD DOWN
15	195631-31-5	RELAY ENCLOSURE COVER (MAIN)
16	195730-16-1	191658 SUPPORT BRACKET SUB-ASSEMBLY
17	230184	15A DPDT SWITCH/CIRCUIT BKR

1. COMMON TO: 1950124 & 1950128

230V RELAY ENCLOSURE ASSEMBLY

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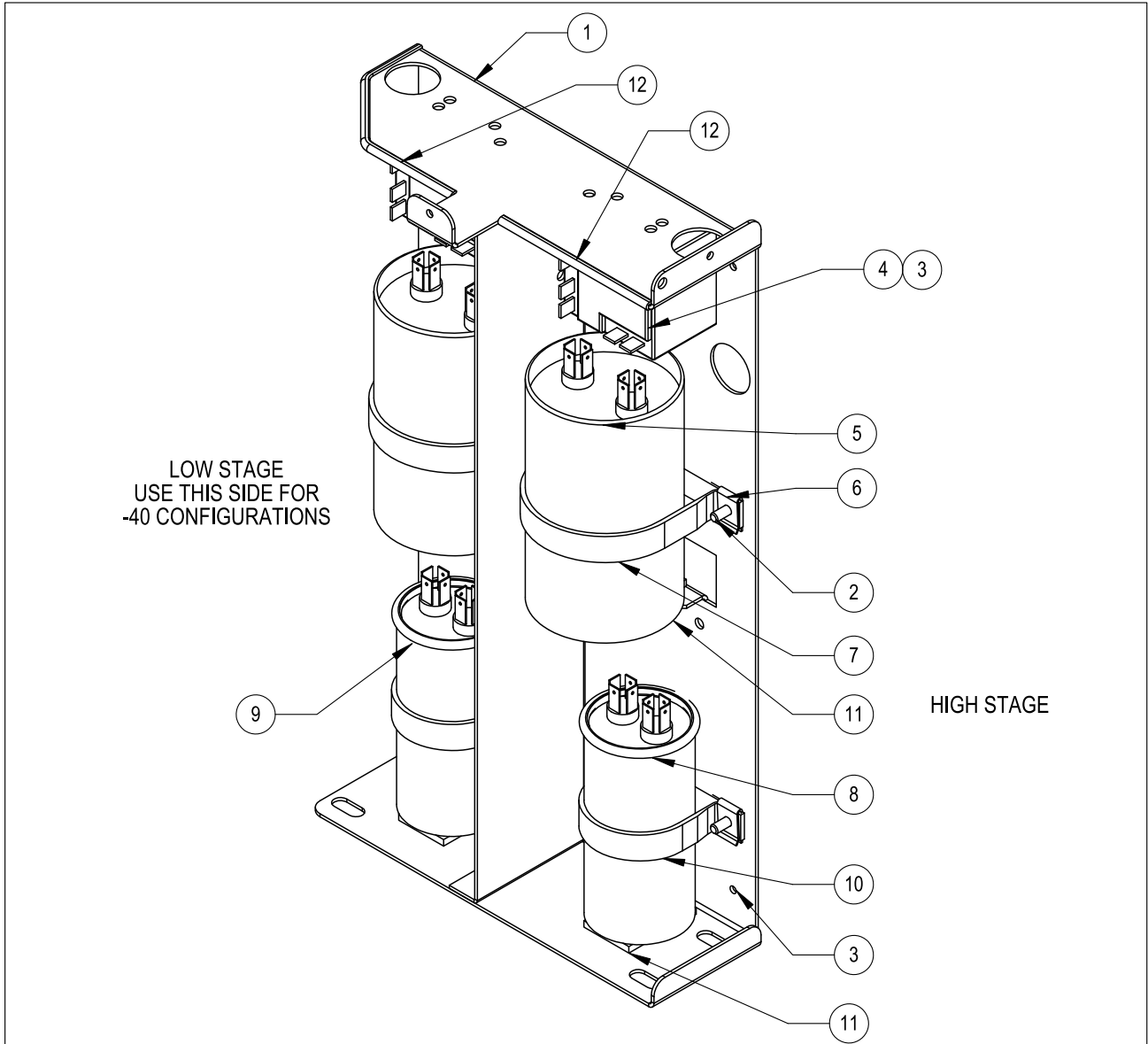


Section 8
Parts List

BILL OF MATERIALS		
ITEM NO.	PART NO.	PART DESCRIPTION
1	22143	#8-32 x 1-1/4 SS PHP SCREW
2	30077	1-1/2" SNAP BUSHING
3	191932	HIGH VOLTAGE BOARD 120V
4	191989	MICRO BOARD (HIGH END)
5	230184	15A DPDT SWITCH/CIRCUIT BKR
6	400165	SWITCHER BOARD
7	420065	175V TRANSFORMER
8	460169	POWER INLET, 16/20A
9	490009	#6-32 X 3/8 SS FHP UC SCREW
10	590020	#8-32 X 3/8 SS PHP EXT SEMS SCREW
11	590027	#6-32 X 1/4 SS PHP EXT SEMS SCREW
12	900134	TUBEAXIAL FAN, 30 CFM, 12V
13	195631-16-1	RELAY ENCLOSURE SPOTWELD SUB-ASSEMBLY
14	195631-16-4	RELAY ENCLOSURE COVER/191656 SUPPORT
15	195631-31-3	TRANSFORMER HOLD DOWN
16	195631-31-5	RELAY ENCLOSURE COVER (MAIN)
17	195730-16-1	191658 SUPPORT BRACKET SUB-ASSEMBLY

Exploded Drawing
120V Relay
Enclosure -
Freezers

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NOTES:

1. SEE PSS 8602-724-012 FOR ASSEMBLY WIRING AND OTHER DETAILS.
2. AFTER ATTACHING NOMEMX COVER (250138) WITH SCREWS (590029), STICK ESD LABEL (220555) TO OUTSIDE OF COVER.
3. IDENTIFY EACH ASSEMBLY WITH LABELS ON THE BOTTOM AND BACK THAT INCLUDE THE FOLLOWING:
 FIRST LINE - ASSEMBLY NUMBER AND REVISION
 SECOND LINE - BAR CODE OF ASSEMBLY AND REVISION
 THIRD LINE - UNIQUE SERIAL NUMBER INCLUDING DATE OF MANUFACTURE IN THE FOLLOWING FORMAT AND ORDER:
 THREE LETTER MANUFACTURING SITE, TWO DIGIT YEAR MANUFACTURED, TWO DIGIT WEEK MANUFACTURED FOLLOWED
 BY A UNIQUE FOUR DIGIT NUMBER.
 FOURTH LINE - BAR CODE OF UNIQUE SERIAL NUMBER.
 FIFTH LINE - ASSEMBLY DESCRIPTION IN THE FOLLOWING FORMAT: UPRIGHT, TEMPERATURE, VOLTAGE AND FREQUENCY.

