



Thermo Scientific TSC Series

-40C and -86C ULT Chest Freezer

Operating and Maintenance Manual 7028763 Rev. 4

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Important installer and user information:

A redundant temperature sensing device has been included in this ULT 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 No. | Description | Qty |
|----------|------------------------|-----|
| 213F | 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 |

-86C Models Covered

| Number | Model | Cu. ft. | Voltage |
|----------|-------|---------|---------|
| TSC390A | 8763 | 3 | 115/60 |
| TSC390V | 8764 | 3 | 230/50 |
| TSC1390D | 8765 | 12.7 | 230/50 |
| TSC1390V | 8767 | 12.7 | 230/60 |
| TSC1390A | 8768 | 12.7 | 120/60 |
| TSC1790A | 8769 | 17 | 120/60 |
| TSC1790V | 8770 | 17 | 230/50 |
| TSC1790D | 8771 | 17 | 230/60 |
| TSC2090V | 8772 | 20 | 230/50 |
| TSC2090D | 8773 | 20 | 230/60 |
| TSC2090A | 8774 | 20 | 120/60 |

-40C Models Covered

| Number | Model | Cu. ft. | Voltage |
|----------|-------|---------|---------|
| TSC350A | 8775 | 3 | 115/60 |
| TSC350V | 8776 | 3 | 230/50 |
| TSC1350V | 8777 | 12.7 | 230/50 |
| TSC1350D | 8778 | 12.7 | 230/60 |
| TSC1350A | 8779 | 12.7 | 120/60 |
| TSC1750A | 8780 | 17 | 120/60 |
| TSC1750V | 8781 | 17 | 230/50 |
| TSC1750D | 8782 | 17 | 230/60 |
| TSC2050V | 8783 | 20 | 230/50 |
| TSC2050D | 8784 | 20 | 230/60 |
| TSC2050A | 8785 | 20 | 120/60 |

MANUAL NUMBER 7028763

| | | | | |
|----|---------------------|---------|--|-----|
| 4 | 40544 | 12/9/15 | BUS information (preventive maintenance and BUS control panel and operation) | ccs |
| 3 | 40286/FR-2805 | 7/1/15 | New start relay - expl enclosure drawing and 8702 & 8722 elec schematics | ccs |
| 2 | 31013/FR-2673 | 6/18/14 | RoHS compliant washer on oil separator (expl base dwg, refig schematics) | ccs |
| 1 | 30775/30673/FR-2607 | 2/4/14 | Intended use and battery check info - pgs ii & 5-4 | ccs |
| -- | 30369/FR-2548 | 9/25/13 | Pressure change on refrigeration 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 and -86C freezers (see page i for model numbers) 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 the human body).

Registration: This medical application is considered a Class I device by the FDA. This product is classified as product code - JRM, regulation number 862.2050 and is considered a Class I 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.



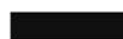
Equipment being maintained or serviced must be turned off and locked off to prevent possible injury.



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



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



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- ✓ Always use the proper protective equipment (clothing, gloves, goggles, etc.)
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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

Figures 1-1 and 1-2 show the front view of the freezer and indicate the following freezer components:

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

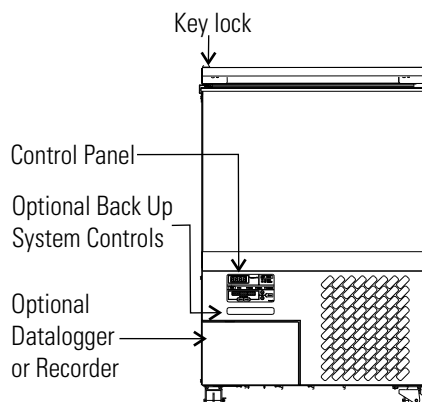


Figure 1-1. Front View 3 cu ft Models

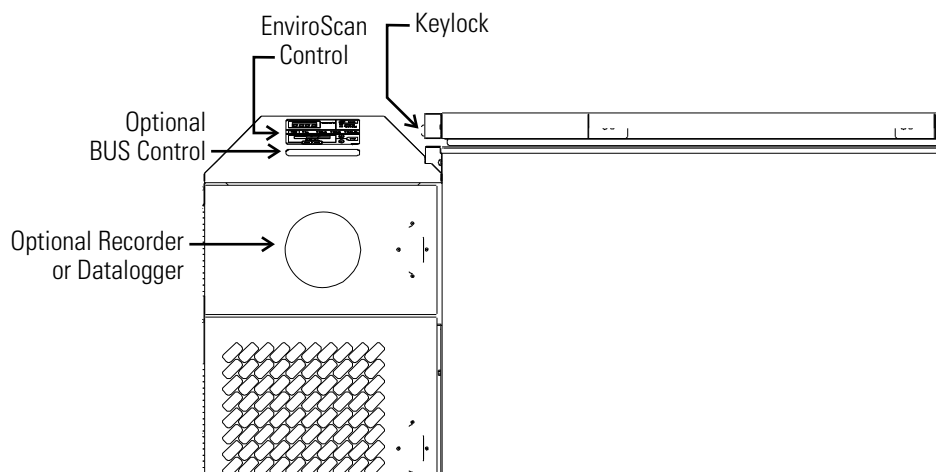


Figure 1-2. Front View Remaining Models

Figures 1-3 and 1-4 display the rear view of the freezer and indicate the following freezer components:

- Remote alarm contacts and selectable analog output connection - 0-1V, 4-20mA (default), 0-5V).
- Power inlet for power cord connection.
- Optional BUS connections for probe and solenoid.
- RS-232 or RS-485 interface.
- Power Switch (mains disconnect).

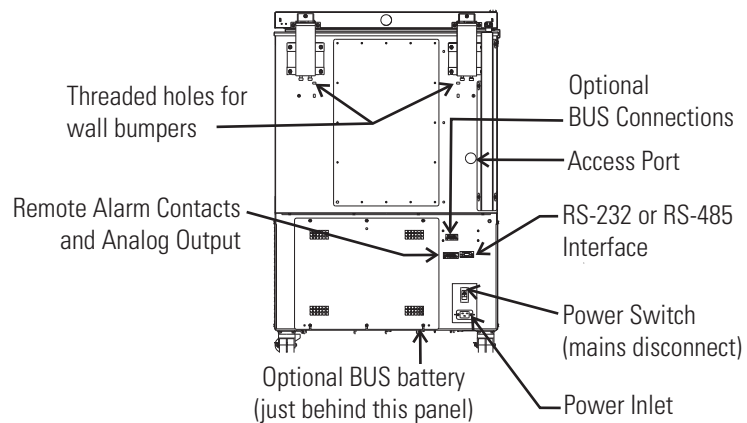


Figure 1-3. Rear View 3 cu ft Models

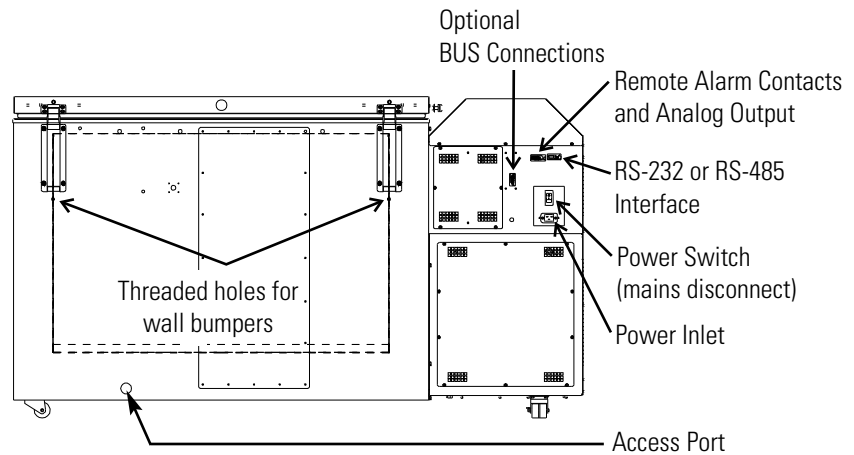


Figure 1-4. Rear View Remaining Models

The probe cover houses the control, optional recorder, datalogger, Model 1535 alarm, or BUS probes.

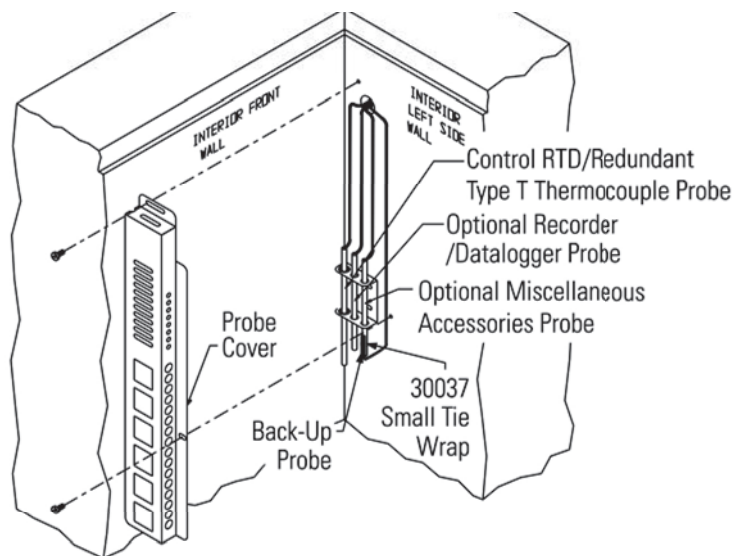


Figure 1-5. Probe Cover

Figures 1-6, 1-7, and 1-8 indicate the following components:

- Freezer filter location
- Battery power switch (freezer and BUS)
- Thermocouple receptacle
- Battery mounting bracket
- Freezer and optional BUS battery

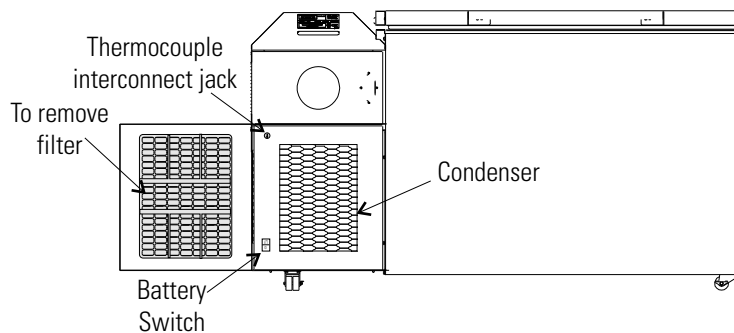


Figure 1-6. All Models Except 3 cu ft

Section 1
Installation and Start-up

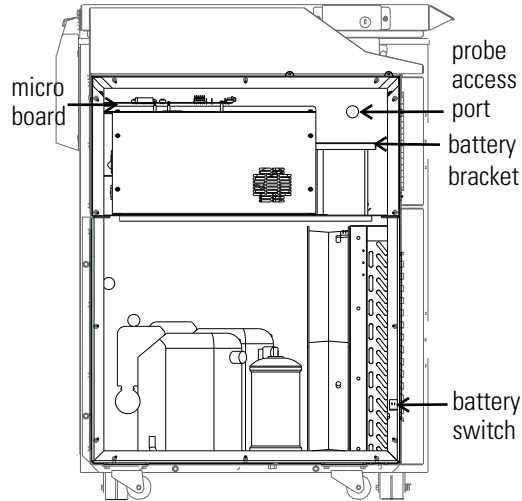


Figure 1-7. Freezer Left Side - Sidecar panel removed

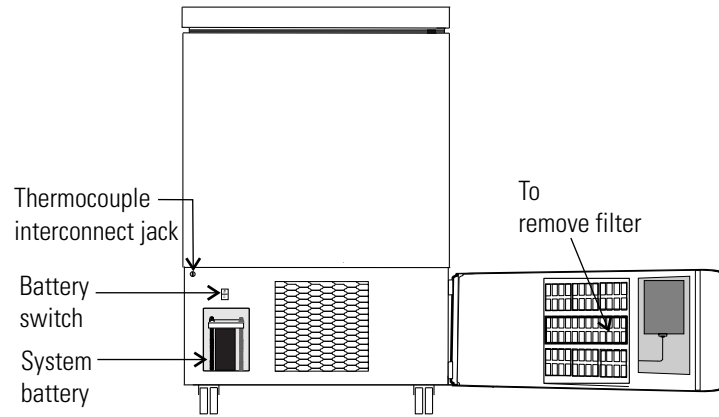


Figure 1-8. 3 cu ft Models

Control Panel Keys, Display, Indicators

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.

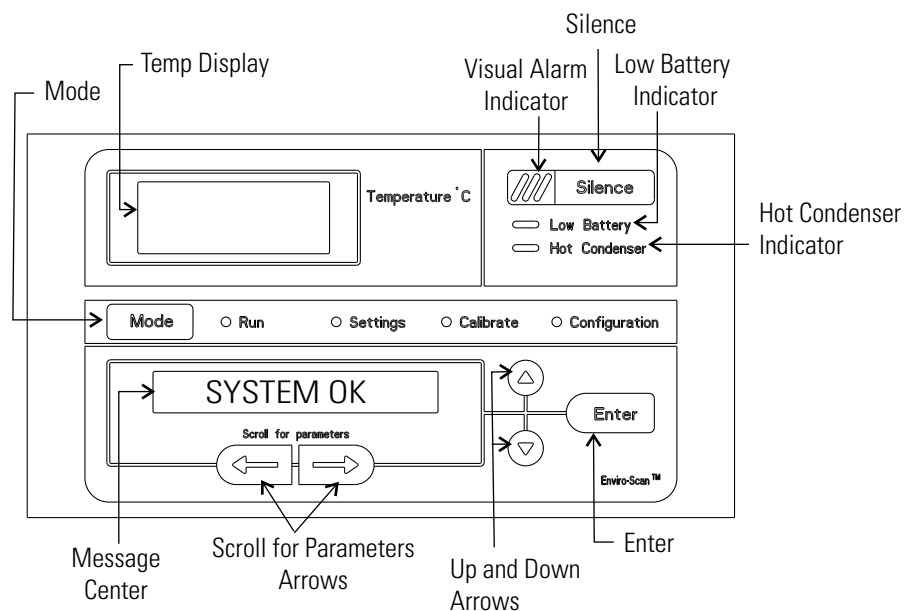


Figure 1-9. Control Panel Keys, Display and Indicators

Section 1

Installation and Start-up

Panel Keys, Display, Indicators (cont.)

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

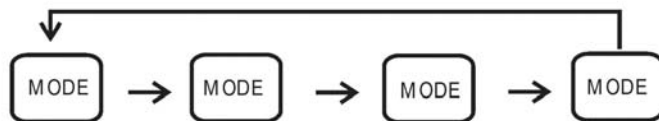
Run is the default mode which the freezer will normally be in during operation.

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.

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



| 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

Panel Keys, Display, Indicators (cont.)

Scroll for 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 ringback 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.

Install Freezer

To remove the freezer from the pallet, use a 7/16" wrench to remove all the bolts securing the shipping bracket to the pallet.

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

Remove the shipping bracket. Remove the ramp boards from the pallet and place the slotted end 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, as described previously. When the freezer is in position, set the front caster brakes.

Note Do not move the freezer with the product load inside. ▲

Choose Location

Locate the freezer on a firm, level surface in an area with an ambient temperature between 18°C and 32°C. Provide ample room to reach the mains disconnect switch (power switch) located on the rear of the freezer.

Note For proper ventilation and airflow, a minimum clearance of 5” at the rear and front and a clearance of 8” on the side of the freezer is required. Allow adequate space for lid opening. If ambient increases above 36°C, clearance at the rear of the cabinet must be increased to 8”. ▲

Install Wall Bumpers

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

| Quantity | 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.

RS-232 Communications

TSC Series freezers have a data communications interface. The factory default setting is RS-232.

The wiring identification for the interface is shown in Figure 1-10. 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.

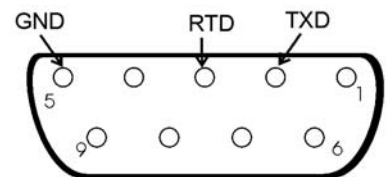


Figure 1-10. RS-232 Interface

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:

Baud1200
 Data bits8 (7 bit ASCII with leading zero)
 Start bits1
 Stop bits2
 Paritynone

RS-232 Communications (continued)

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.

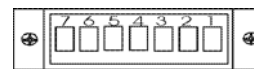
SP - Space LF - Line feed
CR - Carriage return EOT - End of text (4)
NUL - Null character (00)

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)

Note The RS-232 is not compatible with Model 1535 Monitor/Alarm System. ▲

** -86C units only*



Remote Alarm Contacts and Analog Output

TSC Series freezers have remote alarm contacts and analog output. See Figures 1-3 and 1-4 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, high temperature alarm or low temperature alarm. They will also trip on high stage (-86C units only), control probe and microboard failures. Figure 1-11 shows the remote contacts in alarm state.

| 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 |

CONTACT RATING: 1A @ 30V
CONTACTS IN ALARM STATE

Figure 1-11. Remote Alarm Contacts

Section 1

Installation and Start-up

Remote Alarm Contacts and Analog Output (cont.)

The analog output function allows the freezer to output signals representing the temperature of the freezer cabinet. The factory default setting is 4-20 mA. Refer to Table 1-2 for output specifications.

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.

Table 1-2. Analog Output Specifications

| | 4-20 mA | 0-1V | 0-5V |
|-------------|---------------|---------------|---------------|
| Temperature | -100 to +50°C | -100 to +50°C | -100 to +50°C |

Attach Power Cord

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

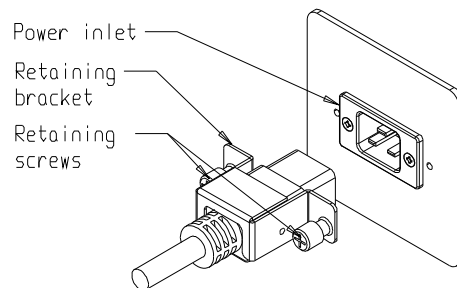


Figure 1-12. Power Cord Attachment

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 1-4) and turn it to Standby mode (⏻). During initial freezer start-up, the system battery may require charging and the Low Battery message may appear in the message center.

Note 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 set points can be entered. The following set points can be entered in Settings mode: Control temperature, high temperature alarm set point, low temperature alarm set point, and (optional) BUS set point. Default settings are shown in the table below. See Chart 1-1 for more detail.

| -86C Units | | -40C Units | |
|------------------------|-------|------------------------|-------|
| Control Set Point | -80°C | Control Set Point | -40°C |
| High Temperature Alarm | -70°C | High Temperature Alarm | -30°C |
| Low temperature alarm | -90°C | Low temperature alarm | -50°C |
| Optional BUS Set Point | -60°C | Optional BUS Set Point | -30°C |

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

Set Operating Temperature

The freezer has an operating temperature range of -50°C to -86°C (-86C units) or -10°C to -40°C (-40C units), depending on ambient temperature. The freezer is shipped from the factory with a temperature set point of -80°C (-86C units) or -40° (-40C units). To change the operating temperature set point:

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

If no control 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 temp reaches or exceeds the high temp alarm set point.

To set the high temperature alarm set point:

1. Press the Mode key until the Set 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 set point 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. ▲

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

Set Low Temperature Alarm

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

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 message center.
3. Press the up or down arrow key until the desired low temperature alarm set point 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. The run mode displays the cabinet temperature on the temperature display and 'SYSTEM OK' on the message center under normal operating conditions. In addition, the Run mode allows display of the following information:

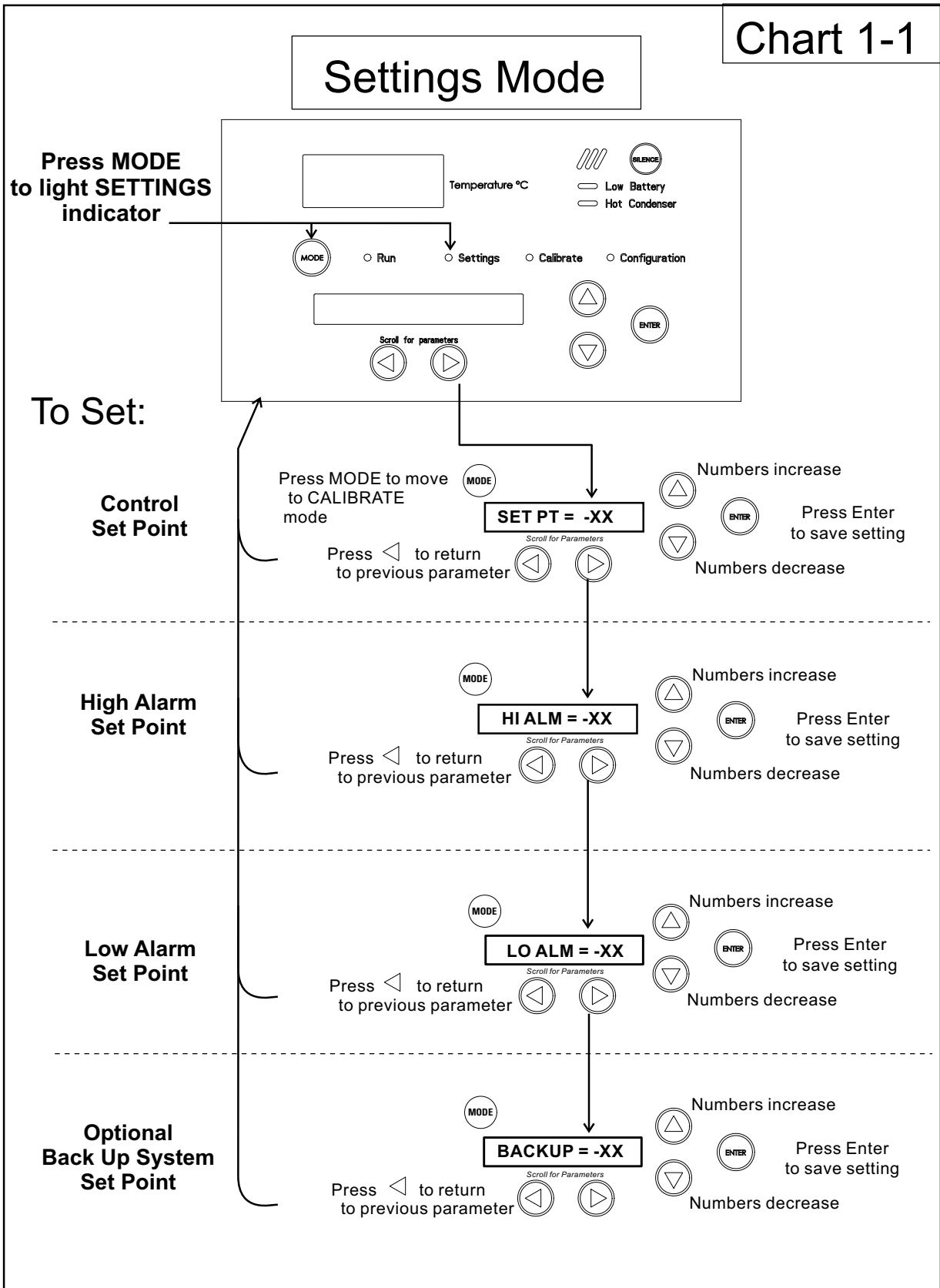
LINE VOLTAGE

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

Calibrate Mode

Once 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. ▲

Calibrate Control Probe

Plug a type T thermocouple reader into the receptacle located inside the lower door (see Figures 1-4 and 1-6). Compare the control temperature set point to the temperature of the measuring device. See Chart 2-1 at the end of this section for more detail.

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.

Temperature Stabilization Periods

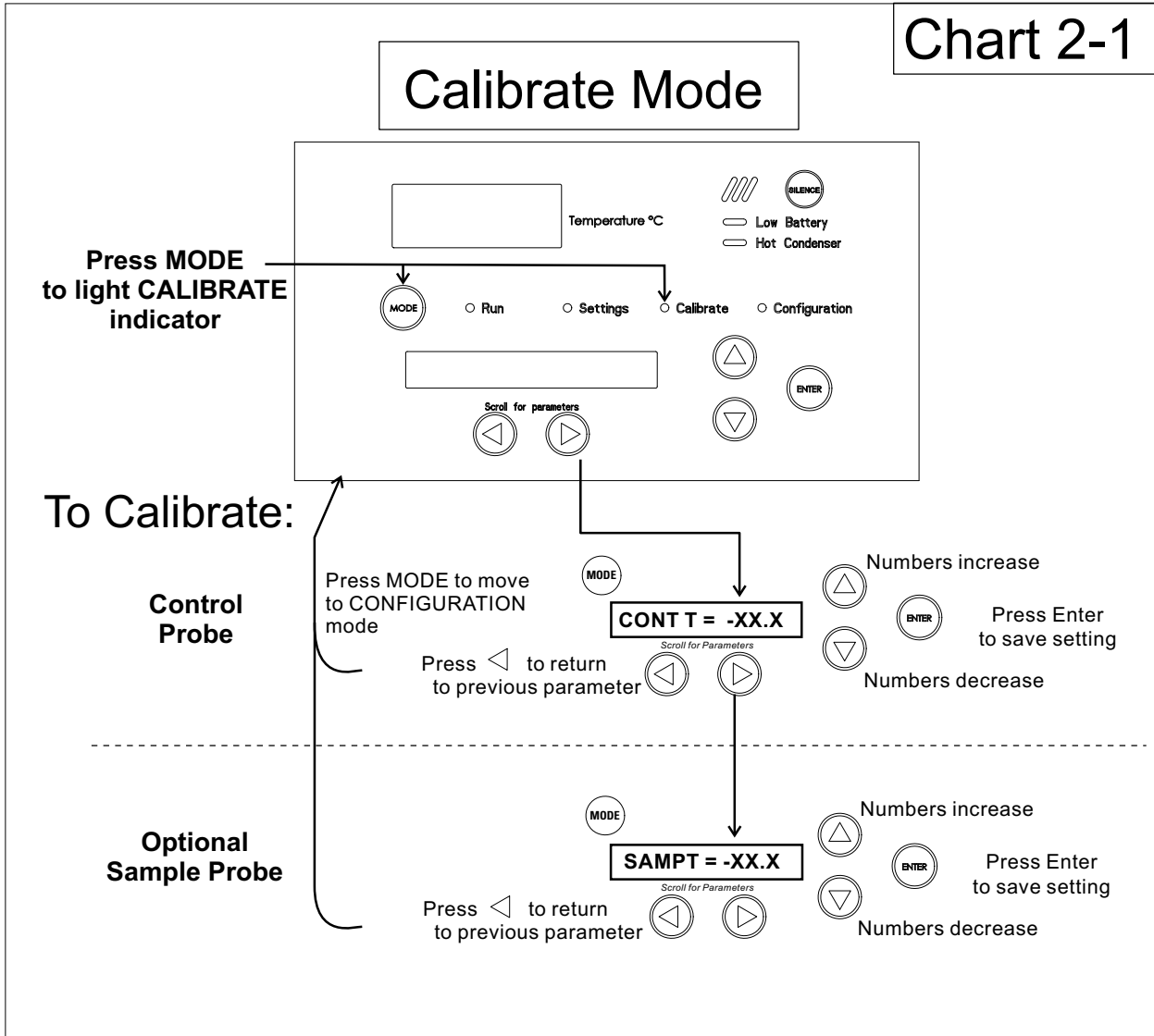
Startup - Allow 12 hours for the temperature in the cabinet to stabilize before proceeding.

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

Note During calibration, the temperature display will not be available.

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

Chart 2-1



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.

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.

System Battery Test

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.

