



CRYOEXTRA CE8100 SERIES

Liquid Nitrogen Storage System

Operating and Maintenance Manual

326636H01 • Revision C • April 2020

IMPORTANT Read this instruction manual. Failure to follow the instructions in this manual can 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.

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

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Safety and First Aid

This manual covers the use and maintenance of CryoExtra™ Cryogenic Freezers and the associated control system. It is intended for use by trained personnel only. All service and maintenance should be performed by an authorized CryoExtra Distributor.

In this manual, the following symbols and conventions are used:



This symbol used alone indicates important operating instructions which reduce the risk of injury or poor performance of the unit.



CAUTION : This symbol, in the context of a CAUTION, indicates a potentially hazardous situation which if not avoided could result in minor to moderate injury or damage to the equipment or property damage.



WARNING: This symbol, in the context of a WARNING, indicates situations where, if not avoided, could result in serious injury or death.



WARNING: This symbol indicates situations where dangerous voltages exist and potential for electrical shock is present.



The snowflake symbol indicates extreme low temperatures and high risk of frostbite. Do not touch bare metal or samples with unprotected body parts.



This symbol indicates a need to use gloves during the indicated procedures. If performing decontamination procedures, use chemically resistant gloves. Use insulated gloves for handling samples and when using liquid nitrogen.



Before installing, using or maintaining this product, please be sure to read this manual and product warning labels carefully. Failure to follow these instructions may cause this product to malfunction, which could result in injury or damage.



READ BEFORE OPERATING THIS EQUIPMENT.

General

Liquid nitrogen (LN₂) is used in CryoExtra Cryogenic Freezers as a refrigerant. Understanding and following certain safety precautions is extremely important when handling LN₂ and cryogenic containers (Dewars).

Liquid Nitrogen Properties

Nitrogen is a colorless, odorless, tasteless gas. Gaseous nitrogen makes up about 78% of the Earth's atmosphere by volume. Once collected and isolated, nitrogen can be liquefied.

Boiling Point @ 1 atm	-195.8°C , -320.3°F, 77.4 K
Thermal Conductivity (Gas)	25.83 mW/(m.K)
Heat of Vaporization (Liquid)	198.38 kJ/kg
Density @ 1 atm (Liquid)	1.782 lbs/L , 807.4 g/L , 808.6 kg/m ³

Liquid Nitrogen Safety

Transferring LN₂ and operating the Controller should be done in accordance with the manufacturer/supplier instructions. It is important that all safety precautions written on the storage Dewar and recommended by the manufacturer be followed.



WARNING: Do not modify this equipment without authorization of the manufacturer.

- **Nitrogen is a potential asphyxiant and can cause rapid suffocation without warning. Store and use in area with adequate ventilation. Do not vent container in confined spaces. Do not enter confined spaces where gas may be present unless area has been well ventilated. If inhaled, move to fresh air. If breathing is difficult, supplemental oxygen may be required. If not breathing, give artificial respiration. SEEK MEDICAL ATTENTION IMMEDIATELY!**



- **Liquid nitrogen can cause severe frostbite to the eyes or skin. DO NOT touch frosted pipes or valves. Cold nitrogen vapor can damage the eyes or skin. In case of frostbite, consult a physician at once. If a physician is not readily available, warm the affected area with water that is near body temperature.**
- **Never place LN₂ in a sealed container without a pressure relief device. The expansion ratio of liquid nitrogen to gaseous nitrogen is approximately 1 to 700 (i.e. 1 cubic foot of LN₂ becomes 700 cubic feet of gas when evaporated).**

The two most important safety aspects to consider when handling LN₂ are adequate ventilation and eye and skin protection. Although nitrogen gas is non-toxic, it is dangerous in that the gas will displace oxygen in a normal breathing

atmosphere. Liquid products are of even greater threat since a small amount of liquid evaporates into a large amount of gas. Therefore, it is imperative that cryogenic supply and storage Dewars be stored and operated in well-ventilated areas.

Persons transferring LN₂ should make every effort to protect the eyes and skin from accidental contact with liquid or cold vapor. Thermo Fisher Scientific recommends the following protective clothing and accessories when transferring LN₂ or handling hoses, valves and plumbing components:

Recommended protective clothing

- Cryogenic gloves (loose fitting)
- Full-face shield or chemical splash goggles
- Cryogenic apron
- Long sleeve shirt and cuff less pants
- Closed toe shoes (no sandals)

Equipment Usage

Cryogenic containers must be operated in accordance with the manufacturer / supplier instructions. Safety instructions will also be posted on the side of each Dewar. Cryogenic containers must be kept in a well-ventilated area protected from weather and away from heat sources.

In applications that use a modular liquid cylinder as a source of LN₂, the supply will need to be replenished at regular intervals to ensure proper operation of the freezer. When exchanging liquid cylinders, follow the below procedure:

1. Allow all plumbing components to warm to room temperature before attempting to change supplies.
2. Close all valves associated with the liquid supply cylinder.
3. Relieve pressure in the plumbing assembly by initiating a brief fill by either pressing "Start Fill" or using the manual fill button.
4. Loosen the plumbing connection for the transfer hose at the liquid cylinder.
5. Remove empty liquid cylinder and replace with full liquid cylinder pressurized to 22 – 35 psig (1.52 - 2.41 bar).
6. Attach the transfer hose to the plumbing connection on the liquid cylinder. Ensure that the hose is connected to the connection labeled "LIQUID".
7. Tighten the transfer hose plumbing connection at the liquid cylinder.
8. Open the liquid supply valve on the liquid cylinder.
9. Inspect plumbing for audible and visual leaks. Request repair if necessary.
10. Manually initiate a fill to verify proper operation.

Recommended First Aid

Every site that stores and uses LN₂ should have an appropriate Material Safety Data Sheet (MSDS) present. The MSDS may be obtained from the manufacturer / distributor. The MSDS will specify the symptoms of overexposure and first aid to be used. Here is a typical summary. If symptoms of asphyxia such as headache, drowsiness, dizziness, excitation, excess salivation, vomiting or unconsciousness are observed, remove to fresh air. If breathing has stopped, give artificial respiration. **CALL A PHYSICIAN IMMEDIATELY.**

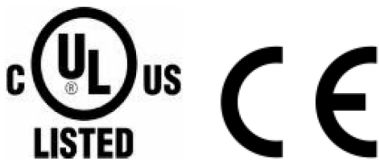
If breathing is difficult, supplemental oxygen may be required. If exposure to cryogenic liquids or cold vapor occurs, restore tissue to normal, body temperature (37°C) as rapidly as possible and then protect the injured tissue from further damage and infection.

Rapid warming of the affected areas is best achieved by bathing it in warm water. The temperature of the water used should not exceed 40°C. Under no circumstances should the frozen part be rubbed either before or after warming. If the eyes are involved, flush them thoroughly with warm water for at least 15 minutes. In case of massive exposure, remove clothing while showering with warm water. The patient should not drink alcohol or smoke. **CALL A PHYSICIAN IMMEDIATELY.**

Certifications and Listings

All fully automatic CryoExtra cryogenic freezer systems equipped with a Controller are UL / CUL listed and CE marked to the Low Voltage Directive (LVD). Specially designated freezer models are also CE marked to the Medical Device Directive (MDD). The LVD is a European Union directive regulating the construction and operation of electrical equipment that is not considered a medical device.

The MDD is a European Union directive regulating medical device construction and operation. These listings and certifications encompass the entire freezer system and not just the electronic Controller.



EU. Representative:

Thermo Fisher Scientific – Laboratory Equipment Division

Robert-Bosch-Str. 1

D-63505 Langenselbold, Germany

CryoExtra brand manufactured liquid nitrogen freezers covered in this manual are non-hazardous, open mouth vacuum insulated dewars. They are constructed of stainless steel and aluminum and specifically designed to hold liquid nitrogen. They are not subject to any pressure vessel codes as they are open to atmospheric pressure.

CryoExtra liquid nitrogen containers are shipped empty without liquid nitrogen or any hazardous material from our factory. An MSDS is not available for the final formed and welded assembly. An MSDS on the stainless steel or aluminum alloys used is available but is not specific for the complete manufactured vessel.

Product Information

This section will give an overview of CryoExtra cryogenic freezers and components.

