Fisher Scientific

Isotemp

Fisher Scientific Isotemp Ultra Low Temperature Chest Freezers

Operation Manual

7005150 Rev. 0

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Important installer and user information:

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

Models Covered

Model Number	Cu. ft.	Voltage
5150 I903CA	3	120
5151 I903C (D/V/W)	3	230
5153 I913CA	12.7	120
5152 I913C (D/V/W)	12.7	230
5154 I917CA	17	120
5155 I917C (D/V/W)	17	230
5157 I920CA	20	120
5156 I920C (D/V/W)	20	230

Packing List

Part No.	Description	Qty
34040	Key Ring	1
213F	Key	2
380520	Neoprene Cap	2
510016	1/4-20 x 5-1/2" Bolt	2
402058	Vacu-Key	1
195763	Retaining Clip	1
370563	Remote Alarm Connector	1

MANUAL NUMBER 7005150

REV	ECR/ECN	DATE	DESCRIPTION	By
0	FR-2055	7/13/09	Original	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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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.)
- ✔ Always dissipate extreme cold or heat and wear protective clothing.
- ✔ Always follow good hygiene practices.
- ✔ Each individual is responsible for his or her own safety.

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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.

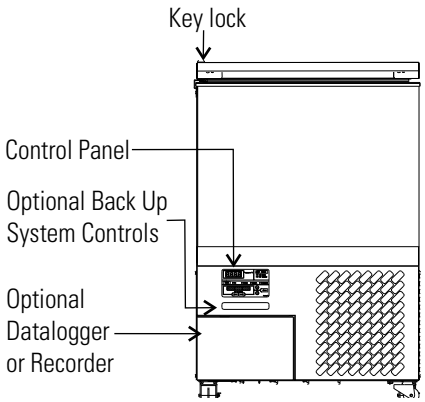


Figure 1-1. Front View 3 cu ft Models

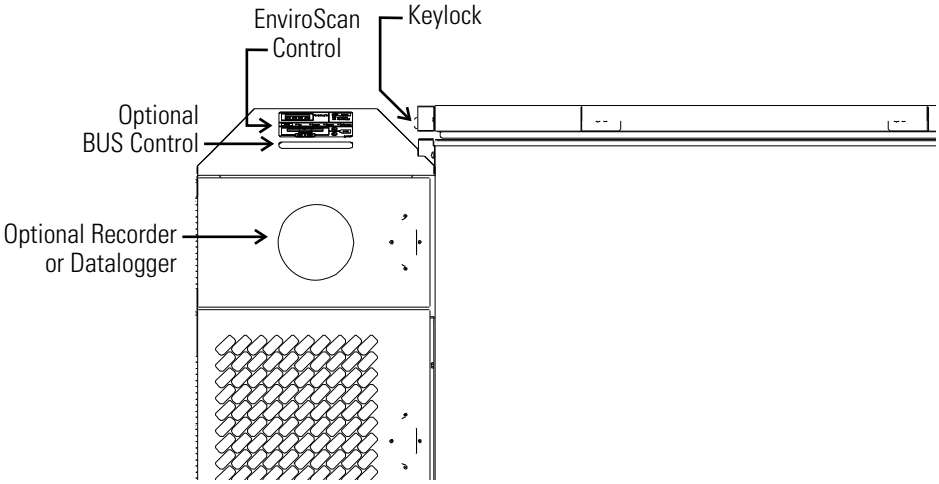


Figure 1-2. Front View Remaining Models

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).