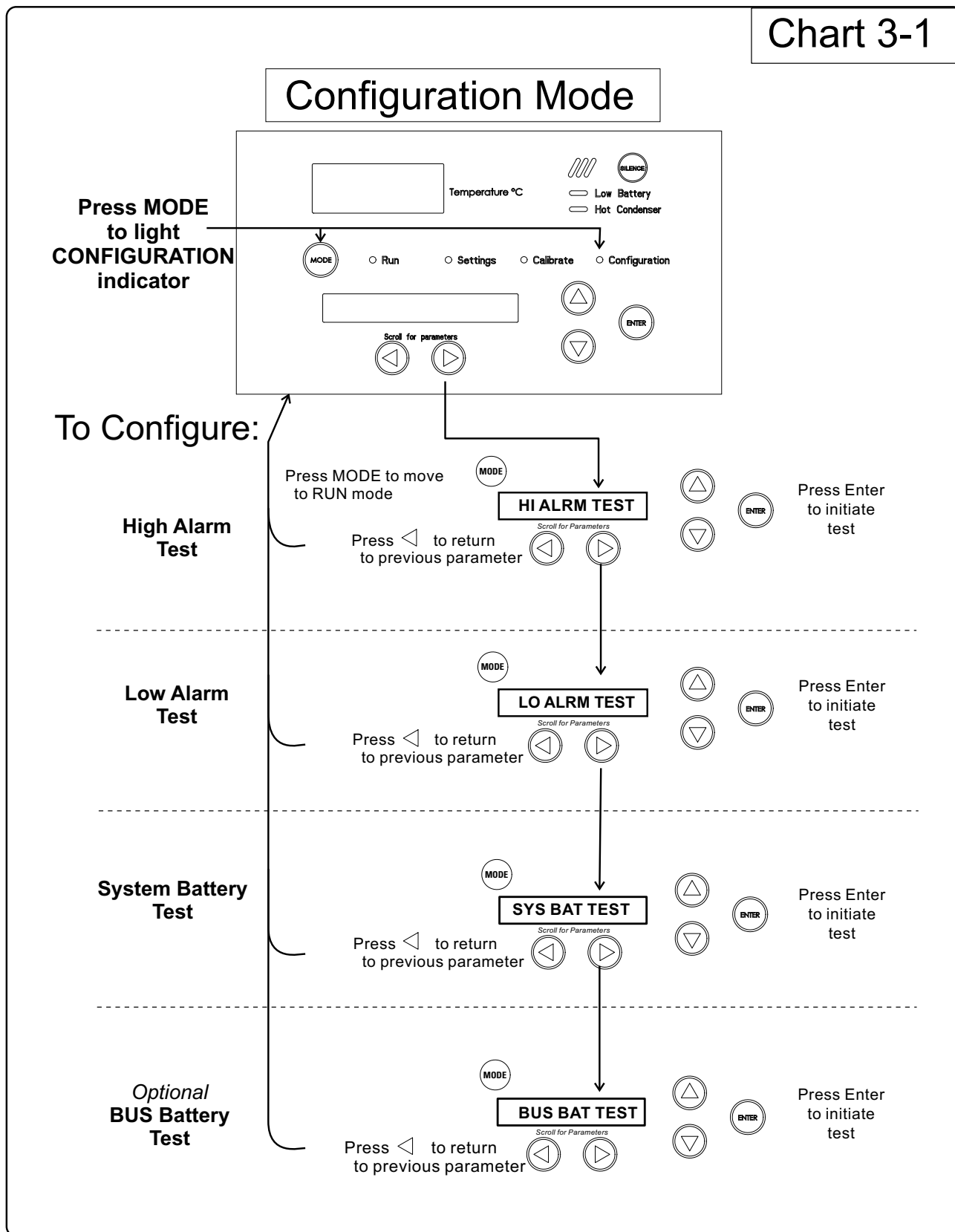
Warm Excursion

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

Reset Excursion

This function resets the cold and warm excursions.

Chart 3-1

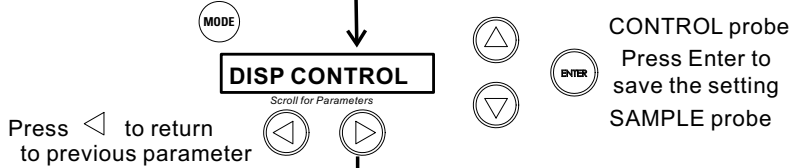


Configuration Mode, Chart 3-1, Page 2 of 3

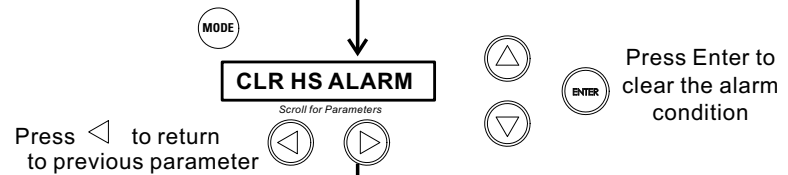
refer to previous page

To Configure:

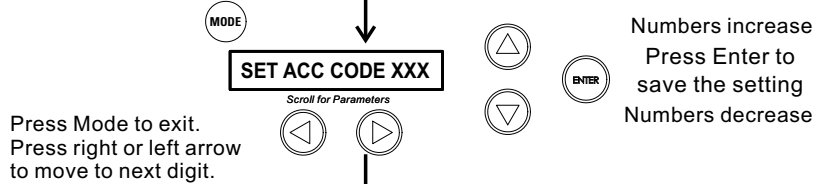
Display Temperature



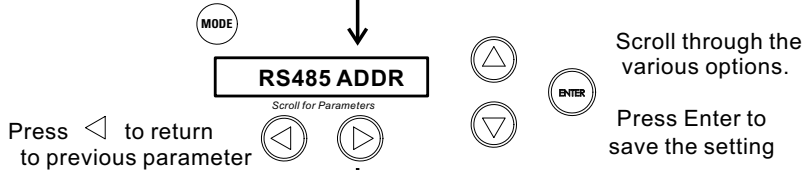
Clear High Stage Alarm



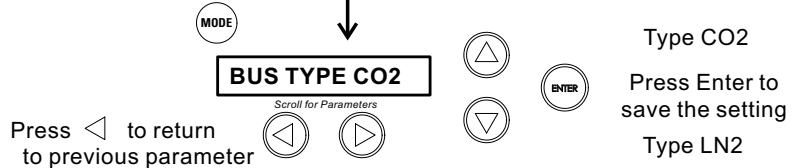
Access Code



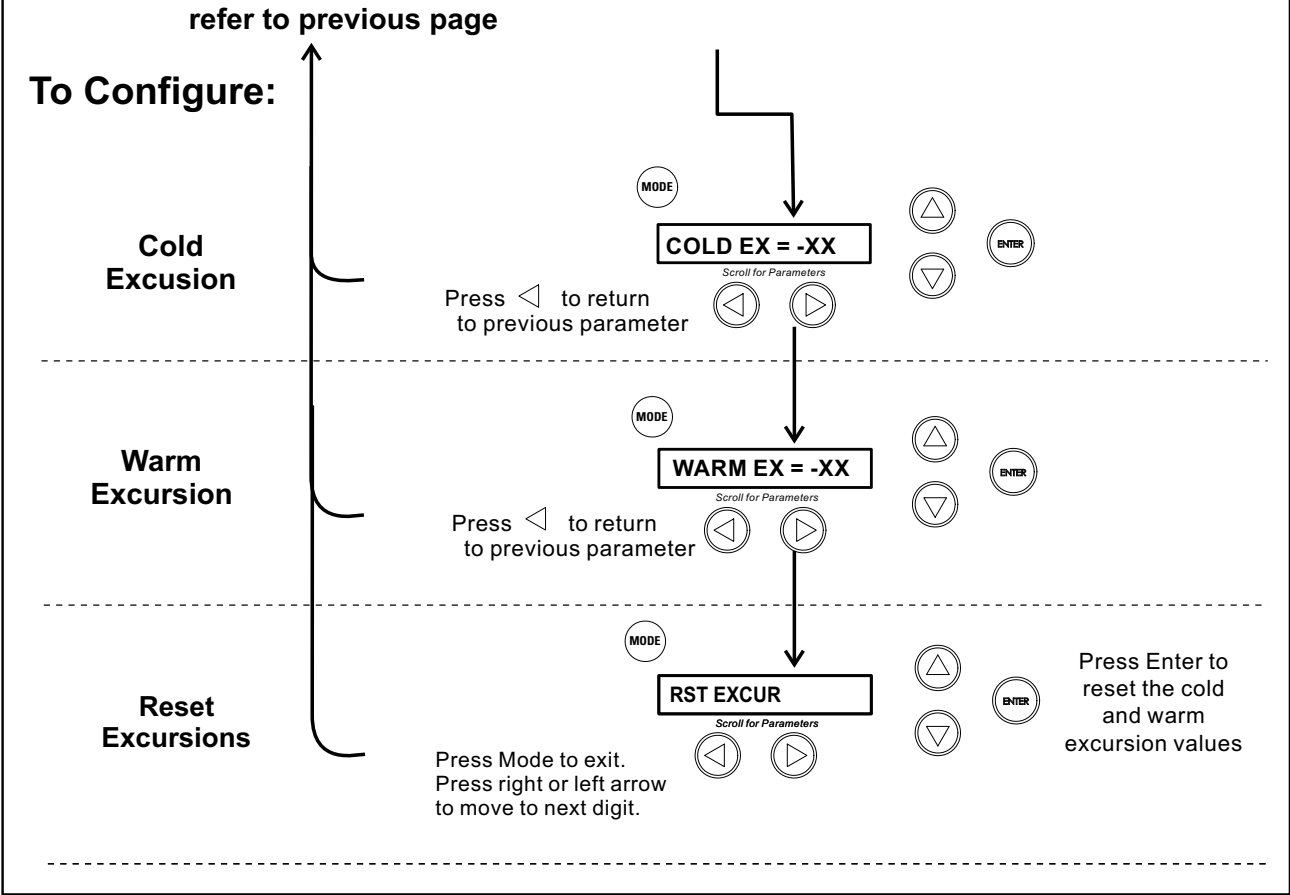
RS-485 Address



Optional Back Up System Type



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



Section 4 Alarms

The TSC Series freezer alarm system is shown below. When an alarm is active, a message appears in the LED message center. Press the Silence key to mute the audible alarm for the ringback period. The visual alarm continues 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.

Table 4-1. Alarms

| 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

| Error | High End Message | Notes |
|-------|------------------|---|
| Er00 | "INV. MODEL" | <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 | " NO FREQUENCY" | This error condition will prevent peripherals (fans, compressors, etc.) from powering up with the incorrect voltage. |
| ErC1 | "FREQ <50Hz" | <p>Name: Voltage/Frequency failure</p> <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 / <85 VAC < 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 | "FREQ >60Hz" | |
| ErE1 | "VAC < 180V" | <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> |
| ErF1 | "VAC > 260V" | <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 | "VAC < 85V" | <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 | "VAC > 160V" | <p>ErH1 .. Unit is 115V and the voltage detected is above the high limit (160VRMS)</p> |

Section 4
Alarms

| Error (cont.) | High End Message | Notes |
|---------------|-----------------------------------|---|
| Er02 | "CNT PRB FLT" | <p>Name: Control (Cabinet) Sensor Failure Description: This condition indicates that the control sensor has failed to produce a valid reading for ≥ 12 consecutive reads (~60 seconds). 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 regardless of the key position for this mode of failure. 'Er02' will be added to the main display queue and the last valid cabinet temperature value will not be displayed</p> |
| Er03 | "HSHX PRB FLT" -86C units only | <p>Name: Heat Exchange Sensor Failure Description: This condition indicates that the heat exchange sensor has failed to produce a valid reading for ≥ 12 consecutive reads (~60 seconds). Response: The display will show "Er03" only when the button sequence to read the heat exchange sensor is depressed.</p> |
| Er05 | N/A | <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 with out any error indication if it does not pass this at power on.</p> |
| Er06 | N/A | <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 | "MICRO FAIL" | <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 -86C system will have 10 minute staging between the high stage compressor and the low stage compressor activation (-40C units will activate the compressor). 5. The system will go to bottom out temperatures. |

| Error (cont.) | High End Message | Notes |
|----------------------------------|------------------|---|
| Er09 | N/A | <p>Name: Stuck Button</p> <p>Description: This condition indicates that the display board has a stuck button.</p> <p>Response: The Er09 will show on the display periodically.</p> |
| Er11 | "COND PRB FLT" | <p>Name: Condenser Probe Sensor Failure</p> <p>Description: This condition indicates that the condenser probe sensor has failed to produce a valid reading for ≥ 12 consecutive reads (~60 seconds).</p> <p>Response: The display shows "Er11".</p> |
| N/A | "SMPL PRB FLT" | <p>Name: Sample Probe Sensor Failure</p> <p>Description: This condition indicates that the sample probe sensor has failed to produce a valid reading for ≥ 12 consecutive reads (~60 seconds).</p> <p>Response: The message center shows "SMPL PRB FLT".</p> |
| dErr | N/A | <p>This is a general display error in which the value being displayed can not be represented within the characters provided.</p> |
| (four dashes) ---- in display | N/A | <p>Name: Lost Communication</p> <p>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

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.

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

Clean Air Filter

The air filter should be cleaned a minimum of four times per year.

1. Open the lower panel door by grasping the handle.
2. Locate the grille on the door. See Figures 1-6 and 1-8. 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 close the door.

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. Order part number 398216 for 3 cu. ft. units, or 398217 for 13, 17, and 20 cu. ft. units.

Clean Condenser

The condenser should be cleaned a minimum of once per year.

1. Open the front door by grasping the handle. See Figures 1-6 and 1-8.
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.

Defrost Chamber

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 Figures 5-1 and 5-2.
4. Open the lid and remove sub-lids. Place towels on the chamber floor.
5. Allow the frost to melt and become loose. Remove 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.

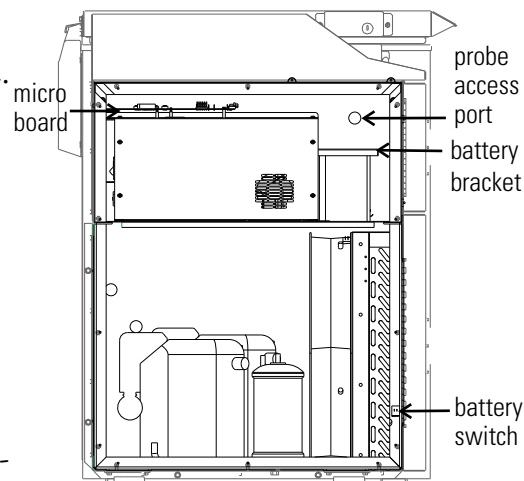


Figure 5-1. Battery and Switch location

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.

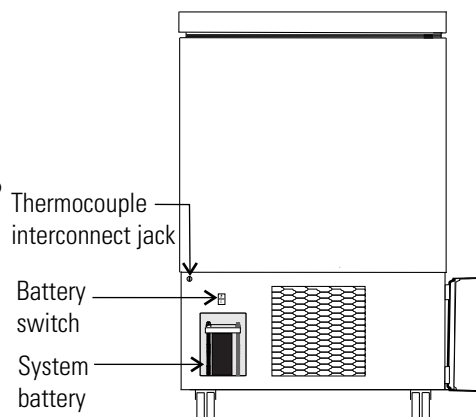


Figure 5-2. Battery and Switch location

Clean Lid Gasket

The lid gasket should be cleaned a minimum of once per month. Using a soft cloth, remove any frost build-up from the gasket, sub-lids and lids. The clean gasket alarm occurs every three months as a reminder to remove frost build-up from the gasket and doors. Press the Silence key to mute the audible alarm. The lid gasket may need to be cleaned more frequently if dirt or excessive frost build-up prevents the door from closing properly.

Prepare Unit for Storage

Defrost the unit as previously described. This prepares the unit for storage. Turn Off the battery power switch (O). Turn Off the freezer power switch.

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

Replace Battery(s)

The following instructions describe the battery replacement procedure for specific models.

All Models Except 3 cu ft

1. Open the lower panel door by grasping the handle and pulling.
2. Locate the battery power switch (Figure 5-1). Turn the battery power switch to the Off position (O).
3. Remove the four screws holding the recorder bezel to gain access to the battery.
4. Remove the three nuts securing the battery bracket. See Figure 5-1.
5. Remove the bracket and old battery. Discard properly. Install the new battery and secure.
6. Reconnect the battery (red to positive and black to negative).
7. Replace the recorder bezel.
8. Turn the battery power switch to Standby mode (⏻).
9. Close lower panel door.

3 cu ft Models

1. Open the lower panel door by locating the handle on the underside of this door and pulling.
2. Locate the battery power switch (Figure 5-2). Turn the battery power switch to the Off position (O).
3. Remove the two nuts securing the battery bracket. See Figure 5-2.
5. Remove the bracket and old battery. Discard properly. Install the new battery and secure.
6. Reconnect the battery (red to positive and black to negative).
7. Replace the recorder bezel.
8. Turn the battery power switch to Standby mode (⏻).
9. Close lower panel door.

Note 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 (P/N 400159). Dispose of the used batteries in a safe manner and in accordance with good environmental practices. ▲

Check Battery(s)

All Models except 3 cu ft (Figure 5-1):

1. Locate the power switch on the back of the unit. Turn the switch off. (O).
2. Open the lower door on the front left corner of the sidecar. Turn off the battery switch (O).
3. Remove all the screws from the side panel, except the lower ones. Just loosen these and lift the panel off.
4. The battery is rectangular in shape, located above the compressor compartment, to the right and behind the relay box. Remove the three wingnuts that secure the cover on the battery. Remove the cover.
5. Remove the battery from the mounting bracket.
6. Disconnect the red and black wires from the battery.
7. Use a voltmeter set to DC volts. Matching the wire colors, connect the meter to the battery.
8. If the voltage reads less than 10.8 volts, replace the battery. If above 10.8, re-install as previously.
9. Re-install side panel. Turn the battery power switch to Standby mode (Ⓞ), then close lower door. Turn power switch On.

3 cu ft Models (Figure 5-2):

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 left side of the filter compartment.
2. Directly above the battery(s) is the battery power switch. Turn the battery power switch to the off position (O).
3. Remove the three wingnuts that secure the cover on the battery. Remove the cover.
4. Remove the battery from the mounting bracket.
5. 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 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 the Technical Services Department.

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

| Action | Monthly | Yearly | Every 2 Years |
|---|--|--------|---------------|
| Verify ambient temperature, <90°F | ✓ | | |
| Check and clean probe cover, gaskets, hinges and lid(s) of ice and snow. See Figure 1-5 for probe location. See "Clean Lid Gasket". | ✓ <i>More frequent cleaning may be required, depending on use and environmental conditions.</i> | | |
| Check air filter. Clean or replace as needed. See "Clean Air Filter". | | ✓ 4X | |
| Check alarm back-up battery. See "Connect Unit to Electrical Power" in Section 1 and "Replace Battery" in Section 5. | ✓ | | **Replace |
| Check condenser fan motor for unusual motor noise or vibration. | | ✓ | |
| * Verify and document calibration, at the minimum, annually. See Section 2 Calibration. | | ✓ | |
| * Clean condenser compartment and wipe off condenser. See "Clean Condenser" in Section 5. | | ✓ | |
| Recommended Maintenance *Back-up System - inject test & battery. See Section 6. | ✓ | | |

* *Qualified service technicians only*

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

Section 6 Factory Installed Options

Back Up System (BUS) - P/N 1950445, 1950447

Note 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.

Install Injection Assembly

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

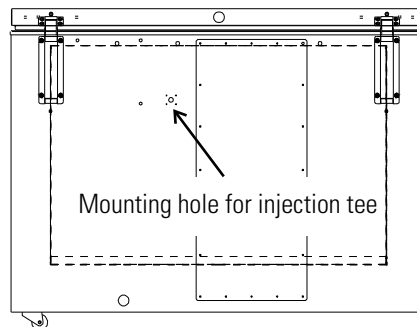


Figure 6-1. Mounting location

1. Locate the mounting hole for installing the injection tee assembly. See Figure 6-1.

Note Cover 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 exterior hole.

Install Injection Assembly (continued)

4. Remove the tape covering 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. Go to the interior and seal around injection assembly with Permagum.

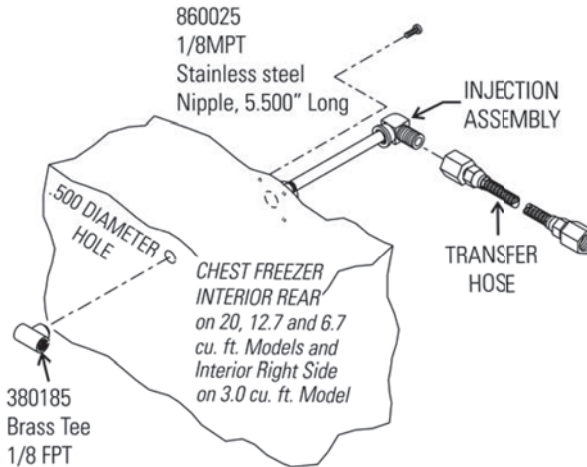


Figure 6-2. Injection Assembly

6. 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.

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

Install Temperature Probe

1. Plug the solenoid/probe connector into the BUS connection. Loop the probe wire back into the base/side car. Secure the connector with a screw on the ends of the connector. The connector is keyed.
2. Route the temperature probe through the probe port. The probe port is located in the upper right corner (viewed from the side) of 12.7 and 20 cu. ft. models, and in the lower right corner (viewed from the back) of 3.0 cu. ft. models.

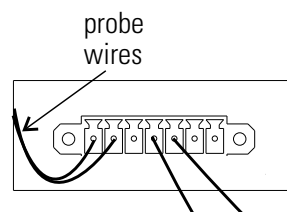


Figure 6-3. Probe and Solenoid Connections

Install Temperature Probe (continued)

- Carefully remove the existing Permagum sealant from around the probe port opening.
- Open the freezer lid and locate the probe cover on the upper front left wall. Remove the two Phillips head screws securing the probe cover (see Figure 6-5).

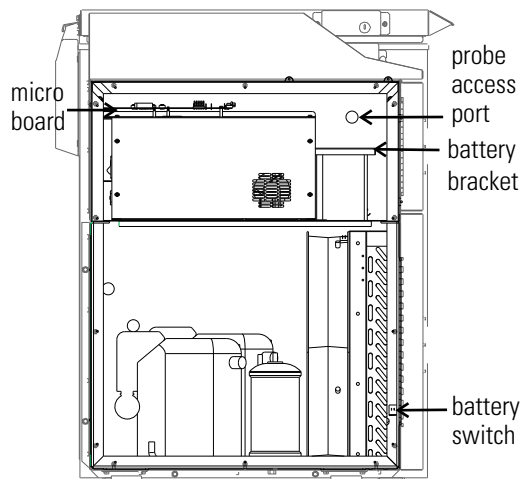


Figure 6-4. Probe Access Port

- Route the BUS probe through the probe port, approximately 12". Secure the back-up probe to the temperature probe using a small tie wrap (Figure 6-5).

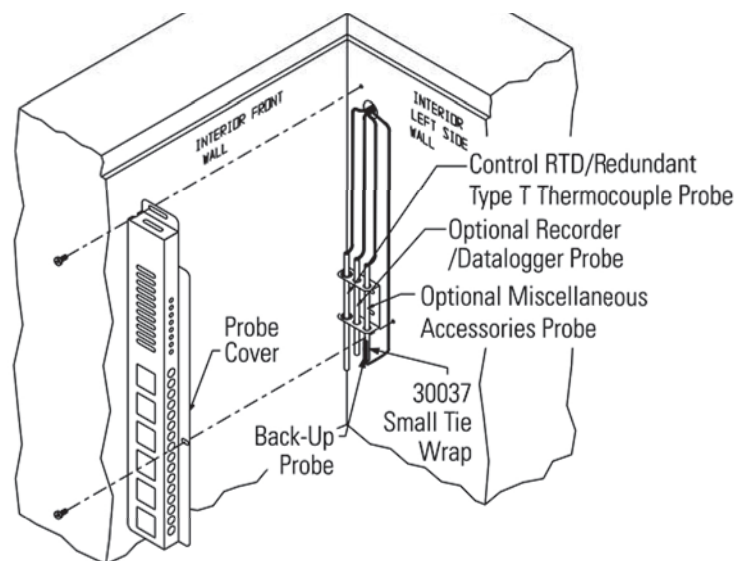


Figure 6-5. Probe location

- Seal around the interior and exterior opening of the probe port with Permagum sealant.
- Reinstall the probe cover (Figure 6-5).

Connect Probe/Solenoid Harness

1. Carefully coil the extra probe lead in the compressor compartment, and secure it to the compartment wall with a tie wrap and tie wrap anchor provided. Additional tie wraps and anchors may be used to secure the probe lead to the exterior back wall of the freezer.
2. Loosen the terminal screws on the solenoid. Slide the spade lug connectors under the screws and tighten to secure.
3. Connect power to the freezer. Turn the freezer On, with battery switch Off (O).
 - a. The Solenoid Engaged light on the BUS control panel illuminates (no injection occurs). This light stays on until the unit is below BUS setpoint.
 - b. The Low Battery indicator may also illuminate.
4. Turn the battery switch to Standby mode (⏻) to charge both batteries.

BUS Control Panel

The following section describes the configuration and operation of the BUS.



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. ▲

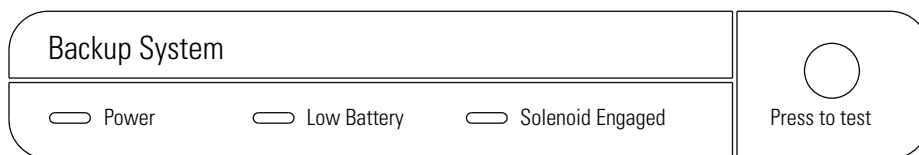


Figure 6-6. BUS Control Panel

BUS Control Panel (continued)

Power - indicates the unit has AC power.

Low Battery - battery charge is low. The battery needs replaced or recharged.

Solenoid Engaged - BUS has opened the solenoid so it can inject gas (CO₂ or LN₂).

Press-To-Test - Activates the solenoid and injects LN₂ or CO₂ into the freezer chamber as long as the button is depressed. The solenoid engaged indicator should light. If the Low Battery indicator lights during the test, replace the BUS battery.

Note The solenoid will not engage if lid is open. ▲

Caution The back-up system is designed to inject CO₂ or LN₂. In the unlikely event of back-up system failure, the back-up system will activate and allow CO₂ or LN₂ to flow until stopped manually or is manually shut off. ▲

Configure Optional Back Up System (BUS)

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

Set Optional BUS Set Point

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 the Mode key until the Settings indicator lights.
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.
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.

Set Optional BUS Set Point (continued)



Warning Changing operating temp set point can affect BUS set point. BUS set point self adjusts to maintain a temp of at least 10°C above the operating temp set point. ▲

Note The BUS set point cannot be set any colder than the high temperature alarm set point. (See Section 1 - Setting the High Temperature Alarm). 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 the BUS Operation

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

1. Disconnect the AC power to the freezer by turning 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. **Recommended Maintenance** - Monthly maintenance action to check CO₂ or LN₂ back-up system operation, alarms and battery voltage.

Disconnect Fitting Assembly, Transfer Hose

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

1. Close the supply valve.
2. Depress the test button on the Back-Up System control box to remove the 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

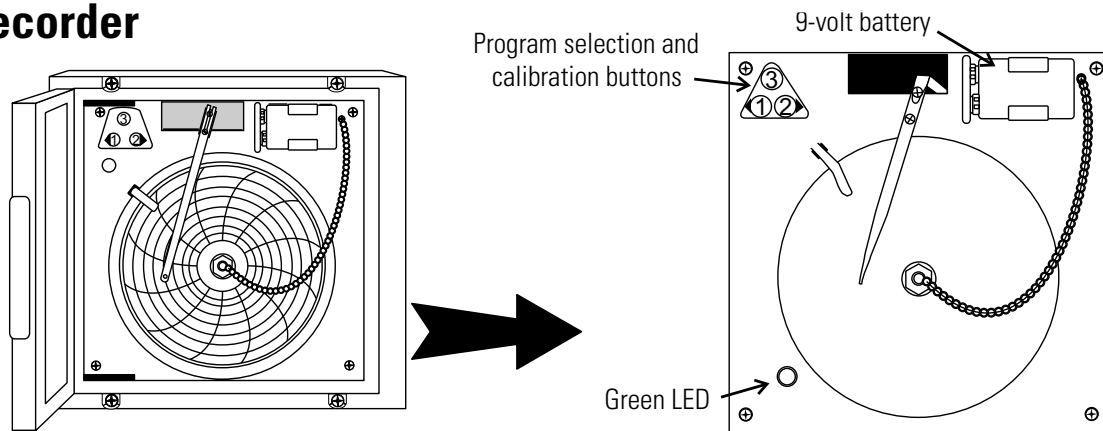


Figure 6-7. Recorder Details

Install Chart Paper

The following sections describes the set up and operation of the optional chart recorder.