Thermo Fisher Scientific offers a wide range of LN₂ freezers with a Controller that can accommodate a variety of inventory systems designed to meet all of your cryogenic storage needs. Each freezer is a hand-made, double-walled, vacuum insulated stainless steel Dewar designed to maintain temperature with minimal LN₂ evaporation.

Intended Use

The general purpose cryogenic storage models are intended for professional use in research and the medical device versions are intended to be used in situations that directly support medical applications. They are not suitable for use with flammable anesthetics. This equipment has been tested and found to comply with the limits for medical devices to IEC 60601-1-2: [or EN 60601-1-2:2001 or Medical Device Directive 93 / 42 / EEC (MDD)]. The medical device versions of the CryoExtra models (designated with an M at the end of the model name) can be used to support a medical application as an accessory but is considered as a medical device in its own right by the medical device competent authority. The M-suffix models of the CryoExtra have been certified by a Notified Body to the MDD to be suitable for use in applications up to and including class IIa – storing of samples for eventual re-introduction to the body.

Thermo Scientific CryoExtra Freezer Models

Thermo Scientific CryoExtra cryogenic freezers offer specialized features and functionality. Below is the list of the CryoExtra cryogenic freezer models.

S.no	Name / Model	Description
1	CryoExtra 20 / CE8120	110 V – 230 V
2	CryoExtra 40 / CE8140	110 V – 230 V
3	CryoExtra 80 / CE8180	110 V – 230 V
4	CryoExtra 94 / CE8194	110 V – 230 V
5	CryoExtra 20-MDD / CE8120M	110 V – 230 V
6	CryoExtra 40-MDD / CE8140M	110 V – 230 V
7	CryoExtra 80-MDD / CE8180M	110 V – 230 V
8	CryoExtra 94-MDD / CE8194M	110 V – 230 V

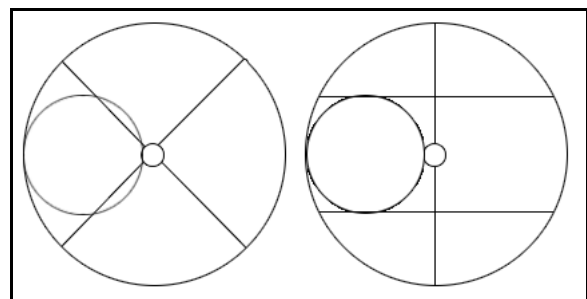


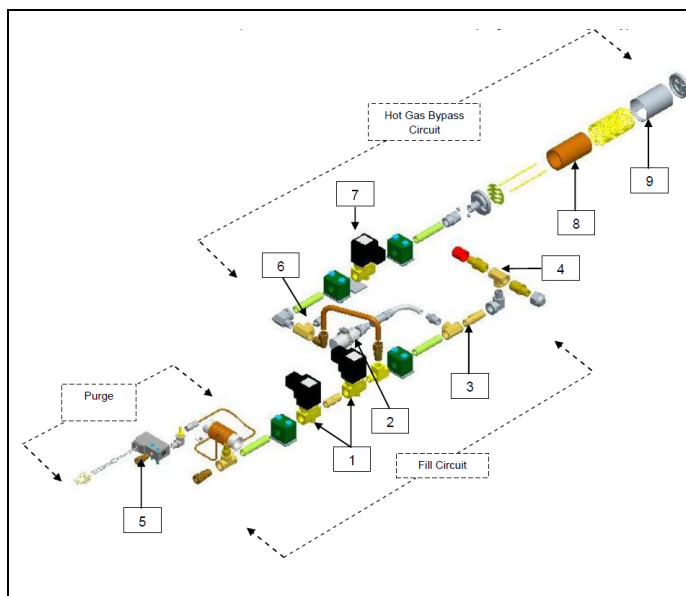
Figure 1. Top-view of HE Freezer showing offset neck and P and R turn-trays

The CryoExtra High Efficiency / Vapor Series freezers will maintain a vapor storage temperature of -190°C with minimal LN₂ evaporation while accommodating a wide variety of inventory systems.

Freezer Model	Minimum Door Width in. (mm)	Minimum Ceiling Height in. (mm)	Liftover Height in. (mm)	Turn-tray Platform Height in. (mm)	Weight Empty lbs. (kg)	Weight Liquid Full lbs. (kg)	Qty of Casters	Direct Load per Caster (Full) lbs. (kg)
CryoExtra 20 / CryoExtra 20MDD	32 (813)	90.1 (2289)	55.3 (1405)	6 (152)	515 (234)	1340 (608)	4	335 (152)
CryoExtra 40 / CryoExtra 40MDD	42 (1066)	87.8 (2230)	39.2 (995)	9 (228)	720 (327)	2140 (971)	4	535 (243)
CryoExtra 80 / CryoExtra 80MDD	60 (1524)	90.3 (2294)	38.8 (985)	9.5 (242)	1721 (781)	4830 (2191)	4	1208 (548)
CryoExtra 94 / CryoExtra 94MDD	60 (1524)	98.6 (2540)	43.8 (1112)	9.5 (242)	1721 (781)	4875 (2211)	4	1219 (553)

Plumbing Assembly

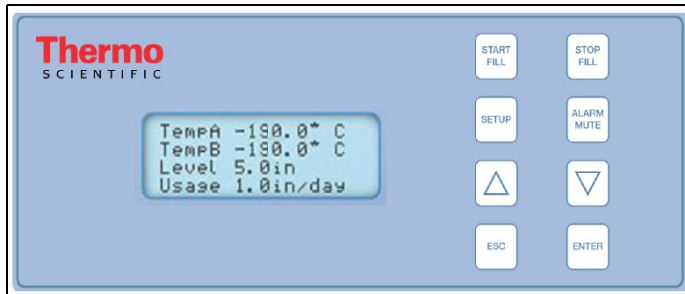
The plumbing assembly carries and regulates the flow of LN₂ from the liquid supply through the fill line and into the freezer. It is comprised of three main circuits: fill circuit, purge circuit and gas bypass circuit.



Key	Part Number	Component	Spec Details
1	14224611 S	Fill Solenoid Valve	24 VDC, R ≈ 70 Ω (single), 35 Ω (dual)
2	1810032	Pressure Relief Valve	50 PSI (3.45 bar)
3	11648945	Inline Filter	40-micron
4	n/a	Fill Tee – Transfer Hose Connections	½ in. ODT, 45° flare, ¼ in. MPT
5	13284954S	Purge (3-way) Solenoid Valve	24 VDC, R ≈ 140 Ω
6	10713400	Gas Bypass Temp Sensor	Pt-1000 RTD
7	14224611 S	Gas Bypass Solenoid Valve	24 VDC, R ≈ 70 Ω
8	11499812	Gas Bypass Muffler	-
9	11885449	Gas Bypass Muffler Deflector	-

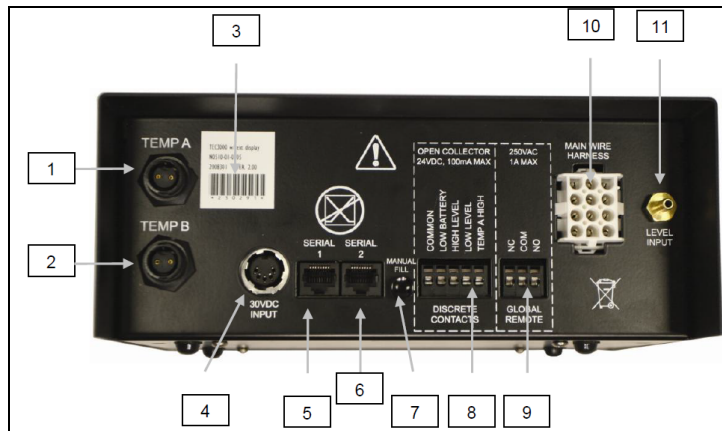
Controller Display

The Controller front panel display is the primary user interface for the Controller. There are two display options: text or symbolic.