Upright Freezer Start Component
Enclosure Assembly

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Section 8
Parts List

UPRIGHT FREEZER START COMPONENT BRACKET ASSEMBLIES							
ITEM NO.	DESCRIPTION	1823050 -86C 230V 50 Hz	1823060 -86C 208/230V 60Hz	1812060 -86C 120V 60 Hz	1445230 -40C 230V 50 Hz	146230 -40C 208/230V 60Hz	146120 -40C 120V 60 Hz
1	COMPONENT BRACKET	120230	120230	120230	120230	120230	120230
2	#8 X 1/2 PHP TYPE AB	24021 (4)	24021 (4)	24021 (4)	24021 (2)	24021(2)	24021 (2)
3	8-32 X 3/8 SCREW	590020 (4)	590020 (4)	590020 (4)	590020 (2)	590020 (2)	590020 (2)
4	START RELAY	312286 (2)	312186 (2)	312086 (2)	312287 (1)	312187 (1)	312087 (1)
5	START CAPACITOR	623050 (2)	623060 (2)	612060 (2)	170236 (1)	170154 (1)	170154 (1)
6	#8 SPEED NUT, S.S.	327675 (4)	327675 (4)	327675 (4)	327675 (2)	327675 (2)	327675 (2)
7A	2.5" VINYL COATED STRAP	N/A	N/A	600106 (4)	N/A	N/A	600106 (2)
7B	2" VINYL COATED STRAP	600108 (2)	600108 (2)	N/A	600108 (1)	600108 (1)	N/A
8	RUN CAPACITOR	223050	223060	212060	N/A	N/A	N/A
9	RUN CAPACITOR	223050	223050	212060	170097 (1)	170226 (1)	170224 (1)
10	1.75" VINYL COATED STRAP	600107 (2)	600107 (2)	SEE 7A	600107 (1)	600107 (1)	SEE 7A
11	NEOPRENE TAPE 1/8" X 1" X 2"	28003 (4)	28003 (4)	28003 (4)	28003 (2)	28003 (2)	28003 (2)
12	EDGE GUARD (CUT TO LENGTH)	114012	114012	114012	114012	114012	114012
NOT SHOWN *	ULT MAIN HARNESS (REFERENCE ONLY)	350092	350092	350092	350093	350093	350093
NOT SHOWN	ENCLOSURE LOW STAGE HARNESS	350108	350108	350108	350108	350108	350108
NOT SHOWN	ENCLOSURE HIGH STAGE HARNESS	350107	350107	350107	N/A	N/A	N/A
NOT SHOWN	NOMEX COVER	250138	250138	250138	250138	250138	250138
NOT SHOWN	ESD WARNING LABEL	220555 (2)	220555 (2)	220555 (2)	220555 (2)	220555 (2)	220555 (2)
NOT SHOWN, SEE NOTE 3	IDENTIFICATION LABEL	823050 (2)	823060 (2)	812060 (2)	423050 (2)	423060 (2)	412060 (2)

* THE ULT MAIN HARNESS IS LISTED FOR INFORMATION ONLY. IT IS NOT PART OF THIS ASSEMBLY.

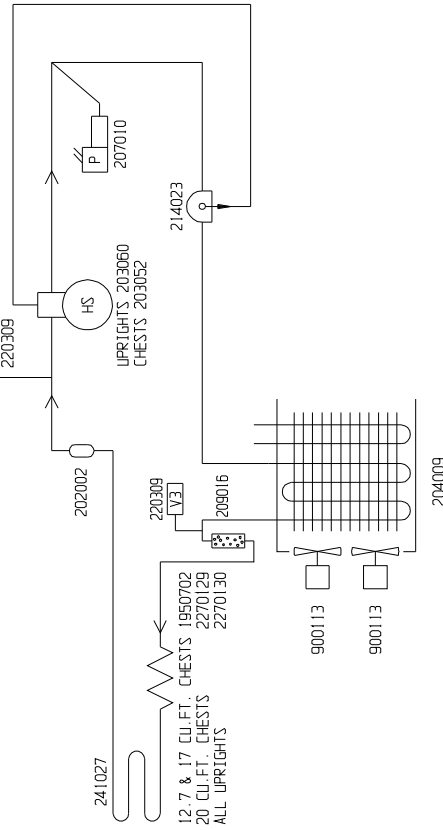
Upright Freezer Start Component
Enclosure Assembly

120230-01-2-D Rev 10
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HIGH TEMP STAGE

REFRIGERATION

HIGH TEMPERATURE STAGE REFRIGERANT:
 UPRIGHTS
 13.0 CU.FT. UNITS: R-404A 18.5 OZ. (525gr) ±1/2 OZ (14gr)
 17.0 CU.FT. UNITS: R-404A 22 OZ. (624gr) ±1/2 OZ (14gr)
 23.0 CU.FT. UNITS: R-404A 22 OZ. (624gr) ±1/2 OZ (14gr)
 HIGH TEMPERATURE STAGE OIL: MOBILE EAL ARCTIC 22CC POLYOL ESTER OIL
 COMPRESSOR, 40 OZ (11183ml)
 CHESTS
 12.7 CU.FT. UNITS: R-404A 19 OZ. (538gr) ±1/2 OZ (14gr)
 17.0 CU.FT. UNITS: R-404A 21 OZ. (595gr) ±1/2 OZ (14gr)
 20.0 CU.FT. UNITS: R-404A 23 OZ. (652gr) ±1/2 OZ (14gr)
 HIGH TEMPERATURE STAGE OIL: MOBILE EAL ARCTIC 22CC POLYOL ESTER OIL
 COMPRESSOR: 40 OZ (11183ml)
 OIL SEPARATOR: 15 OZ (444ml)



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- COMMON TO: 5728, 8800, 8813, 8824, 8838, 13.0 CU.FT. UPRIGHT FREEZERS (120 V)
 5728, 8804, 8817, 8828, 8842, 17.0 CU.FT. UPRIGHT FREEZERS (120 V)
 8809, 8821, 8832, 8848, 23 CU.FT. UPRIGHT FREEZERS (120 V)
 5315, 8728, 8756, 8779, 12.7 CU.FT. CHEST FREEZER (120V)
 5318, 8730, 8757, 8780, 17.0 CU.FT. CHEST FREEZER (120V)
 5321, 8737, 8762, 8785, 20.0 CU.FT. CHEST FREEZER (120V)