1. Open the plastic 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.

Change Program

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

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 |

Calibrate Chart Recorder

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.

Section 6

Factory Installed Options

Calibrate Chart Recorder (continued)

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. ▲

Section 7 Specifications

| Number (Model) | TSC390A (8763) | TSC390V (8764) |
|--|---|--|
| Temperature Range | -50°C (-58°F) to -86°C (-123°F) in an 18C to 32C * (64.4F to 89.6F) ambient | |
| Exterior Dimensions | 28.5"W x 43.8" H x 29.9" F-B (72.4cm x 111.3cm x 75.9cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | |
| Interior Dimensions | 18.5"W x 16.5"H x 18.5" F-B (47.0cm x 41.9cm x 47.0cm) | |
| Capacity | 3.0 cu. ft. (84.9 liters) | |
| Refrigeration | Cascade system, (2) hermetically-sealed compressors | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | |
| Electrical - nominal voltage ±10% | 115VAC, 1 PH, 60 Hz, 10.5 FLA Operating Range: 108VAC-130VAC | 230VAC, 1 PH, 50 Hz, 5.4 FLA Operating Range: 208VAC-240VAC |
| Breaker Requirements | 15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker | 15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker |
| Shipping Weight | 432 lbs. (196kg) | |

| Number (Model) | TSC1390D (8765) | TSC1390V (8767) | TSC1390A (8768) |
|--|--|---|---|
| Temperature Range | -50°C (-58°F) to -86°C (-123°F) in an 18C to 32C * (64.4F to 89.6F) ambient | | |
| Exterior Dimensions | 72.0"W x 40.5" H x 33.4" F-B (182.9cm x 102.9cm x 84.8cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | | |
| Interior Dimensions | 42.5"W x 28.0"H x 18.5" F-B (108.0cm x 71.1cm x 47.0cm) | | |
| Capacity | 12.7 cu. ft. (360 liters) | | |
| Refrigeration | Cascade system, (2) hermetically-sealed compressors | | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | | |
| Electrical - nominal voltage ±10% | 230VAC, 1 PH, 50 Hz, 12.0 FLA Operating Range: 208VAC-240VAC | 230VAC, 1 PH, 60 Hz, 12.0 FLA Operating Range: 208VAC-240VAC | 120VAC, 1 PH, 60 Hz, 16.0 FLA Operating Range: 108VAC-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 | 716 lbs. (325kg) | | |

Section 7
Specifications

| Number (Model) | TSC1790A (8769) | TSC1790V (8770) | TSC1790D (8771) |
|--|--|---|---|
| Temperature Range | -50°C (-58°F) to -86°C (-123°F) in an 18C to 32C * (64.4F to 89.6F) ambient | | |
| Exterior Dimensions | 87.6.0"W x 40.5" H x 33.8" F-B (222.5cm x 102.9cm x 85.9cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | | |
| Interior Dimensions | 58.8"W x 28.0"H x 18.5" F-B (149.4cm x 71.1cm x 47.0cm) | | |
| Capacity | 17.0 cu. ft. (481.4 liters) | | |
| Refrigeration | Cascade system, (2) hermetically-sealed compressors | | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | | |
| Electrical - nominal voltage ±10% | 120VAC, 1 PH, 60 Hz, 16.0 FLA Operating Range: 108VAC-130VAC | 230VAC, 1 PH, 50 Hz, 12.0 FLA Operating Range: 208VAC-240VAC | 230VAC, 1 PH, 60 Hz, 12.0 FLA Operating Range: 208VAC-240VAC |
| 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 |
| Shipping Weight | 821 lbs. (372kg) | | |

| Number (Model) | TSC2090V (8772) | TSC2090D (8773) | TSC2090A (8774) |
|--|--|---|---|
| Temperature Range | -50°C (-58°F) to -86°C (-123°F) in an 18C to 32C * (64.4F to 89.6F) ambient | | |
| Exterior Dimensions | 96.0"W x 40.5" H x 33.4" F-B (243.8cm x 102.9cm x 84.8cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | | |
| Interior Dimensions | 66.5"W x 28.0"H x 18.5" F-B (168.9cm x 71.1cm x 47.0cm) | | |
| Capacity | 20.0 cu. ft. (566.3 liters) | | |
| Refrigeration | Cascade system, (2) hermetically-sealed compressors | | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | | |
| Electrical - nominal voltage ±10% | 230VAC, 1 PH, 50 Hz, 12.0 FLA Operating Range: 208VAC-240VAC | 230VAC, 1 PH, 60 Hz, 12.0 FLA Operating Range: 208VAC-240VAC | 120VAC, 1 PH, 60 Hz, 16.0 FLA Operating Range: 108VAC-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 | 833 lbs. (378kg) | | |

| Number (Model) | TSC350A (8775) | TSC350V (8776) |
|--|---|--|
| Temperature Range | -10°C (-14°F) to -40°C (-40°F) in an 18C to 32C * (64.4F to 89.6F) ambient | |
| Exterior Dimensions | 28.5"W x 43.8" H x 29.9" F-B (72.4cm x 111.3cm x 75.9cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | |
| Interior Dimensions | 18.5"W x 16.5"H x 18.5" F-B (47.0cm x 41.9cm x 47.0cm) | |
| Capacity | 3.0 cu. ft. (84.9 liters) | |
| Refrigeration | Hermetically-sealed compressor | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | |
| Electrical - nominal voltage ±10% | 115VAC, 1 PH, 60 Hz, 6.0 FLA Operating Range: 108VAC-130VAC | 230VAC, 1 PH, 50 Hz, 3.0 FLA Operating Range: 208VAC-240VAC |
| Breaker Requirements | 15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker | 15 Amp Dedicated Circuit, 15 Amp Time Delay Breaker |
| Shipping Weight | 395 lbs. (179kg) | |

| Number (Model) | TSC1350V (8777) | TSC1350D (8778) | TSC1350A (8779) |
|--|--|--|--|
| Temperature Range | -10°C (-14°F) to -40°C (-40°F) in an 18C to 32C * (64.4F to 89.6F) ambient | | |
| Exterior Dimensions | 72.0"W x 40.5" H x 33.4" F-B (182.9cm x 102.9cm x 84.8cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | | |
| Interior Dimensions | 42.5"W x 28.0"H x 18.5" F-B (108.0cm x 71.1cm x 47.0cm) | | |
| Capacity | 12.7 cu. ft. (360 liters) | | |
| Refrigeration | Hermetically-sealed compressor | | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | | |
| Electrical - nominal voltage ±10% | 230VAC, 1 PH, 50 Hz, 3.0 FLA Operating Range: 208VAC-240VAC | 230VAC, 1 PH, 60 Hz, 3.0 FLA Operating Range: 208VAC-240VAC | 120VAC, 1 PH, 60 Hz, 6.0 FLA Operating Range: 108VAC-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 | 659 lbs. (299kg) | | |

Section 7
Specifications

| Number (Model) | TSC1750A (8780) | TSC1750V (8781) | TSC1750D (8782) |
|--|--|--|--|
| Temperature Range | -10°C (-14°F) to -40°C (-40°F) in an 18C to 32C * (64.4F to 89.6F) ambient | | |
| Exterior Dimensions | 87.6.0"W x 40.5" H x 33.8" F-B (222.5cm x 102.9cm x 85.9cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | | |
| Interior Dimensions | 58.8"W x 28.0"H x 18.5" F-B (149.4cm x 71.1cm x 47.0cm) | | |
| Capacity | 17.0 cu. ft. (481.4 liters) | | |
| Refrigeration | Hermetically-sealed compressor | | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | | |
| Electrical - nominal voltage ±10% | 120VAC, 1 PH, 60 Hz, 9.0 FLA Operating Range: 108VAC-130VAC | 230VAC, 1 PH, 50 Hz, 7.0 FLA Operating Range: 208VAC-240VAC | 230VAC, 1 PH, 60 Hz, 7.0 FLA Operating Range: 208VAC-240VAC |
| 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 |
| Shipping Weight | 764 lbs. (347kg) | | |

| Number (Model) | TSC2050V (8783) | TSC2050D (8784) | TSC2050A (8785) |
|--|--|--|---|
| Temperature Range | -10°C (-14°F) to -40°C (-40°F) in an 18C to 32C * (64.4F to 89.6F) ambient | | |
| Exterior Dimensions | 96.0"W x 40.5" H x 33.4" F-B (243.8cm x 102.9cm x 84.8cm) Add 7.9" (20.1cm) to F-B for wall spacer/handle. | | |
| Interior Dimensions | 66.5"W x 28.0"H x 18.5" F-B (168.9cm x 71.1cm x 47.0cm) | | |
| Capacity | 20.0 cu. ft. (566.3 liters) | | |
| Refrigeration | Hermetically-sealed compressor | | |
| Insulation | Non CFC, foamed-in-place urethane: 5.0" (12.7cm) cabinet; 2.0" (5.0cm) lid; 1.0" (12.5cm) sub-lids | | |
| Electrical - nominal voltage ±10% | 230VAC, 1 PH, 50 Hz, 6.5 FLA Operating Range: 208VAC-240VAC | 230VAC, 1 PH, 60 Hz, 6.5 FLA Operating Range: 208VAC-240VAC | 120VAC, 1 PH, 60 Hz, 10.0 FLA Operating Range: 108VAC-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 | 776 lbs. (352kg) | | |

Certifications

Declaration of Conformity is available from the factory

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

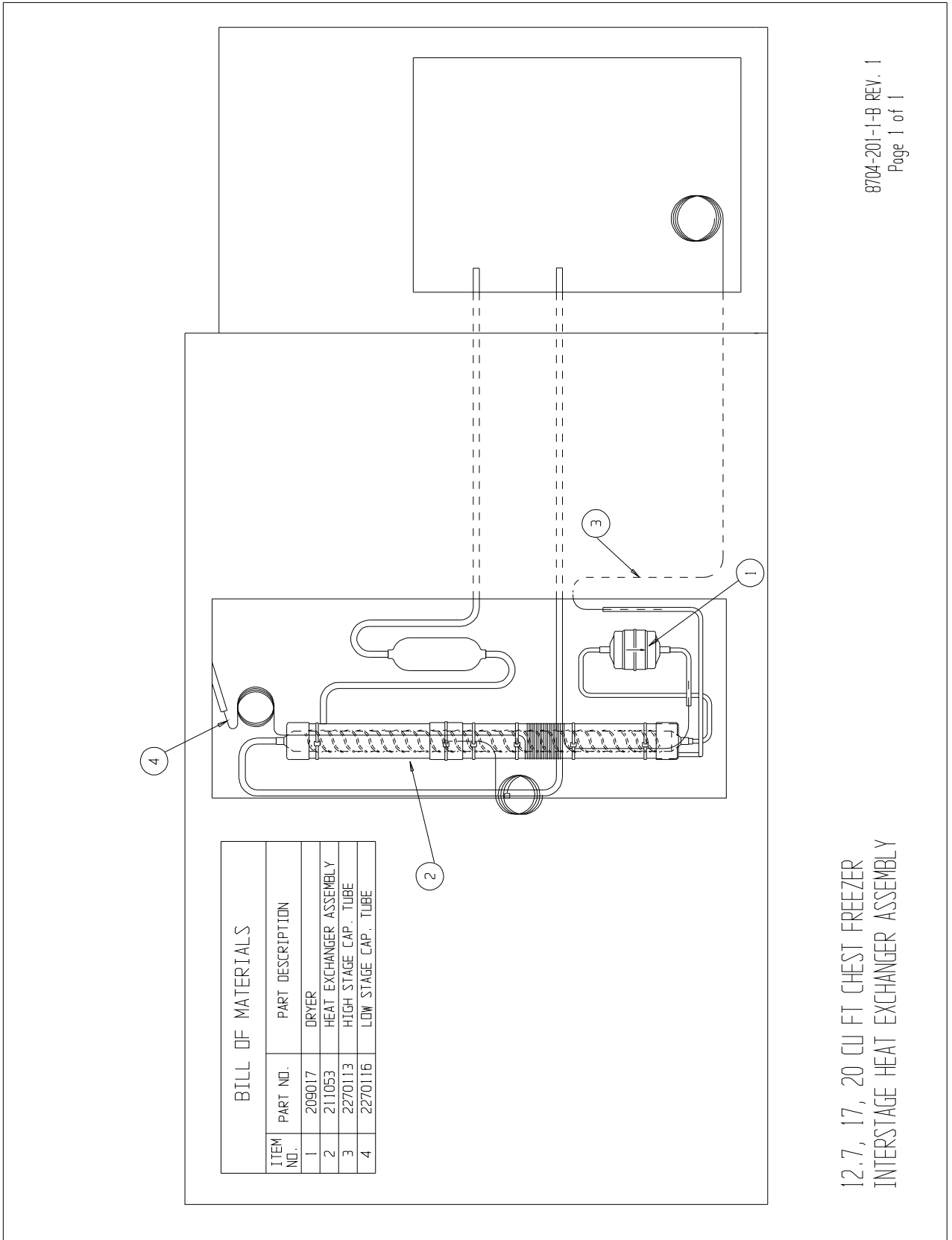
Intended Use

This product is intended for use as a General Purpose Laboratory Freezer for storing samples or inventory between -40 and -86C.

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.

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.



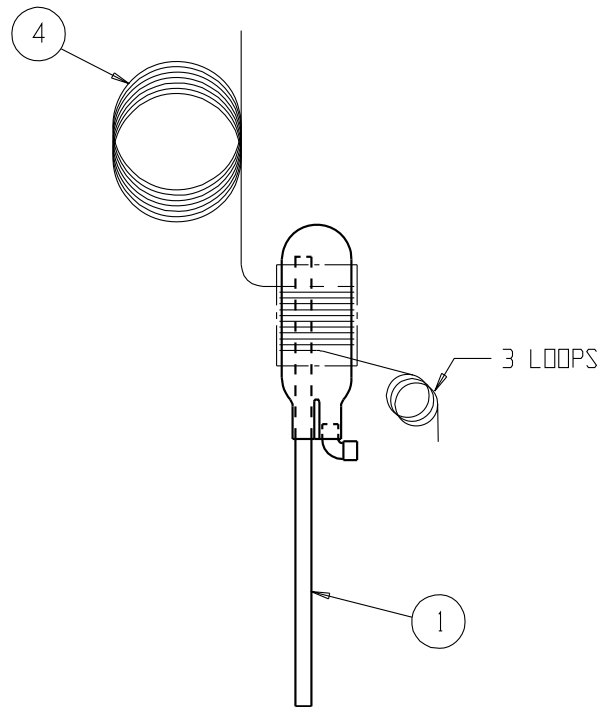
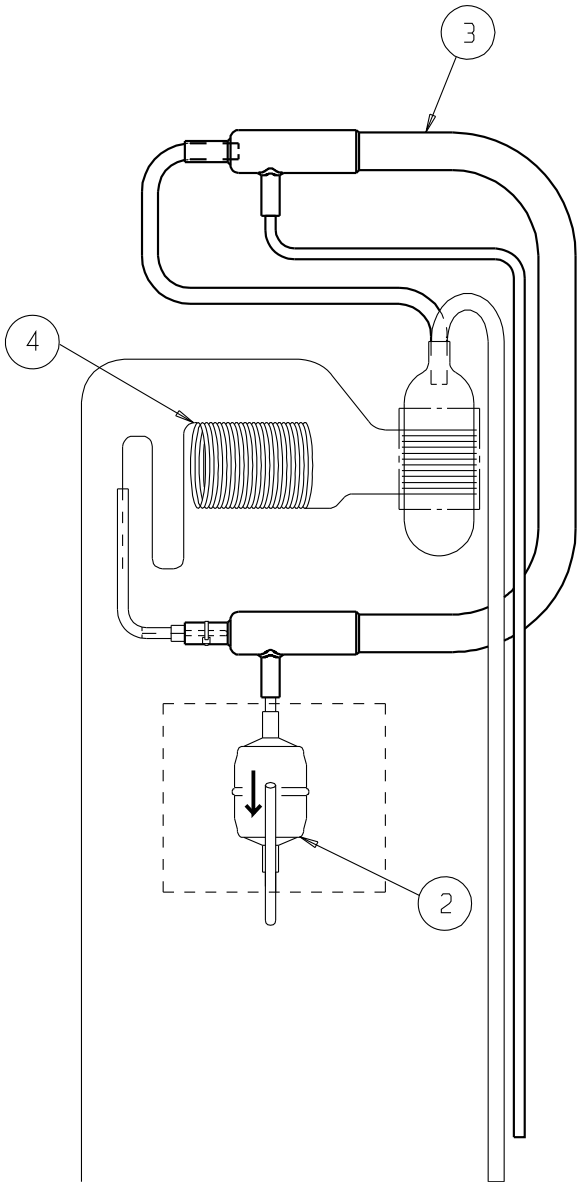
8704-201-1-B REV. 1
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12.7, 17, 20 CU FT CHEST FREEZER
INTERSTAGE HEAT EXCHANGER ASSEMBLY

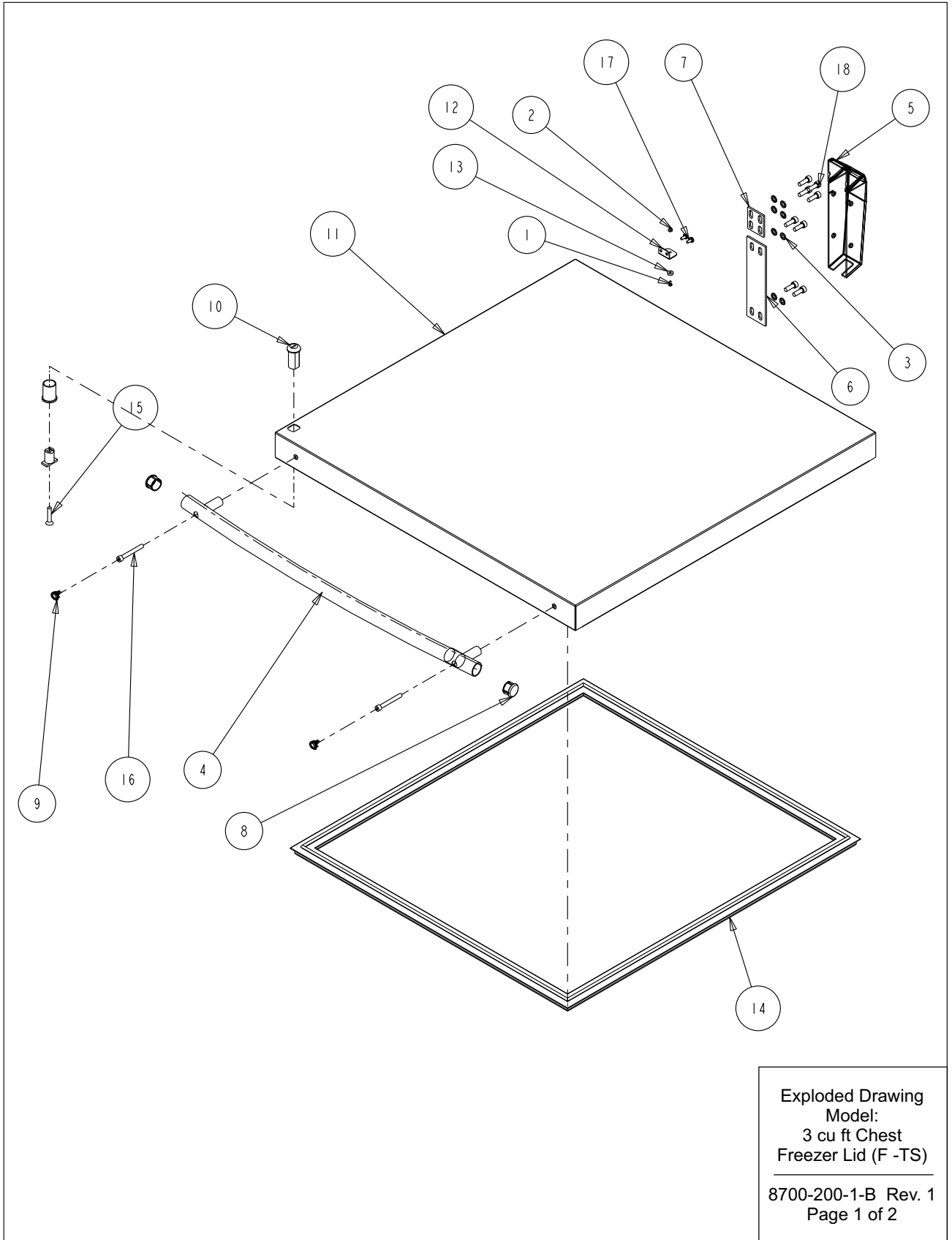
Section 8
Spare Parts

BILL OF MATERIALS

| ITEM NO. | PART NO. | PART DESCRIPTION |
|----------|----------|----------------------------|
| 1 | 202003 | ACCUMULATOR ASSEMBLY |
| 2 | 209019 | DRYER |
| 3 | 211044 | HEAT EXCHANGER ASSEMBLY |
| 4 | 227992 | HIGH & LOW STAGE CAP. TUBE |



Exploded Drawing
3 cu ft Chest Freezer
Heat Exchanger
8700-201-1-B Rev. 0
Page 1 of 1

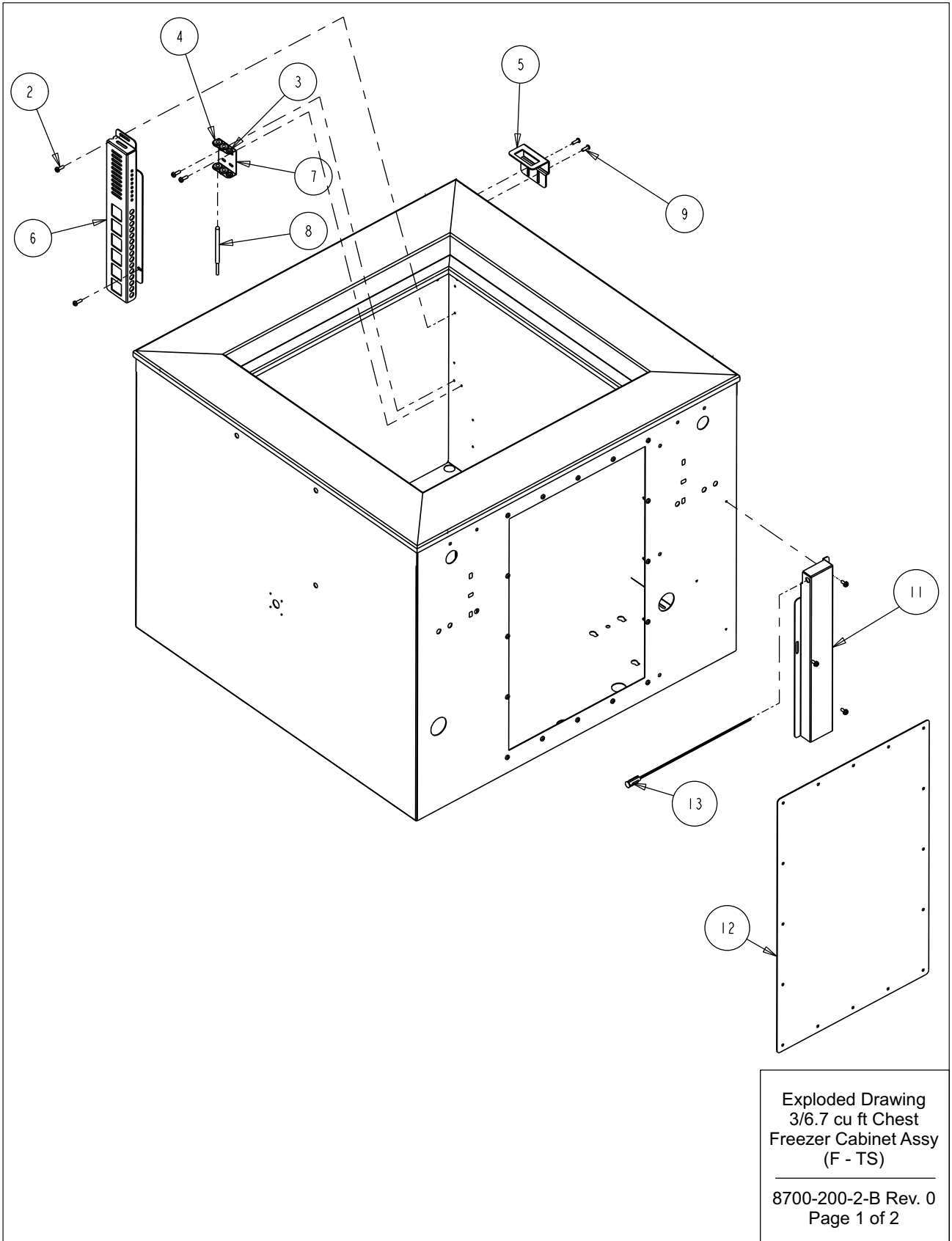


Section 8
Spare Parts

| BILL OF MATERIALS | | |
|-------------------|----------|--------------------------------------|
| ITEM NO. | PART NO. | PART DESCRIPTION |
| 1 | 22130 | #4-40 X 1/4 SS PHP SCREW |
| 2 | 23005 | #4-40 SS HEX NUT |
| 3 | 23062 | 1/4 SS EXT TOOTH LOCKWASHER |
| 4 | 115038 | 646 SID BLUE RADIUSED HANDLE |
| 5 | 116136 | SPRING LOADED HINGE |
| 6 | 116137 | HINGE SHIM LAYOUT |
| 7 | 116138 | HINGE SHIM LAYOUT |
| 8 | 180314 | THERMO ULT CHEST HANDLE END CAP |
| 9 | 180315 | ULT CHEST HANDLE SCREW COVER |
| 10 | 195332 | LOCK MOUNT ASSEMBLY |
| 11 | 195950 | 3.0 CU. FT. CHEST FREEZER LID |
| 12 | 195970 | 3/6.7 LID SWITCH MAGNET MOUNT |
| 13 | 360257 | SWITCH MAGNET |
| 14 | 431148 | 3.0 CU. FT. CHEST FREEZER LID GASKET |
| 15 | 490023 | #1/4-28 X 1-1/4 SS FHP SCREW |
| 16 | 530027 | 1/4-20 X 2L SS HEX SOCKET CAP SCREW |
| 17 | 590020 | #8-32 X 3/8 SS PHP EXT SEMS SCREW |
| 18 | 3176861 | 1/4-20 x 3/4 SOCKET HEAD SCREW |

Exploded Drawing
Model:
3 cu ft Chest
Freezer Lid (F -TS)