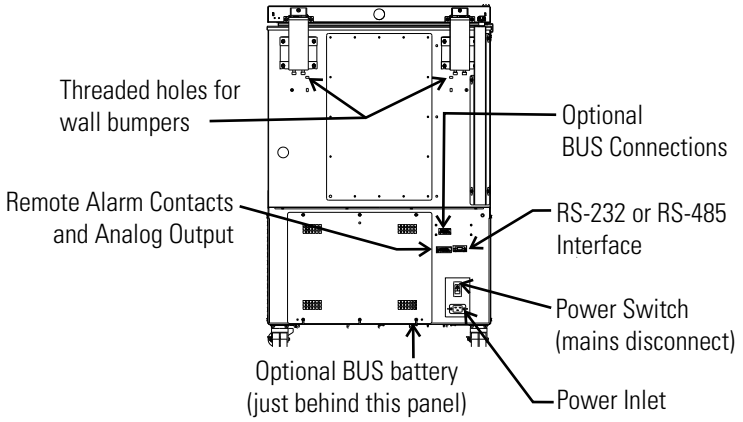


Figure 1-3. Rear View 3 cu ft Models

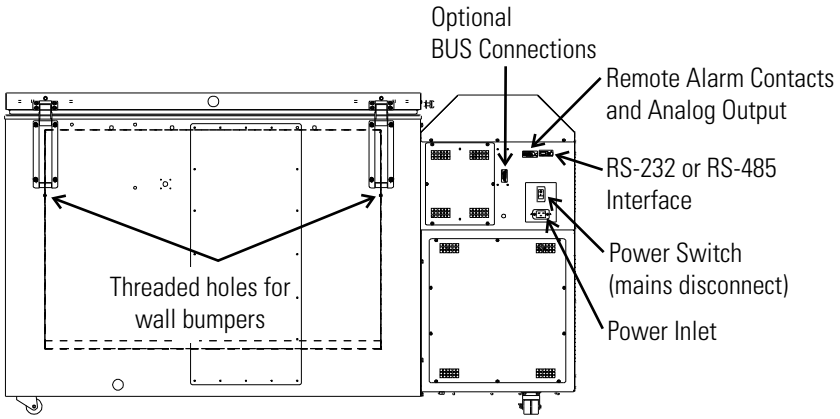


Figure 1-4. Rear View Remaining Models

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

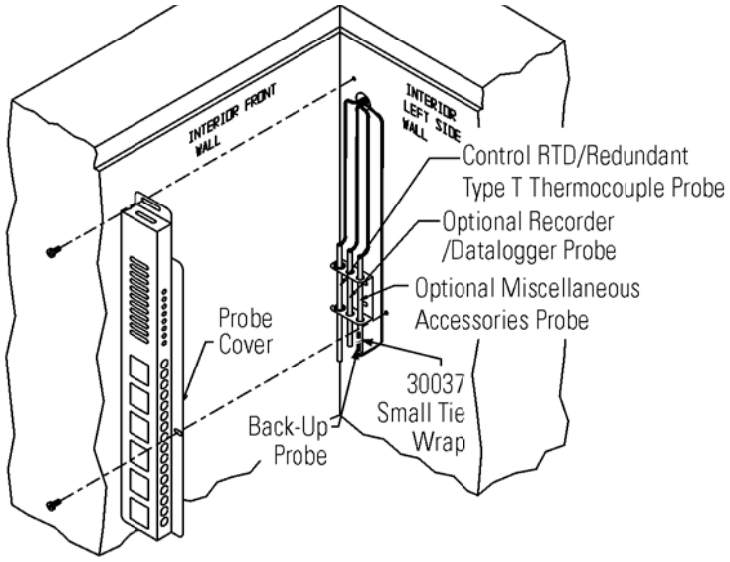


Figure 1-5. Probe Cover

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

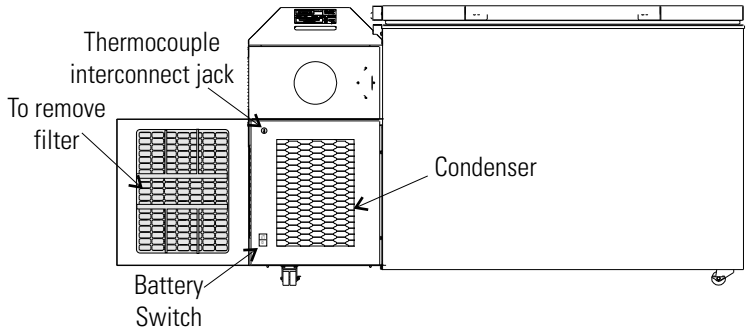


Figure 1-6. All Except 3 cu ft Models

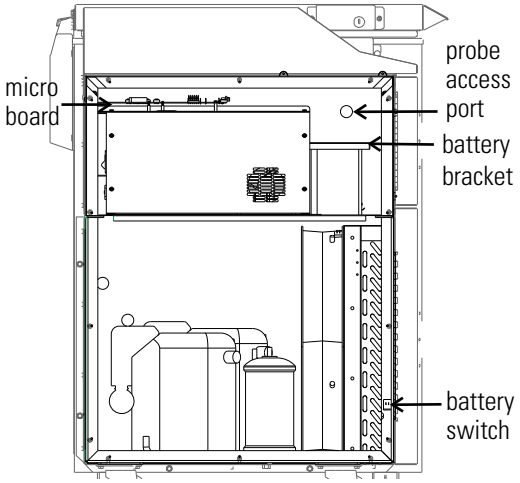


Figure 1-7. Freezer Left Side - Sidecar panel removed

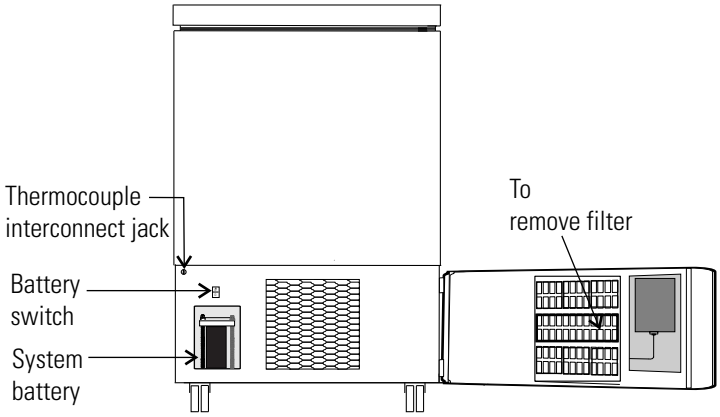


Figure 1-8. 3 cu ft Models

Control Panel Keys, Display, Indicators

1. Mode select switch - Used to select Run, Settings, Calibrate and System Configuration Modes.
2. Temperature display - Displays temperature in degrees Celsius.
3. Alarm indicator - Light pulses on/off during an alarm condition of the cabinet.
4. Silence - Mutes the audible alarm.
5. Low Battery - indicates a low battery condition of the freezer battery.
6. Hot Condenser - indicates a hot condenser condition.
7. Message Center - displays system status and alarms.
8. Scroll for Parameters arrows - moves the operator through the choices of the selected mode.
9. Up and down arrows - Increases or decreases values, toggles between choices.
10. Enter - Stores the value into computer memory.