10	FR-2761	01-14-15	AJC	SAG	CCS	CHG. 13 UPRIGHT 21 TO 18.5 CHARGE
9	FR-2761	01-07-15	AJC	SAG	DRP	CHANGED UPRIGHT CHARGES
8	FR-2694	07-10-14	AJC	KDG	DRP	SPECIFIED OIL SEP. 15 OZ. OF OIL
7	FR-2673	06-04-14	MAM	KDG	DRP	CHG'D. 214006 OIL SEP. TO 214023
6	FR-2499	07-30-13	AJC	SAG	DRP	U.R. COMP. FROM 203056 TO 203060
5	FR-2400	08-20-12	AJC	KDG	DRP	U.R. COMP. 203053 TO 203056-REL. 8
4	FR-2267	2/03/12	JME	KDG	DRP	UPRIGHT OIL FROM 24 OZ. TO 22 OZ.
3	FR-2267	01/16/12	JME	SAG	DRP	CHEST OIL FROM 24 OZ. TO 40 OZ.
2	FR-2267	11/07/11	JME	SAG	DRP	COMPRESSOR CHANGE/RELEASE 7
1	FR-2202	08/02/11	AJC	SAG	DRP	ADDED CAP TUBE 2270120
0	FR-2202	05/09/11	SFS	SAG	DRP	RELEASED FOR PRODUCTION/RELEASE 6
REV/ECR NO./DATE BY CAD/APPO/DESCRIPTION OF REVISION						
DATE: 05/09/11 DOWN SAG CAD SAG APPD DRP SCALE: NONE						
CUSTOMER						
JOB TITLE -40°C ULTRA-LOW TEMPERATURE FREEZERS, 120V						
DWG TITLE REFRIGERATION SCHEMATIC						
LOCATION JOB NUMBER DRAWING NUMBER						
FREEZERS 8800-90-0-B						

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SCIENTIFIC
 BOX 649, MARIETTA, OHIO 45750
 9999183

HIGH TEMP STAGE

REFRIGERATION

HIGH TEMPERATURE STAGE REFRIGERANT:

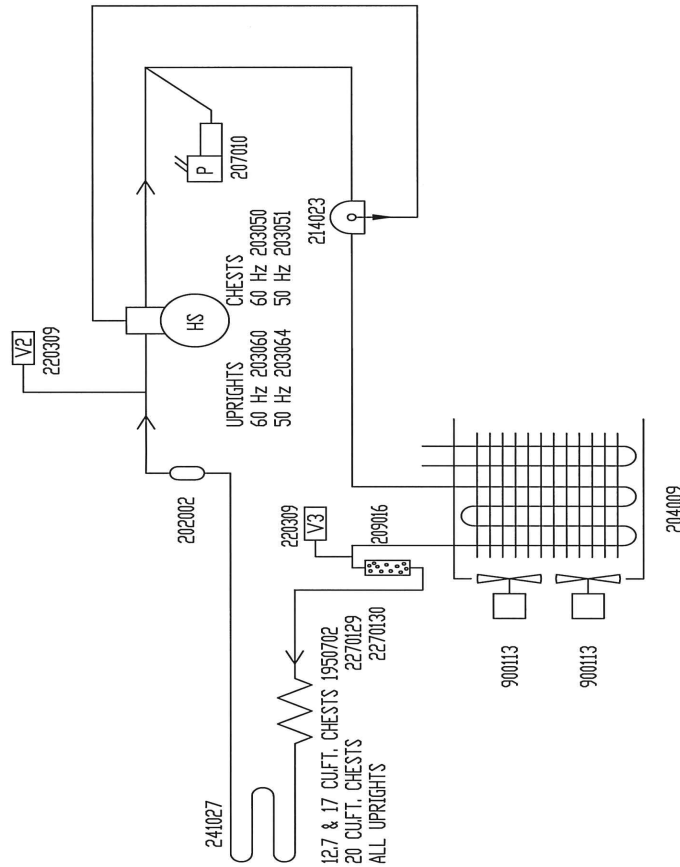
50 AND 60 Hz UPRIGHTS
13.0 CUFT. UNITS: R-404A 21 OZ. (595gr) ±1/2 OZ (14gr)
17.0 CUFT. UNITS: R-404A 22 OZ. (624gr) ±1/2 OZ (14gr)
23.0 CUFT. UNITS: R-404A 22 OZ. (624gr) ±1/2 OZ (14gr)

HIGH TEMPERATURE STAGE OIL/MOBILE EAL ARCTIC 22CC POLYOL ESTER OIL
COMPRESSOR, 40 OZ.(1183ml)
OIL SEPARATOR, 15 OZ.(444 ml)

CHESTS

12.7 CUFT. UNITS: R-404A 19 OZ. (538gr) ±1/2 OZ (14gr)
17.0 CUFT. UNITS: R-404A 21 OZ. (595gr) ±1/2 OZ (14gr)
20.0 CUFT. UNITS: R-404A 23 OZ. (652gr) ±1/2 OZ (14gr)

HIGH TEMPERATURE STAGE OIL/MOBILE EAL ARCTIC 22CC POLYOL ESTER OIL
COMPRESSOR, 40 OZ.(1183ml)
OIL SEPARATOR, 15 OZ.(444ml)



1. COMMON TO:

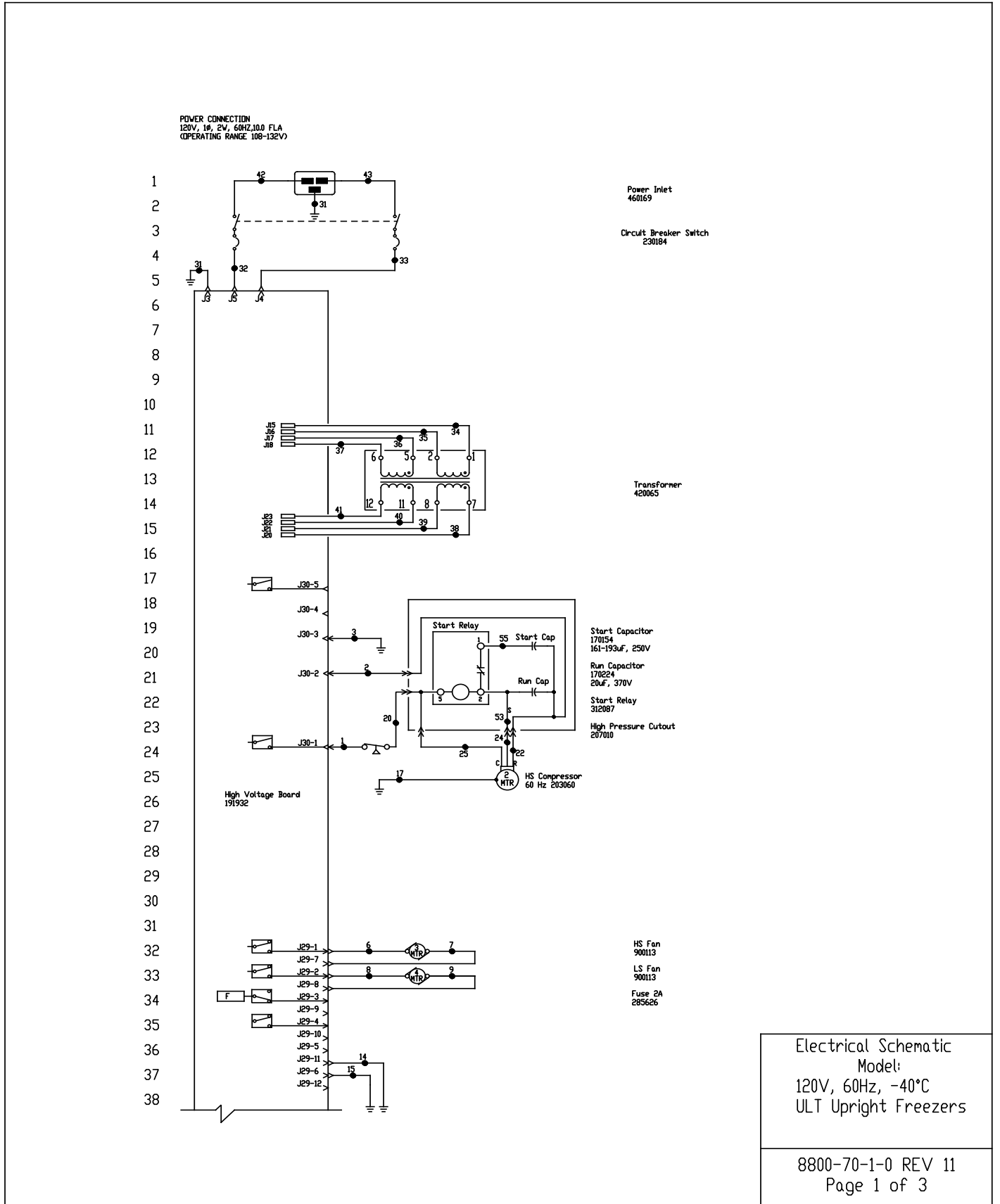
- 7240, DIF24040, TS340240, VWR24040, 7240EP, DIF24040EP, TS340240EP, 13.0 CUFT. UPRIGHT FREEZERS (230 V)
- 7260, DIF26040, TS340260, VWR26040, 7260EP, DIF26040EP, TS340260EP, 17.0 CUFT. UPRIGHT FREEZERS (230 V)
- 7400, DIF24040, TS340400, VWR24040, 7400EP, DIF24040EP, TS340400EP, 23.0 CUFT. UPRIGHT FREEZERS (230 V)
- 7330, HFC1350, TS3330, UL1750-0-V, 7330EP, TS3330EP, UL1750-0-EP, 12.7 CUFT CHEST FREEZER (230V)
- 7700, HFC1750, TS3750, UL1750-0-V, 7700EP, TS3750EP, UL1750-0-EP, 17.0 CUFT CHEST FREEZER (230V)
- 7800, HFC1800, TS3800, UL1800-0-V, 7800EP, TS3800EP, UL1800-0-EP, 20.0 CUFT CHEST FREEZER (230V)