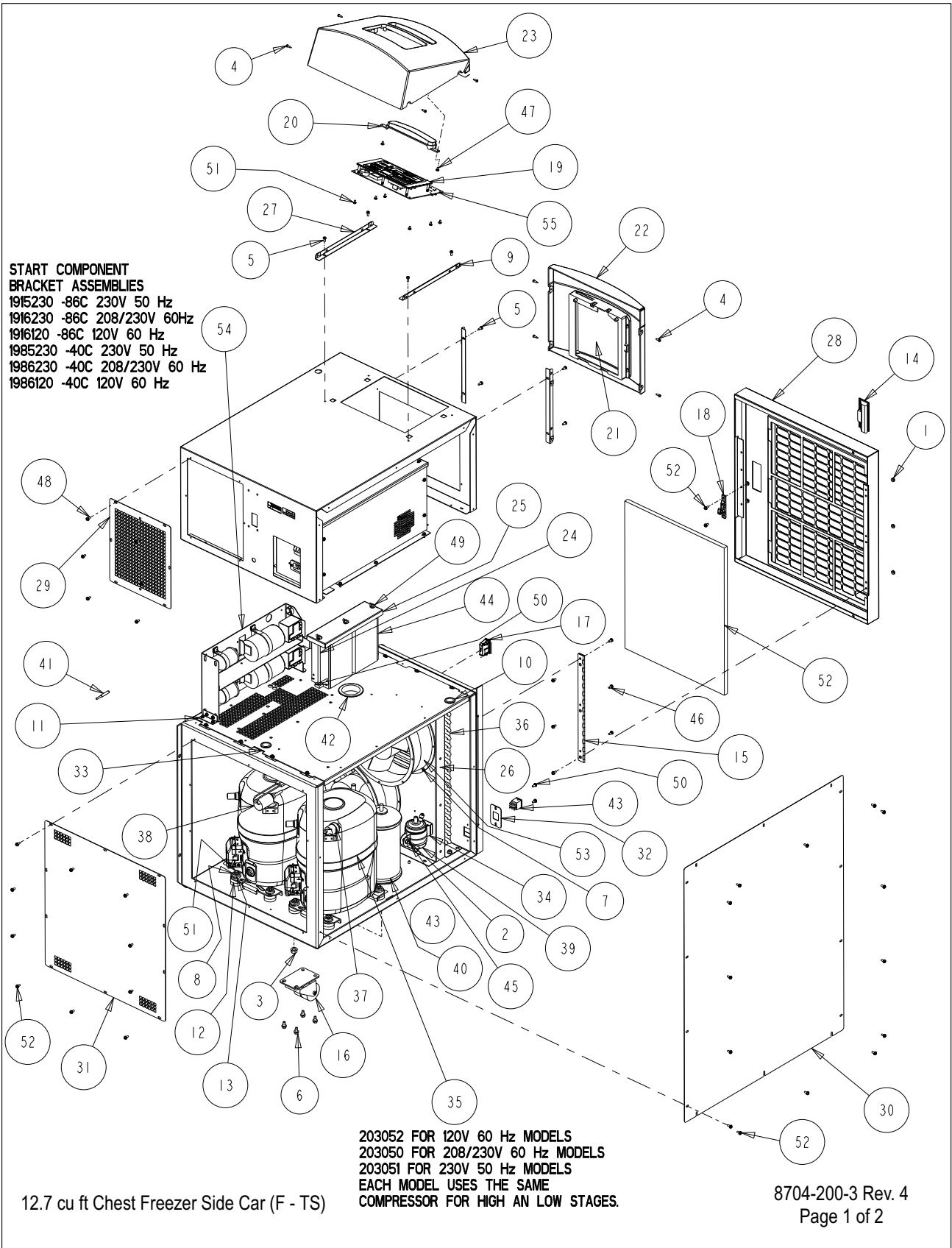
8700-200-1-B Rev. 1
Page 2 of 2



Section 8
Spare Parts

| BILL OF MATERIALS | | |
|-------------------|-------------|-----------------------------------|
| ITEM NO. | PART NO. | PART DESCRIPTION |
| 1 | 24030 | #8 X 1/2" TEKS SCREW |
| 2 | 24042 | #8-32 X 1/2 SS PHP SCREW F POINT |
| 3 | 30073 | 5/16" X 3/16" ID GROMMET |
| 4 | 114020 | 5/8" X 1/2" ID GROMMET |
| 5 | 189526 | LID LOCK MOUNT LAYOUT |
| 6 | 195866 | PROBE GUARD |
| 7 | 195867 | PROBE MOUNT |
| 8 | 290176 | CONTROL PROBE |
| 9 | 550022 | #8-32 X 1/2L BUTTON HD TORX SCREW |
| 10 | 590020 | #8-32 X 3/8 SS PHP EXT SEMS SCREW |
| 11 | 1950371 | 3 C.F. CHEST LID SWITCH BRACKET |
| 12 | 195622-34-1 | REAR COVER PLATE |
| 13 | 360230 | MAGNETIC SWITCH |

Exploded Drawing
3/6.7 cu ft Chest
Freezer Cabinet Assy
(F - TS)
8700-200-2-B Rev. 0
Page 2 of 2

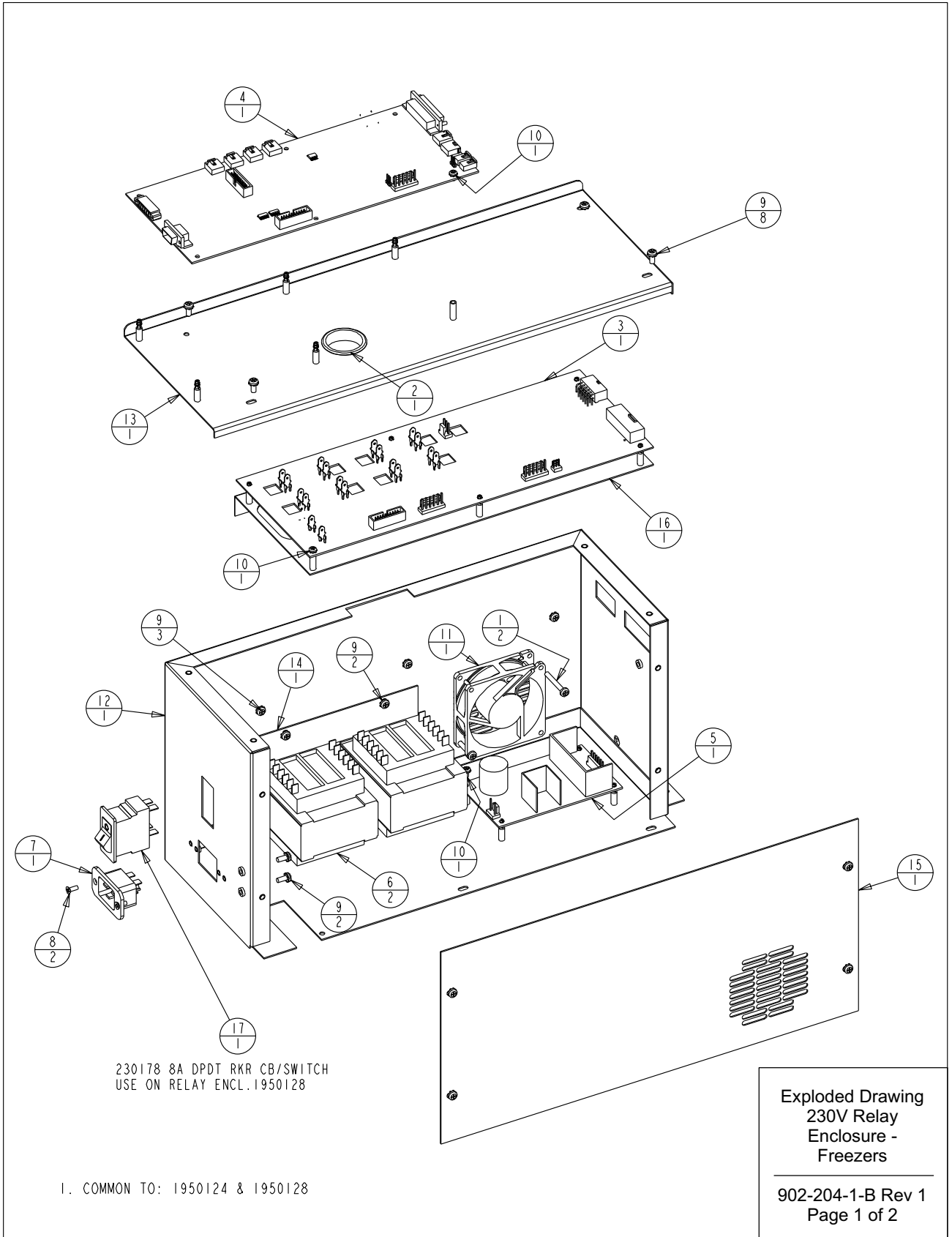


Section 8
Spare Parts

| | | | 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 | 24016 | #6 X 1/2" SS PHP SCREW AB POINT |
| | | | 5 | 24032 | #8-32 X 3/8 SS PHP SCREW F POINT |
| | | | 6 | 24038 | 1/4-20 X 1/2 SELF TAPPING SCREW |
| | | | 7 | 24042 | #8-32 X 1/2 SS PHP SCREW F POINT |
| | | | 8 | 24049 | 1/4 ZP FLAT WASHER |
| | | | 9 | 25040 | #6 U SPEED NUT STL. STL. |
| | | | 10 | 30016 | 1" SNAP BUSHING |
| | | | 11 | 111047 | COMPONENT ASSEMBLY HOLD DOWN BRACKET |
| | | | 12 | 114033 | COMPRESSOR MOUNTING FOOT |
| | | | 13 | 114034 | COMPRESSOR MOUNTING SLEEVE |
| | | | 14 | 115032 | BLACK ABS PLASTIC PULL |
| | | | 15 | 116115 | FRONT PANEL HINGE |
| | | | 16 | 120011 | DUAL WHEEL CASTER |
| | | | 17 | 121071 | LATCH CATCH, PART OF 121071 ASSEMBLY |
| | | | 18 | 121071 | LATCH KEEPER, PART OF 121071 ASSEMBLY |
| | | | 19 | 140452 | CONTROL PANEL ASSEMBLY |
| | | | 20 | 180306 | THERMO BACK-UP SYSTEM BLANK PANEL "SID BLUE" |
| | | | 21 | 180308 | CONTROL CENTER RECORDER BLANK "SID BLU" |
| | | | 22 | 180311 | THERMO SIDE CAR RECORDER BEZEL |
| | | | 23 | 180327 | THERMO CHEST CONTROL CENTER BEZEL |
| | | | 24 | 191385 | FILTER HOLD DOWN ROD |
| | | | 25 | 195768 | BATTERY MOUNT TOP |
| | | | 26 | 195782 | CHEST FREEZER FAN SHROUD |
| | | | 27 | 195783 | CHEST FREEZER CONTROL PANEL MOUNTING ANGLE |
| | | | 28 | 195791 | CHEST FREEZER FRONT PANEL ASSEMBLY |
| | | | 29 | 195806 | CHEST FREEZER REAR ACCESS PANEL |
| | | | 30 | 195807 | CHEST FREEZER SIDE CAR SIDE COVER |
| | | | 31 | 195808 | CHEST FREEZER SIDE CAR REAR PANEL |
| | | | 32 | 195931 | 3.0 & 6.7 CU. FT. BATTERY SWITCH BRACKET |
| | | | 33 | 195949 | CHEST FREEZER SIDE CAR DIVIDER |
| 34 | 200126 | 2" RIGID HANGER | | | |
| 35 | 203050 | BRISTOL HIGH/LOW STAGE COMPRESSOR | | | |
| 36 | 204010 | CONDENSER W/DESUPERHEATER | | | |
| 37 | 207008 | PRESSURE SWITCH | | | |
| 38 | 207010 | PRESSURE SWITCH | | | |
| 39 | 209020 | LIQUID LINE FILTER DRYER WITH ACCESS PORT | | | |
| 40 | 214023 | OIL SEPARATOR | | | |
| 41 | 290178 | CONDENSER PROBE | | | |
| 42 | 330039 | 2-1/2" SNAP BUSHING | | | |
| 43 | 360248 | MINI SNAP-IN POWER SWITCH | | | |
| 44 | 400159 | SEALED LEAD ACID BATTERY - 12 VOLT - 7.2 Ah | | | |
| 45 | 550043 | 1/4-20 X 1"L ZP CARRIAGE BOLT | | | |
| 46 | 590020 | #8-32 X 3/8 SS PHP EXT SEMS SCREW | | | |
| 47 | 590027 | #6-32 X 1/4 SS PHP EXT SEMS SCREW | | | |
| 48 | 590029 | #8-32 X 3/8 SS PHP EXT SEMS SCREW W/PATCH | | | |
| 49 | 610009 | 1/4-20 S.S. WING NUT | | | |
| 50 | 610078 | 1/4-20 NUT RETAINER (.025-.063 PANEL) | | | |
| 51 | 680008 | 1/4-20 X 1-3/4 SELF TAPPING SCREW | | | |
| 52 | 760212 | 12, 17 AND 20 CU. FT. CHEST AIR FILTER | | | |
| 53 | 900113 | 10" TUBEAXIAL FAN, 115V | | | |
| 54 | 120230-01-1 | CHEST FREEZER START COMPONENT BRACKET ASSEMBLY | | | |
| 55 | 191953_ | FREEZER DISPLAY BOARD | | | |

12.7 cu ft Chest Freezer Side Car (F - TS)

8704-200-3 Rev. 4
Page 2 of 2



Section 8
Spare Parts

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|------|---|
| 0 | FR-2202 | 06-23-11 | KDG | KDG | DRP | RELEASED FOR PRODUCTION / REL. 6 |
| 1 | FR-2409 | 10-10-12 | AJC | KDG | CCS | REMOVED 1950122 & 1950126 LOW END BOXES |

| 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 |

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ThermoFisher
SCIENTIFIC

BOX 649, MARIETTA, OHIO 45750

MODEL/PART NAME: RELAY ENCLOSURE ASSEMBLY

DWG TITLE: 230 VOLT RELAY ENCLOSURE ASSY

DWN: KDG CAD: KDG APPD: DRP DATE: 06-23-11 SCALE: 0.250

MATERIAL: -

PAINT: N/A

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

DRAWING NUMBER

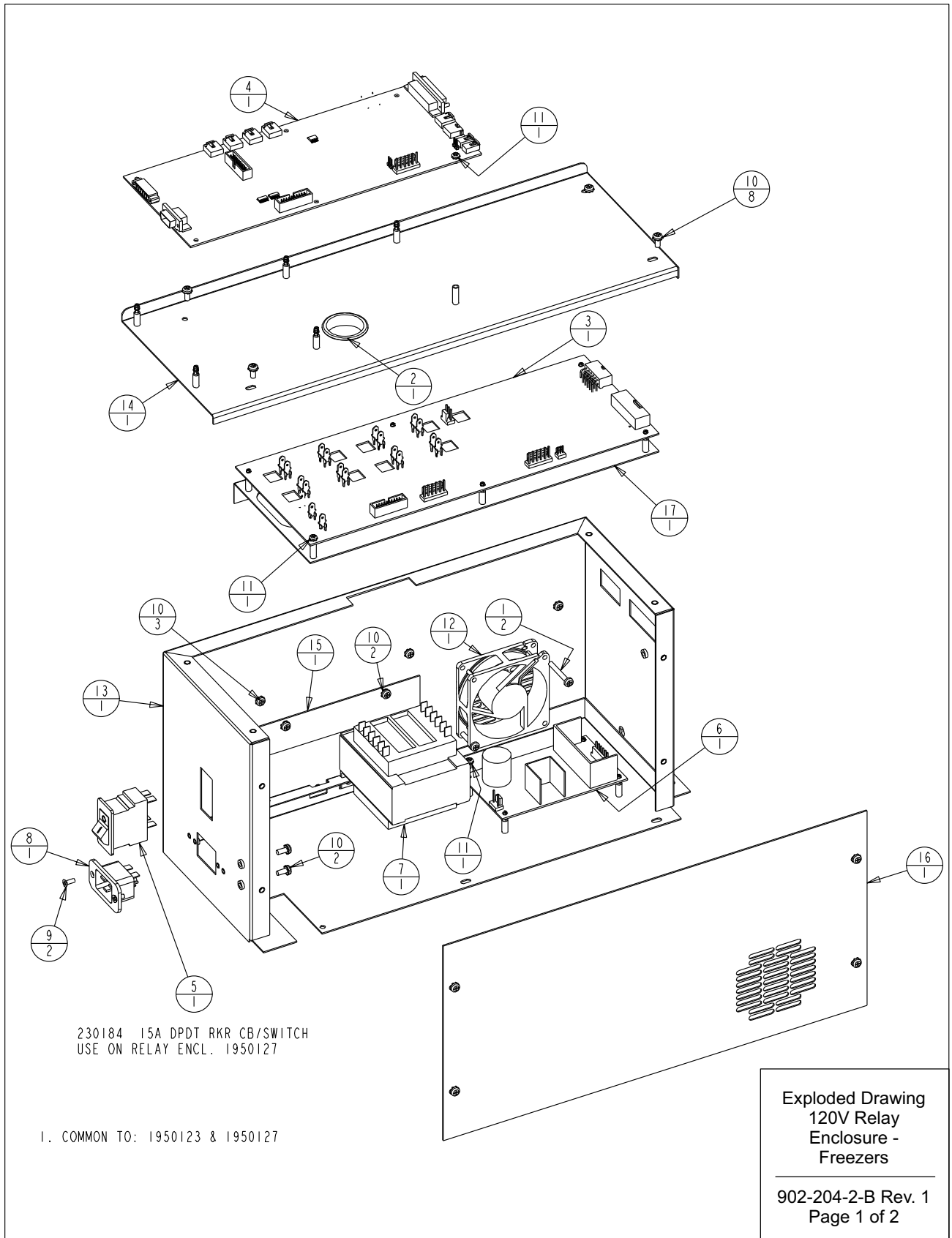
902-204-1

SIZE

B

Exploded Drawing
230V Relay
Enclosure -
Freezers

902-204-1-B Rev 1
Page 2 of 2



Section 8
Spare Parts

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|------|---|
| 0 | FR-2202 | 06-23-11 | KDG | KDG | DRP | RELEASED FOR PRODUCTION / REL. 6 |
| 1 | FR-2409 | 10-10-12 | AJC | KDG | CCS | REMOVED 1950121 & 1950125 LOW END BOXES |

| 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 | 230183 | 20A 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 |

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

ThermoFisher
SCIENTIFIC

BOX 649, MARIETTA, OHIO 45750

MODEL/PART NAME: RELAY ENCLOSURE ASSEMBLY

DWG TITLE: 120 VOLT RELAY ENCLOSURE ASSY

DWN: KDG CAD: KDG APPD: DRP DATE: 06-23-11 SCALE: 0.250

MATERIAL: -

PAINT: N/A

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

DRAWING NUMBER

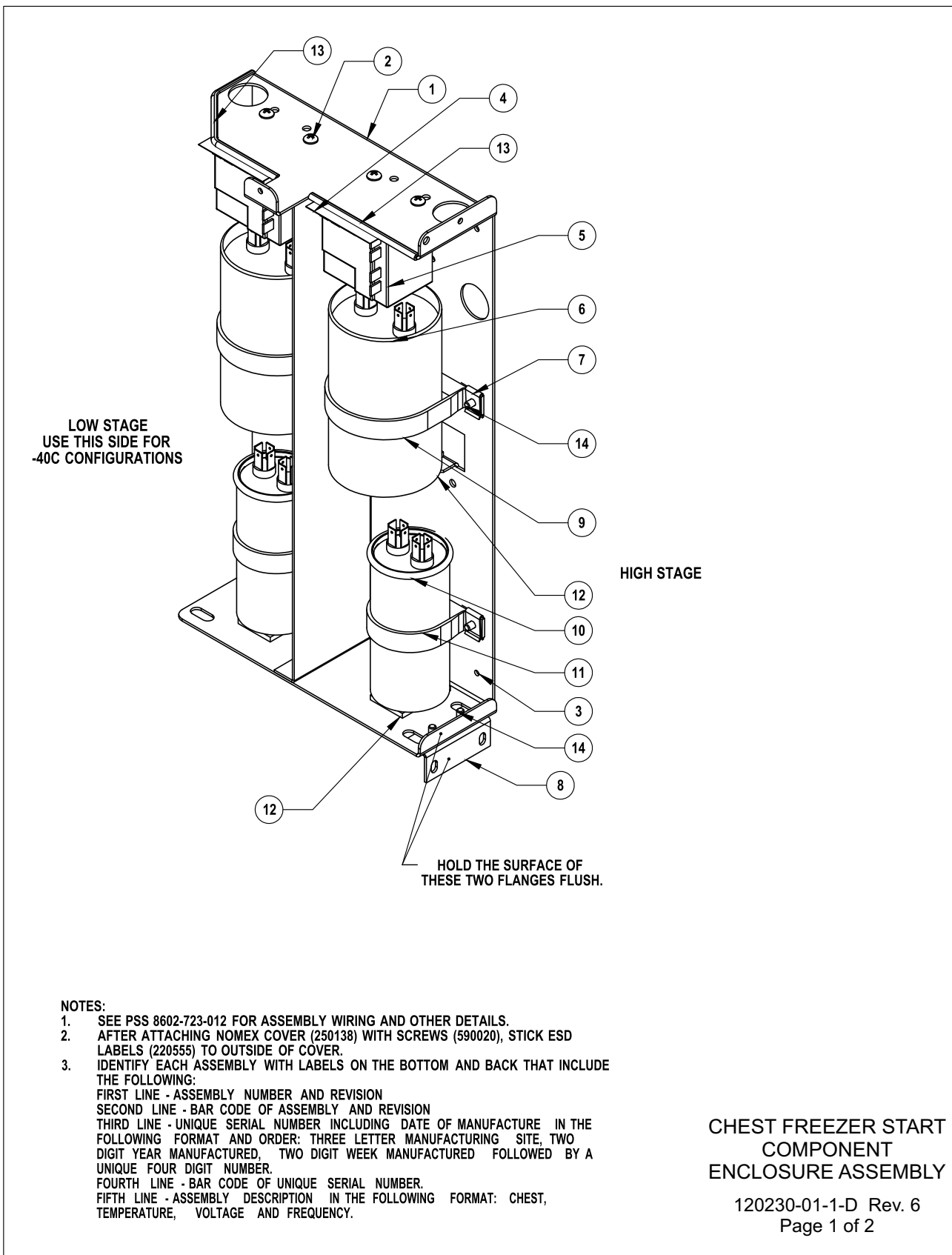
902-204-2

SIZE

B

Exploded Drawing
120V Relay
Enclosure -
Freezers

902-204-2-B Rev. 1
Page 2 of 2



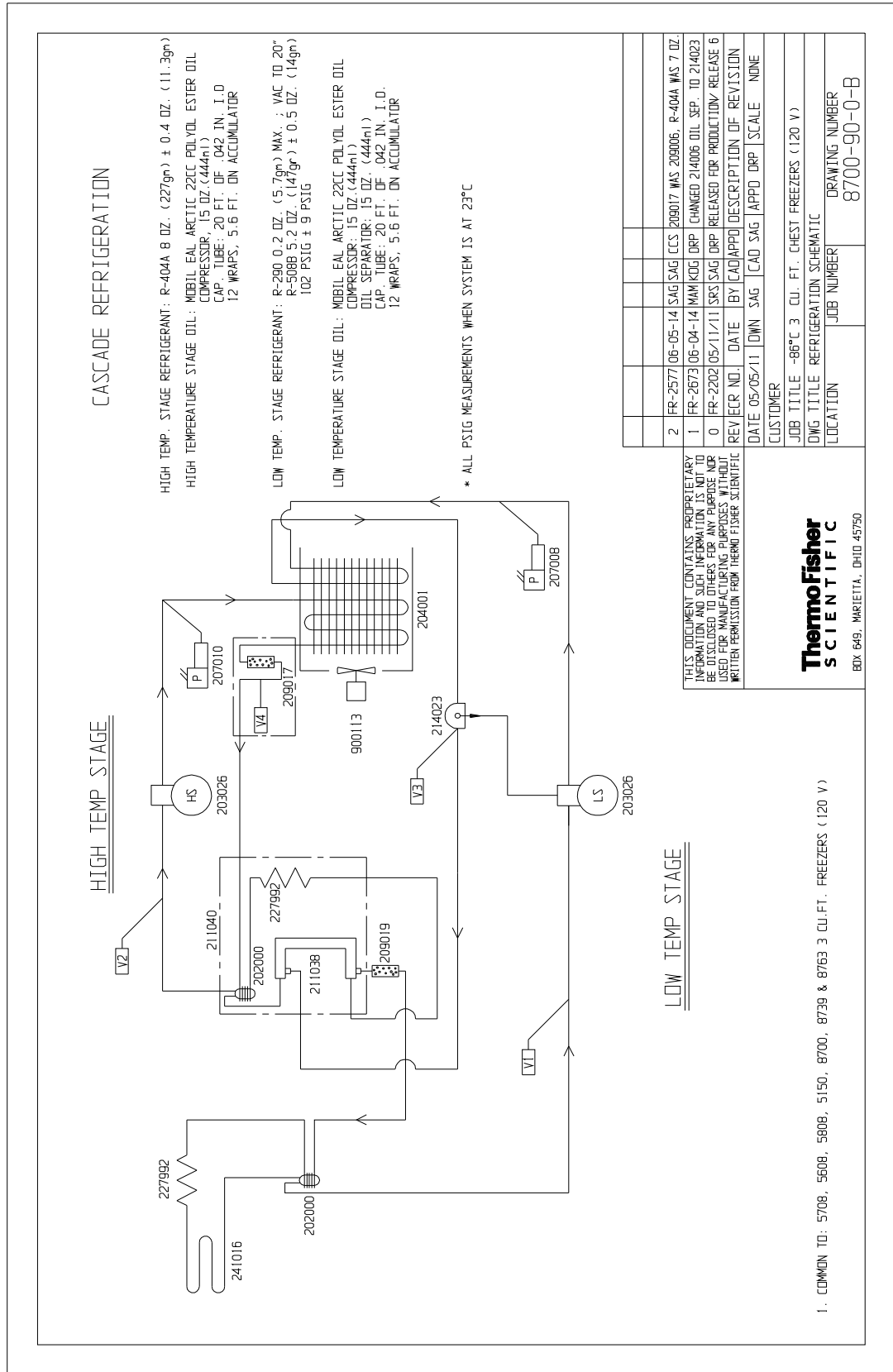
Section 8
Spare Parts

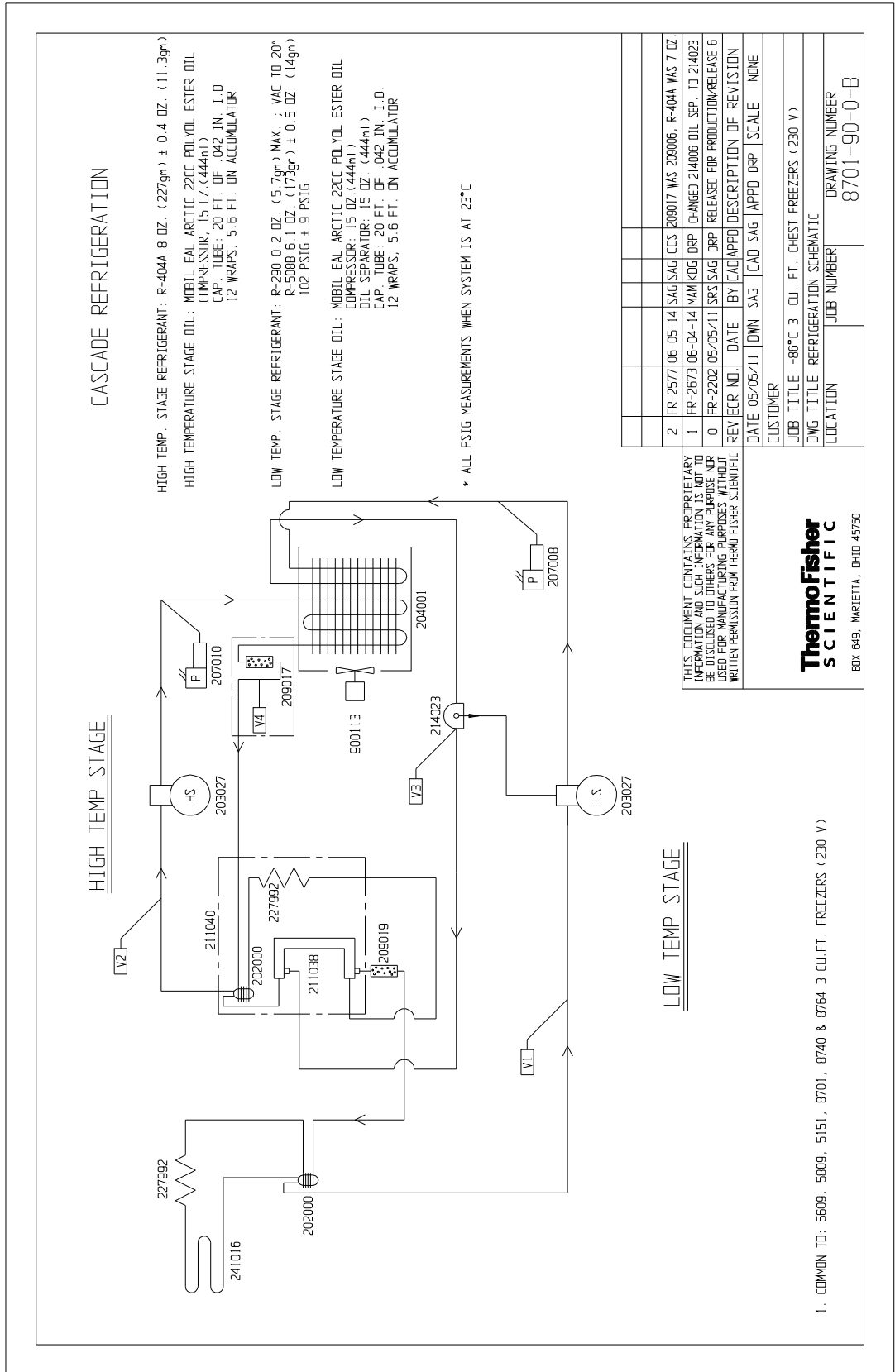
| CHEST FREEZER START COMPONENT BRACKET ASSEMBLIES | | | | | | | | |
|--|------------------------------|-----------------------------------|-------------------------------|----------------------------|----------------------------|--------------------------------|----------------------------|------------|
| ITEM NO. | DESCRIPTION | 1915230 -86C 230V 50 Hz | 1916230 -86C 208/230V 60Hz | 1916120 -86C 120V 60 Hz | 1985230 -40C 230V 50 Hz | 1986230 -40C 208/230V 60 Hz | 1986120 -40C 120V 60 Hz | |
| 1 | COMPONENT BRACKET | 120230 | 120230 | 120230 | 120230 | 120230 | 120230 | |
| 2 | #8 X 1/2 PHP TYPE B | 680013 (4) | 680013 (4) | 680013 (4) | 680013 (2) | 680013 (2) | 680013 (2) | |
| 3 | 8-32 X 3/8 SCREW | 590020 (2) | 590020 (2) | 590020 (2) | 590020 (2) | 590020 (2) | 590020 (2) | |
| 4 | NOMEX INSULATOR | 270172 (2) | 270172 (2) | 270172 (2) | 270172 (1) | 270172 (1) | 270172 (1) | |
| 5 | START RELAY | 300430 (2) | 312188 (2) | 300428 (2) | 300430 (1) | 312188 (1) | 300428 (1) | |
| 6 | START CAPACITOR | 170154 (2) | 170154 (2) | 170154 (2) | 170154 (1) | 170154 (1) | 170154 (1) | |
| 7 | #8 SPEED NUT, S.S. | 327675 (4) | 327675 (4) | 327675 (4) | 327675 (2) | 327675 (2) | 327675 (2) | |
| 8 | HOLD DOWN BRACKET | 111047 | 111047 | 111047 | 111047 | 111047 | 111047 | |
| 9 | 2.5" VINYL COATED STRAP | 600106 (2) | 600106 (2) | 600106 (2) | 600106 (1) | 600106 (1) | 600106 (1) | |
| 10 | RUN CAPACITOR | 170097 (2) | 170226 (2) | 170224 (2) | 170097 (1) | 170226 (1) | 170224 (1) | |
| 11 | 1.75" VINYL COATED STRAP | 600107 (2) | 600107 (2) | 600107 (2) | 600107 (1) | 600107 (1) | 600107 (1) | |
| 12 | NEOPRENE TAPE 1/8" X 1" X 2" | 28003 (4) | 28003 (4) | 28003 (4) | 28003 (2) | 28003 (2) | 28003 (2) | |
| 13 | EDGE GUARD (CUT TO LENGTH) | 114012 | 114012 | 114012 | 114012 | 114012 | 114012 | |
| 14 | #8 X 1/2 PHP TYPE AB | 24021 (6) | 24021 (6) | 24021 (6) | 24021 (4) | 24021 (4) | 24021 (4) | |
| NOT SHOWN * | 15 | ULT MAIN HARNESS (REFERENCE ONLY) | 350082 | 350082 | 350082 | 350109 | 350109 | 350109 |
| NOT SHOWN | 16 | ENCLOSURE LOW STAGE HARNESS | 350108 | 350108 | 350108 | 350108 | 350108 | 350108 |
| NOT SHOWN | 17 | ENCLOSURE HIGH STAGE HARNESS | 350107 | 350107 | 350107 | N/A | N/A | N/A |
| NOT SHOWN | 18 | NOMEX COVER | 250138 | 250138 | 250138 | 250138 | 250138 | 250138 |
| NOT SHOWN | 19 | ESD CAUTION LABEL | 220555 (2) | 220555 (2) | 220555 (2) | 220555 (2) | 220555 (2) | 220555 (2) |
| NOT SHOWN, SEE NOTE 3 | 20 | IDENTIFICATION LABEL | 723050 | 723060 | 712060 | 123050 | 123060 | 112060 |