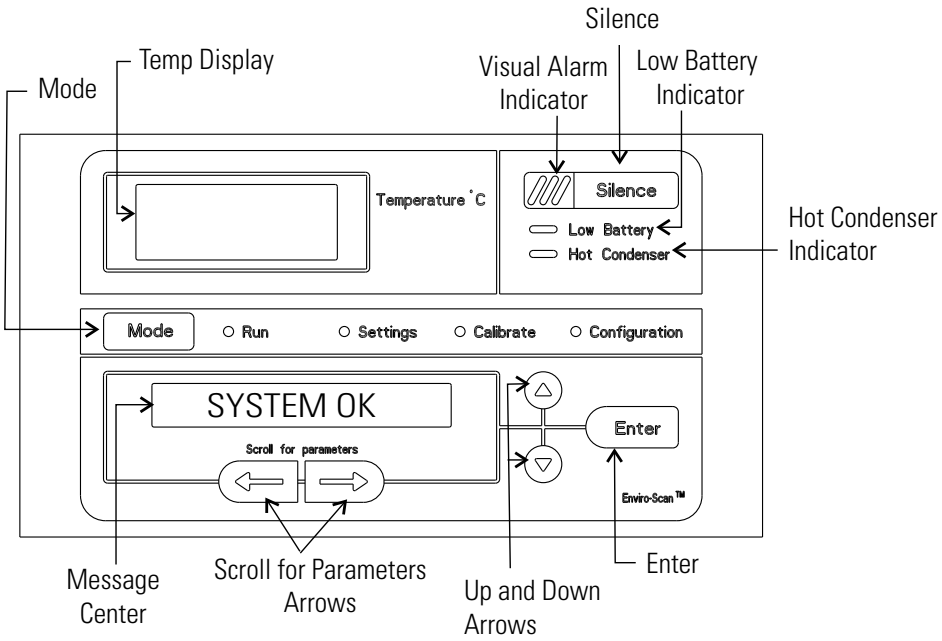


Figure 1-9. Control Panel Keys, Display and Indicators

Panel Keys, Display, Indicators (cont.)

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

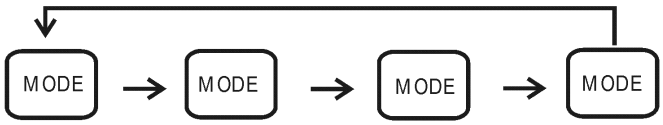
Run is the default mode which the freezer will normally be in during operation.

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 CO_2 or LN_2

Table 1-1. Modes of Operation

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.

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

Isotemp ULT 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.

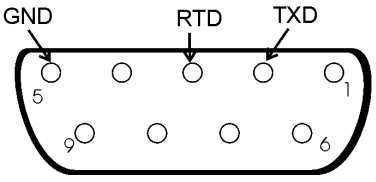


Figure 1-10. RS-232 Interface

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:

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

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) (OVERTEMP) (SP) (LF) (CR) (EOT) (SP) (UNDER TEMP)

The words "OVER TEMP" or "UNDER TEMP" are transmitted when an alarm condition exists along with the temperature. 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)

Remote Alarm Contacts and Analog Output

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.