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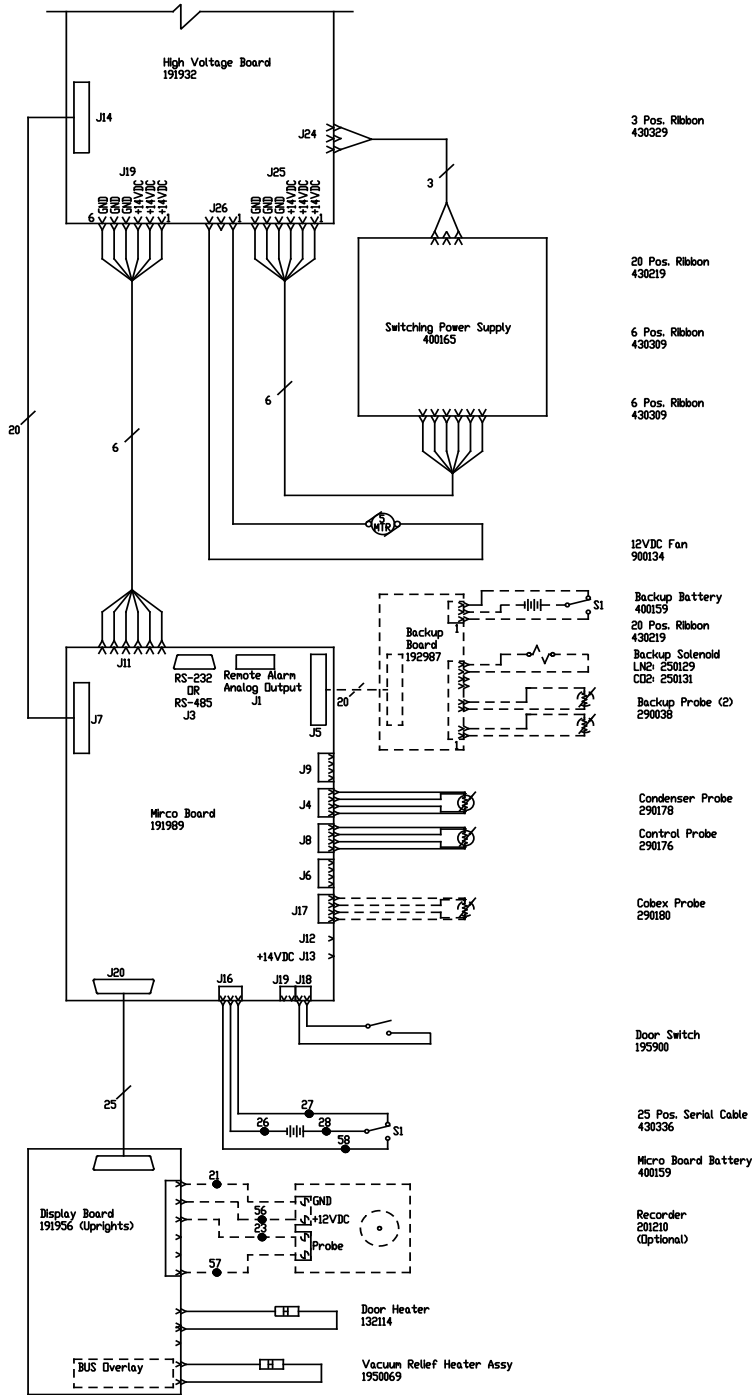
BOX 649, MARIETTA, OHIO 45750

11	41795	12-13-17	KWB TFI	Y-m-b	ADDED QPD MODELS IN 'COMMON TOP DETAILS
10	40483	10-27-17	KWB TFI	Y-m-b	ADDED OIL SEPARATOR NOTE AND UPDATED 'COMMON TOP DETAILS
9	FR-2761	01-07-15	AJC SAG	DRP	CHANGED CHARGE, ADDED 5713 & 5726
8	FR-2694	07-10-14	AJC KDG	DRP	SPECIFIED OIL SEP. IS OZ. OF OIL
7	FR-2673	06-04-14	MAMI KDG	DRP	CHG'D. 21406 OIL SEP. TO 214023
6	FR-2499	07-30-13	AJC SAG	DRP	CHANGED UR. COMPRESSORS & CHARGE
5	FR-2400	08-20-12	AJC KDG	DRP	UR COMP 203054, 55 TO 20307, 58-REL.8
4	FR-2267	2/02/12	JWE KDG	DRP	UPRIGHT OIL FROM 24 OZ. TO 22 OZ.
3	FR-2267	01/16/12	JWE SAG	DRP	CHEST OIL FROM 24 OZ. TO 40 OZ.
2	FR-2267	11/07/11	JWE SAG	DRP	COMPRESSOR CHANGE/RELEASE 7
1	FR-2202	08/02/11	AJC SAG	DRP	ADDED CAP TUBE 227020
0	FR-2202	05/09/11	SRS SAG	LDN	RELEASED FOR PRODUCTION/RELEASE 6
REV	ECR NO.	DATE	BY	PAD/APPD	DESCRIPTION OF REVISION
	DATE	05/09/11	DWN SAG	CAD SAG	APPD LDN SCALE NONE
CUSTOMER					
JOB TITLE -40°C ULTRA-LOW TEMPERATURE FREEZERS, 230V					
DWG TITLE REFRIGERATION SCHEMATIC					
LOCATION					
FREEZERS			JOB NUMBER		DRAWING NUMBER
					8801-90-0-B