Controller Stand Alone Back Panel / Physical Connections

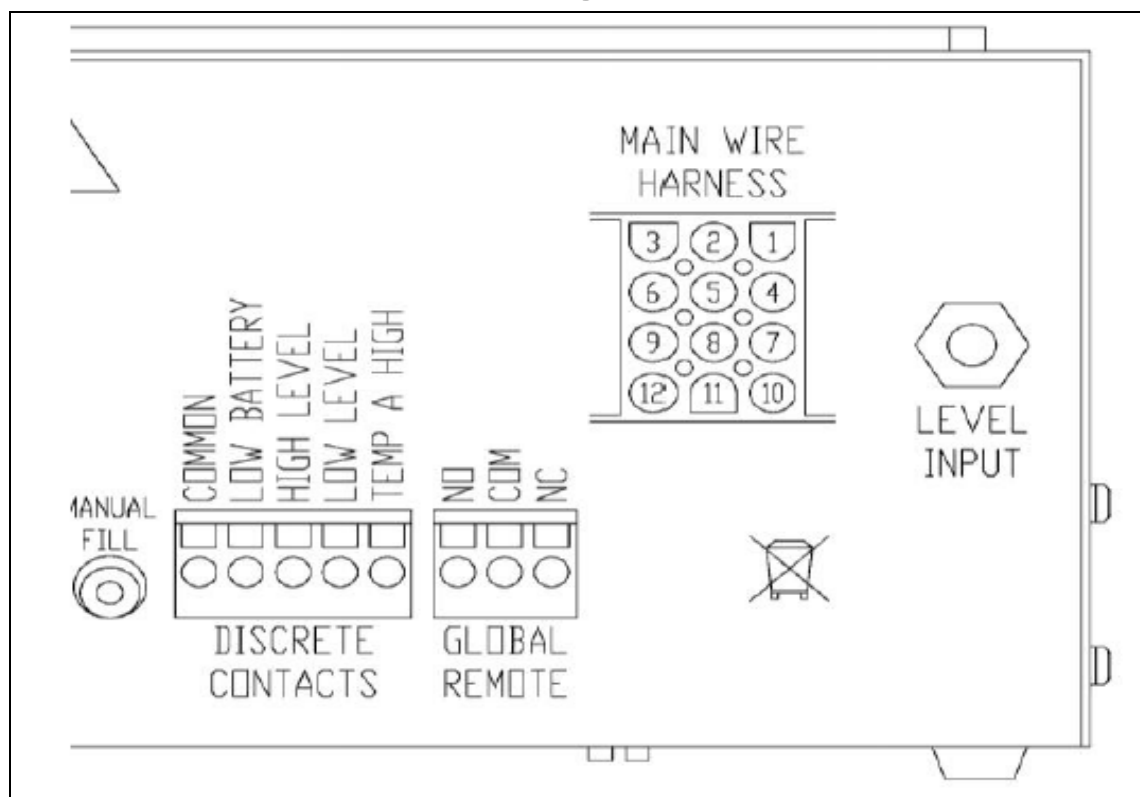
The Controller physical and electrical connections are located on the bottom of the stand-alone (non-cabinet) Controller and on the back panel of the cabinet Controller.



LDC Display	20 x 4 LCD with backlight
START FILL Key	Used to manually initiate a fill
STOP FILL Key	Used to manually terminate a fill – Disables Auto Fill for 30 minutes
SETUP Key	Used to access Setup Menus and parameters
ALARM MUTE Key	Used to silence the audible alarm for 30 minutes. Will reset the latching alarm once it has been corrected
▲ Key	Used to increase parameter values or to toggle “YES / NO” or “ON / OFF” values
▼ Key	Used to decrease parameter values or to toggle “YES / NO” or “ON / OFF” values
ESC Key	Used to escape or exit a menu or menu level
ENTER Key	Used to select a menu or value or save a setting change

1	Temp A Port	Connection for Temp A probe
2	Temp B Port	Connection for Temp B probe
3	Serial Number Barcode	Controller serial number written below barcode
4	30 VDC Power Input	Main power supply connection
5	Serial 1 Port	RJ-45 connection for Serial / COM 1
6	Serial 2 Port	RJ-45 connection for Serial / COM 2
7	Manual Fill Button	Used to manually fill freezer. When depressed and held, the fill valves open. When released, the fill valves close. Press to Fog Clear.
8	Discrete Contacts	Open collector alarm terminals
9	Global Remote	Dry contact alarm terminals
10	Wire Harness Connection	12-pin wire harness connection to plumbing assembly and battery backup
11	Level Connection	Level signal input. Clear, vinyl tube connects to hose barb

Controller 12-Pin Wiring Harness Connections



POSITION	DESCRIPTION	WIRE COLOR	WIRE GAUGE	LENGTH
1	+24 VDC BATTERY BACKUP	DARK BLUE	18	50"
2	-24 VDC BATTERY BACKUP	ORANGE	18	50"
4	+ FILL VALVE	BROWN	18	82"
5	- FILL VALVE	PURPLE	18	82"
7	+ PURGE VALVE	YELLOW	20	48"
8	- PURGE VALVE	RED	20	48"
9	+ BYPASS SENSOR	RED	22	67"
10	+ BYPASS VALVE	BLACK	18	75"
11	- BYPASS VALVE	GRAY	18	75"
12	- BYPASS SENSOR	WHITE	22	67"

Specifications

Controller Dimensions (stand-alone)

Length	9.1 in. (232 mm)
Width	3.5 in. (89 mm)
Height	8.0 in. (203 mm)
Weight	6.5 lbs. (2.95 kg)

Display

Type	Liquid Crystal Display (LCD) with backlight
Size	20 x 4 Character
Resolution	8 x 5 Pixels per Character
Keypad	8 keys, Multi function

Electrical – Controller Only

Input Voltage	30 VDC
Input Current (max)	5 A
Input Current (continuous)	1 A
Power Consumption (max)	28 W
Power Consumption (continuous)	6 W
Fill Valve Output Voltage	24 VDC
Short Protection	Current limiting, automatic reset

Electrical – Jerome Power Supply (WSL730M V1)

Input Voltage	110 – 230 VAC, automatically switching
Input Frequency	50 – 60 Hz
Output Voltage	30 VDC
Max Current Capability	3 A
Input Current	0.73 A @ 110 VAC 0.35 A @ 230 VAC

Power Requirements – Controller + Power Supply

Input Voltage	110-230 VAC / 50-60 Hz
Input Current (max)	0.73A @ 110VAC
Input Current (continuous)	0.35A @ 230VAC
Input Power (max)	30 Watts
Input Power (continuous)	8 Watts

Controller Physical Connections

Temperature Probes	2-pin twist lock
Input Power	5-pin DIN
Output Power / Sensors / Battery Backup	15-pin AMP
Serial Ports	RJ-45, 4-pin RS-485

Temperature Sensor

Type	2-wire Platinum RTD (Pt-1000)
Quantity	2
Resistance	1000 Ω @ 0°C
Sensitivity	3.85 Ω / °C

Temperature Measurement

Resolution	0.1°C (0.2°F)
Accuracy – Single Point Calibration *	\pm 1.0°C (1.8°F)
Accuracy – Two Point calibration **	\pm 2.0°C (3.6°F)
Range	-200°C to 70°C (-328°F to 158°F)

Level Measurement

Type	Differential Pressure Sensor
Accuracy	\pm 0.5 in. (13 mm) LN ₂
Resolution	0.1 in. (2.5 mm)
Range	3.0 in. to 48 in. (76 mm to 1219 mm)

* Accuracy determined over range of -200°C to -135°C. Accuracy decreases slightly as range increases.

** Accuracy determined over a range of -200°C to 0°C. Accuracy decreases slightly as range increases.

Operating Environment

Ambient Temperature and Relative Humidity

CryoExtra cryogenic freezers are designed to be operated in environments near room temperature (65°F – 80°F, 18°C – 27°C) and relative humidity below 50%. Due to the large gradient between LN₂ and ambient temperatures, an additional change of a few degrees will not have a significant impact on the freezer performance. Although temperature changes will affect the top temperatures during normal operation and lid opening to a greater degree, it again will not be a significant effect. The relative humidity should be maintained low enough so that condensation does not form on the Controller. Elevated humidity levels can lead to excessive condensation and frost on and around the lid. In situations where the relative humidity is high and uncontrollable, the lid should be routinely wiped dry to prevent ice formation. Should significant ice formation develop, that as necessary. Refer to the **“Preventative Maintenance”** procedures for details.