Isotemp ULT 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. Figure 1-11 shows the remote contacts in alarm state.

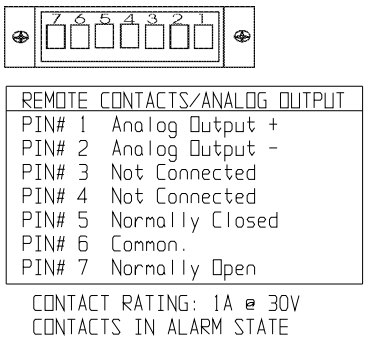


Figure 1-11. Remote Alarm Contacts

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.

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.

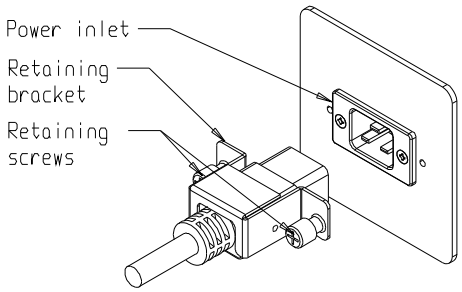


Figure 1-12. Power Cord Attachment

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 below for more detail.

Control Set Point	-80°C
High Temperature Alarm	-70°C
Low temperature alarm	-90°C
Optional BUS Set Point	-60°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, depending on ambient temperature. The freezer is shipped from the factory with a temperature set point of -80°C. 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

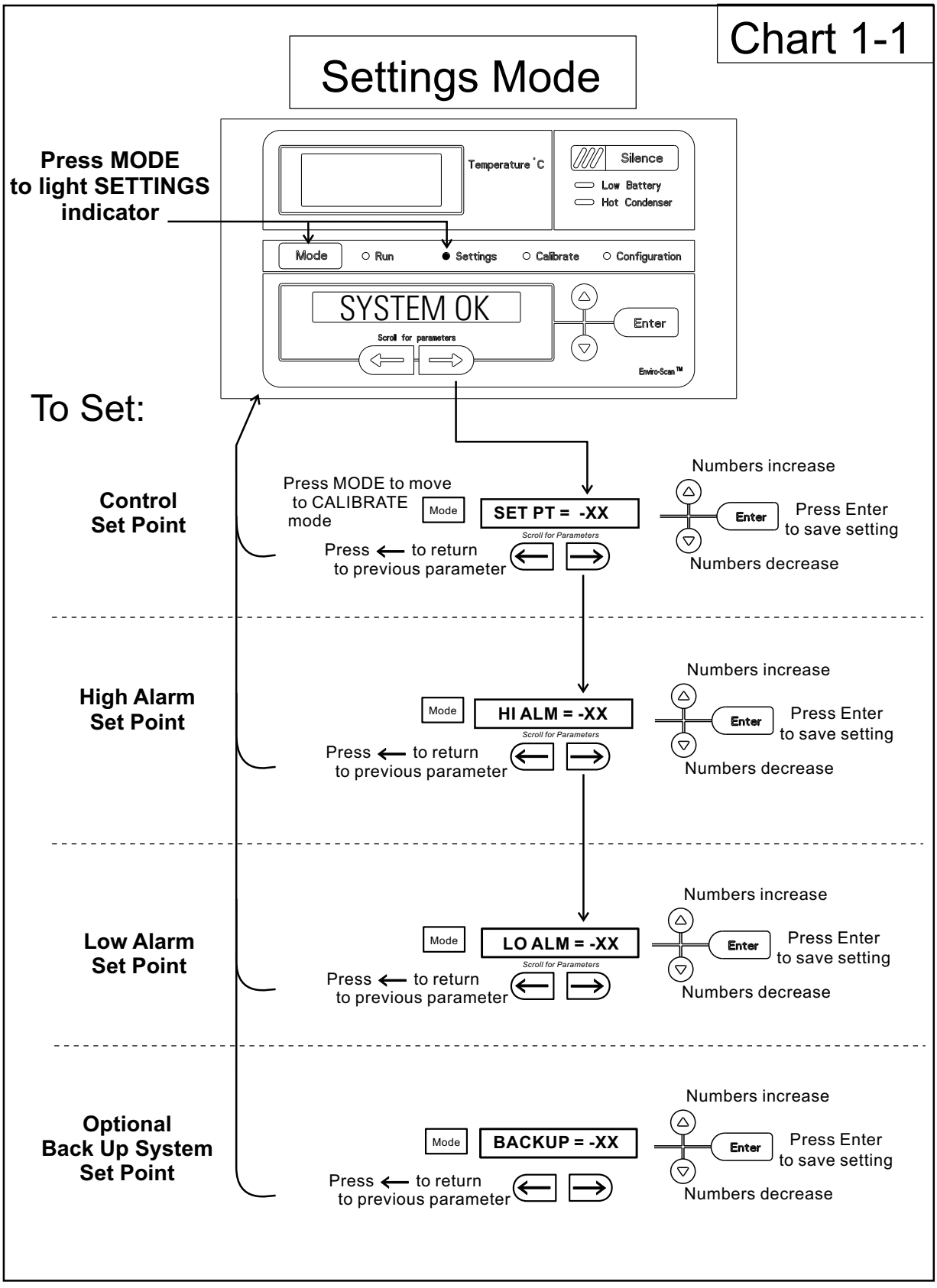
Run mode is the default mode for the freezer. The run mode displays the cabinet temperature on the temperature display and 'SYSTEM OK' on the message center under normal operating conditions. In addition, the Run mode allows display of the following information:

LINE VOLTAGE

COMPENSATED VOLTAGE

HSHX TEMPERATURE (heat exchanger temperature)

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
Settings Mode
Press MODE to light SETTINGS indicator
Temperature °C
Silence
Low Battery
Hot Condenser
Mode
Run
Settings
Calibrate
Configuration
SYSTEM OK
Scroll for parameters
Enter
Enviro-Scan™
To Set:
Control Set Point
Press MODE to move to CALIBRATE mode
Mode
SET PT = -XX
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save setting
Numbers decrease
High Alarm Set Point
Mode
HI ALM = -XX
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save setting
Numbers decrease
Low Alarm Set Point
Mode
LO ALM = -XX
Scroll for Parameters
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save setting
Numbers decrease
Optional Back Up System Set Point
Mode
BACKUP = -XX
Press ← to return to previous parameter
Numbers increase
Enter
Press Enter to save setting
Numbers decrease

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.

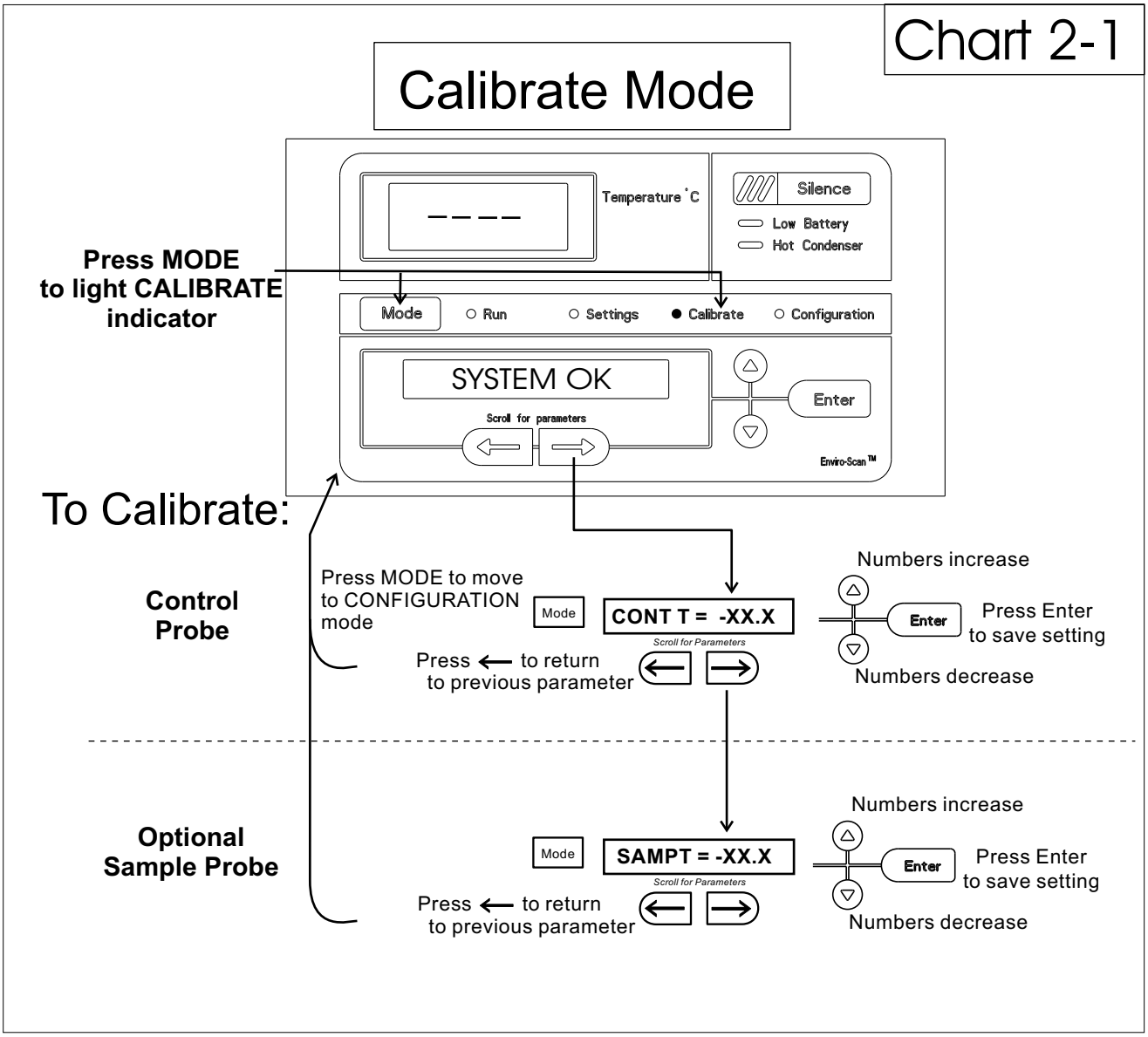
Temperature Stabilization Periods

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
Calibrate Mode
Temperature °C
Silence
Low Battery
Hot Condenser
Press MODE
to light CALIBRATE
indicator
Mode
Run
Settings
Calibrate
Configuration
SYSTEM OK
Enter
Scroll for parameters
Enviro-Scan™
To Calibrate:
Control
Probe
Press MODE to move
to CONFIGURATION
mode
Mode
CONT T = -XX.X
Scroll for Parameters
Press ← to return
to previous parameter
Numbers increase
Enter
Press Enter
to save setting
Numbers decrease
Optional
Sample Probe
Mode
SAMPT = -XX.X
Scroll for Parameters
Press ← to return
to previous parameter
Numbers increase
Enter
Press Enter
to save setting
Numbers decrease

Section 3 Configuration

Configuration Mode

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 Mute 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 Mute 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

Should a high stage alarm occurred, it may become necessary to the 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. ▲

Set Access Code (continued)

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 BUS (back up system), allows the user to select which type of gas is injected into the freezer chamber. The options are CO_2 and LN_2.

1. Press the Mode key until the Configuration indicator lights.

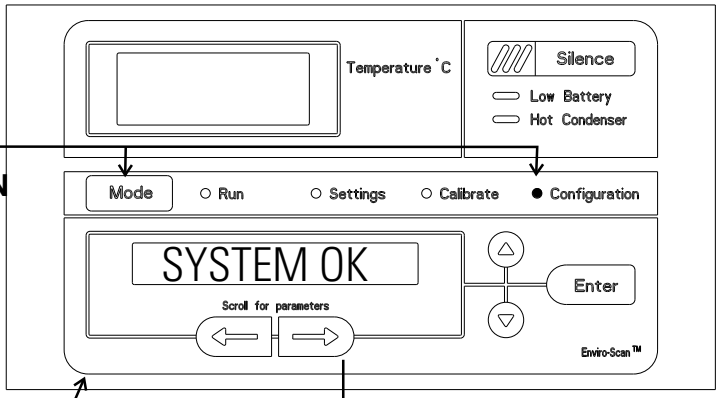
2. Press the right arrow until BUS TYPE CO2 or BUS TYPE LN2 is displayed in the message center.

3. Press up/down arrow to toggle between the two display selections.

4. Press Enter to save.

Chart 3-1

Configuration Mode



Press MODE to light CONFIGURATION indicator

To Configure:

Press MODE to move to RUN mode

High Alarm Test

Mode — **HI ALRM TEST** — Enter

Scroll for Parameters

Press ← to return to previous parameter

Press Enter to initiate test

Low Alarm Test

Mode — **LO ALRM TEST** — Enter

Scroll for Parameters

Press ← to return to previous parameter

Press Enter to initiate test

System Battery Test

Mode — **SYS BAT TEST** — Enter

Scroll for Parameters

Press ← to return to previous parameter

Press Enter to initiate test

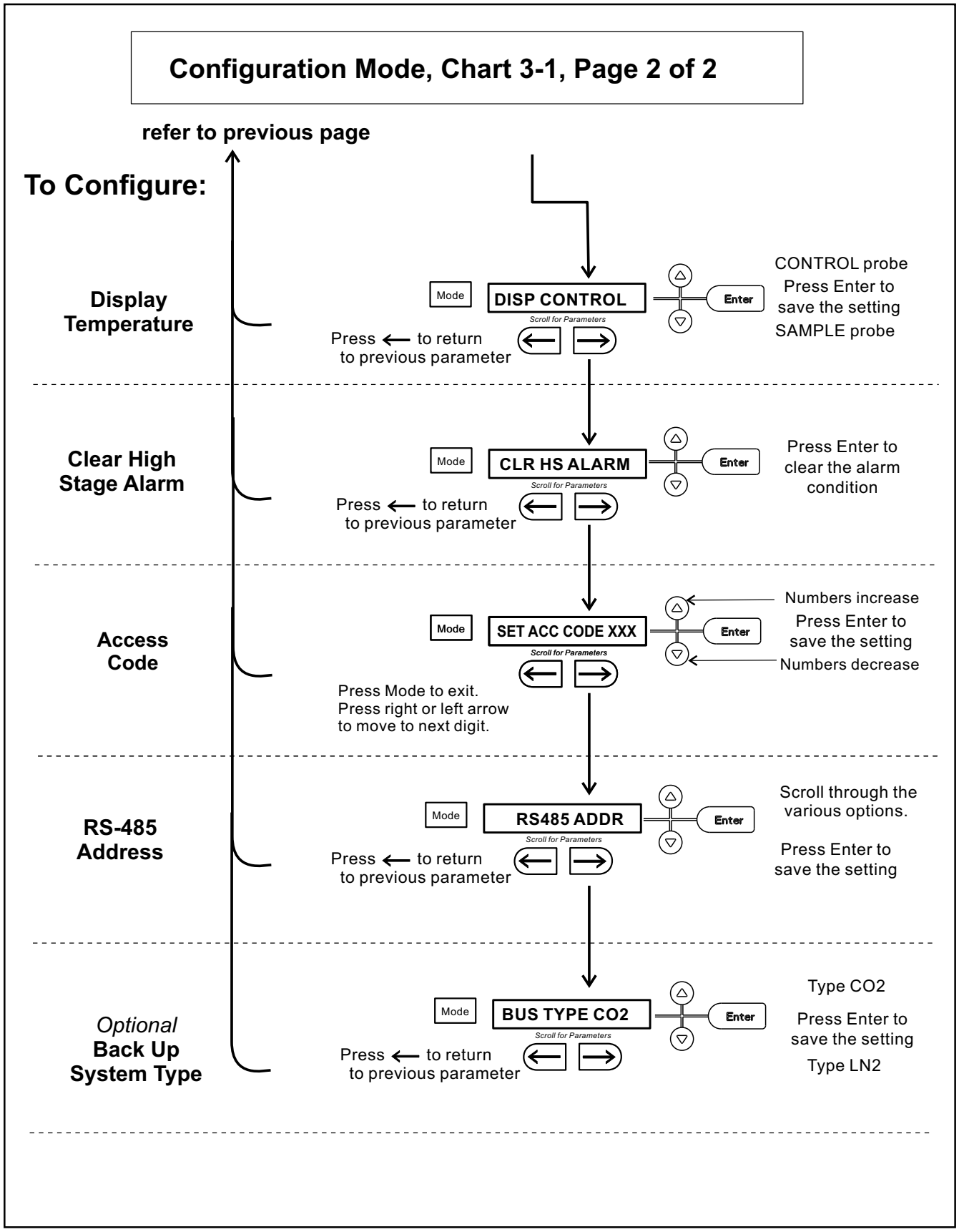
Optional **BUS Battery Test**

Mode — **BUS BAT TEST** — Enter

Scroll for Parameters

Press ← to return to previous parameter

Press Enter to initiate test


Configuration Mode, Chart 3-1, Page 2 of 2
refer to previous page
To Configure:
Display Temperature
Mode
DISP CONTROL
Scroll for Parameters
Enter
CONTROL probe
Press Enter to save the setting
SAMPLE probe
Press ← to return to previous parameter
Clear High Stage Alarm
Mode
CLR HS ALARM
Scroll for Parameters
Enter
Press Enter to clear the alarm condition
Press ← to return to previous parameter
Access Code
Mode
SET ACC CODE XXX
Scroll for Parameters
Enter
Numbers increase
Press Enter to save the setting
Numbers decrease
Press Mode to exit.
Press right or left arrow to move to next digit.
RS-485 Address
Mode
RS485 ADDR
Scroll for Parameters
Enter
Scroll through the various options.
Press Enter to save the setting
Press ← to return to previous parameter
Optional
Back Up System Type
Mode
BUS TYPE CO2
Scroll for Parameters
Enter
Type CO2
Press Enter to save the setting
Type LN2
Press ← to return to previous parameter

Section 4 Alarms

Alarms

The Isotemp ULT 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.

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.	12 hours	No
Control Probe Failure - see below	PROBE 1 FAIL	1 min.	15 min.	No
Heat Exchanger Probe Failure - see below	PROBE 2 FAIL	1 min.	15 min.	No
Condenser Probe - see 4.2	PROBE 3 FAIL	1 min.	15 min.	No
Sample Probe Failure (optional) - see below	PROBE 4 FAIL	1 min.	15 min.	No
High Stage System Failure	HS SYST FAIL	1 min.	15 min.	No
Condenser Hot Condition	HOT CONDENSR	1 min.	none	No
Wrong Power	WRONG POWER	0 min.	none	No
Voltage Compensation	VCOMPEN FAIL	0 min.	15 min.	No
Micro Board Failure	MICRO FAIL	0 min.	15 min.	No

All alarm delays and ringback times are +30 seconds.
*The automatic battery test runs 12 hours after initial start-up, then every 12 hours thereafter. A user initiated battery test can be performed from the configuration menu. See Section 3.

Wrong Power Alarm

If a 230V freezer is connected to a 120V power source or a 120V freezer is connected to a 230V power source, the electronics detect that an incorrect power source has been connected to the freezer. Under this condition, the fans and compressors will not turn on and an audible and visual alarm occur with "WRONG POWER" in the LED message center.

The “WRONG POWER” alarm may also occur if the battery switch is turned to Standby mode (⏻) prior to applying power to the freezer. The audible and visual alarms remain until the freezer is connected to the correct power source.

High Stage System Failure Alarm

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.

Voltage Compensation Alarm

If the freezer is compensating for high or low line voltage, the system will measure the compensated AC voltage. If the voltage is incorrect, the unit will stop attempting to compensate, and the compressors will run on direct line voltage. Under this condition, the message center will display “VCOMPEN FAIL”.

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 Silenceduring multiple alarms causes all active alarms to be muted 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.

Probe Failure Alarms

The microprocessor in Isotemp ULT freezers continually scans all probes including the control probe, heat exchanger probe, condenser probe and optional sample probe to ensure that they are operating properly. Should an error be detected, the "PROBE # FAIL" alarm will occur as described above. If an error is detected with the control probe (PROBE 1 FAIL), the high and low stage compressors will run continuously. As a result, the cabinet temperature will decrease until it reaches the lowest temperature that the refrigeration system can maintain. If an error is detected with the heat exchanger probe (PROBE 2 FAIL), the freezer will cycle properly at its temperature set point using a 5 minute step start between the high and low stage compressors. If an error is detected with the condenser probe (PROBE 3 FAIL) or optional sample probe (PROBE 4 FAIL), there is no impact on the performance of the freezer. However, the hot condenser alarm may also occur when the condenser probe fails. Contact the Technical Services Department.

Section 5 Maintenance

Clean Cabinet Exterior

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 front 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 filter should be installed (P/N 398216 for the 3 cu ft model and 398217 for 13, 17 and 20 cu ft models).

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 amd 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.