Section 10
Electrical Schematics

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- 3 Pos. Ribbon
430329
- 20 Pos. Ribbon
430219
- 6 Pos. Ribbon
430309
- 6 Pos. Ribbon
430309
- 12VDC Fan
900134
- Backup Battery
400159
- 20 Pos. Ribbon
430219
- Backup Solenoid
LN2: 250129
CID: 250131
- Backup Probe (2)
290038
- Condenser Probe
290178
- Control Probe
290176
- Cobex Probe
290180
- Door Switch
195900
- 25 Pos. Serial Cable
430336
- Micro Board Battery
400159
- Recorder
201210
(Optional)

Electrical Schematic
Model:
120V, 60Hz, -40°C
ULT Upright Freezers

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WIRE #	COLOR	GAUGE	WIRE #	COLOR	GAUGE
1	BLK	14	29	-	-
2	RED	14	30	-	-
3	GRN/YEL	14	31	GRN/YEL	14
4			32	BLK	14
5			33	BLU	14
6	BLK	18	34	BLK	14
7	BLK	18	35	BLU	14
8	BLK	18	36	BLK	14
9	BLK	18	37	BLU	14
10			38	BLK	14
11			39	BLU	14
12			40	BLK	14
13			41	BLU	14
14	GRN/YEL	18	42	BLK	14
15	GRN/YEL	18	43	BLU	14
16			44	-	-
17	GRN/YEL	14	45	-	-
18			46	-	-
19			47	-	-
20	BLK	14	48	-	-
21	BLK	18	49	-	-
22	RED	18	50	-	-
23	BLK	18	51	-	-
24	YEL	14	52	-	-
25	BLK	14	53	YEL	14
26	BLK	18	54	-	-
27	BLK	18	55	BLU	14
28	RED	18	56	RED	18
			57	RED	18
			58	WHT	18

MODELS:

13 CUFT.(120V) - 7240A, DXF24040A, HFU40240BA, TSD40240A
 17 CUFT.(120V) - 7320A, DXF32040A, HFU40320BA, TSD40320A
 23 CUFT.(120V) - 7400A, DXF40040A, HFU40400BA, TSD40400A

RS-232 SPECIFICATION

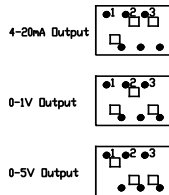
BAUD = 1200
 PARITY = N
 BITS = 8
 STOP BITS = 2

REMOTE CONTACTS/ANALOG OUTPUT	
PIN# 1	Analog Output +
PIN# 2	Analog Output -
PIN# 3	Not Connected
PIN# 4	Not Connected
PIN# 5	Normally Closed
PIN# 6	Common
PIN# 7	Normally Open

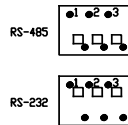
RS-232 PORT	
PIN# 2	TXD
PIN# 3	RXD
PIN# 5	GND

CONTACT RATING 1A @ 30V
 CONTACTS IN ALARM STATE

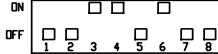
SV1 Settings for Analog Output



SV2 Settings for Communication Output



SW3 SETTINGS



1. Schematic represents single models.
2. Door switches shown in open position.
3. Battery switch shown in the OFF position.
4. Circuit breaker switch shown in OFF position.
5. Options and accessories shown in dashed lines.

REV	NO.	DATE	BY	APP'D	DESCRIPTION OF REVISION	
11	41795	12-14-17	KHB	TFI	UPDATED "MODELS" DETAILS	
10	FR-3006	08-14-17	KCB	KDG	KHB	191987 BACKUP BOARD TO 192987
9	FR-2881	06-15-16	KHB	SAG	DRP	32887 WAS 30642
8	FR-2781	04-02-15	KCB	KDG	DRP	NBD 13214 & 192869 HTR 700 STYLE DOOR TO 900
7	31856	01-27-15	GLS	SAG	DRP	WIRE #2 FROM BLU TO RELJAS BUILT CHANGES
6	FR-2499	07-30-13	AJC	SAG	DRP	CHANGED COMPRESSOR & START COMPONENTS
5	FR-2489	09-24-12	AJC	KDG	DRP	RELA, LOW 19288 MICRO BUILT TO HIGH END 19289
4	FR-2386	08-29-12	AJC	KDG	DRP	REVISED OPERATING RANGE FROM 100-120V
3	FR-2329	03/05/12	AJC	SAG	DRP	ADDED HIGH PRESSURE CUTOFF
2	FR-2267	02/23/12	JWE	SAG	DRP	REPLACED PTCR WITH HARD START COMP
1	FR-2267	11/28/11	JWE	SAG	DRP	COMPRESSOR CHANGE / RELEASE 7
0	FR-2282	04/29/11	SRS	SAG	DRP	RELEASED FOR PRODUCTION / RELEASE 6