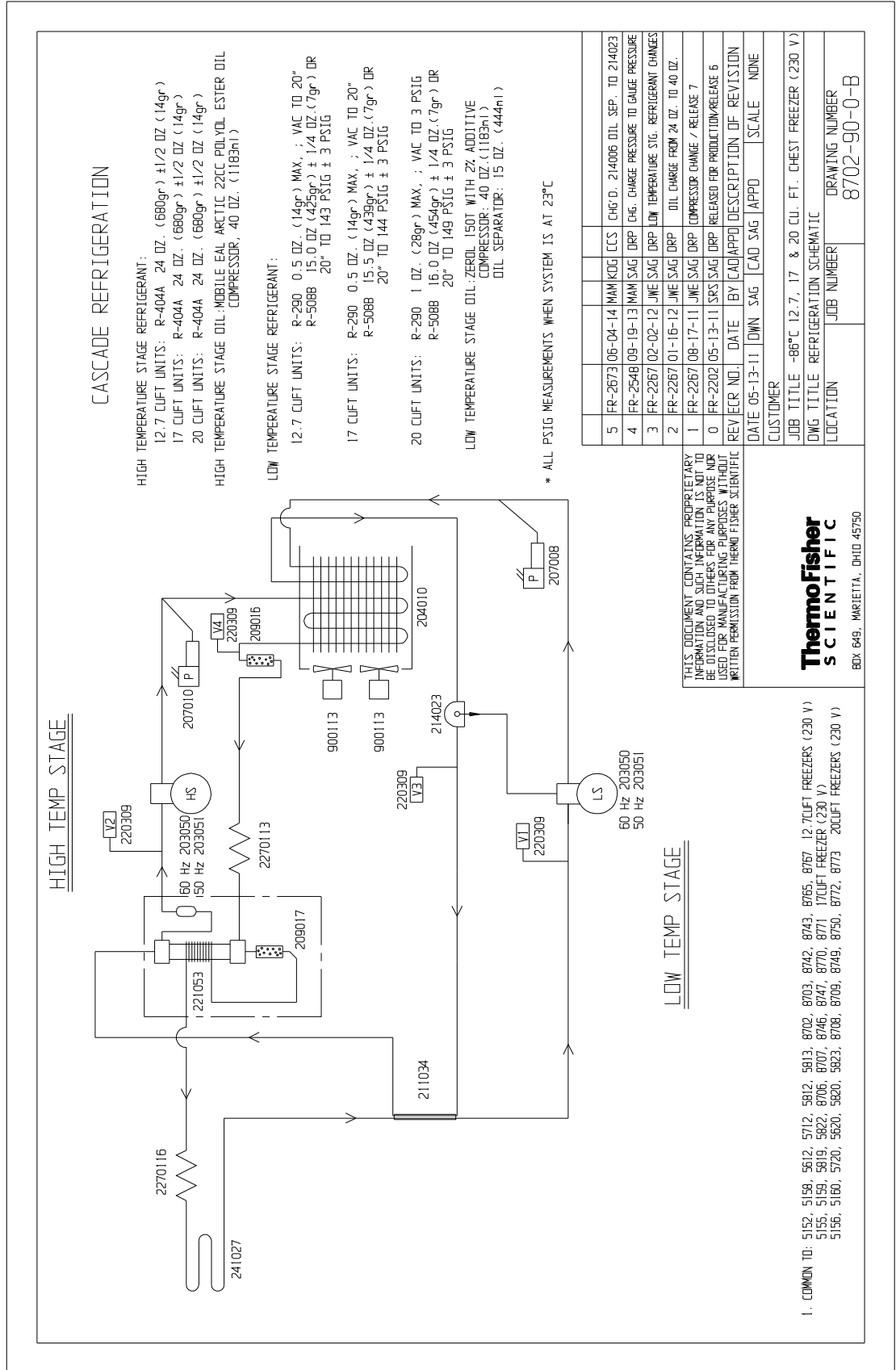
* THE ULT MAIN HARNESS IS LISTED FOR INFORMATION ONLY. IT IS NOT PART OF THIS ASSEMBLY.

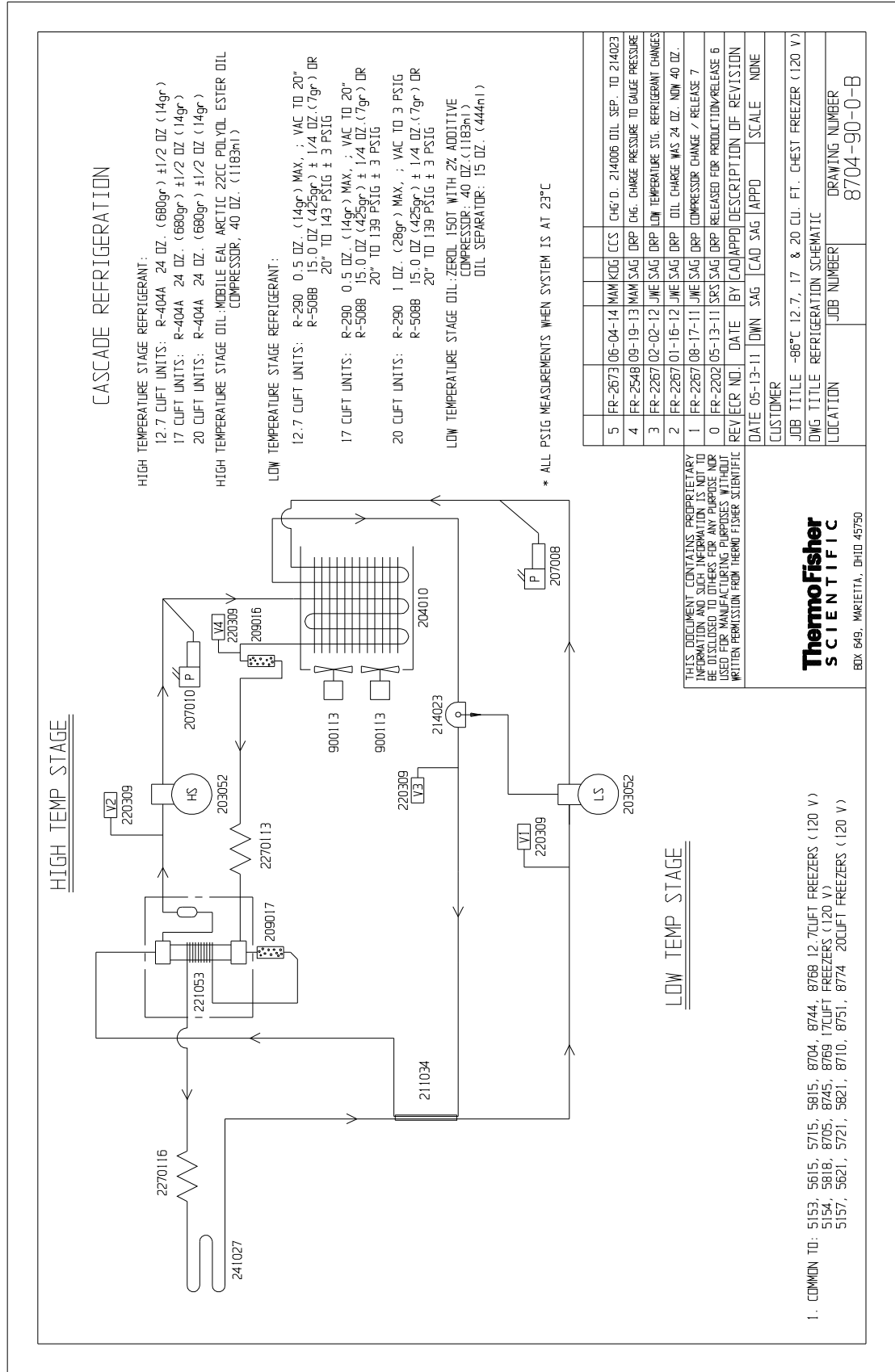
CHEST FREEZER START COMPONENT
ENCLOSURE ASSEMBLY

120230-01-1-D Rev. 6
Page 2 of 2



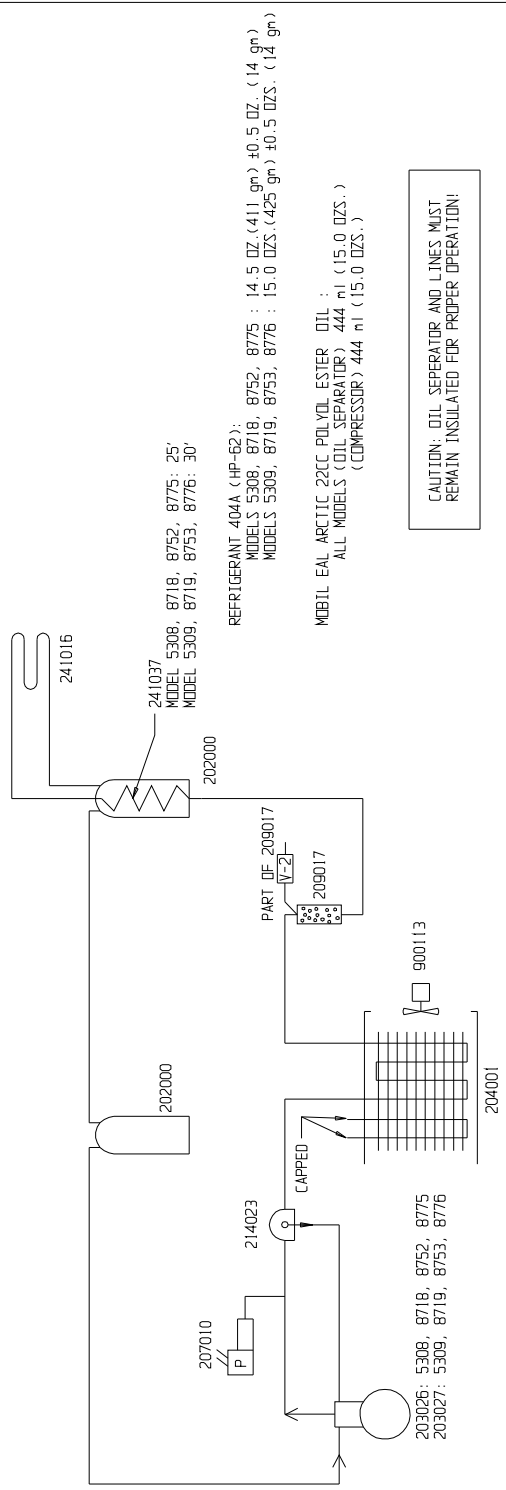






DRAWING NUMBER: 8717-90-0-B

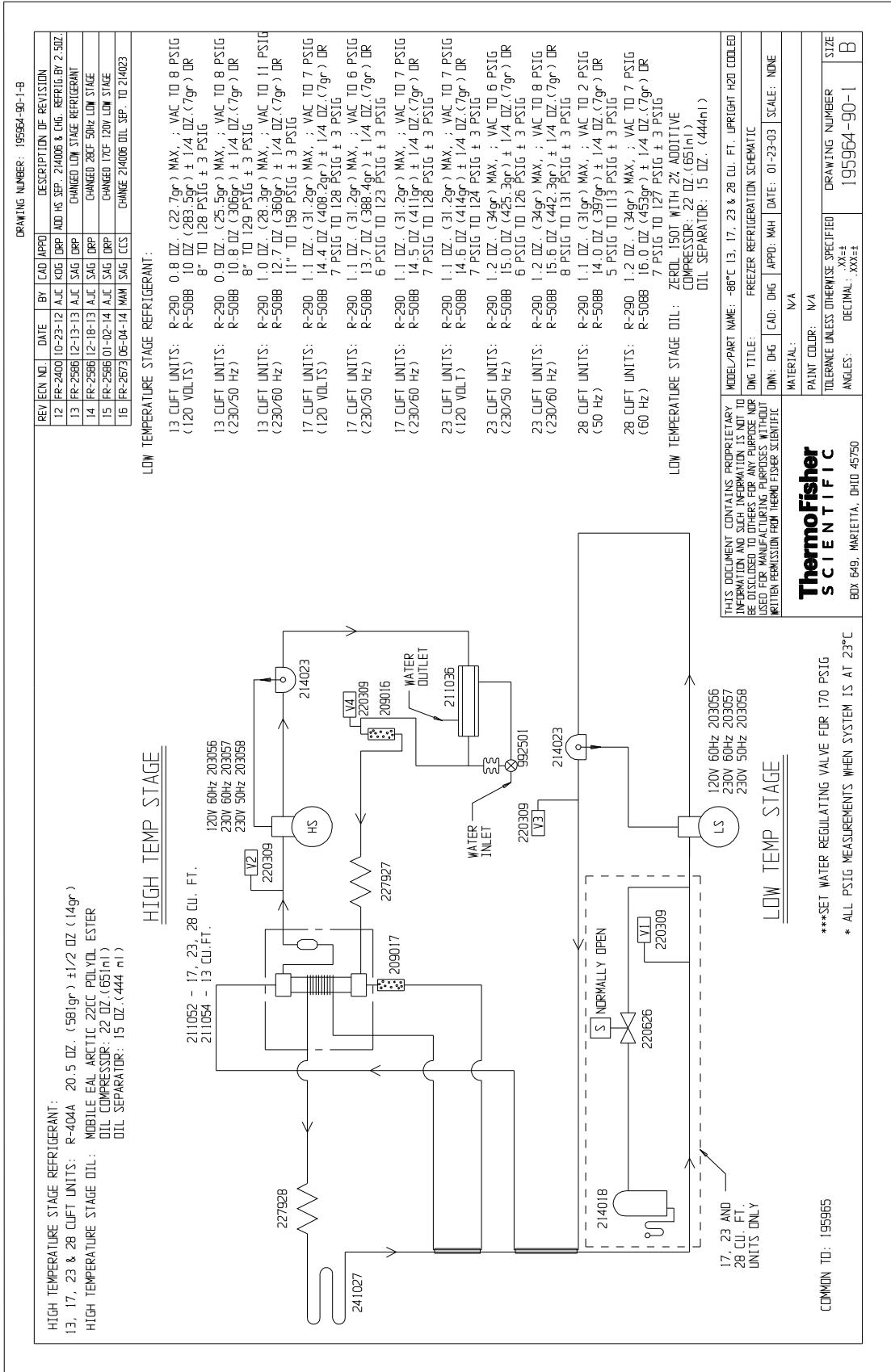
| REV | ECN NO. | DATE | BY | APPD | DESCRIPTION OF REVISION | |
|-----|---------|----------|-----|------|-------------------------|-----------------------------------|
| 0 | FR-2002 | 05/11/11 | SPS | SAG | DRP | RELEASE FOR PRODUCTION/RELEASE 6 |
| 1 | FR-2673 | 06-04-14 | MMW | KOG | DRP | CHANGE 214006 OIL SEP. TO 214023 |
| 2 | FR-2577 | 06-05-14 | SAG | CCS | DRP | 209017 WAS 209006. CHANGED R-404A |

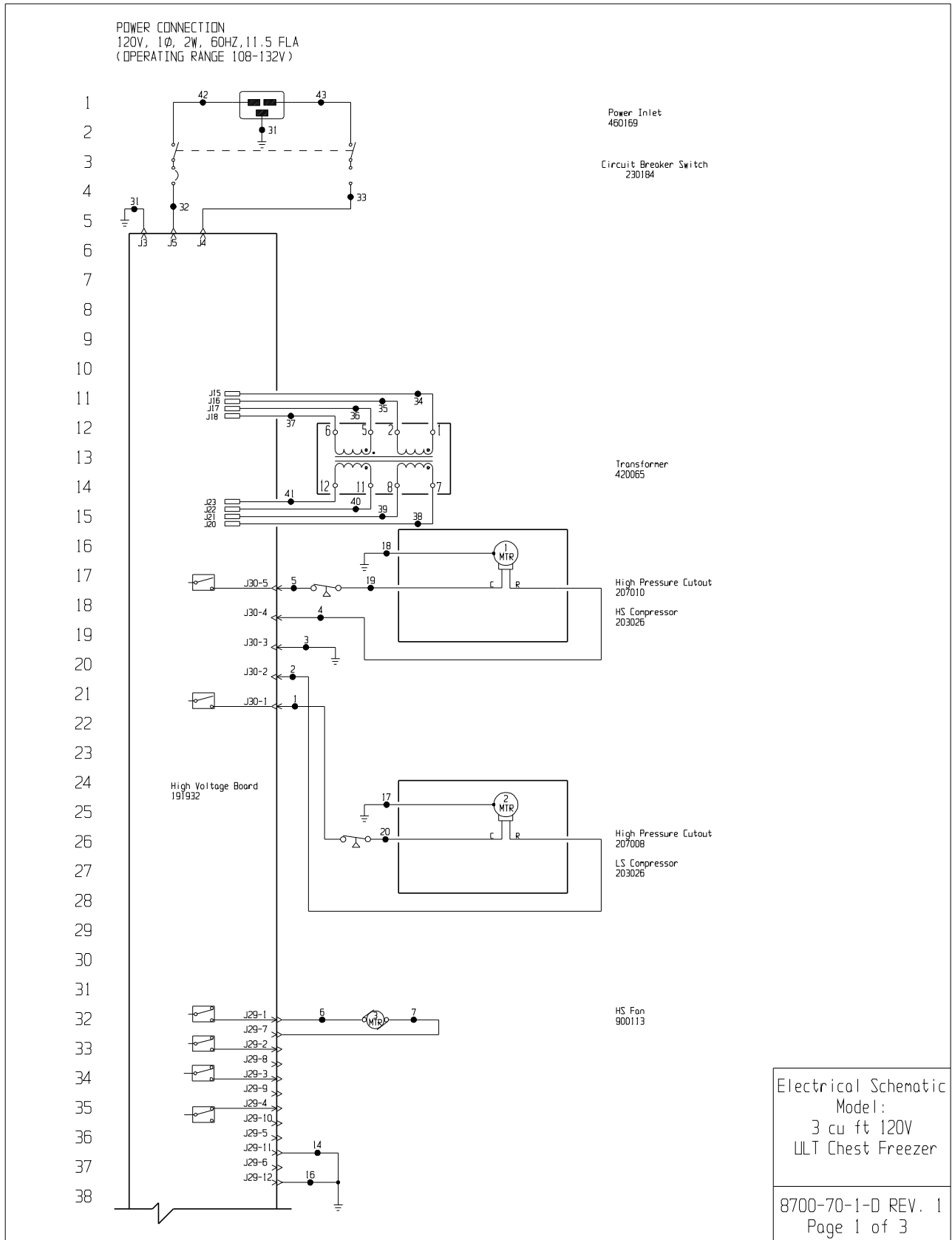


CAUTION: OIL SEPARATOR AND LINES MUST REMAIN INSULATED FOR PROPER OPERATION!

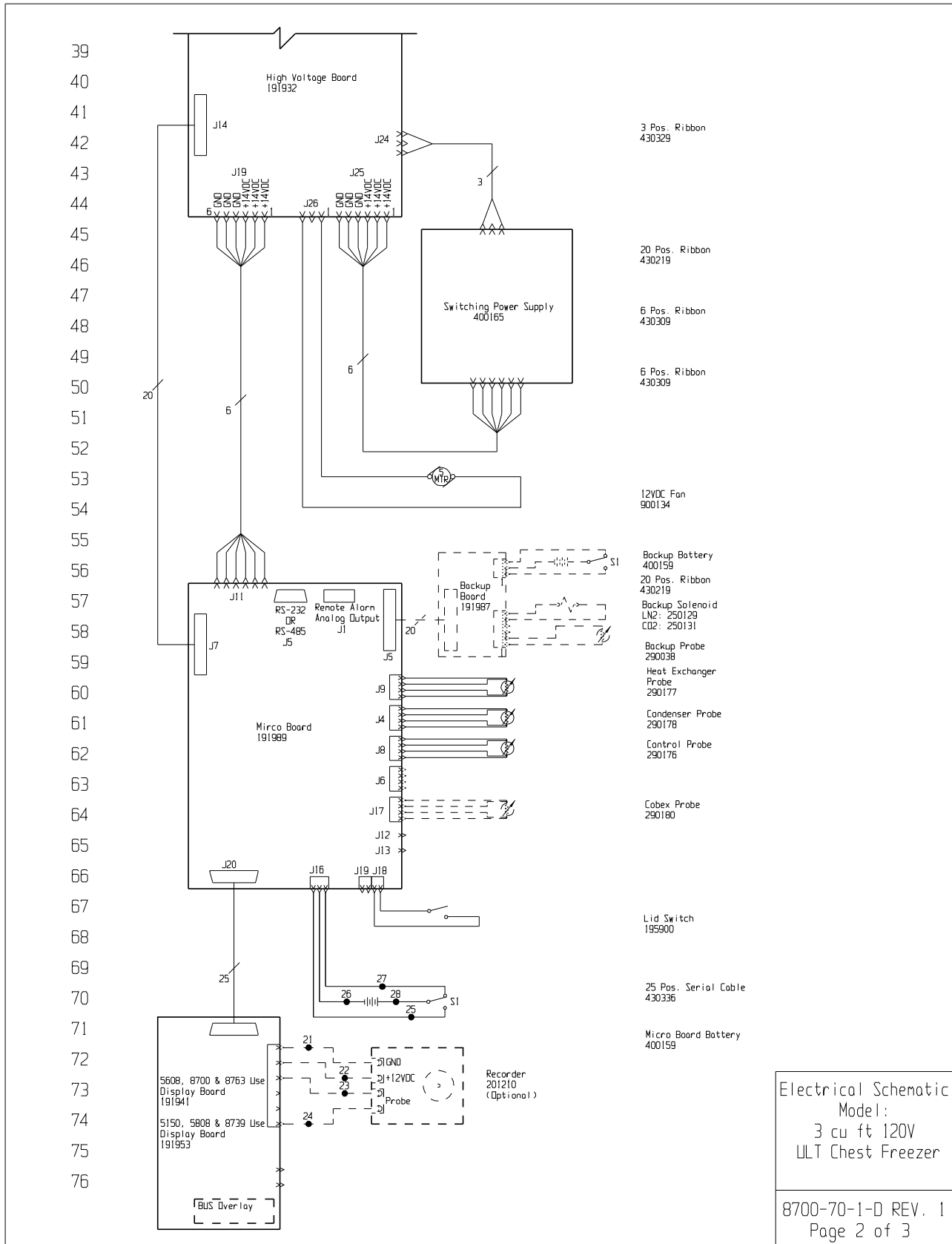
| | |
|---|------------------------------------|
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| MODEL/PART NAME: -40°C 3 CU. FT. FREEZERS, 120V & 230V | DWG TITLE: REFRIGERATION SCHEMATIC |
| UNV: GLS | APPD: DRP |
| DATE: 6-18-09 | SCALE: NONE |
| MATERIAL: | |
| PAINT COLOR: | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | DRAWING NUMBER |
| ANGLES: .XX± | 8718-90-0 |
| .XXX± | SIZE |
| | B |

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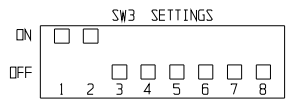


Section 10
Electrical Schematics



| | WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE |
|----|--------|---------|-------|--------|---------|-------|
| 77 | 1 | BLK | 14 | 25 | WHT | 18 |
| | 2 | RED | 14 | 26 | BLK | 18 |
| 78 | 3 | GRN/YEL | 14 | 27 | BLK | 18 |
| | 4 | RED | 14 | 28 | RED | 18 |
| 79 | 5 | BLK | 14 | 29 | | |
| | 6 | BLK | 18 | 30 | | |
| 80 | 7 | BLK | 18 | 31 | GRN/YEL | 14 |
| | 8 | | | 32 | BLK | 14 |
| 81 | 9 | | | 33 | BLU | 14 |
| | 10 | | | 34 | BLK | 14 |
| 82 | 11 | | | 35 | BLU | 14 |
| | 12 | | | 36 | BLK | 14 |
| 83 | 13 | | | 37 | BLU | 14 |
| | 14 | GRN/YEL | 18 | 38 | BLK | 14 |
| 84 | 15 | | | 39 | BLU | 14 |
| | 16 | GRN/YEL | 18 | 40 | BLK | 14 |
| 85 | 17 | GRN/YEL | 14 | 41 | BLU | 14 |
| | 18 | GRN/YEL | 14 | 42 | BLK | 14 |
| 86 | 19 | BLK | 14 | 43 | BLU | 14 |
| | 20 | BLK | 14 | | | |
| 87 | 21 | BLK | 18 | | | |
| | 22 | RED | 18 | | | |
| 88 | 23 | BLK | 18 | | | |
| | 24 | RED | 18 | | | |