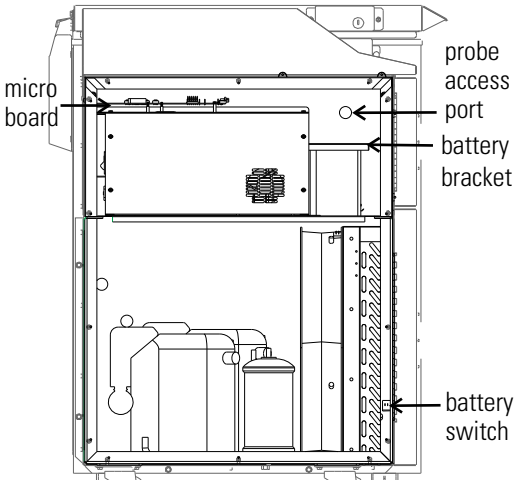


Figure 5-1. Battery and Switch location

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.

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.

Replace Battery(s)

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

All Models Except 3 cu ft

1. Open the front 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 front door by grasping the handle 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.

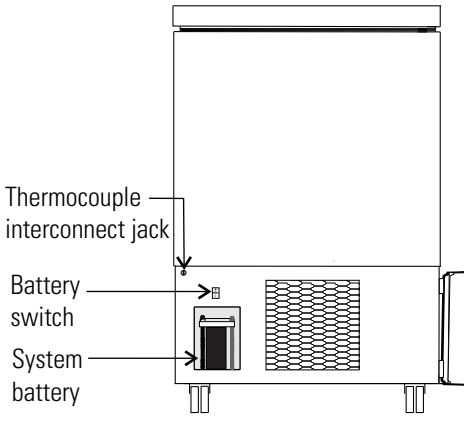


Figure 5-2. Battery and Switch location

3 cu ft Models (continued)

Note For a consistent and dependable charge, replace the battery every 2 years. Replacement batteries must be rechargeable are available from Fisher Scientific. 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. ▲

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. ▲

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 opening.

Action	Monthly	Yearly	Every 2 Years
Verify ambient temperature, <90°F	✔		
* Adjust door handle for firm latching, as needed	✔		
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".	✔ *More frequent cleaning may be required, depending on use and environmental conditions.*		
Check air filter. Clean or replace as needed. See "Clean Air Filter".	✔		
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.		✔	

* Qualified service technicians only

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

Section 6 Factory Installed Options

BUS - Back Up System

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.

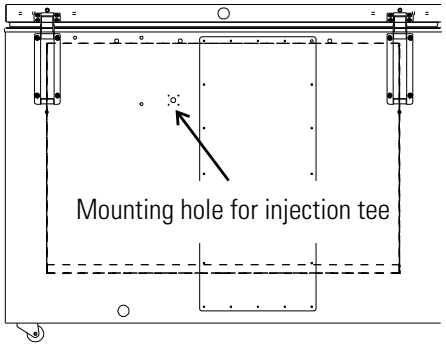


Figure 6-1. Mounting location

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.

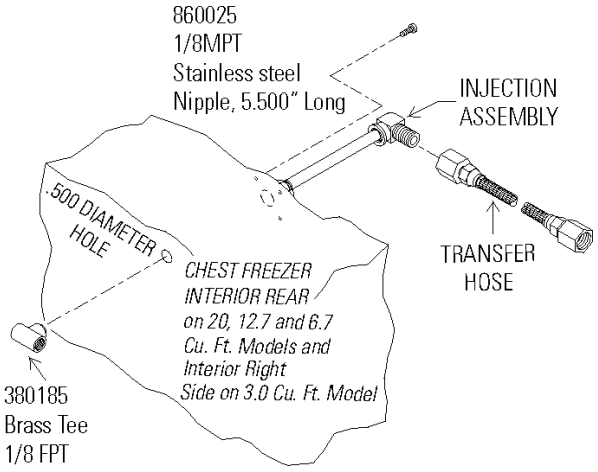


Figure 6-2. Injection Assembly

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 CO_2 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.

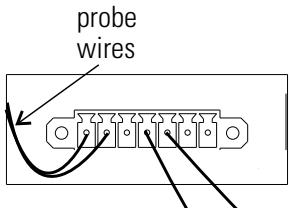


Figure 6-3. Probe and Solenoid Connections

Install Temperature Probe (continued)

3. Carefully remove the existing Permagum sealant from around the probe port opening.

4. 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).

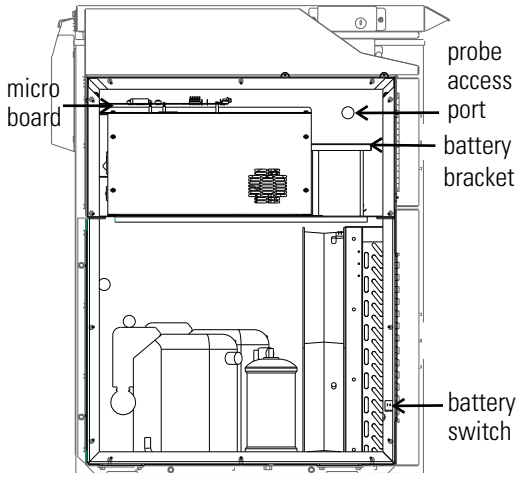


Figure 6-4. Probe Access Port

5. 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).

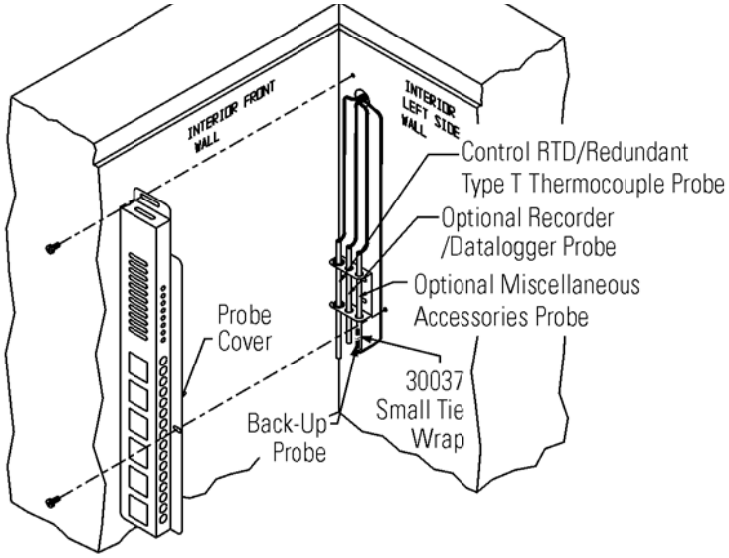


Figure 6-5. Probe location

6. Seal around the interior and exterior opening of the probe port with Permagum sealant.

7. 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 LN_2. ▲

Caution Make sure the pressure relief valve on any LN_2 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 CO_2 in Appendix B of this manual. ▲