Electrical Schematic
 Model:
 120V, 60Hz, -40°C
 ULT Upright Freezers



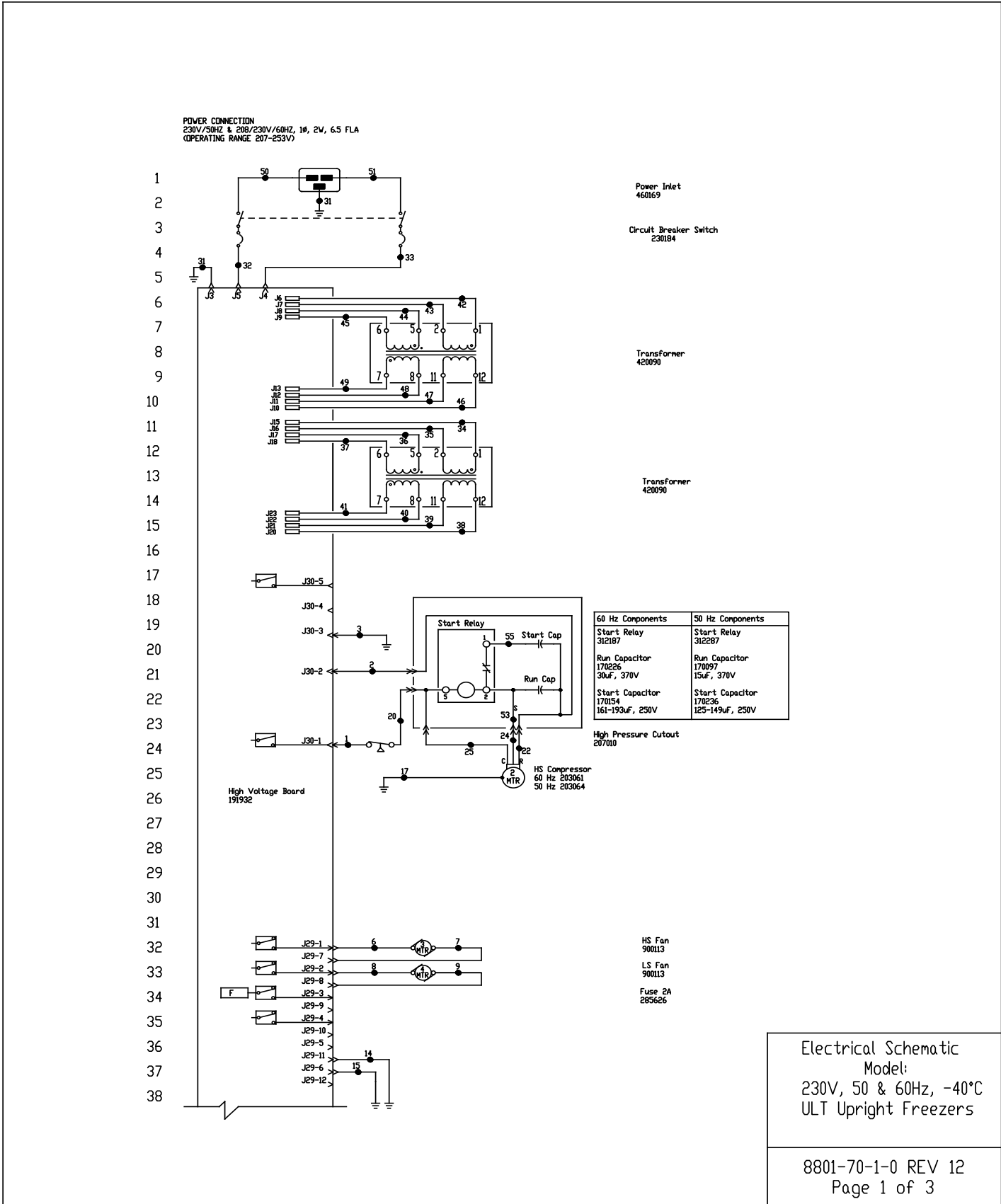
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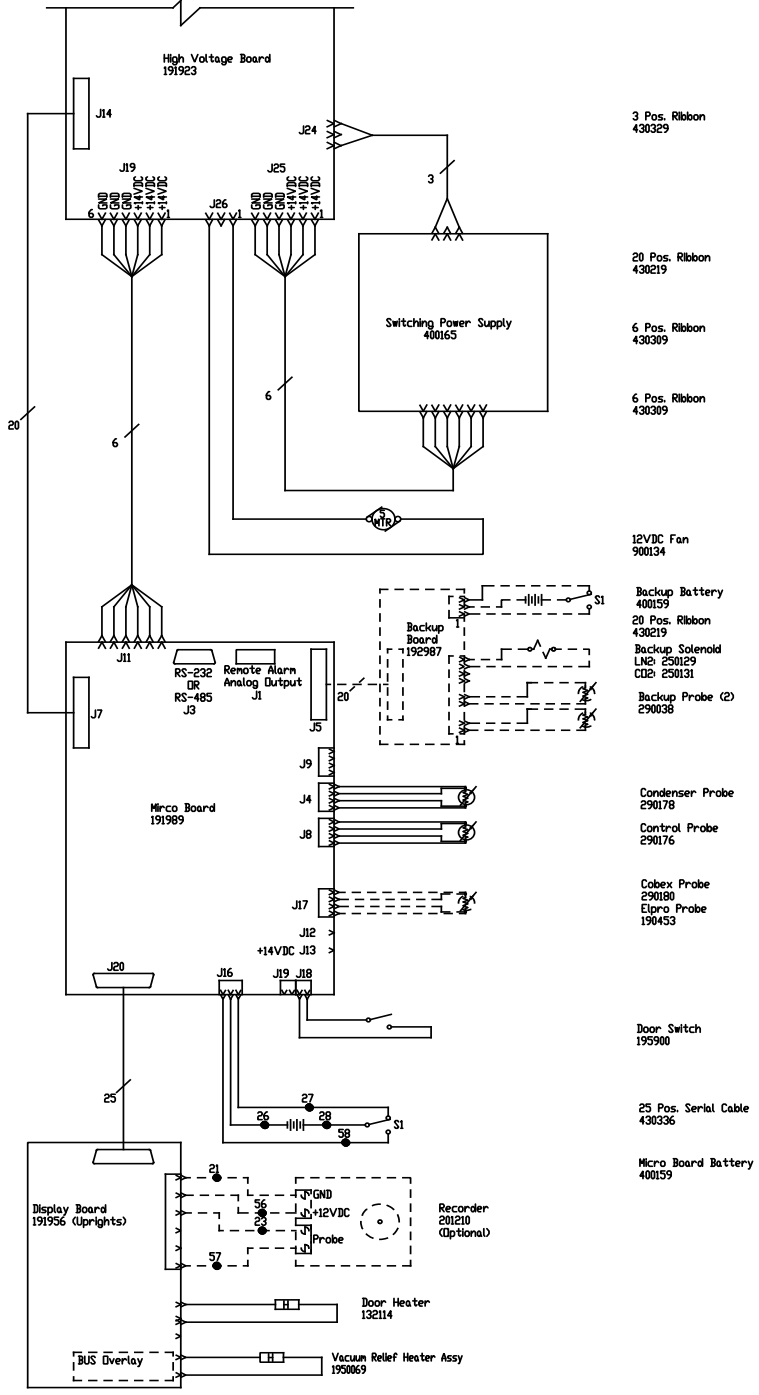
MODEL/PART NAME: LOW-END, -40° UPRIGHT FREEZERS, 120V, 60Hz
DWG TITLE: UNIT SCHEMATIC
DWG HCE CAD KDG APP'D LIN DATE: 10-10-10 SCALE: NONE
MATERIAL:
PANT COLOR:
TOLERANCE UNLESS OTHERWISE SPECIFIED .001± .002± .003±
ANGLE: DECIMAL .000±
DRAWING NUMBER: 8800-70-1
SIZE: D

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Section 10
Electrical Schematics



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- 3 Pos. Ribbon
430329
- 20 Pos. Ribbon
430219
- 6 Pos. Ribbon
430309
- 6 Pos. Ribbon
430309
- 12VDC Fan
900134
- Backup Battery
400159
- 20 Pos. Ribbon
430219
- Backup Solenoid
LNC 250129
- CO2 250131
- Backup Probe (2)
290038
- Condenser Probe
290178
- Control Probe
290176
- Cobex Probe
290180
- Elpro Probe
190453
- Door Switch
195900
- 25 Pos. Serial Cable
430336
- Micro Board Battery
400159
- Recorder
201210
(Optional)