Atmospheric Pressure

CryoExtra cryogenic freezers are designed to be operated in environments with atmospheric pressure range of 8.2 psi (57.2 kPa) to 14.7 psi (101 kPa).

Thermal Load

Since CryoExtra Freezers use LN₂ as the refrigerant and do not employ any type of mechanical refrigeration, the thermal load will be negligible to negative.

Installation and Startup

This section will review the basic receiving, installation and startup procedures for CryoExtra Freezers. Always inspect the bill of lading for accuracy and external crate / packaging for damage before accepting the shipment.

Included with each full auto freezer:

- Literature Packet
 - Controller Quick Start Reference Guide – PN 326636H02
 - Manual Freezer Status Log – PN 10936355
 - Warranty Statement / Registration / Certificate
- Controller – Packaged in box separately for CryoExtra models
- Transfer hose – 6 ft. – Inside freezer
- CryoExtra Dipstick – Inside freezer
- Desiccant bag – To be removed and discarded – Inside freezer
- Liquid Nitrogen handling instructions
- CryoExtra Checklist – Signed by shipping inspector

Installation

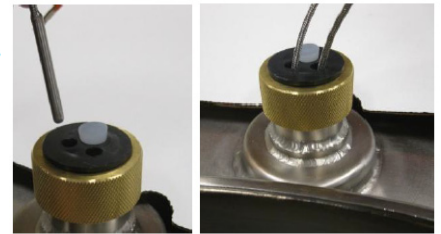
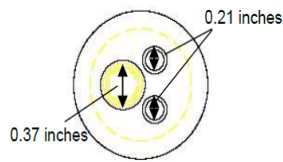
Note: Do not apply power to the Controller or connect an LN₂ supply until later in this procedure to avoid injury or damaging the equipment.

Following the careful uncrating and unpacking of the freezer, install using these basic instructions.



CAUTION : Only install the freezer on a level surface. Never fill freezer and move to another location. Always fill the freezer where it is to be installed/used.

- Locate the temperature sensor tube assembly that will house the two temperature probes. A three-tube temperature sensor assembly will be installed in the center of the top of the freezer. The two smaller tubes are designed to house the included temperature probes. The third, larger tube is designed to accommodate a third-party temperature probe. A silicone plug will be installed in this third tube. If the third tube is going to be used, simply remove the silicone plug.



- Insert the two temperature probes into the sensor tubes and position the sensors at the preferred height in the freezer space. Selecting probe A and B as well as the sensor placement is adjustable and completely up to the user. Thermo Fisher Scientific does recommend placing sensor (Temp A) at the “top box” level. This refers to the level in the freezer space where the highest sample is being stored. If storing vials in boxes, then this would be at the level with the top box. This is recommended as it will be the warmest temperature experience by samples being stored in the freezer space.
- Connect the temperature probes to the Controller temperature ports using the twist lock connectors.



- For CryoExtra models, once the temperature probes are in the desired position, apply a small amount of the silicone sealant, included with the freezer, surrounding the temperature probes where they enter the sensor tubes. This will help maintain their position and help keep moisture from entering the freezer storage space. Proceed to the next step.
- Connect the clear vinyl tubing to the Controller Level Input hose barb and connect the other end of the tubing to the 3 way purge valve.
- Ensure all of the plumbing assembly connections to the Controller wire harness are secure.

Note: Do not connect the battery backup (if equipped) to the wire harness until later in the installation procedure.

- Connect the 12-pin wire harness to the Controller wire harness connection.

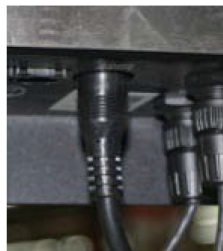


- If the freezer is equipped with battery backup measure the voltage at the end connector for approximately 24 VDC to 27 VDC; if no voltage is present, the included battery fuse must be installed before connecting the battery to the main wire harness. Open the battery enclosure and unscrew the fuse harness. Install the fuse; close the fuse harness and the battery enclosure. (This is done at the factory but should be verified at installation)



Note: Do not connect the battery backup to the main wire harness until the power supply has been verified to power up the Controller.

- Plug in the power supply to an appropriate wall outlet with the proper AC voltage. Avoid wall outlets that are connected to emergency generator power if possible. Although an uninterruptible power supply (UPS) is ideal to ensure continuous power, a surge protector or power conditioner is recommended.
- Plug the power supply into the Controller 30 VDC power input. The Controller display should illuminate and begin the startup sequence.



WARNING: To avoid risk of electrical shock, this equipment must only be connected to a properly grounded power source or outlet.

- Following the startup sequence, the Controller may start to alarm. This is normal.
- Press “Alarm Mute” to silence the audible buzzer for 30 minutes. For installation and startup purposes, the alarm buzzer can be disabled; however, be sure to enable it when installation is complete. For instructions, see the “**Alarm Buzzer**” section of this manual.
- Connect the battery backup to the main wiring harness. While running on outlet power, the Controller supplies a steady 27 VDC trickle charge to the battery backup. The battery backup may need to be charged for several hours before it is able to power the Controller.



- Remove a caplug from the fill tee on the plumbing assembly in order to connect the LN₂ supply. If using an LN₂ cylinder as the liquid supply, securely connect and tighten the transfer hose to both the fill tee connection and the supply connection labeled “LIQUID”. If using a bulk LN₂ supply system, securely connect and tighten the supply connection to the freezer fill tee connection.

Note: The recommended LN₂ supply pressure is 22-35 psig (1.52 - 2.41 bar).

First Fill Startup procedure

1. Once the freezer has been properly installed, begin the first fill procedure. Fill freezer at the desired location where it is to be used. Do not fill to move freezer to another location.
2. Open or remove the lid for the first fill due to the accelerated LN₂ evaporation rate when filling a warm freezer.
3. Verify supply pressure at 22-35 psig (1.52 – 2.41 bar) open valve and press “Start Fill” to begin filling the freezer.
4. The first fill will take significantly longer than subsequent fills due to a warm freezer.
5. It is recommended to place empty inventory system components such as racks, boxes, frames or canisters in the freezer during the first fill. This will cool the inventory system as well as help the freezer reach its top box temperature rating faster.
6. It is normal for some condensation or frost to develop around the neck opening during the initial fill.

7. Once the Controller reads a level; press stop fill; allow liquid to equalize and insert dipstick; verify level to the Controller level display; change the offset value (+ or -) to match liquid level; press start fill to continue the fill process. When freezer has reached its high level set point wait 10 minutes for system to equalize then verify level with dipstick and calibrate if necessary.
8. Once the Controller matches freezer LN₂ level, close or place the lid and allow the freezer to equilibrate and reach its temperature rating.
9. It is recommended that biological samples are not introduced into the freezer until several days after the top box temperature has stabilized at or below the freezer's temperature rating. It is recommended to restart Controller after 24 hours of initial install to reset the Liquid Usage.
10. Refer to the **"Operation"** section of this manual for further instructions.

Note: Pressing Stop Fill will disable Controller's automatic fill function for 30 minutes.

Operation

This section of the manual will detail the functions and features of the Controller and demonstrate how to access and adjust the various user settings and options.

All CryoExtra Freezers utilize LN₂ as the means of refrigeration. Under atmospheric conditions, the temperature of LN₂ is -196°C (-320°F, 77 K). Depending on the model, the LN₂ resides either in or below the freezer storage space. Through normal usage and time, the LN₂ will naturally boil off reducing the amount of refrigerant in the freezer. It is imperative that the LN₂ level be properly maintained in order for the storage space temperature to be maintained. This, along with monitoring and recording temperature, is the main function of the Controller.

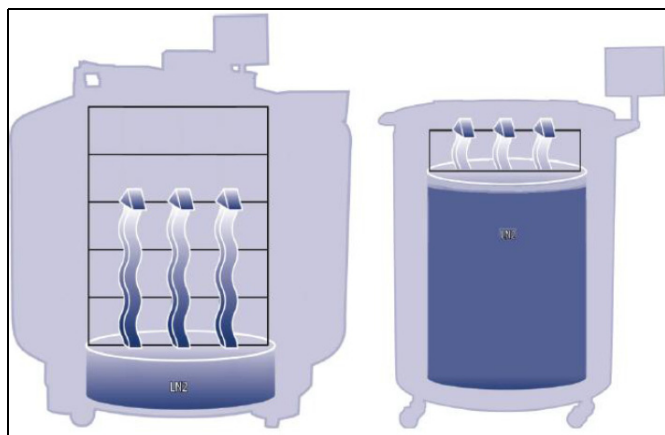


Figure 2. Illustration showing LN₂ as the refrigerant.
Left: LN₂ below the storage space naturally boils off and cools the freezer.
Right: LN₂ resides in the freezer storage space.