BUS Control Panel (continued)

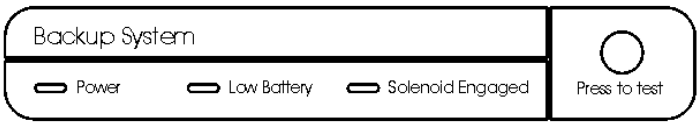


Figure 6-6. BUS Control Panel

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 (CO_2 or LN_2).

Press-To-Test - Activates the solenoid and injects LN_2 or CO_2 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. ▲

Configure Optional BUS (Back Up System)

The optional BUS can be configured for LN_2 or CO_2 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 CO_2, 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

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.

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

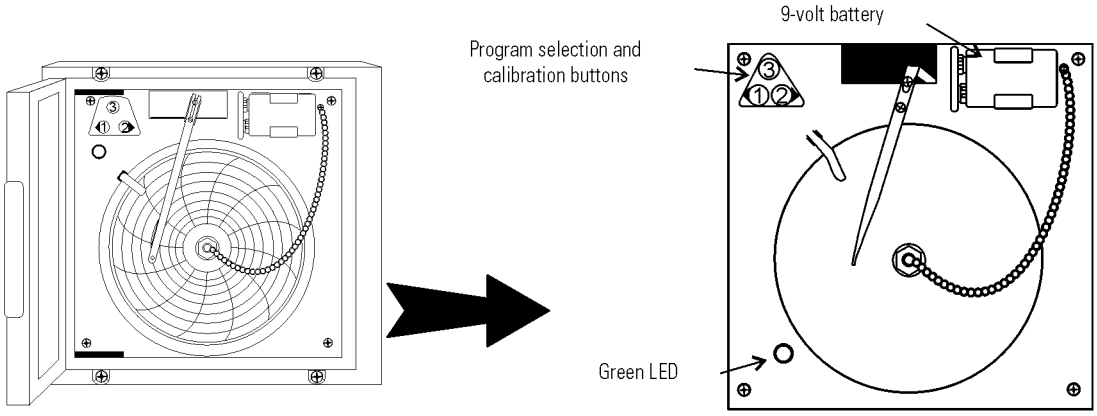


Figure 6-7. Recorder Details

Install Chart Paper

The following section 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.

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 Fisher Scientific. ▲

Section 7 Specifications

Model	5150	5151
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 28.8" F-B (72.4cm x 111.3cm x 73.2cm) 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	120VAC, 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, 120VAC, Dedicated Circuit, 15 Amp Time Delay Breaker	15 Amp, 230VAC, Dedicated Circuit, 15 Amp Time Delay Breaker
Shipping Weight	432 lbs. (196.0 kg)	

Model	5152	5153
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 28.8" F-B (182.9cm x 102.9cm x 73.2cm) 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 47.6cm)	
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	120VAC, 1 PH, 60 Hz, 16.0 FLA Operating Range: 108VAC-130VAC	230VAC, 1 PH, 50/60 Hz, 12.0 FLA Operating Range: 208VAC-240VAC
Breaker Requirements	20 Amp, 120VAC, Dedicated Circuit, 20 Amp Time Delay Breaker	15 Amp, 230VAC, Dedicated Circuit, 15 Amp Time Delay Breaker
Shipping Weight	716 lbs. (324.8 kg)	

Model	5154	5155
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 28.8" F-B (222.5cm x 102.9cm x 73.2cm) 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	120VAC, 1 PH, 60 Hz, 16.0 FLA Operating Range: 108VAC-130VAC	230VAC, 1 PH, 50/60 Hz, 12.0 FLA Operating Range: 208VAC-240VAC
Breaker Requirements	20 Amp, 120VAC, Dedicated Circuit, 20 Amp Time Delay Breaker	15 Amp, 230VAC, Dedicated Circuit, 15 Amp Time Delay Breaker
Shipping Weight	821 lbs. (372.4 kg)	

Model	5156	5157
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 28.8" F-B (243.8cm x 102.9cm x 73.2cm) 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 47.6cm)	
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	120VAC, 1 PH, 60 Hz, 16.0 FLA Operating Range: 108VAC-130VAC	230VAC, 1 PH, 50/60 Hz, 12.0 FLA Operating Range: 208VAC-240VAC
Breaker Requirements	20 Amp, 120VAC, Dedicated Circuit, 20 Amp Time Delay Breaker	15 Amp, 230VAC, Dedicated Circuit, 15 Amp Time Delay Breaker
Shipping Weight	833 lbs. (377.8 kg)	

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 ±10% of the nominal voltage
Installation Category II [1]
Pollution Degree 2 [2]
Class of Equipment I

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[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.

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 without causing damage. Do not pour the liquid on pavement.

Appendix B Handling Liquid CO_2



Warning High concentrations of CO_2 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% CO_2). The short term exposure limit for 15 minutes or less is 30,000 PPM (3% CO_2). Carbon dioxide monitors are recommended for confined areas where concentrations of carbon dioxide gas can accumulate. ▲

Store and use liquid CO_2 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 CO_2 gas reduce the concentration of oxygen and can result in asphyxiation. Because CO_2 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 CO_2 is exposed to the air is condensed moisture; not the gas itself. The issuing gas is invisible. ▲

Never dispose of liquid CO_2 in confined areas or places where others may enter.

Disposal of liquid CO_2 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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