Electrical Schematic
Model:
230V, 50 & 60Hz, -40°C
ULT Upright Freezers

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Section 10
Electrical Schematics

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WIRE #	COLOR	GAUGE	WIRE #	COLOR	GAUGE
1	BLK	14	29	-	-
2	RED	14	30	-	-
3	GRN/YEL	14	31	GRN/YEL	14
4			32	BLK	14
5			33	BLU	14
6	BLK	18	34	BLK	14
7	BLK	18	35	BLU	14
8	BLK	18	36	BLK	14
9	BLK	18	37	BLU	14
10			38	BLK	14
11			39	BLU	14
12			40	BLK	14
13			41	BLU	14
14	GRN/YEL	18	42	BLK	14
15	GRN/YEL	18	43	BLU	14
16			44	BLK	14
17	GRN/YEL	14	45	BLU	14
18			46	BLK	14
19			47	BLU	14
20	BLK	14	48	BLK	14
21	BLK	18	49	BLU	14
22	RED	18	50	BLK	14
23	BLK	18	51	BLU	14
24	YEL	14	52	-	-
25	BLK	14	53	YEL	14
26	BLK	18	54	-	-
27	BLK	18	55	BLU	14
28	RED	18	56	RED	18
			57	RED	18
			58	WHT	18

MODELS:
 13 CUFT.(230V) - 7240D, DXF24040D, HFU40240BD, TSD40240D, 7240V, DXF24040V, HFU40240BV, TSD40240V, 7240GPD, DXF24040GPD, TSD40240GPD
 17 CUFT.(230V) - 7320D, DXF32040D, HFU40320BD, TSD40320D, 7320V, DXF32040V, HFU40320BV, TSD40320V, 7320GPD, DXF32040GPD, TSD40320GPD
 23 CUFT.(230V) - 7400D, DXF40040D, HFU40400BD, TSD40400D, 7400V, DXF40040V, HFU40400BV, TSD40400V, 7400GPD, DXF40040GPD, TSD40400GPD

RS-232 SPECIFICATION

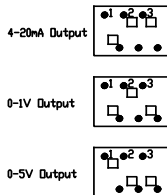
BAUD = 1200
 PARITY = N
 BITS = 8
 STOP BITS = 2

REMOTE CONTACTS/ANALOG OUTPUT
PIN# 1 Analog Output +
PIN# 2 Analog Output -
PIN# 3 Not Connected
PIN# 4 Not Connected
PIN# 5 Normally Closed
PIN# 6 Common
PIN# 7 Normally Open

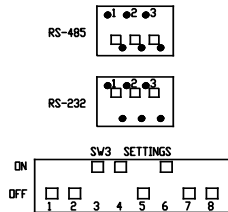
RS-232 PORT
PIN# 2 TXD
PIN# 3 RXD
PIN# 5 GND

CONTACT RATING 1A @ 30V
 CONTACTS IN ALARM STATE

SV1 Settings for Analog Output



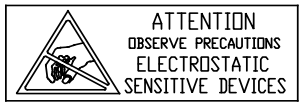
SV2 Settings for Communication Output



- Schematic represents upright models.
- Door switch shown in open position.
- Battery switch shown in the OFF position.
- Circuit breaker switch shown in OFF position.
- Options and accessories shown in dashed lines.

REV	ECN NO.	DATE	BY	CAD APPD	DESCRIPTION OF REVISION	
12	41795	12-13-17	KHB	TFI	UPDATED 'MODELS' DETAILS	
11	FR-3006	08-14-17	KCB	KGC	KHB	191987 BACKUP BOARD TO 192987
10	FR-2881	06-15-16	KHB	SAG	DRP	32287 WAS 30432, 32287 WAS 30445
9	FR-2843	04-05-16	KCB	SAG	DRP	23084 WAS 23078
8	FR-2781	04-02-15	KCB	KGC	DRP	IND 13214 & 192869 HTR 700 STYLE BOARD TO 900
7	31856	01-27-15	GLS	SAG	DRP	WIRE #2 FROM BLU TO RED/AS BUILT CORRECTIONS
6	FR-2499	07-30-13	AJC	SAG	DRP	CHANGED COMPRESSORS & START COMPONENTS
5	FR-2409	09-24-12	AJC	KGC	DRP	REL. & LOW PRESSURE HIGH BUILT HIGH END 19289
4	FR-2386	08-29-12	AJC	KGC	DRP	REVISED OPERATING RANGE FROM 208-240V
3	FR-2329	03/08/12	AJC	SAG	DRP	ADDED HIGH PRESSURE CUTOFF
2	FR-2267	02/23/12	JVE	SAG	DRP	REPLACED PTCR WITH HARD START COMP.
1	FR-2267	11/28/11	JVE	SAG	DRP	COMPRESSOR CHANGE / RELEASE 7
0	FR-2202	04/29/11	SRS	SAG	LIN	RELEASED FOR PRODUCTION / RELEASE 6

Electrical Schematic
 Model:
 230V, 50 & 60Hz, -40°C
 ULT Upright Freezers



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ThermoFisher SCIENTIFIC
 BOX 649, MARICETTA, OHIO 45750

MODEL/PART NAME: LDV-ENB, -40° UPRIGHT FREEZERS, 230V, 50 & 60 Hz
DWG TITLE: UNIT SCHEMATIC
DWG HCE: CAD KGC APPD: LIN DATE: 10-10-10 SCALE: NONE
MATERIAL:
PAINTE COLOR:
TOLERANCE UNLESS OTHERWISE SPECIFIED: .XX±.2 .XXX±.3
ANGLES: DECIMAL

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THERMO FISHER SCIENTIFIC FREEZER WARRANTY

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

During the first two years of the warranty period, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor included. The ULT Freezers include an additional two year warranty on the compressors, parts only, F.O.B. factory. Installation and calibration is not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to any work being performed. Expendable items, i.e., glass, filters, pilot lights, light bulbs and door gaskets are excluded from this warranty.

Replacement or repair of component parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original two year warranty period. The Technical Services Department must give prior approval for the return of any components or equipment.

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

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



Rev. 10/14

THERMO FISHER SCIENTIFIC FREEZER INTERNATIONAL DEALER WARRANTY

The Warranty Period starts two months from the date your equipment is shipped from our facility. This allows for shipping time so the warranty will go into effect at approximately the same time your equipment is delivered. The warranty protection extends to any subsequent owner during the warranty period. Dealers who stock our equipment are allowed an additional four months for delivery and installation, providing the warranty is registered online.

During the first two years of the warranty period, component parts proven to be non-conforming in materials or workmanship will be repaired or replaced at Thermo's expense, labor excluded. The ULT Freezers include an additional two year warranty on the compressors, parts only, F.O.B. factory. Installation and calibration is not covered by this warranty agreement. The Technical Services Department must be contacted for warranty determination and direction prior to any work being performed. Expendable items, i.e., glass, filters, pilot lights, light bulbs and door gaskets are excluded from this warranty.