Functions and Features

The Controller utilizes a variety of functions and features that enables it to closely monitor and control the environment inside a cryogenic freezer. This section will give an overview of the following features and their functionality:

- Liquid Nitrogen Level Measurement
- Automatic Liquid Nitrogen Level Control
- Liquid Nitrogen Usage
- Temperature Measurement

- User Defined Alarms
- Passwords / Security
- Communication Capabilities
- Hot Gas Bypass
- Battery Backup (Optional)

Liquid Nitrogen Level Measurement

The LN₂ level in the tank is determined through the use of a differential pressure sensor. This sensor operates on the physical principle of hydrostatic head pressure. The pressure generated by a column of fluid is proportional to the height or depth, of the fluid column. In this application, the pressure generated by the LN₂ at the bottom of the freezer will increase as the LN₂ level increases. This differential pressure system allows the Controller to measure the exact LN₂ level accurately.

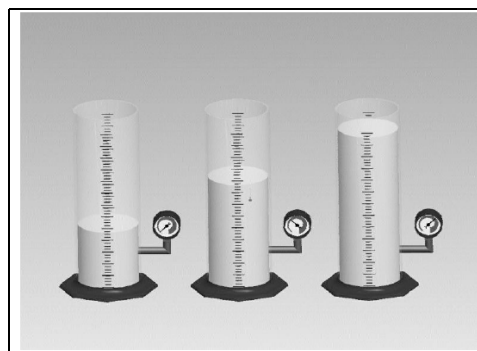


Figure 3. As the fluid level in the cylinder increases, the imposed head pressure at the bottom of the cylinder increases proportionally. The pressure gauges measure this increase in level.

This pressure signal generated by the LN₂ is transmitted from the bottom of the inner vessel through the freezer's annular line to the differential pressure sensor inside the Controller. The Controller then compares this pressure signal to its atmospheric pressure readings and is then able to determine the exact LN₂ level. The term "differential pressure" refers to the fact that the level is determined from the difference between the hydrostatic head pressure of the fluid column and atmospheric pressure. The measured LN₂ level is displayed in inches, millimeters or as percentage full.

Unlike alternative level sensing systems, such as thermistor based systems, differential pressure allows the exact level to be measured and displayed, not just a level range. This completely enclosed system requires minimal maintenance and is not affected by humidity, moisture or other environmental variables. Also, the differential pressure system allows the automatic level settings and alarms to be set and adjusted electronically instead of having to physically move sensors.

Automatic Liquid Nitrogen Level Control

The Controller is equipped with a fully automated LN₂ level control system. This level control system is based on user-defined parameters that can be adjusted to maintain a LN₂ level in a freezer over a range of 3.0 inches (76 mm) up to 48.0 inches (1219 mm). Since this control system utilizes the differential pressure system described previously, these parameters can be adjusted electronically using the Controller keypad or remotely through a networked computer.

This automatic fill control feature can be disabled. Below is a brief explanation of the four user defined level control parameters. For instructions on accessing and adjusting the level control settings, see the Liquid **“Level Setpoints and Alarms”** section.

- **High Level Alarm** – If the LN₂ level in a freezer reaches or exceeds this setting, a High Level Alarm will result. This audible / visual alarm will cause the High Level discrete contact and the global remote to switch to alarm state.
- **High Level Setpoint** – When the LN₂ level in a freezer reaches this setting (with or without automatic fill enabled) the Controller will close the fill valves and terminate the fill.
- **Low Level Setpoint** – When the LN₂ level is at or below this setting (with automatic fill enabled) the Controller will initiate a filling cycle.
- **Low Level Alarm** – If the LN₂ level in a freezer is at or below this setting, a Low Level Alarm will result. This audible / visual alarm will cause the Low Level discrete contact and the global remote to switch to alarm state.

Note: Certain events can temporarily disable Auto Fill Control. Pressing “Stop Fill” will disable Auto Fill Control for 30 minutes. In the event of a Hot Gas Bypass Alarm or a Fill Time Alarm, Auto Fill Control will be disabled until the respective alarm is cleared by pressing “Alarm Mute” or restarting the Controller.

Overfill Protection

The overfill protection will prevent an automatic fill if the LN₂ level reading is 0 or if the level reading suddenly drops to 0.

This prevents an overfill scenario in any situation where the Controller loses its ability to measure the LN₂ level.

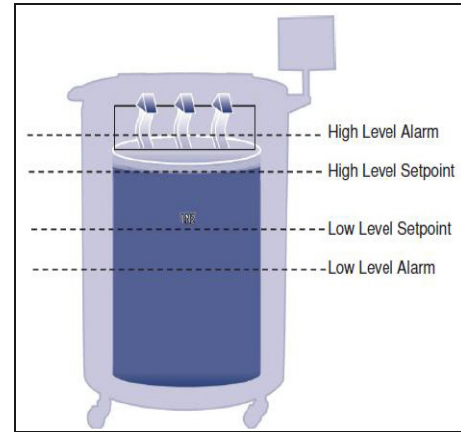


Figure 4. Example of automatic level control parameters

Note: Pressing Stop Fill will temporarily terminate Controller’s automatic fill function for 30 Minutes.

Liquid Nitrogen Usage

The Controller is able to calculate and display an estimated rate of LN₂ evaporation inside a freezer. This liquid usage is displayed in inches or millimeters per day. It takes time for the real-time data to accumulate in order for the liquid usage rate to be calculated.

The liquid usage is calculated by measuring the time it takes the LN₂ level in a freezer to decrease 0.5 inches (12.7 mm) and then extrapolating that value out to a 24 hour period in order to obtain a per day liquid usage.

$$LiquidUsage = \left(\frac{L1 - L2}{ElapsedTime(hrs)} \right) \times 24hrs$$

For example:

If the LN₂ level to decrease from 6.0 to 5.5 inches in 12 hours, then the displayed liquid usage will be 1.0 inch/day. See below.

$$LiquidUsage = \left(\frac{6.0 - 5.5}{12hrs} \right) \times 24hrs = 1.0/(day)$$

This calculation is suspended during fills and will resume 15 minutes after a fill to allow the LN₂ level in the freezer to stabilize. The liquid usage calculation can be reset by restarting the Controller or cycling the power. For liquid usage display options, refer to the **“Display and Output Settings”**.

Note: Several scenarios can lead to a temporarily exaggerated liquid usage. If the level abruptly decreases 0.5 inches, then there will be a spike in the liquid usage. Having the freezer lid off for an extended period of time, adding or removing samples and racks, attempting to fill from an empty LN₂ supply or moving the freezer all can lead to an accelerated evaporation rate. Although the liquid usage is an accurate estimate of the daily evaporation rate, it can be temporarily skewed by certain events; however, because of method used to calculate the usage, it will recover as more data is acquired.

Temperature Measurement

The Controller is equipped with two independent temperature measurement channels. They are designed to be used with 1000 ohm platinum RTD temperature probes, also referred to as Pt-1000 RTDs. The electrical resistance of the very fine platinum wires in these probes changes linearly with temperature. Platinum's very linear relationship between resistance and temperature makes Pt-1000 RTDs ideal for temperature measurement in cryogenic environments. The temperatures displayed on the Controller LCD are not real-time readings, but rather a running average of the previous few measurements. The Controller takes temperature measurements several times a second and then averages the previous few measurements while updating the displayed temperature every second. The hot gas bypass temperature sensor is also a Pt-1000 RTD.