3 CU. FT. CHEST MODELS:
5150, 5608, 5808, 8700, 8739, 8763



RS-232 SPECIFICATION

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

REMOTE CONTACTS/ANALOG OUTPUT

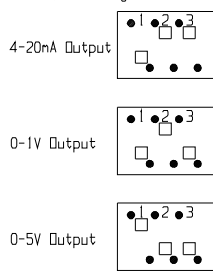
| | |
|--------|-----------------|
| PIN# 1 | Analog Output + |
| PIN# 2 | Analog Output - |
| PIN# 3 | Not Connected |
| PIN# 4 | Not Connected |
| PIN# 5 | Normally Closed |
| PIN# 6 | Common |
| PIN# 7 | Normally Open |

RS-232 PORT

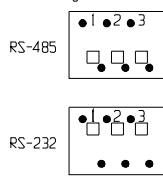
| | |
|--------|-----|
| PIN# 2 | TXD |
| PIN# 3 | RXD |
| PIN# 5 | GND |

CONTACT RATING: 1A @ 30V
CONTACTS IN ALARM STATE

SW1 Settings for Analog Output



SW2 Settings for Communication Output



- Lid 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 | APPRO | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|-------|---------------------------------------|
| 1 | FR-2386 | 08-29-12 | AJC | SAG | CCS | REVISED OPERATING RANGE FROM 103-127V |
| 0 | FR-2202 | 05/03/11 | SRS | SAG | DRP | RELEASED FOR PRODUCTION / RELEASE 6 |

Electrical Schematic
Model:
3 cu ft 120V
ULT Chest Freezer



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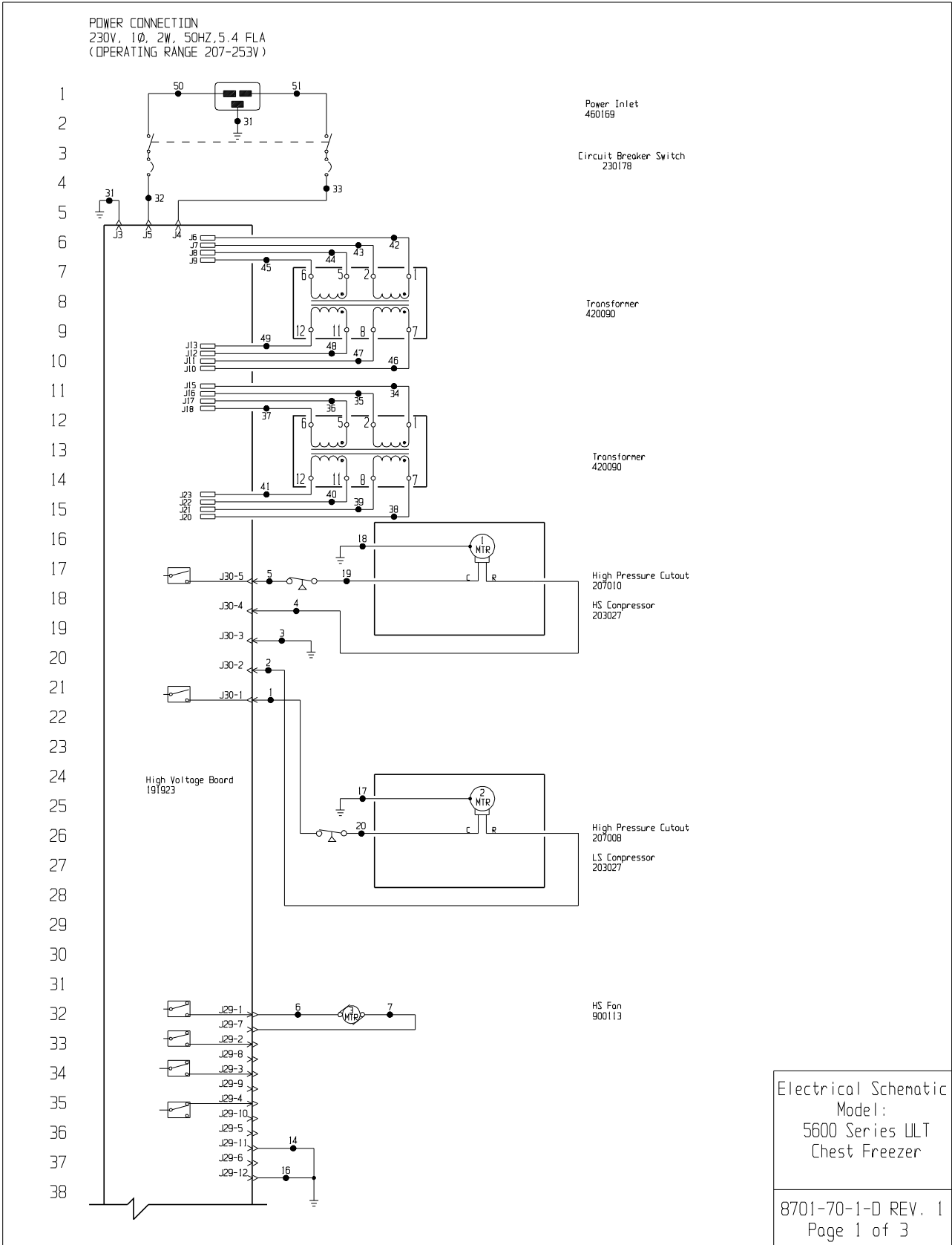


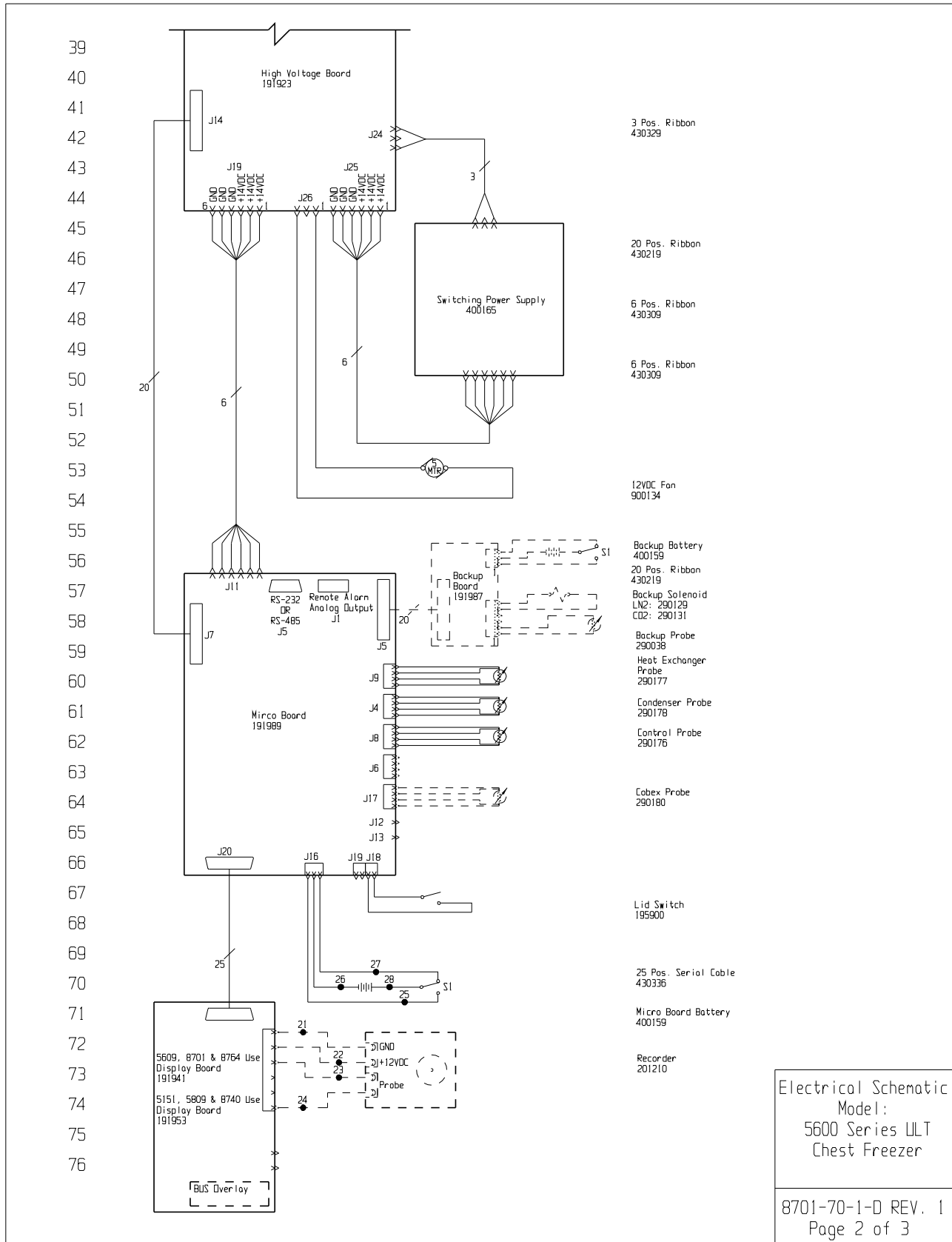
MODEL/PART NAME: 5600 SERIES, 120V, ULT FREEZERS
DWG TITLE: UNIT SCHEMATIC
DWN: HCE CAD: KDG APPD: LDN DATE: 10-10-10 SCALE: NONE

| | |
|--------------------------------------|----------------|
| MATERIAL: | |
| PAINTE COLOR: | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | DRAWING NUMBER |
| ANGLES: DECIMAL: .XX± | 8700-70-1 |
| | SIZE |
| | D |

8700-70-1-D REV. 1
Page 3 of 3

Section 10
Electrical Schematics

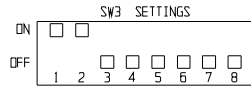




Section 10
Electrical Schematics

| WIRE # | WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE |
|--------|--------|---------|-------|--------|---------|-------|
| 77 | | | | | | |
| 78 | 1 | BLK | 14 | 25 | WHT | 18 |
| | 2 | RED | 14 | 26 | BLK | 18 |
| 79 | 3 | GRN/YEL | 14 | 27 | BLK | 18 |
| | 4 | RED | 14 | 28 | RED | 18 |
| 80 | 5 | BLK | 14 | 29 | | |
| | 6 | BLK | 18 | 30 | | |
| 81 | 7 | BLK | 18 | 31 | GRN/YEL | 14 |
| | 8 | | | 32 | BLK | 14 |
| 82 | 9 | | | 33 | BLU | 14 |
| | 10 | | | 34 | BLK | 14 |
| 83 | 11 | | | 35 | BLU | 14 |
| | 12 | | | 36 | BLK | 14 |
| 84 | 13 | | | 37 | BLU | 14 |
| | 14 | GRN/YEL | 18 | 38 | BLK | 14 |
| 85 | 15 | | | 39 | BLU | 14 |
| | 16 | GRN/YEL | 18 | 40 | BLK | 14 |
| 86 | 17 | GRN/YEL | 14 | 41 | BLU | 14 |
| | 18 | GRN/YEL | 14 | 42 | BLK | 14 |
| 87 | 19 | BLK | 14 | 43 | BLU | 14 |
| | 20 | BLK | 14 | 44 | BLK | 14 |
| 88 | 21 | BLK | 18 | 45 | BLU | 14 |
| | 22 | RED | 18 | 46 | BLK | 14 |
| 89 | 23 | BLK | 18 | 47 | BLU | 14 |
| | 24 | RED | 18 | 48 | BLK | 14 |
| 90 | | | | 49 | BLU | 14 |
| 91 | | | | 50 | BLK | 14 |
| | | | | 51 | BLU | 14 |

3 CU. FT. CHEST MODELS:
5151, 5809, 8701, 8740, 8764



| 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 |

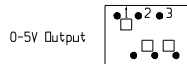
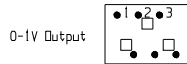
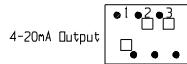
CONTACT RATING: 1A @ 30V
CONTACTS IN ALARM STATE

RS-232 SPECIFICATION

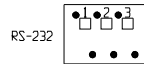
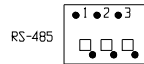
BAUD = 1200
PARITY = N
BITS = 8
STOP BITS = 2

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

SW1 Settings for Analog Output



SW2 Settings for Communication Output



- Lid 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.



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ThermoFisher
SCIENTIFIC

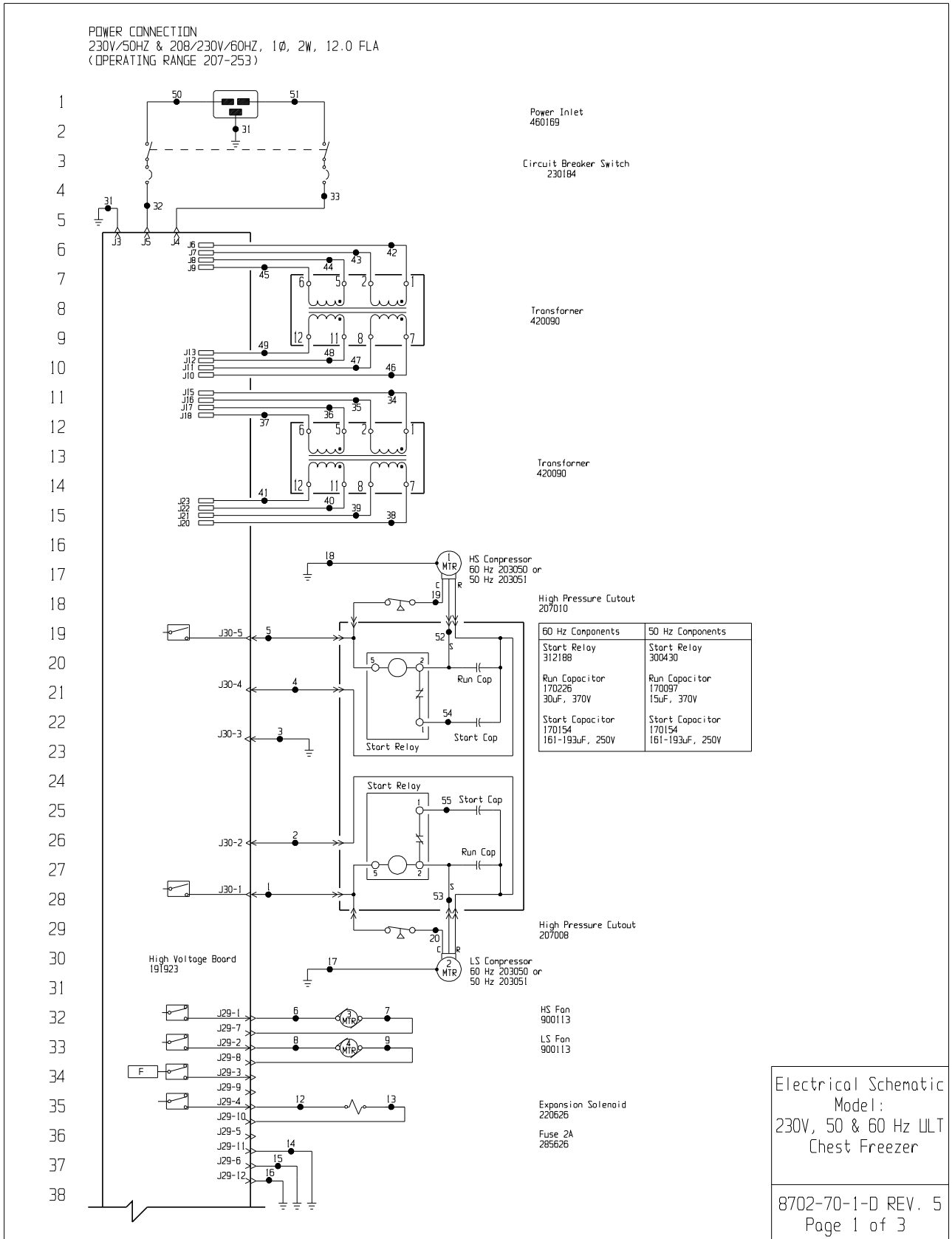
BOX 649, MARIETTA, OHIO 45750

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|------|---------------------------------------|
| 1 | FR-2386 | 08-29-12 | AJC | KDG | CCS | REVISED OPERATING RANGE FROM 207-250Y |
| 0 | FR-2202 | 05/19/11 | SRS | SAG | DRP | RELEASED FOR PRODUCTION / RELEASE 6 |

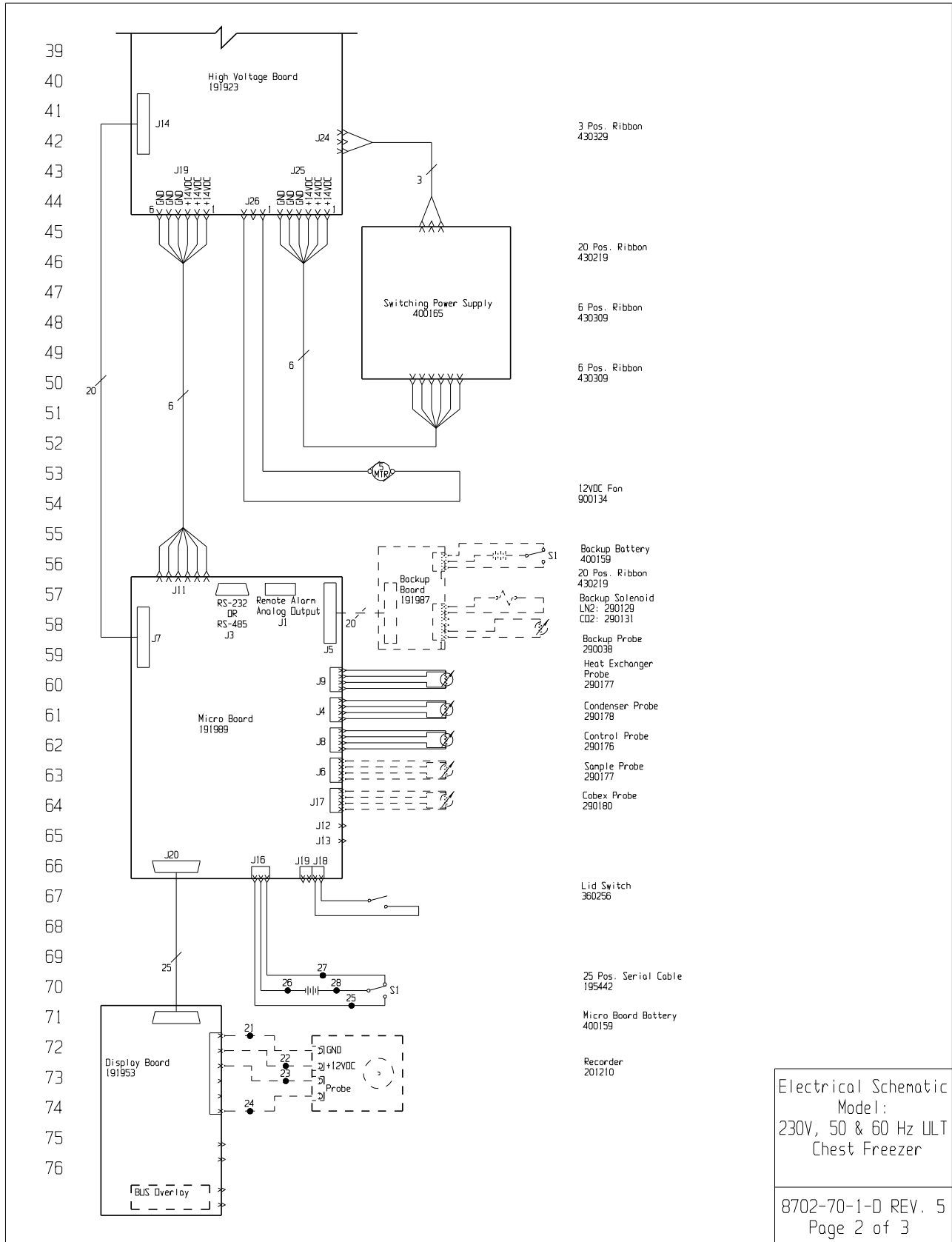
MODEL/PART NAME: 5600 SERIES, 230V, ULT FREEZERS
DWG TITLE: UNIT SCHEMATIC
DWN: SAG CAD: SAG APPD: LDN DATE: 05/19/11 SCALE: NONE
MATERIAL:
PAINT COLOR:
TOLERANCE UNLESS OTHERWISE SPECIFIED
ANGLES: DECIMAL: .XX±
DRAWING NUMBER: 8701-70-1
SIZE: D

Electrical Schematic
Model:
5600 Series ULT
Chest Freezer

8701-70-1-D REV. 1
Page 3 of 3



Section 10
Electrical Schematics



| WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE |
|--------|-------|-------|--------|---------|-------|
| 77 | 1 | 14 | 29 | - | - |
| | 2 | 14 | 30 | - | - |
| 78 | 3 | 14 | 31 | GRN/YEL | 14 |
| | 4 | 14 | 32 | BLK | 14 |
| | 5 | 14 | 33 | BLU | 14 |
| 79 | 6 | 18 | 34 | BLK | 14 |
| | 7 | 18 | 35 | BLU | 14 |
| 80 | 8 | 18 | 36 | BLK | 14 |
| | 9 | 18 | 37 | BLU | 14 |
| 81 | 10 | 18 | 38 | BLK | 14 |
| | 11 | 18 | 39 | BLU | 14 |
| 82 | 12 | 18 | 40 | BLK | 14 |
| | 13 | 18 | 41 | BLU | 14 |
| 83 | 14 | 18 | 42 | BLK | 14 |
| | 15 | 18 | 43 | BLU | 14 |
| 84 | 16 | 18 | 44 | BLK | 14 |
| | 17 | 14 | 45 | BLU | 14 |
| 85 | 18 | 14 | 46 | BLK | 14 |
| | 19 | 14 | 47 | BLU | 14 |
| 86 | 20 | 14 | 48 | BLK | 14 |
| | 21 | 18 | 49 | BLU | 14 |
| 87 | 22 | 18 | 50 | BLK | 14 |
| | 23 | 18 | 51 | BLU | 14 |
| 88 | 24 | 18 | 52 | YEL/WHT | 14 |
| | 25 | 18 | 53 | YEL | 14 |
| 89 | 26 | 18 | 54 | BLU/WHT | 14 |
| | 27 | 18 | 55 | BLU | 14 |
| 90 | 28 | 18 | | | |

CHEST MODELS:
 12.7 CU.FT. - 5152, 5158, 5612, 5613, 5812, 5813, 8702, 8703, 8742, 8743, 8765, 8767
 17 CU.FT. - 5155, 5159, 5819, 5822, 8706, 8707, 8746, 8747, 8770, 8771
 20 CU.FT. - 5156, 5160, 5620, 5623, 5820, 5823, 8708, 8709, 8749, 8750, 8772, 8773

RS-232 SPECIFICATION

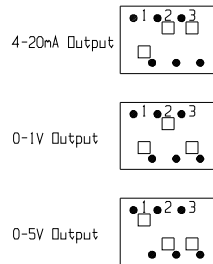
BAUD = 1200
 PARITY = N
 BITS = 8
 STOP BITS = 2

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

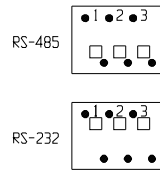
| REMOTE CONTACTS/ANALOG OUTPUT | |
|-------------------------------|-----------------|
| PIN# 1 | Analog Output + |
| PIN# 2 | Analog Output - |
| PIN# 3 | Not Connected |
| PIN# 4 | Not Connected |
| PIN# 5 | Normally Closed |
| PIN# 6 | Common |
| PIN# 7 | Normally Open |

CONTACT RATING: 1A @ 30V
 CONTACTS IN ALARM STATE

SW1 Settings for Analog Output



SW2 Settings for Communication Output



SW3 SETTINGS



1. Schematic represents chest 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.

| | | | | | | |
|-----|---------|----------|-----|-----|------|---|
| 5 | FR-2805 | 06-19-15 | SUN | SAG | CCS | 312180 WAS 300420 |
| 4 | FR-2753 | 12-17-14 | MW | KDG | DRP | ADDED MODELS 5613 & 5623 |
| 3 | FR-2366 | 08-29-12 | AJC | SAG | DRP | REVISED OPERATING RANGE FROM 208-240V |
| 2 | FR-2366 | 07-27-12 | NAM | KDG | DRP | ENG. 300421 RELAY TO 300420, 300420 TO 300430 |
| 1 | FR-2267 | 08/17/11 | JWE | SAG | DRP | COMPRESSOR CHANGE / RELEASE 7 |
| 0 | FR-2202 | 05/04/11 | SPS | SAG | DLP | RELEASED FOR PRODUCTION / RELEASE 6 |
| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |

Electrical Schematic
 Model:
 230V, 50 & 60 Hz ULT
 Chest Freezer

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| | | | | | |
|---|----------|--------|------|-------|--|
| MODEL/PART NAME: ULT -BCC CHEST FREEZERS, 230V, 50 & 60Hz | | | | | |
| DWG TITLE: UNIT SCHEMATIC | | | | | |
| OWN: | SAG | CAD: | SAG | APPD: | |
| DATE: | 05/04/11 | SCALE: | NINE | | |