Replacement or repair of component parts or equipment under this warranty shall not extend the warranty to either the equipment or to the component part beyond the original two year warranty period. The Technical Services Department must give prior approval for the return of any components or equipment.

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

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

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



Rev. 10/14

Appendix A Handling Liquid Nitrogen

Warning Contact of liquid nitrogen or cold gas with skin or eyes may cause serious freezing (frostbite) injury. ▲

Handle liquid nitrogen carefully.

The extremely low temperature can freeze human flesh very rapidly. When spilled on a surface the liquid tends to cover it completely and intimately, cooling a large area. The gas issuing from the liquid is also extremely cold. Delicate tissue, such as that of the eyes, can be damaged by an exposure to the cold gas which would be too brief to affect the skin of the hands or face.

Never allow any unprotected part of your body to touch objects cooled by liquid nitrogen.

Such objects may stick fast to the skin and tear the flesh when you attempt to free yourself. Use tongs to withdraw objects immersed in the liquid, and handle the object carefully.

Wear protective clothing.

Protect your eyes with a face shield or safety goggles (safety glasses without side shields do not give adequate protection). Always wear gloves when handling anything that is, or may have been, in immediate contact with liquid nitrogen. Insulated gloves are recommended, but heavy leather gloves may also be used. The gloves should fit loosely, so that they can be thrown off quickly if liquid should splash into them. When handling liquid in open containers, it is advisable to wear high-top shoes. Trousers (which should be cuffless if possible) should be worn outside the shoes.

The safe handling and use of liquid nitrogen in cryogenic refrigerators and dewar flasks is largely a matter of knowing the potential hazards and using common-sense procedures based on that knowledge. There are two important properties of liquid nitrogen that present potential hazards:

1. It is extremely cold. At atmospheric pressure, liquid nitrogen boils at -320°F (-196°C).
2. Very small amounts of liquid vaporize into large amounts of gas. One liter of liquid nitrogen becomes 24.6 cu. ft. (700l) of gas.

The safety precautions in this booklet must be followed to avoid potential injury or damage which could result from these two characteristics. Do not attempt to handle liquid nitrogen until you read and fully understand the potential hazards, their consequences, and the related safety precautions. Keep this booklet handy for ready reference and review.

Note Because argon is an inert gas whose physical properties are very similar to those of nitrogen, the precautions and safe practices for the handling and use of liquid argon are the same as those for liquid nitrogen. ▲

Use only containers designed for low temperature liquids.

Cryogenic containers are specifically designed and made of materials that can withstand the rapid changes and extreme temperature differences encountered in working with liquid nitrogen. Even these special containers should be filled SLOWLY to minimize the internal stresses that occur when any material is cooled. Excessive internal stresses can damage the container.

Do not cover or plug the entrance opening of any liquid nitrogen refrigerator or dewar. Do not use any stopper or other device that would interfere with venting of gas.

These cryogenic liquid containers are generally designed to operate with little or no internal pressure.

Inadequate venting can result in excessive gas pressure which could damage or burst the container. Use only the loose-fitting necktube core supplied or one of the approved accessories for closing the necktube. Check the unit periodically to be sure that venting is not restricted by accumulated ice or frost.

Use proper transfer equipment.

Use a phase separator or special filling funnel to prevent splashing and spilling when transferring liquid nitrogen into or from a dewar or refrigerator. The top of the funnel should be partly covered to reduce splashing. Use only small, easily-handled dewars for pouring liquid. For the larger, heavier containers, use a cryogenic liquid withdrawal device to transfer liquid from one container to another. Be sure to follow instructions supplied with the withdrawal device. When liquid cylinders or other large storage containers are used for filling, follow the instructions supplied with those units and their accessories.

Do not overfill containers.

Filling above the bottom of the necktube (or specified maximum level) can result in overflow and spillage of liquid when the necktube core or cover is placed in the opening.

Never use hollow rods or tubes as dipsticks.

When a warm tube is inserted into liquid nitrogen, liquid will spout from the top of the tube due to gasification and rapid expansion of liquid inside the tube.

Warning Nitrogen Gas Can Cause Suffocation Without Warning! ▲

Store and use liquid nitrogen only in a well-ventilated place.

As the liquid evaporates, the resulting gas tends to displace the normal air from the area. In closed areas, excessive amounts of nitrogen gas reduce the concentration of oxygen and can result in asphyxiation. Because nitrogen gas is colorless, odorless and tasteless, it cannot be detected by the human senses and will be breathed as if it were air. Breathing an atmosphere that contains less than 18% oxygen can cause dizziness and quickly result in unconsciousness and death.

Note The cloudy vapor that appears when liquid nitrogen is exposed to the air is condensed moisture; not the gas itself. The issuing gas is invisible. ▲

Never dispose of liquid nitrogen in confined areas or places where others may enter.

Disposal of liquid nitrogen should be done outdoors in a safe place. Pour the liquid slowly on gravel or bare earth where it can evaporate without causing damage. Do not pour the liquid on pavement.

Appendix B Handling Liquid CO₂

Warning High concentrations of CO₂ gas can cause asphyxiation! OSHA Standards specify that employee exposure to carbon dioxide in any eight-hour shift of a 40-hour work week shall not exceed the eight-hour time weighted average of 5000 PPM (0.5% CO₂). The short term exposure limit for 15 minutes or less is 30,000 PPM (3% CO₂). Carbon dioxide monitors are recommended for confined areas where concentrations of carbon dioxide gas can accumulate. ▲

Store and use liquid CO₂ only in a well-ventilated place.

As the liquid evaporates, the resulting gas tends to displace the normal air from the area. In closed areas, excessive amounts of CO₂ gas reduce the concentration of oxygen and can result in asphyxiation. Because CO₂ gas is colorless, odorless and tasteless, it cannot be detected by the human senses and will be breathed as if it were air. Breathing an atmosphere that contains less than 18% oxygen can cause dizziness and quickly result in unconsciousness and death.

Note The cloudy vapor that appears when liquid CO₂ is exposed to the air is condensed moisture; not the gas itself. The issuing gas is invisible. ▲

Never dispose of liquid CO₂ in confined areas or places where others may enter.

Disposal of liquid CO₂ should be done outdoors in a safe place. Pour the liquid slowly on gravel or bare earth where it can evaporate without causing damage. Do not pour the liquid on pavement.

Appendix C First Aid

If a person seems to become dizzy or loses consciousness while working with liquid nitrogen or carbon dioxide, move to a well-ventilated area immediately. If breathing has stopped, apply artificial respiration. If breathing is difficult, give oxygen. Call a physician. Keep warm and at rest.

If exposed to liquid or cold gas, restore tissue to normal body temperature (98.6° F) as rapidly as possible, followed by protection of the injured tissue from further damage and infection. Remove or loosen clothing that may constrict blood circulation to the frozen area. Call a physician. Rapid warming of the affected part is best achieved by using water at 108° F. Under no circumstance should the water be over 112° F, nor should the frozen part be rubbed either before or after rewarming. The patient should neither smoke nor drink alcohol.

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