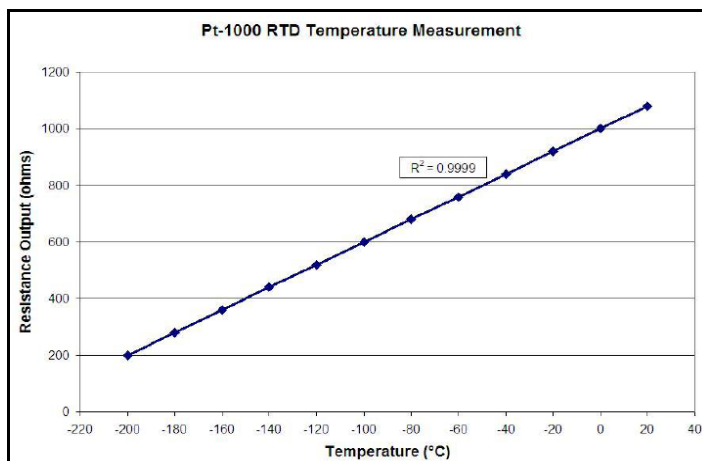


Figure 5. Platinum's linear relationship between temperature and resistance

User Defined Alarms

The Controller employs 18 different audible / visual alarms. These alarms are designed to alert the user to possible problems with the freezer temperature, LN₂ level, Controller power and LN₂ supply. In the event that a condition triggers an alarm, an audible buzzer will sound, that particular alarm will appear on the Controller LCD display and the global remote alarm contacts will switch to alarm state. If the triggered alarm is one of the four specified discrete contacts, then that contact will also switch to alarm state. For more information on the global remote and discrete contacts, refer to the **“Remote Alarm Monitoring”** section.

To clear an alarm, first correct the condition and then press the “Alarm Mute” key or restart the Controller. If the alarm condition is still present, then pressing the “Alarm Mute” key will only mute the audible buzzer for 30 minutes. The condition must be corrected in order to clear the alarm.

Note: Most Controller alarms have a one minute delay to avoid false positive or nuisance alarms. * Denotes alarms that do not have a one minute time delay.

Table 1. Controller alarms and descriptions

Alarm Display	Description
High Temp A* Can be Enabled or Disabled	Temperature A is reading at or above the Temp A High Alarm setting. When disabled, there will be no visible or audible alarm indication. The alarm event code will continue to be recorded in the internal data log.
High Temp B* Can be Enabled or Disabled	Temperature B is reading at or above the Temp B High Alarm setting. When disabled, there will be no visible or audible alarm indication. The alarm event code will continue to be recorded in the internal data log.
Low Temp A Can be Enabled or Disabled	Temperature A is reading at or below the Temp A Low Alarm setting. When disabled, there will be no visible or audible alarm indication. The alarm event code will continue to be recorded in the internal data log.
Low Temp B Can be Enabled or Disabled	Temperature B is reading at or below the Temp B Low Alarm setting. When disabled, there will be no visible or audible alarm indication. The alarm event code will continue to be recorded in the internal data log.
High Level	LN ₂ level is at or above the High Level Alarm setting.
Low Level	LN ₂ level is at or below the Low Level Alarm setting.
Liquid Usage Warning	Liquid Usage rate doubles within a 24 hour period. The liquid usage warning will not be indicated on the unit either audibly or visually. It will only be recorded in the internal data log.
Liquid Usage Alarm Can be Enabled or Disabled	Liquid Usage increases by a factor of 5 within a 24 hour period. When this alarm is disabled, there will be no visual or audible indication at the Controller, the event code continues to log
Fill Time	Fill cycle has not completed within the Maximum Fill Time setting (Auto fill is disabled until this alarm is cleared).
Bypass Time Alarm*	Hot Gas Bypass cycle has not completed within the Bypass Alarm Time Delay setting (Once the subsequent fill has ended, auto fill will be disabled until this alarm is cleared).
Temp A Calibration*	Temperature A is reading lower than absolute zero (-273°C / -460°F / 0 K).
Temp B Calibration*	Temperature B is reading lower than absolute zero (-273°C / -460°F / 0 K).
Bypass Calibration*	Bypass sensor is reading lower than absolute zero (-273°C / -460°F / 0 K).
Low Battery	Backup Battery voltage has dropped below 21 VDC.
Power Failure Can be Enabled or Disabled	Controller main power has been disconnected and it has been running on battery power for 30 minutes.
Lid Open	Freezer lid has been open longer than Lid Open Alarm Time setting.
Communication Loss	Controller has lost communication with the LCD display or the controller lost communications with another controller on an OFAF network.



CAUTION : If any alarms occur, contact your authorized CryoExtra Distributor or Technical Service.

Remote Alarm Monitoring

The Controller is equipped with a global remote alarm relay and four specific discrete dry contacts that allow remote monitoring of alarm conditions. Once activated, these latching contacts will retain their alarm state until the alarm condition is corrected and cleared. Although CryoExtra does not provide remote monitoring or programmable logic Controller (PLC) systems, these devices can be easily connected to the Controller. For example, it is possible to setup a Controller so that if a Low Level Alarm is triggered, the remote monitoring system will automatically send an email or place a call to alert the necessary individuals of the freezer's status. For proper discrete contact function, ensure the negative (low voltage) terminal of the remote monitoring system is connected to the COMMON discrete contact terminal and the positive (high voltage) terminal is connected to the respective discrete alarm terminal. Wires can be inserted and removed from the terminals by placing a small flathead screwdriver into the slot above the contact and prying down the latch until the clamp connector opens. Remove the flathead screwdriver to close the clamp connector. For alarm contact test procedures, refer to the **"Remote Alarm Tests"** section. Below are the remote alarm contact specifications and a typical remote monitoring setup schematic.

If an alarm condition has been corrected, but it continues to register through the global or discrete contacts, remove the contacts and cycle the power on the Controller. This will clear the alarm if it has latched in the system.

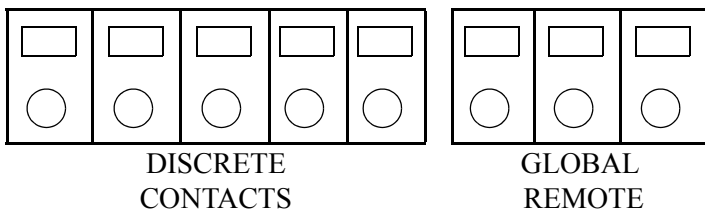


Figure 6. Controller remote alarm contacts

Table 2. Controller Remote Alarm Contact Specifications

Discrete Contacts	Global Remote
Normally Open	Normally Open or Normally Closed
Open Collector	Dry Contact Relay
Latching	Latching
Polarity Sensitive	Non-Polarity Sensitive
24 VDC at 100 mA max	230 VAC at 1 A max

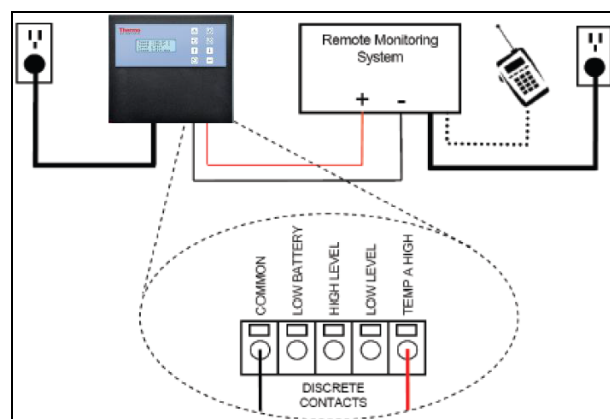


Figure 7. Typical remote alarm monitoring setup schematic. Temp A High monitoring shown

Passwords / Security

The Controller has a multilevel security system that can be customized to meet your security needs. Four different levels of security can be assigned up to 10 passwords allowing users to control who has the ability to change specific settings as well as to what extent these settings may be altered.

For example, in a tissue bank or repository that employs many technicians, the facility manager may want to restrict the technicians' access to allow them to view alarm settings, but not have the ability to adjust the settings. In this situation, the technicians would be assigned a password with low level security privileges. Conversely, if the shift manager wants to have complete access to all menus and settings, then he / she would be assigned a password with high level security privileges. Password entry mode can be disabled in the Password Menu. For more information on passwords and security, refer to the Passwords / Security Setup section.

Password entry mode can be disabled in the Password Menu. For more information on passwords and security, refer to the Passwords / Security Setup section.

Table 3. Password security levels and descriptions. X denotes access to adjust setting.