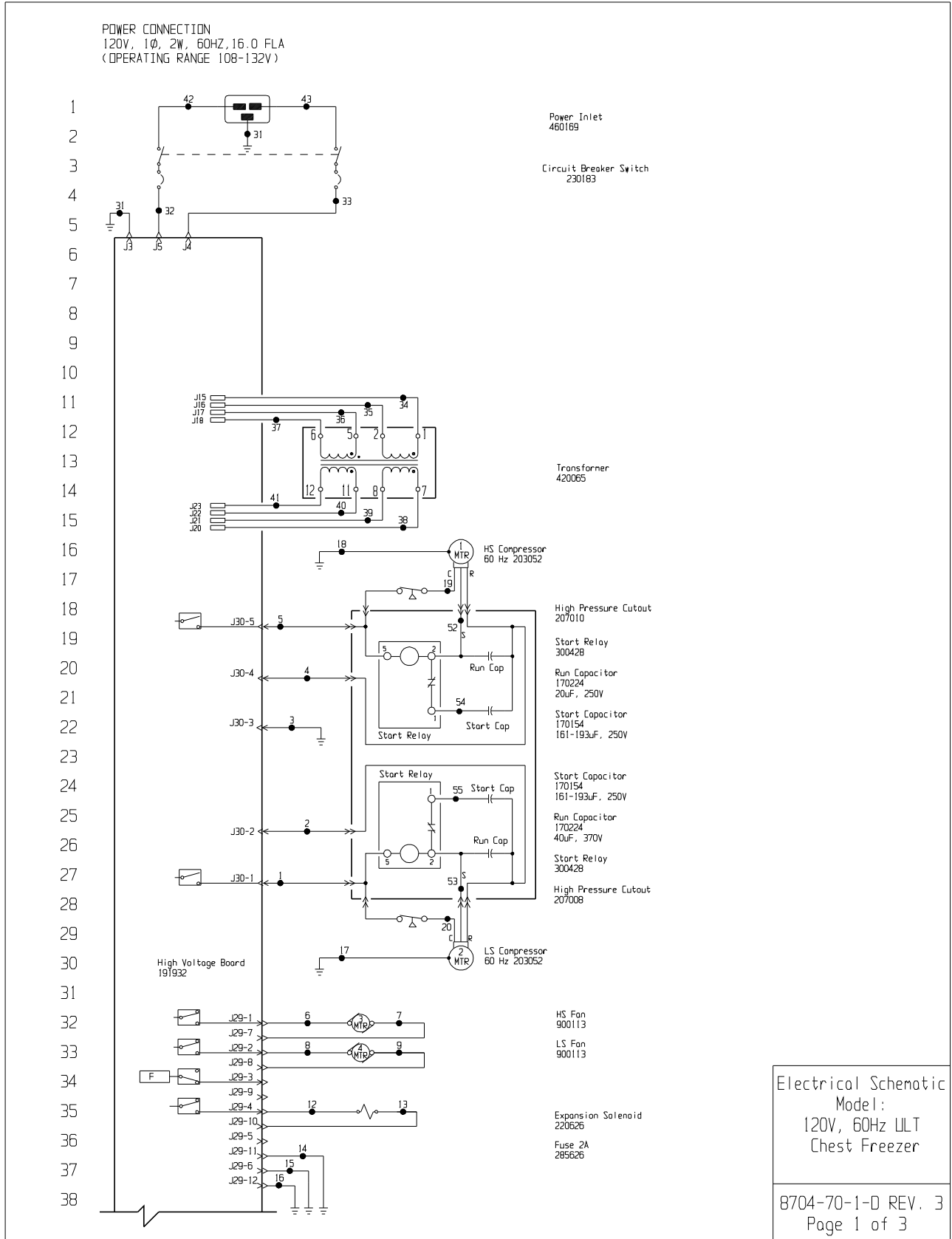


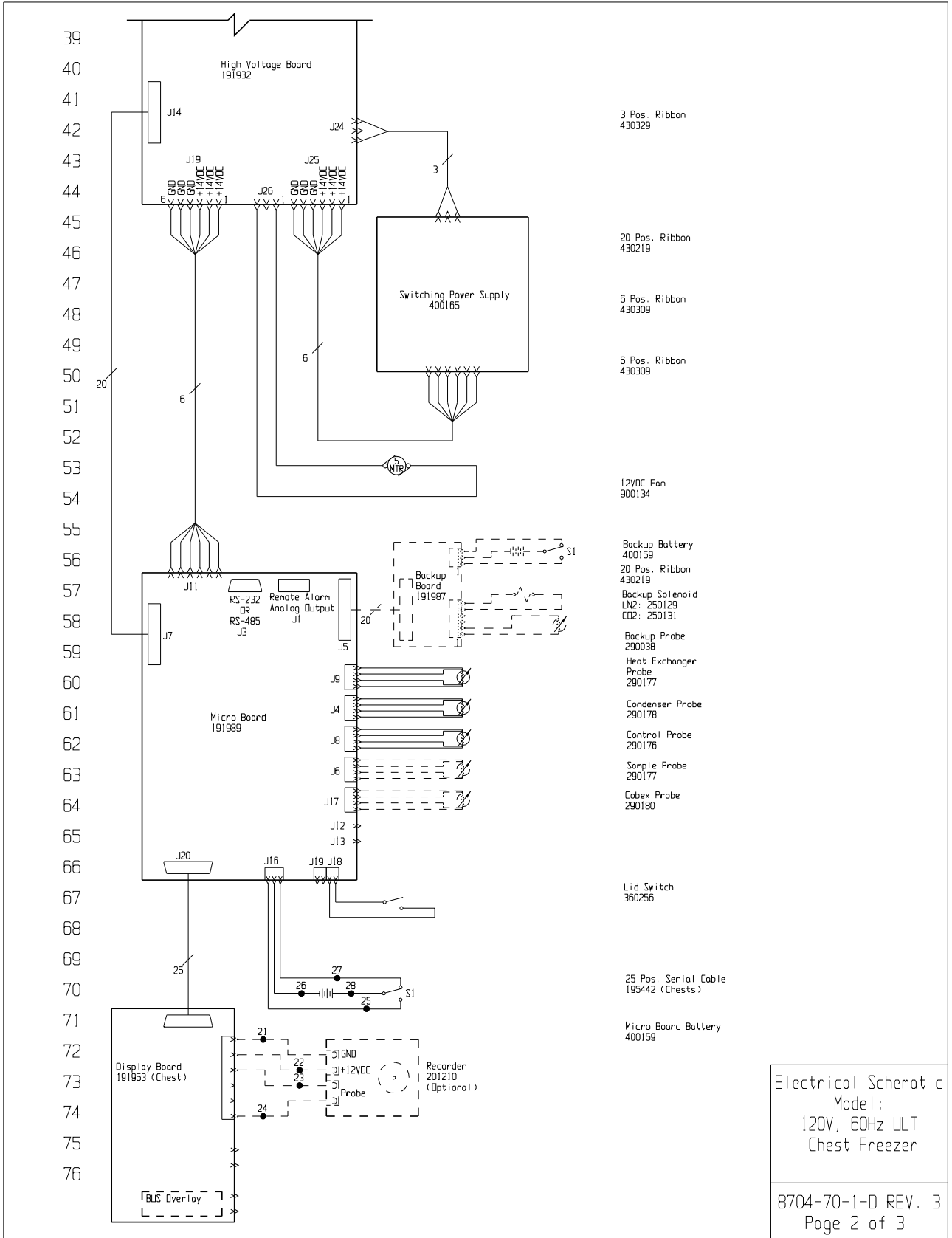
ThermoFisher
 SCIENTIFIC
 BOX 649, MARIETTA, OHIO 45750

| | | | | |
|--------------------------------------|----------------|----------------|--|------|
| PAINT COLOR: | | DRAWING NUMBER | | SIZE |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | XXX± | 8702-70-1 | | D |
| ANGLES: | DECIMAL: .XXX± | | | |

8702-70-1-D REV. 5
 Page 3 of 3

Section 10
Electrical Schematics





Section 10
Electrical Schematics

| WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE |
|--------|-------|---------|--------|-------|---------|
| 77 | 1 | BLK | 14 | 29 | - |
| | 2 | RED | 14 | 30 | - |
| 78 | 3 | GRN/YEL | 14 | 31 | GRN/YEL |
| | 4 | RED/WHT | 14 | 32 | BLK |
| 79 | 5 | BLK/WHT | 14 | 33 | BLU |
| | 6 | BLK | 18 | 34 | BLK |
| 80 | 7 | BLK | 18 | 35 | BLU |
| | 8 | BLK | 18 | 36 | BLK |
| 81 | 9 | BLK | 18 | 37 | BLU |
| | 10 | BLK | 18 | 38 | BLK |
| 82 | 11 | BLK | 18 | 39 | BLU |
| | 12 | BLK | 18 | 40 | BLK |
| 83 | 13 | BLK | 18 | 41 | BLU |
| | 14 | GRN/YEL | 18 | 42 | BLK |
| 84 | 15 | GRN/YEL | 18 | 43 | BLU |
| | 16 | GRN/YEL | 18 | 44 | - |
| 85 | 17 | GRN/YEL | 14 | 45 | - |
| | 18 | GRN/YEL | 14 | 46 | - |
| 86 | 19 | BLK/WHT | 14 | 47 | - |
| | 20 | BLK | 14 | 48 | - |
| 87 | 21 | BLK | 18 | 49 | - |
| | 22 | RED | 18 | 50 | - |
| 88 | 23 | BLK | 18 | 51 | - |
| | 24 | RED | 18 | 52 | YEL/WHT |
| 89 | 25 | WHT | 18 | 53 | YEL |
| | 26 | BLK | 18 | 54 | BLU/WHT |
| 90 | 27 | BLK | 18 | 55 | BLU |
| 91 | 28 | RED | 18 | | |

CHEST MODELS:
12.7 CU.FT. - 5153, 5615, 5815, 8704, 8744, 8768
17 CU.FT. - 5154, 5818, 8705, 8745, 8769
20 CU.FT. - 5157, 5621, 5821, 8710, 8751, 8774

RS-232 SPECIFICATION

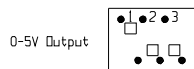
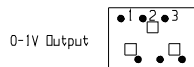
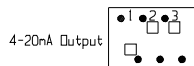
BAUD = 1200
PARITY = N
BITS = 8
STOP BITS = 2

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

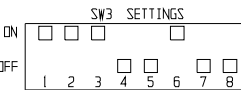
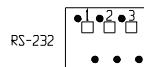
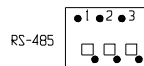
REMOTE CONTACTS/ANALOG OUTPUT
PIN# 1 Analog Output +
PIN# 2 Analog Output -
PIN# 3 Not Connected
PIN# 4 Not Connected
PIN# 5 Normally Closed
PIN# 6 Common
PIN# 7 Normally Open

CONTACT RATING: 1A @ 30V
CONTACTS IN ALARM STATE

SW1 Settings for Analog Output



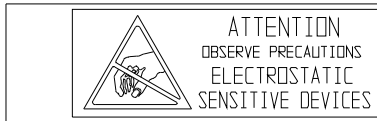
SW2 Settings for Communication Output



1. Schematic represents chest 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 | ECN NO | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|------|---------------------------------------|
| 3 | FR-2386 | 08-29-12 | AJC | SAG | CCS | REVISED OPERATING RANGE FROM 108-130V |
| 2 | FR-2386 | 07-27-12 | MAN | KDG | DRP | CHG. 300421 START RELAY TO 300428 |
| 1 | FR-2267 | 08-17-11 | SAG | SAG | DRP | COMPRESSOR CHANGE / RELEASE 7 |
| 0 | FR-2202 | 05-04-11 | SRS | SAG | DRP | RELEASED FOR PRODUCTION / RELEASE 6 |

Electrical Schematic
Model:
120V, 60Hz ULT
Chest Freezer

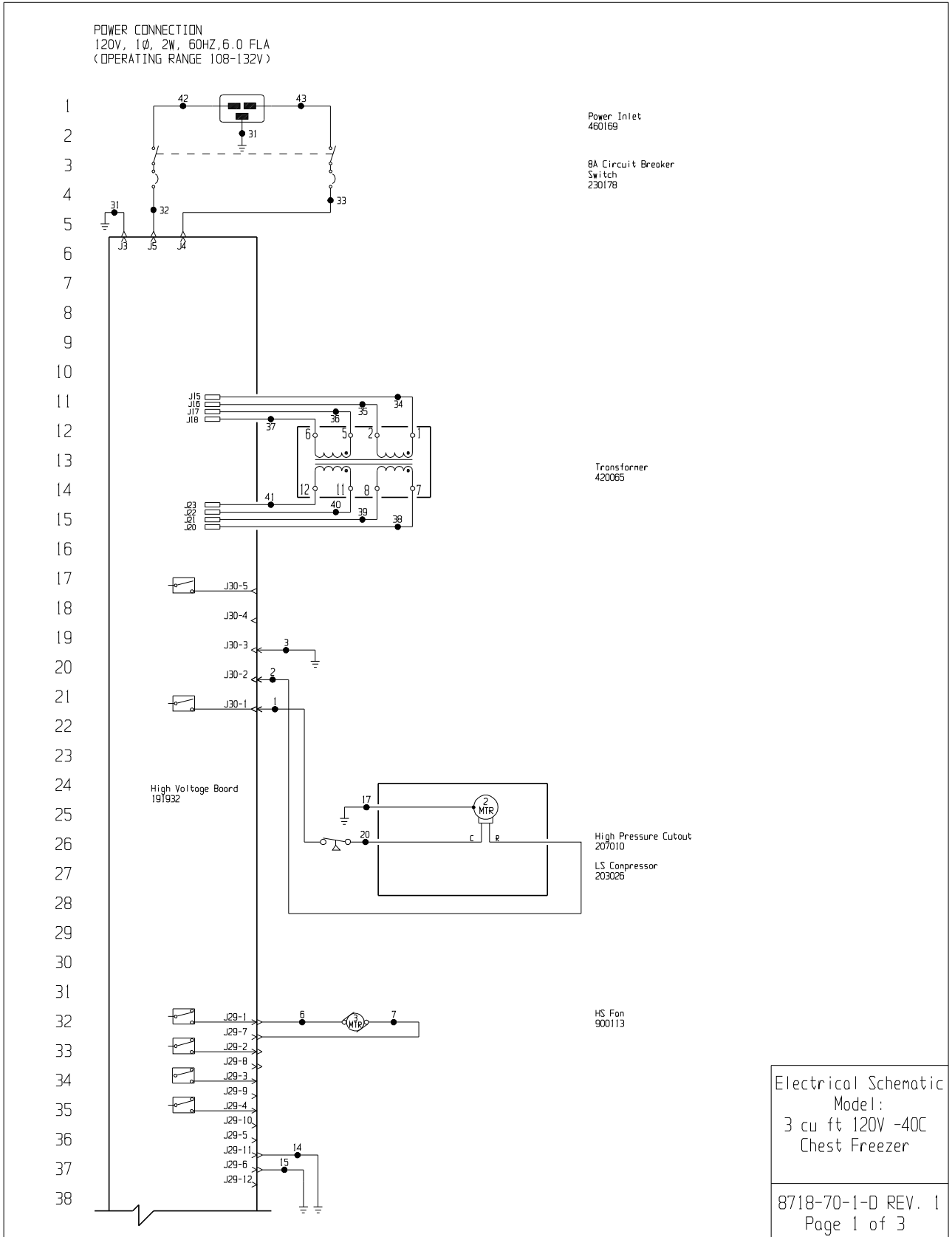


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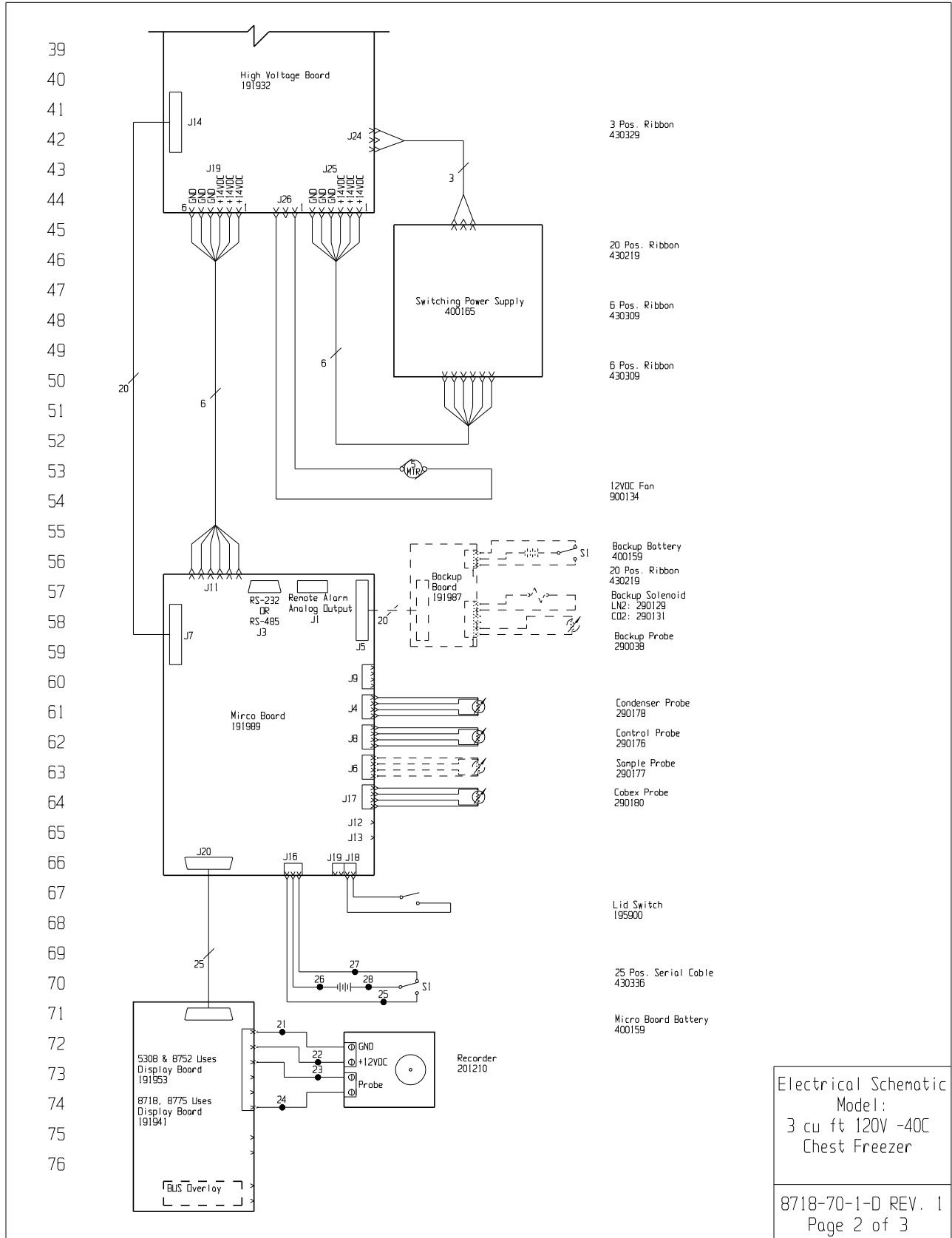
ThermoFisher SCIENTIFIC
BOX 649, MARIETTA, OHIO 45750

| | | | |
|--|----------|----------------|----------------------------|
| MODEL/PART NAME: ULT -BCC CHEST FREEZERS, 120V, 60Hz | | | |
| DWG TITLE: UNIT SCHEMATIC | | | |
| DWN: SAG | CAD: SAG | APPD: DRP | DATE: 05-04-11 SCALE: NONE |
| MATERIAL: | | | |
| PAINT COLOR: | | | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | XX± | DRAWING NUMBER | SIZE |
| ANGLES: DECIMAL: XXX± | | 8704-70-1 | D |

8704-70-1-D REV. 3
Page 3 of 3

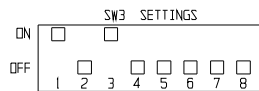


Section 10
Electrical Schematics



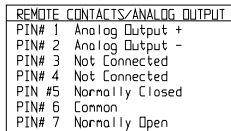
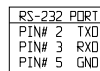
| WIRE # | WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE |
|--------|--------|---------|-------|--------|---------|-------|
| 77 | 1 | BLK | 14 | 25 | WHT | 18 |
| 78 | 2 | RED | 14 | 26 | BLK | 18 |
| | 3 | GRN/YEL | 14 | 27 | BLK | 18 |
| 79 | 4 | | | 28 | RED | 18 |
| | 5 | | | 29 | | |
| 80 | 6 | BLK | 18 | 30 | | |
| | 7 | BLK | 18 | 31 | GRN/YEL | 14 |
| | 8 | BLK | 18 | 32 | BLK | 14 |
| 81 | 9 | BLK | 18 | 33 | BLU | 14 |
| | 10 | | | 34 | BLK | 14 |
| 82 | 11 | | | 35 | BLU | 14 |
| | 12 | | | 36 | BLK | 14 |
| 83 | 13 | | | 37 | BLU | 14 |
| | 14 | GRN/YEL | 18 | 38 | BLK | 14 |
| 84 | 15 | GRN/YEL | 18 | 39 | BLU | 14 |
| | 16 | | | 40 | BLK | 14 |
| 85 | 17 | GRN/YEL | 14 | 41 | BLU | 14 |
| | 18 | | | 42 | BLK | 14 |
| 86 | 19 | | | 43 | BLU | 14 |
| | 20 | BLK | 14 | | | |
| 87 | 21 | BLK | 18 | | | |
| | 22 | RED | 18 | | | |
| 88 | 23 | BLK | 18 | | | |
| | 24 | RED | 18 | | | |

3 CU. FT. CHEST MODELS:
5308, 8718, 8752, 8775



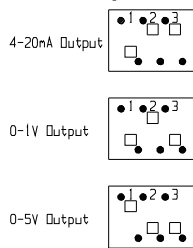
RS-232 SPECIFICATION

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

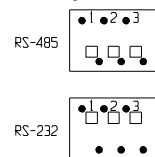


CONTACT RATING: 1A @ 30V
CAONACTS IN ALARM STATE

SW1 Settings for Analog Output



SW2 Settings for Communication Output



1. Door switch shown in open position.
2. Battery switch shown in the OFF position.
3. Circuit breaker switch shown in OFF position.
4. Options and accessories shown in dashed lines.

| REV | ECN NO. | DATE | BY | CAO | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|------|---------------------------------------|
| 1 | FR-2386 | 08-29-12 | AJC | SAG | CCS | REVISED OPERATING RANGE FROM 108-130V |
| 0 | FR-2202 | 05/03/11 | SRS | SAG | DRP | RELEASED FOR PRODUCTION / RELEASE 6 |

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| | | | |
|------------------|------------------------------|-------|----------|
| MODEL/PART NAME: | 3CF -40° CHEST FREEZER, 120V | | |
| DWG TITLE: | ELECTRICAL SCHEMATIC | | |
| DWN: | SAG | CAO: | SAG |
| APPD: | DRP | DATE: | 05/11/11 |
| SCALE: | NONE | | |

| | | | | | |
|---------------|--|---------------------------------------|-----------|---------|---------------|
| MATERIAL: | | DRAWING NUMBER: | 8718-70-1 | SIZE: | D |
| PAINTE COLOR: | | TOLERANCE UNLESS OTHERWISE SPECIFIED: | .XX± | ANGLES: | DECIMAL: .XX± |

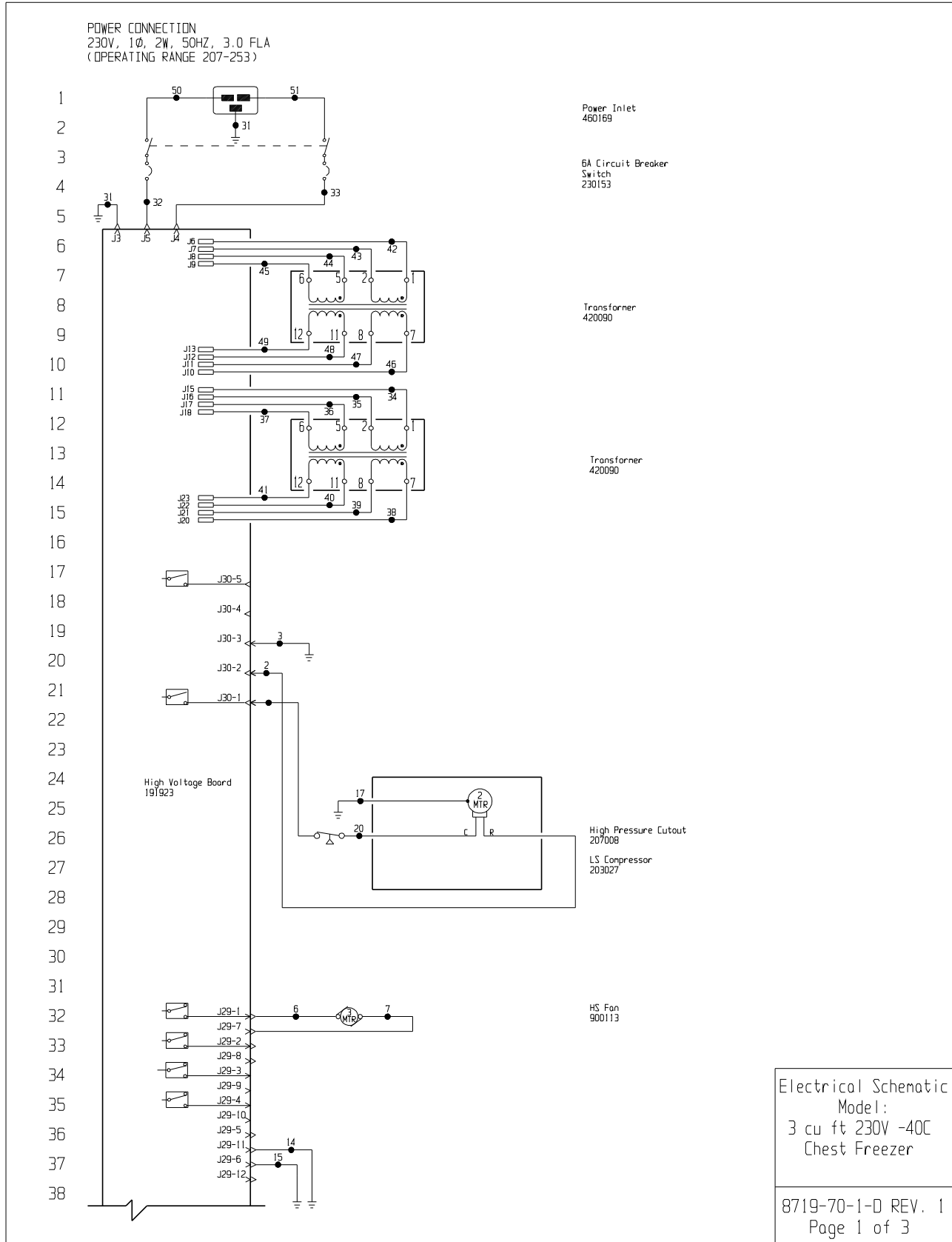
Electrical Schematic
Model:
3 cu ft 120V -40C
Chest Freezer

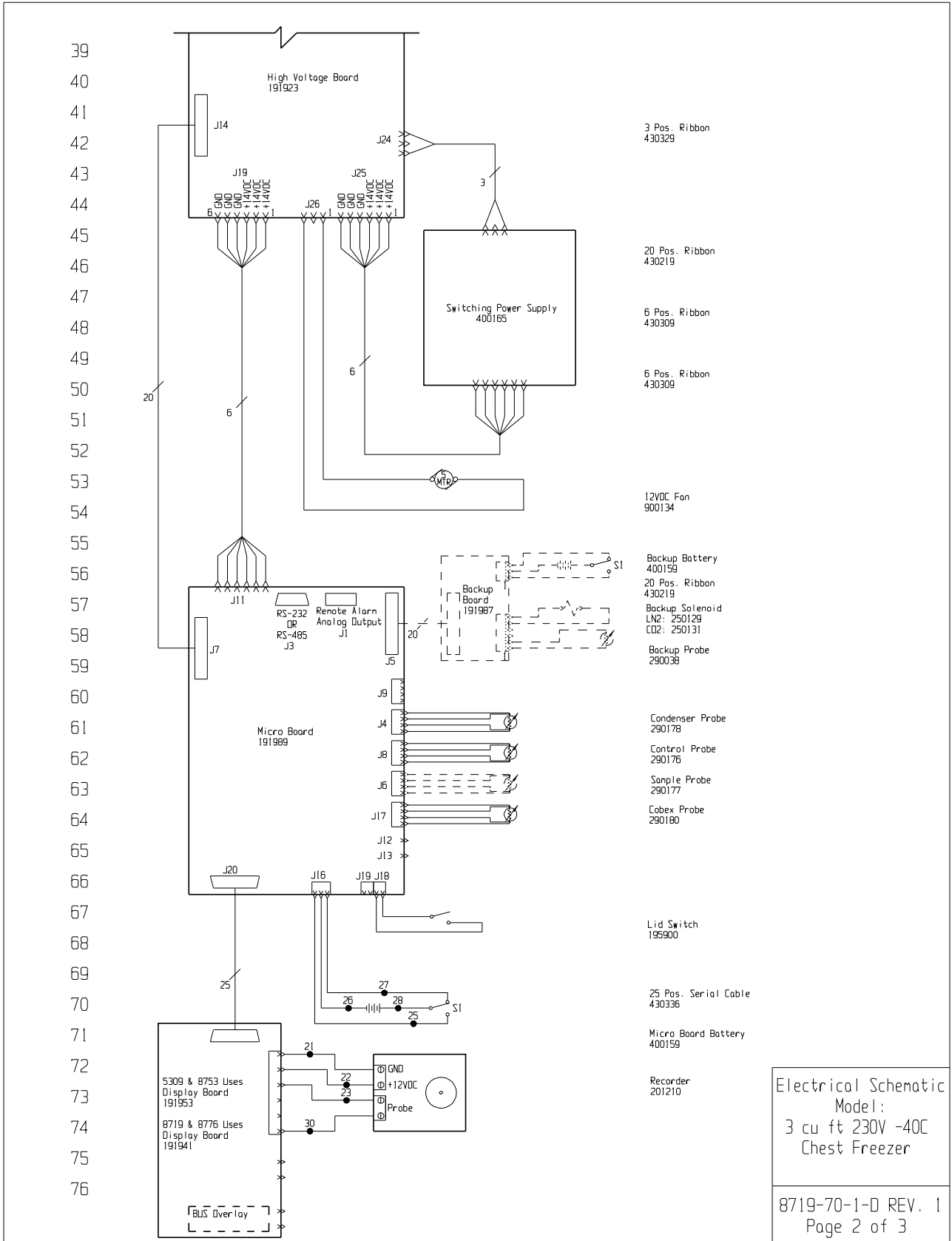
8718-70-1-D REV. 1
Page 3 of 3



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SCIENTIFIC
BOX 649, MARIETTA, OHIO 45750

Section 10
Electrical Schematics

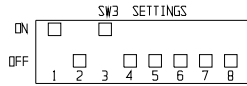




Section 10
Electrical Schematics

| WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE | |
|--------|-------|---------|--------|-------|---------|----|
| 77 | 1 | BLK | 14 | 25 | WHT | 18 |
| | 2 | RED | 14 | 26 | BLK | 18 |
| 78 | 3 | GRN/YEL | 14 | 27 | BLK | 18 |
| | 4 | | | 28 | RED | 18 |
| 79 | 5 | | | 29 | | |
| | 6 | BLK | 18 | 30 | RED | 18 |
| 80 | 7 | BLK | 18 | 31 | GRN/YEL | 14 |
| 81 | 8 | BLK | 18 | 32 | BLK | 14 |
| | 9 | BLK | 18 | 33 | BLU | 14 |
| 82 | 10 | | | 34 | BLK | 14 |
| | 11 | | | 35 | BLU | 14 |
| 83 | 12 | | | 36 | BLK | 14 |
| | 13 | | | 37 | BLU | 14 |
| 84 | 14 | GRN/YEL | 18 | 38 | BLK | 14 |
| 85 | 15 | GRN/YEL | 18 | 39 | BLU | 14 |
| | 16 | | | 40 | BLK | 14 |
| 86 | 17 | GRN/YEL | 14 | 41 | BLU | 14 |
| | 18 | | | 42 | BLK | 14 |
| 87 | 19 | | | 43 | BLU | 14 |
| | 20 | BLK | 14 | 44 | BLK | 14 |
| 88 | 21 | BLK | 18 | 45 | BLU | 14 |
| 89 | 22 | RED | 18 | 46 | BLK | 14 |
| | 23 | BLK | 18 | 47 | BLU | 14 |
| 90 | 24 | | | 48 | BLK | 14 |
| | | | | 49 | BLU | 14 |
| 91 | | | | 50 | BLK | 14 |
| 92 | | | | 51 | BLU | 14 |

3 CU. FT. CHEST MODELS
5309, 8719, 8753, 8776



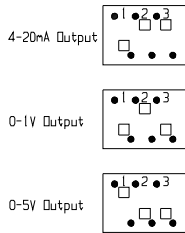
REMOTE CONTACTS/ANALOG OUTPUT
 PIN# 1 Analog Output +
 PIN# 2 Analog Output -
 PIN# 3 Shield
 PIN# 4 Shield
 PIN# 5 Normally Closed
 PIN# 6 Common
 PIN# 7 Normally Open
 CONTACT RATING: 1A @ 30V
 CONTACTS IN ALARM STATE

RS-232 SPECIFICATION

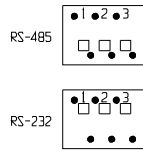
BAUD = 1200
 PARITY = N
 BITS = 8
 STOP BITS = 2

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

SW1 Settings for Analog Output



SW2 Settings for Communication Output



1. Door switch shown in open position.
2. Battery switch shown in the OFF position.
3. Circuit breaker switch shown in OFF position.
4. Options and accessories shown in dashed lines.