Feature	Not Password Protected	Level 1	Level 2	Level 3	Level 4
Start Fill	X				
Stop Fill	X				
Alarm Mute	X				
Quick Reference Settings	X				
Temp and Level Display Units		X	X	X	X
Display Liquid Usage		X	X	X	X
Enable / Disable Temp Sensors			X	X	X
Temp Alarm Settings			X	X	X
High Temp Alarm Test			X	X	X
Hot Gas Bypass Settings			X	X	X
Enable / Disable Alarm Buzzer			X	X	X
Level Control / Alarm Settings			X	X	X
Date / Time			X	X	X
Language Settings			X	X	X
Printer Settings			X	X	X
Temp Calibration			X	X	X
Level Calibration				X	X

Table 3. Password security levels and descriptions. X denotes access to adjust setting.

Feature	Not Password Protected	Level 1	Level 2	Level 3	Level 4
Enable / Disable Auto Fill				X	X
Timed Fill Settings				X	X
OFAF Settings				X	X
Communication Settings				X	X
Reset to default settings				X	X
Password Settings					X

Note: Forgot your password? Contact your authorized CryoExtra Distributor or Technical Service.

Communication / Networking Capabilities

The Controller RS-485 Serial interface offers several advanced communication capabilities. The Controller is equipped with two, independent RJ-45 serial ports. These ports are intended for connection to another CryoExtra Controller, PC, serial printer or other RS-485 device. Up to 100 controller can be successfully networked.



Note: The Controller should never be connected directly to a LAN or public telecommunications network.

Below is a summary of the different communication / networking capabilities:

- **Host Computer** – The Controller can communicate with a computer via an RS-485 converter and Controller Connect or Windows HyperTerminal. Through the use of simple ASCII commands, all Controller settings and functions can be monitored and adjusted with these software programs. In addition to ASCII communication, ControllerConnect also offers a user-friendly event log downloader. The event log is downloaded as a comma

separated variable (.csv) file that can be opened in EXCEL. Either a single Controller or a network of controller may be connected to a host computer. For more information on computer communication capabilities, refer to the **“Communication / Networking”** section.

- **Serial Printer** – The Controller can be connected directly to a serial printer via an RS-485 converter. This allows Controller events to be printed as they occur. This gives users the opportunity to keep hard-copy records of the freezer’s status in addition to the standard event log saved in the Controller’s memory. This printed data bypasses the Controller memory and is not given the opportunity to be altered electronically. For more information on the printer interface, refer to the **“Communication / Networking”** section.
- **MODBUS** – The Controller has RS-485 MODBUS communication capabilities.
- **One Fill All Fill (OF AF)** – A group of controller can be networked in order to coordinate fill cycles and reduce LN₂ transfer losses. For locations with multiple freezers, this function will increase the filling efficiency and drastically reduce LN₂ consumption over time. A sequential or simultaneous OF AF network is possible. For more information on OF AF networking, refer to the **“Advanced Settings Menus”** section.

exceeded, the oldest event will be deleted to make space for the most recent event.

Below is a sample event log and a list of event codes. The event log header displays the version of ControllerConnect used to download the event log, the Controller’s unit ID and the Controller’s firmware version. The events are logged so that Record #1 is the most recent event logged. The event parameters are logged in the units and format of that respective category. For example, if the Controller temperature units are set to be in degrees Celsius, then the temperature will be logged in degrees Celsius. If the time is set to a 24 hour clock, then the event log times will be in that format. Parameter changes will be logged as a string such as “Parameter number 126 changed from 60 to 180.” Contact your CryoExtra Distributor or CryoExtra Technical Service for information regarding these parameter changes.

ControllerConnect v1.1.2

CryoExtra Controller Software ver. 2.00

Event Log And Event Codes

The Controller has a built-in data logging feature that automatically stores vital, time-stamped information including temperatures, LN₂ level, liquid usage and any alarms. Data is logged at a user-defined interval and anytime an event or alarm status changes. The default log interval is 4 hours. The Controller is able to store up to 30,000 events in its non-volatile memory. With a 4 hour log interval, the Controller is able to store approximately 10 years worth of data. This event log can be easily downloaded from the Controller using ControllerConnect. This downloaded file is a.csv file that can be opened, analyzed and plotted in EXCEL.

Besides being a record of the freezer status, the event log is a vital tool for diagnosing problems or detecting potential problems with a freezer. For instructions on how to download the event log, refer to the **“Communication / Networking”** of this manual or the ControllerConnect User Manual (PN 13946348).

Note: Since the event log is stored in non-volatile memory, it will be retained and unaffected when the Controller loses power, is restarted, if the firmware is updated or when the event log is downloaded. However, resetting the Controller to defaults will clear the event log. If the event log memory is

Record	Unit ID	Date	Time	Temp A	Temp B	LN ₂ Level	LN ₂ Usage	Event Codes
1	200	12/15/10	9:00	-186.7	-194.8	6.1	0.5	AH
2	200	12/15/10	5:00	-191.4	-195.8	6.3	0.5	
3	200	12/15/10	1:00	-191.4	-195.8	6.5	0.5	
4	200	12/15/10	00:00	-191.4	-195.8	6.6	0.5	ZO
5	200	12/14/10	21:00	-191.4	-195.8	6.6	0.5	
6	200	12/14/10	17:00	-191.4	-195.8	6.8	0.5	
7	200	12/14/10	9:00	-191.4	-195.8	6.8	0.5	
8	200	12/14/10	7:15	-191.5	-195.8	7.0	0.0	
9	200	12/14/10	6:32	-191.5	-195.8	5.0	0.0	F
10	200	12/14/10	5:00	-191.5	-195.8	5.3	0.0	

Figure 8. Sample event log download

Table 4. Controller Event Log Codes

Event Code	Description
AM	Alarm Mute
AH	Temp A High Alarm
AL	Temp A Low Alarm
BB	Running on battery power
BH	Temp B High Alarm
BL	Temp B Low Alarm
BP	Bypass Sensor Open
BV	Low Battery Voltage Alarm
BY	Hot Gas Bypassing
CA	Temp A Calibration Alarm
CB	Temp B Calibration Alarm
CG	Bypass Sensor Calibration Alarm
F	Filling
FD	Fill Disabled
FT	Fill Time Alarm
HG	Hot Gas Bypass Time Alarm
LH	High Level Alarm
LL	Low Level Alarm
LO	Lid Open Alarm

Table 4. Controller Event Log Codes

Event Code	Description
PF	Power Failure
SC	Stuck Closed Alarm
SO	Stuck Open Alarm
US	Liquid Usage Alarm
UW	Usage Warning
ZO	Level Zeroing

Once the event log has been downloaded, it can be plotted to facilitate analysis.

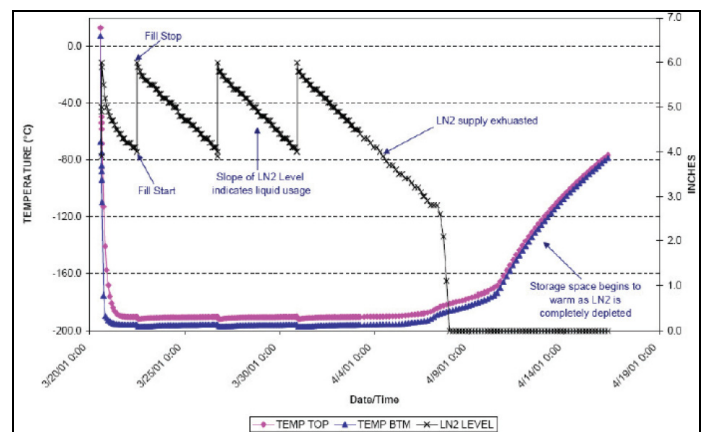


Figure 9. Sample Plotted Event Log

Hot Gas Bypass

The Hot Gas Bypass is a feature on all CryoExtra freezer series equipped with a Controller. The Hot Gas Bypass is able to vent the warm nitrogen gas from the supply line before initiating a fill cycle. This prevents warm gas from entering the freezer space. The bypass system helps to maintain a stable temperature gradient inside the freezer and increases the efficiency by preventing excess LN₂ evaporation while filling. This feature is advantageous for any freezer setup and is especially ideal for sites where longer transfer hoses cannot be avoided.