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|------|---------------------------------------|
| 1 | FR-2386 | 08-29-12 | AJC | SAG | CCS | REVISED OPERATING RANGE FROM 208-240V |
| 0 | FR-2202 | 05/03/11 | SRS | SAG | DRP | RELEASED FOR PRODUCTION / RELEASE 6 |

Electrical Schematic
 Model:
 3 cu ft 230V -40C
 Chest Freezer

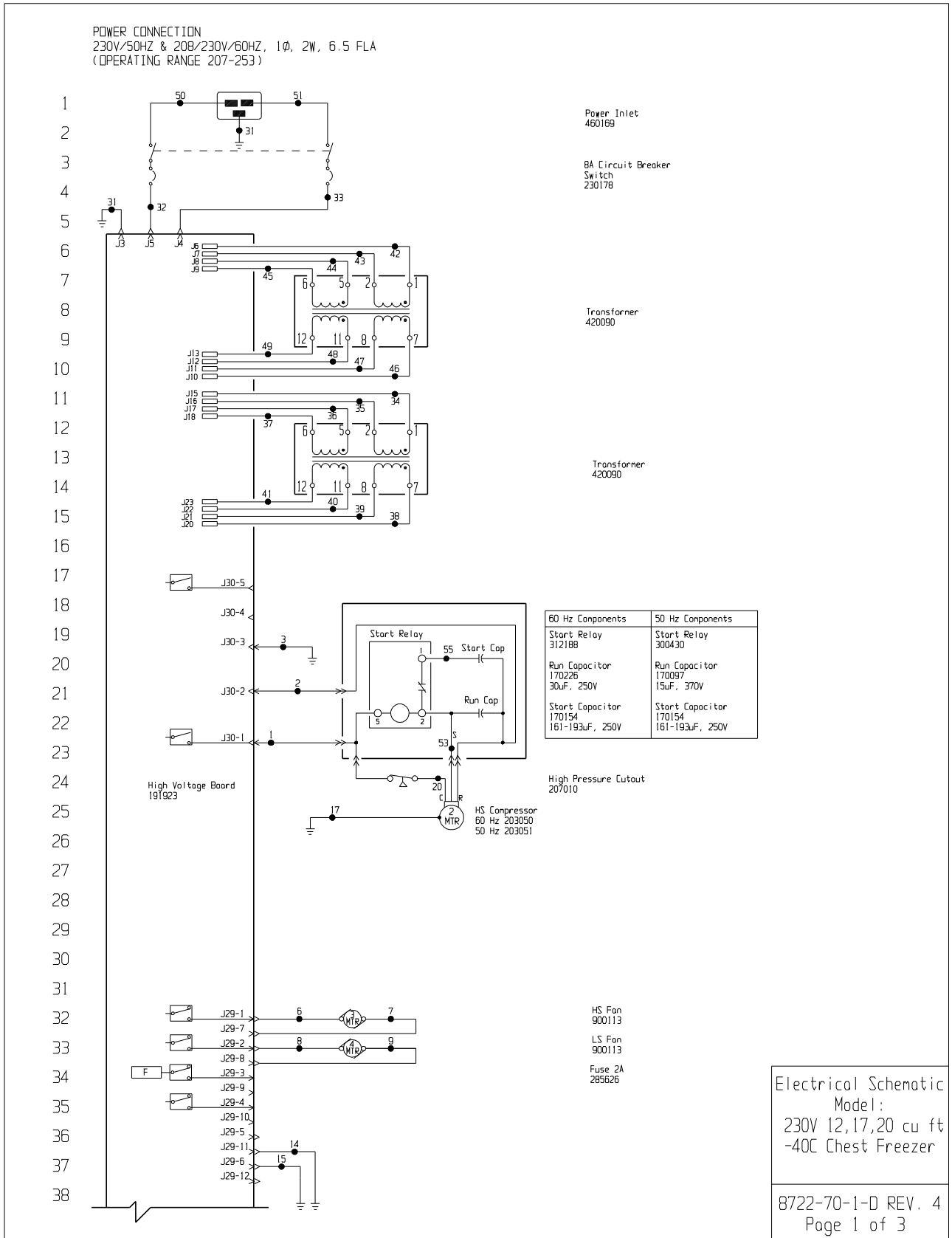


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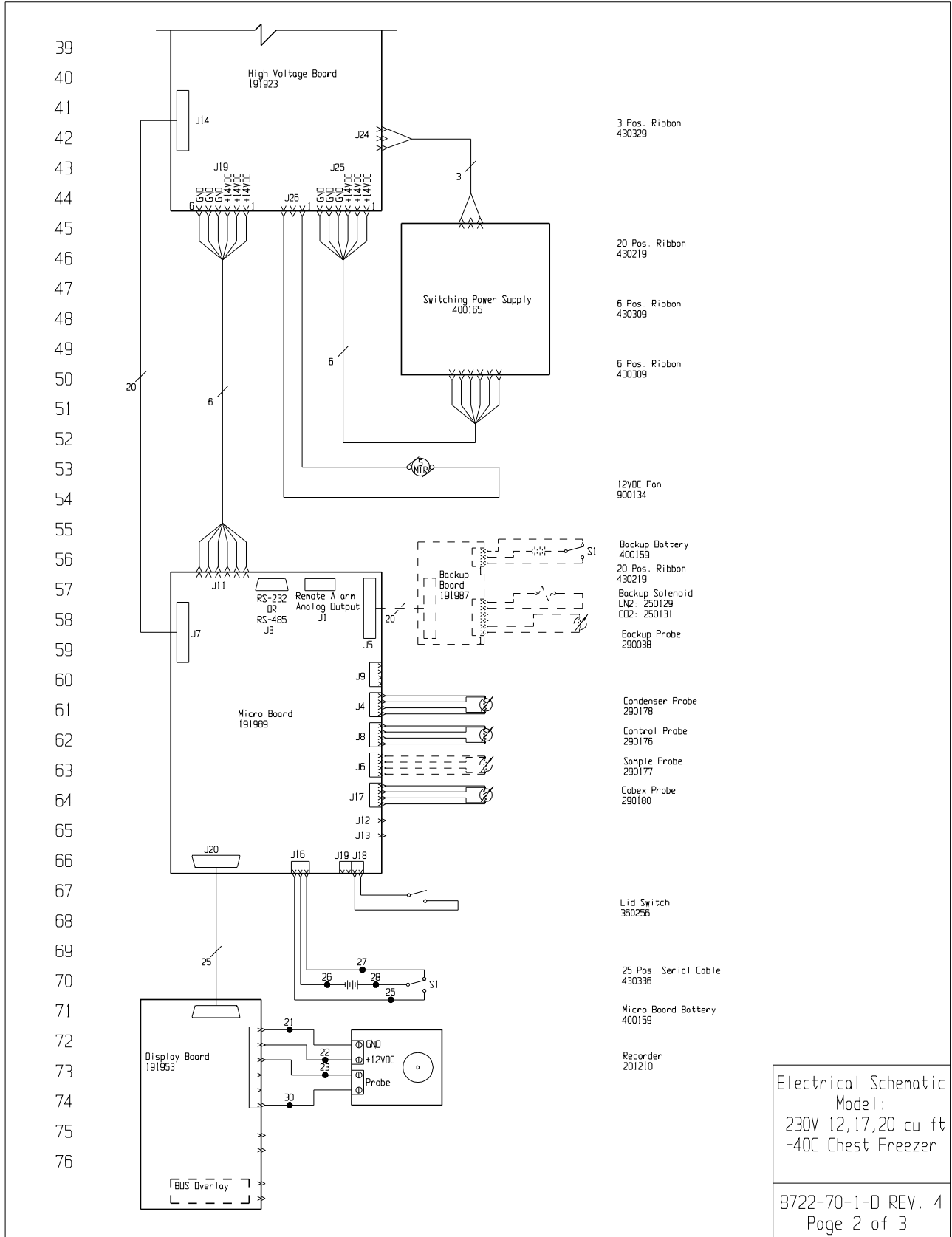
ThermoFisher SCIENTIFIC
 BDX 649, MARIETTA, OHIO 45750

| | | | | | | |
|---|----------------|----------------|----------------|-------------|--|--|
| MODEL/PART NAME: 3CF -40° CHEST FREEZER, 230V | | | | | | |
| DWG TITLE: ELECTRICAL SCHEMATIC | | | | | | |
| OWN: HCE | CAD: KDG | APPD: LON | DATE: 10-10-10 | SCALE: NONE | | |
| MATERIAL: | | | | | | |
| PAINT COLOR: | | | | | | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | | | | | | |
| ANGLES: .XX± | DECIMAL: .XXX± | DRAWING NUMBER | SIZE | | | |
| | | 8719-70-1 | D | | | |

8719-70-1-D REV. 1
 Page 3 of 3

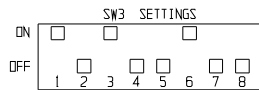


Section 10
Electrical Schematics



| WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE |
|--------|-------|---------|--------|-------|---------|
| 77 | 1 | BLK | 14 | 29 | |
| | 2 | RED | 14 | 30 | RED |
| | 3 | GRN/YEL | 14 | 31 | GRN/YEL |
| 78 | 4 | | 32 | BLK | 14 |
| | 5 | | 33 | BLU | 14 |
| 79 | 6 | BLK | 34 | BLK | 14 |
| | 7 | BLK | 35 | BLU | 14 |
| 80 | 8 | BLK | 36 | BLK | 14 |
| | 9 | BLK | 37 | BLU | 14 |
| 81 | 10 | | 38 | BLK | 14 |
| | 11 | | 39 | BLU | 14 |
| 82 | 12 | | 40 | BLK | 14 |
| | 13 | | 41 | BLU | 14 |
| 83 | 14 | GRN/YEL | 42 | BLK | 14 |
| | 15 | GRN/YEL | 43 | BLU | 14 |
| 84 | 16 | | 44 | BLK | 14 |
| | 17 | GRN/YEL | 45 | BLU | 14 |
| 85 | 18 | | 46 | BLK | 14 |
| | 19 | | 47 | BLU | 14 |
| 86 | 20 | BLK | 48 | BLK | 14 |
| | 21 | BLK | 49 | BLU | 14 |
| 87 | 22 | RED | 50 | BLK | 14 |
| | 23 | BLK | 51 | BLU | 14 |
| 88 | 24 | | 52 | - | - |
| | 25 | WHT | 53 | YEL | 14 |
| | 26 | BLK | 54 | - | - |
| 89 | 27 | BLK | 55 | BLU | 14 |
| | 28 | RED | | | |

CHEST MODELS:
12.7 CU.FT. - 5312, 5313, 8722, 8727, 8754, 8755, 8777, 8778
17 CU.FT. - 5319, 5322, 8731, 8733, 8758, 8759, 8781, 8782
20 CU.FT. - 5320, 5323, 8734, 8736, 8760, 8761, 8783, 8784



RS-232 SPECIFICATION

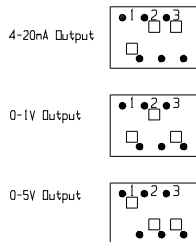
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PARITY = N
BITS = 8
STOP BITS = 2

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

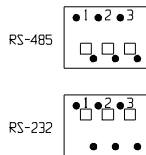
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|-------------------------------|-----------------|
| PIN# 1 | Analog Output + |
| PIN# 2 | Analog Output - |
| PIN# 3 | Shield |
| PIN# 4 | Shield |
| PIN# 5 | Normally Closed |
| PIN# 6 | Common |
| PIN# 7 | Normally Open |

CONTACT RATING: 1A @ 30V
CONTACTS IN ALARM STATE

SW1 Settings for Analog Output



SW2 Settings for Communication Output



1. Door switch shown in open position.
2. Battery switch shown in the OFF position.
3. Circuit breaker switch shown in OFF position.
4. Options and accessories shown in dashed lines.

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|------|-----|------|---|
| 4 | FR-2805 | 06-19-15 | S.JN | SAG | CCS | 312188 WAS 300429 |
| 3 | FR-2386 | 08-29-12 | AJC | SAG | MSB | REVISED OPERATING RANGE FROM 208-240V |
| 2 | FR-2386 | 07-27-12 | NAM | KDG | MSB | CHG. 300421 RELAY TO 300429, 300420 TO 300430 |
| 1 | FR-2267 | 10/26/11 | JWE | SAG | DRP | COMPRESSOR CHANGE / RELEASE 7 |
| 0 | FR-2202 | 05/03/11 | SRS | SAG | LON | RELEASED FOR PRODUCTION / RELEASE 6 |

Electrical Schematic
Model:
230V 12,17,20 cu ft
-40C Chest Freezer

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| | |
|---|----------------|
| MODEL/PART NAME: 12,17,20CF -40° CHEST FREEZERS, 230V | |
| DWG TITLE: UNIT SCHEMATIC | |
| DWN: HCE | CAD: KDG |
| APPD: LON | DATE: 10-10-10 |
| SCALE: NONE | |

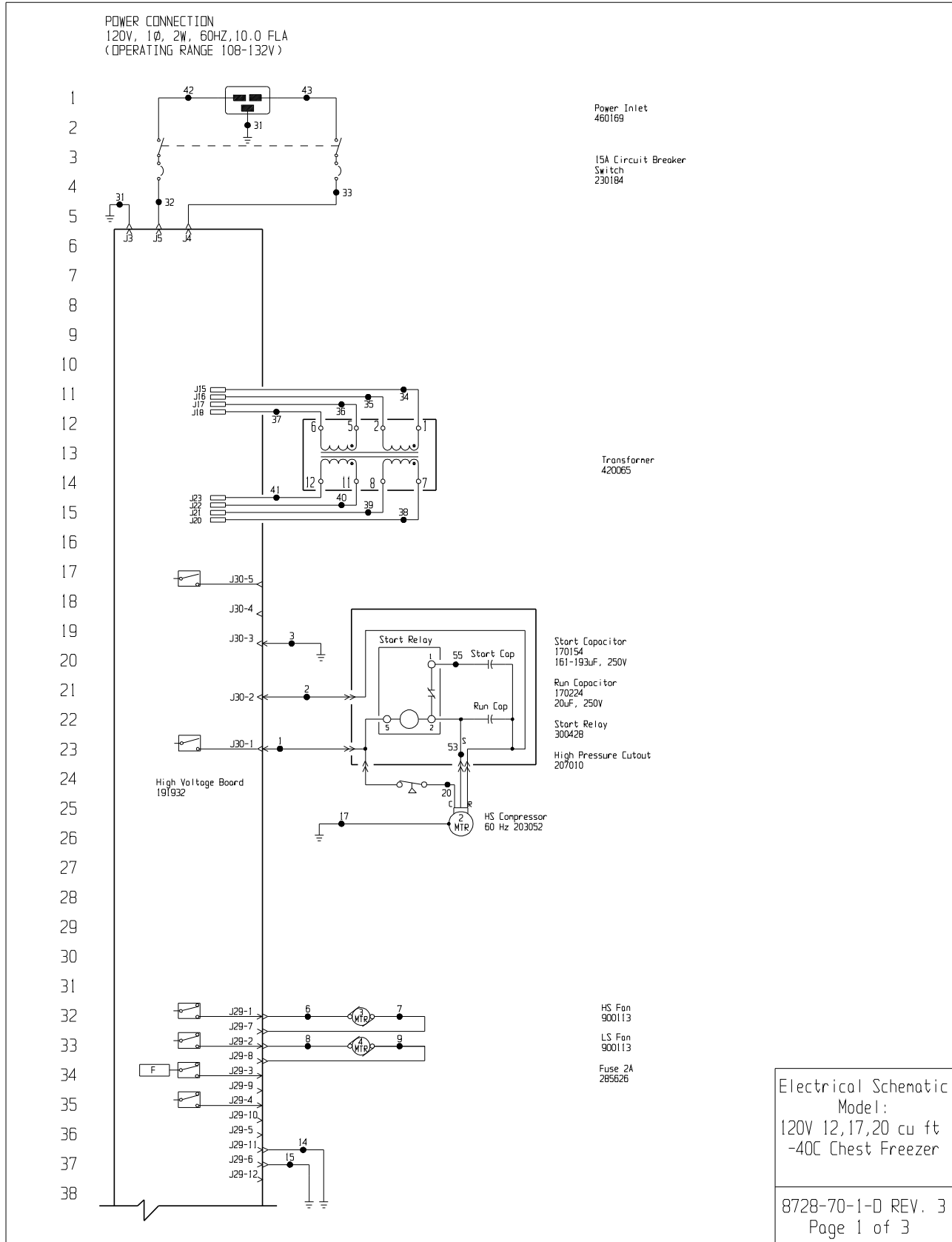


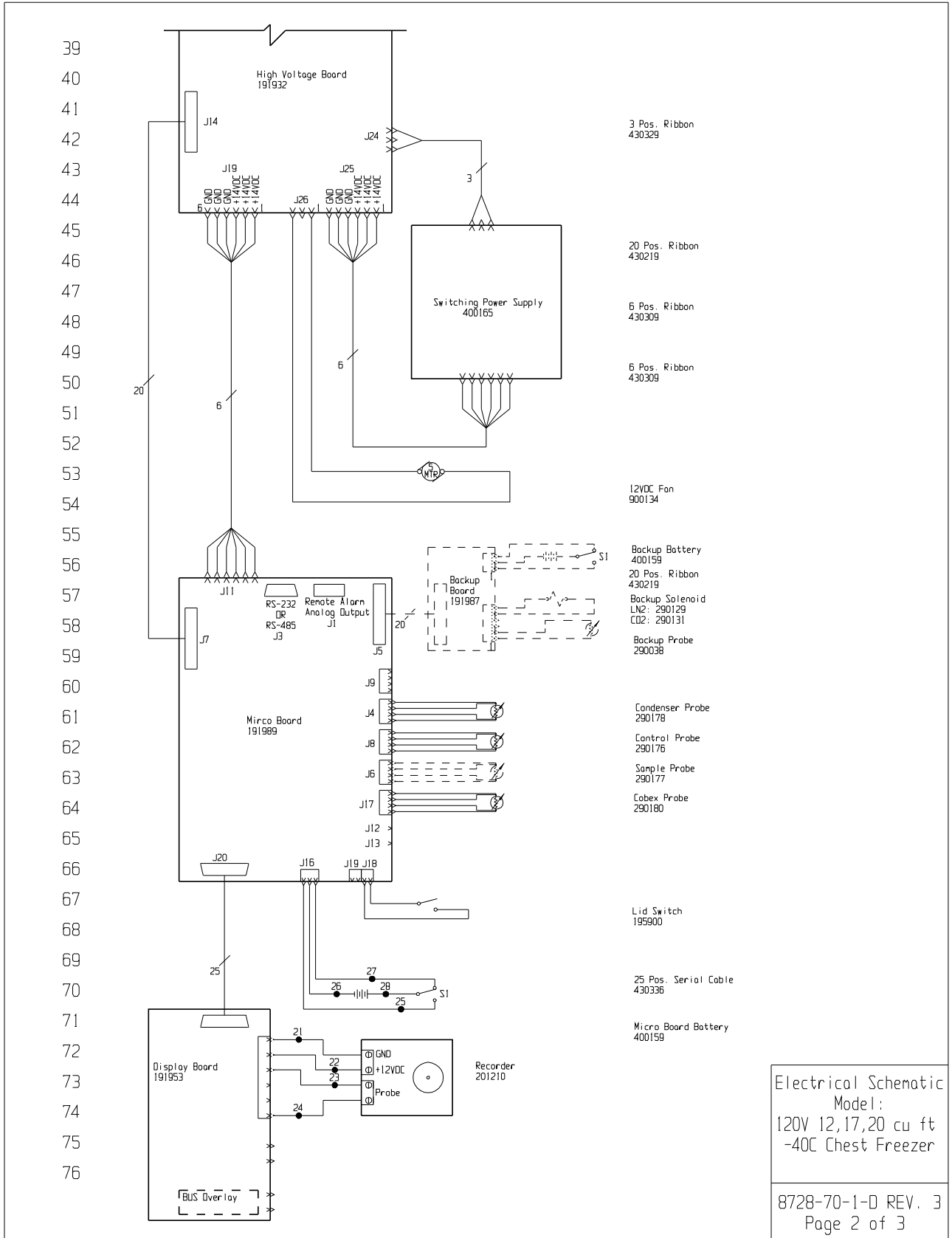
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BOX 649, MARLETTA, OHIO 45750

| | |
|--------------------------------------|----------------|
| MATERIAL: | |
| PAINT COLOR: | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED | DRAWING NUMBER |
| ANGLES: DECIMAL: .XX± | 8722-70-1 |
| DECIMAL: .XXX± | SIZE |
| | D |

8722-70-1-D REV. 4
Page 3 of 3

Section 10
Electrical Schematics

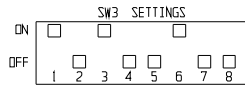




Section 10
Electrical Schematics

| | WIRE # | COLOR | GAUGE | WIRE # | COLOR | GAUGE |
|----|--------|---------|-------|--------|---------|-------|
| 77 | 1 | BLK | 14 | 29 | | |
| 78 | 2 | RED | 14 | 30 | | |
| | 3 | GRN/YEL | 14 | 31 | GRN/YEL | 14 |
| 79 | 4 | | | 32 | BLK | 14 |
| | 5 | | | 33 | BLU | 14 |
| 80 | 6 | BLK | 18 | 34 | BLK | 14 |
| | 7 | BLK | 18 | 35 | BLU | 14 |
| 81 | 8 | BLK | 18 | 36 | BLK | 14 |
| | 9 | BLK | 18 | 37 | BLU | 14 |
| 82 | 10 | | | 38 | BLK | 14 |
| | 11 | | | 39 | BLU | 14 |
| 83 | 12 | | | 40 | BLK | 14 |
| | 13 | | | 41 | BLU | 14 |
| 84 | 14 | GRN/YEL | 18 | 42 | BLK | 14 |
| | 15 | GRN/YEL | 18 | 43 | BLU | 14 |
| 85 | 16 | | | 44 | - | - |
| | 17 | GRN/YEL | 14 | 45 | - | - |
| 86 | 18 | | | 46 | - | - |
| | 19 | | | 47 | - | - |
| 87 | 20 | BLK | 14 | 48 | - | - |
| | 21 | BLK | 18 | 49 | - | - |
| 88 | 22 | RED | 18 | 50 | - | - |
| | 23 | BLK | 18 | 51 | - | - |
| 89 | 24 | RED | 18 | 52 | - | - |
| | 25 | WHT | 18 | 53 | YEL | - |
| 90 | 26 | BLK | 18 | 54 | - | - |
| | 27 | BLK | 18 | 55 | BLU | - |
| 91 | 28 | RED | 18 | | | |

CHEST MODELS:
12.7 CU.FT. - 5315, 8728, 8756, 8779
17 CU.FT. - 5318, 8730, 8757, 8780
20 CU.FT. - 5321, 8737, 8762, 8785



RS-232 SPECIFICATION

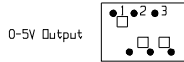
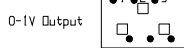
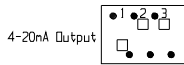
BAUD = 1200
PARITY = N
BITS = 8
STOP BITS = 2

| 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 |

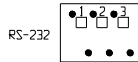
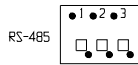
| RS-232 PORT |
|-------------|
| PIN# 2 TXD |
| PIN# 3 RXD |
| PIN# 5 GND |

CONTACT RATING: 1A @ 30V
CONTACTS IN ALARM STATE

SW1 Settings for Analog Output



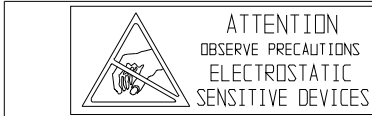
SW2 Settings for Communication Output



1. Door switch shown in open position.
2. Battery switch shown in the OFF position.
3. Circuit breaker switch shown in OFF position.
4. Options and accessories shown in dashed lines.

| REV | ECN NO. | DATE | BY | CAD | APPD | DESCRIPTION OF REVISION |
|-----|---------|----------|-----|-----|------|---------------------------------------|
| 3 | FR-2386 | 08-29-12 | AJC | SAG | CCS | REVISED OPERATING RANGE FROM 108-130V |
| 2 | FR-2386 | 07-27-12 | MAN | KDG | MSB | CHG. 300421 START RELAY TO 30042B |
| 1 | FR-2267 | 10/26/11 | JWE | SAG | DRP | COMPRESSOR CHANGE / RELEASE 7 |
| 0 | FR-2202 | 05/03/11 | SRS | SAG | LON | RELEASED FOR PRODUCTION / RELEASE 6 |

Electrical Schematic
Model:
120V 12,17,20 cu ft
-40C Chest Freezer



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MODEL/PART NAME: 12,17,20CF -40° CHEST FREEZERS, 120V
DWG TITLE: UNIT SCHEMATIC
QWN: HCE CAD: KDG APPD: LON DATE: 10-10-10 SCALE: NONE

ThermoFisher
SCIENTIFIC
BOX 649, MARIETTA, OHIO 45750

| MATERIAL: | PAINTE COLOR: | TOLERANCE UNLESS OTHERWISE SPECIFIED | ANGLES: | DECIMAL: | XX± | DRAWING NUMBER | SIZE |
|-----------|---------------|--------------------------------------|---------|----------|-----|----------------|------|
| | | | | | | 8728-70-1 | D |

8728-70-1-D REV. 3
Page 3 of 3

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.

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 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 the 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.

Introduction

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, 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 performed outdoors in a safe place. Pour the liquid slowly on gravel or bare earth where it can evaporate

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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United States

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