The Hot Gas Bypass system consists of these components:

- Solenoid Valve (24 VDC)
- Temperature sensor (Pt- 1000 RTD)
- Muffler
- Plumbing and electrical connections

Freezers will complete a bypass cycle prior to filling. When a fill is initiated, the bypass solenoid valve will open first and begin venting nitrogen gas from the supply line through the muffler and into the atmosphere. The Controller monitors and displays the temperature in the plumbing system throughout the bypass cycle. As LN₂ begins flowing, the temperature in the plumbing system will decrease.

Once the bypass temperature sensor readings reach the user-defined Bypass Temperature Setpoint, the bypass solenoid valve will close terminating the bypass cycle. The fill solenoid valves will then open and the freezer will begin filling. The default Bypass Temperature Setpoint is -70°C and can be adjusted based on the freezer setup.

The Bypass Alarm Time Delay is the maximum allowable bypass time. If the temperature in the plumbing system does not reach the Bypass Temperature Setpoint within the Bypass Alarm Time Delay setting, the Controller will terminate the bypass cycle, initiate the fill cycle and trigger a Hot Gas Bypass Time Alarm. Once the immediate fill cycle is complete, auto fill will be disabled until the Hot Gas Bypass Time Alarm is acknowledged. This feature prevents a freezer from continuing to attempt to fill from an empty supply. A Hot Gas Bypass Time Alarm could be a sign of an empty supply, a supply with too low of pressure or it could mean that the Bypass Alarm Time Delay needs to be increased in order to effectively purge the supply line of nitrogen gas. The default Bypass Alarm Time Delay is 5 minutes, but should be adjusted based on the freezer setup. It should be arranged so that the Bypass Temperature Setpoint is easily reached within the Bypass Alarm Time Delay setting.

Note: If a Hot Gas Bypass Time Alarm is triggered, once the immediate fill cycle is complete, auto fill will be disabled until the alarm is acknowledged.

Battery Backup (Optional)

The Battery Backup comes standard on all MDD freezers. The Controller is able to run seamlessly on power from this external battery system when the primary power source is interrupted. The Controller is able to run fully functional on the Battery Backup for approximately 72 hours in the event of a power failure. While the Controller is running on its primary power source, it continuously provides a 27 volt trickle charge to keep the Battery Backup fully charged. A Low Battery Alarm will trigger if the Controller is running on Battery Backup and the voltage falls below 21 volts. The Controller will begin losing select functionality when its power source falls below 18 volts. Non-essential circuits are disabled first to conserve power.

The battery status can be viewed in the Add-on Menus. With a Battery Backup connected while the Controller is running on main power, the battery status screen will read On AC Power. While running on Battery Backup, the battery status screen will display on battery backup 26 VDC 80%-100%. With no Battery Backup connected, the battery status screen will display On AC Power. This feature is available with Firmware Version 2.02 or higher.

The Battery Backup system consists of these components:

- Two, 12 VDC lead acid batteries wired in series
- Inline fuse (4A 250 V F)
- Battery housing
- Electrical connections

Note: The amount of time that a freezer will operate on power from the Battery Backup will vary depending on the fill status, the fill intervals and the size of the freezer.

Adjusting Settings and Options

Password Entry

This section describes how to access the Controller menus and adjust the various settings and options. With password entry enabled, the Controller will prompt for a password anytime a user attempts to access the setup menus. A flashing cursor on the password entry screen will make it clear which digit is being changed. Feature is available with Firmware Version 2.02.

These instructions will start from the main monitoring display screen, assume password entry mode is enabled and the user has Security Level 4 clearance. Once in the setup menus, the user can press the “ESC” key to exit that menu level or press the “ESC” key repeatedly until the display returns to the main monitoring screen. After 30 seconds of

inactivity, the display will automatically return to the main monitoring display screen.

controller with newer displays have the added functionality of a quick reference scroll menu. Pressing the up and down arrow keys simultaneously while on the main monitoring screen will display the Controller's serial number and firmware version. Pressing the up or down arrow keys will then scroll through the level, temperature and gas bypass settings. The user can return to the main monitoring screen by pressing the "ESC" key or waiting 30 seconds.

Main Monitoring Display Screen



Temperature Settings

This section describes how to access and adjust the various temperature settings on the Controller.

Note: Security Level 2 or higher is required to adjust the Temperature Settings.

Enable / Disable Sensors

The default setting for both Temp A and Temp B sensors is enabled.

1. Press "SETUP"

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the appropriate number. Press "ENTER" to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password
0000

2. Press "ENTER"

The display will read "Temperature Menu".

3. Press "ENTER"

The display will read "Temp A Menu".

Press ENTER for
Temperature Menu or
press SETUP for next
menu

Note: : To access Temp B Menu, press "SETUP" instead of "ENTER".

Press ENTER for
Temp A Menu or press
SETUP for next menu

4. Press "ENTER"

The display will read "Temp A Enabled".

Use the "▲/▼" keys to change Temp A to DISABLED and press "ENTER" to save the setting change.

Temp A ENABLED
Use ▲/▼ to adjust
Press ENTER to save

If a setting was changed, a confirmation display will read "New Setting Accepted".

New Setting Accepted

High Temperature Alarm Test

The high temperature alarm test allows a user to simulate a high temperature alarm without having to remove it from the freezer. Once initiated, the Controller will apply a small voltage to the sensor, which causes the sensor to heat up.

The Controller will continue to heat the sensor until it exceeds the High Temp Alarm setting. Once surpassed, a High Temp Alarm will result and the sensor readings will begin to decrease. The alarm buzzer will sound and the remote alarm contacts will switch to alarm state until the simulated alarm is cleared. (Press Alarm Mute)

Note: The heat generated by the sensor during the High Temperature Alarm Test is NOT enough to affect the actual temperature in the freezer storage space. If the sensor is submerged in LN₂, the heat generated by the sensor may not be sufficient to initiate a high temperature alarm.

1. Press "SETUP"

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the appropriate number. Press "ENTER" to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press "ENTER"

The display will read "Temperature Menu".

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press “ENTER”

The display will read “Temp A Menu”.

Press ENTER for Temp A Menu or press SETUP for next menu

Note: To access Temp B Menu, press “SETUP” instead of “ENTER”.

4. Press “ENTER”

The display will read “Temp A Enabled”.

Temp A ENABLED
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

The display will read “Initiate High Temp A Alarm Test”. Use the “▲/▼” keys to change NO to YES and press “ENTER” to initiate the alarm test.

Initiate High Temp A Alarm Test
NO TEMP A -196.2°C

If High Temp Alarm Test is initiated, the display will read “Testing” and show the temp change throughout the test.

Initiate High Temp A Alarm Test TESTING
TEMP A -115.8°C

Note: : If the temperature probe is open or no probe is connected the Controller will not go into the high temperature alarm test mode.

Temperature Alarm Settings

This section describes how to navigate and adjust the temperature alarm settings. The high temperature alarm is used to alert the user when the temperature in the freezer space has risen above the set threshold. The low temperature alarm can be used as a calibration error or redundant overflow indicator.

To be used as a calibration error indicator, the low temperature alarm would be set to a temperature slightly colder than the LN₂ saturation temperature. Since the temperature in the freezer storage space can never be colder than LN₂, if this alarm is triggered, it is an indication that the sensor requires recalibration.

To be used as a redundant overflow or high level alarm, the low temperature alarm would be set to a temperature slightly warmer than the LN₂ saturation temperature and the sensor placed higher than the desired liquid level in the freezer. If the low temperature alarm is triggered, then it is an indication that sensor is submerged in LN₂ and the liquid level is higher than desired.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for Temperature Menus or press SETUP for next menu

3. Press “ENTER”

The display will read “Temp A Menu”.

Note: To access Temp B Menu, press “SETUP” instead of “ENTER”.

Press ENTER for Temp A Menu or press SETUP for next menu

4. Press “ENTER”

The display will read “Temp A Enabled”.

Temp A ENABLED
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

Until the display reads “Temp A High Alarm”.

Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.

Temp A High Alarm -
110.0°C
Use ▲/▼ to adjust
Press ENTER to save

6. Press “SETUP”

The display will read “Temp A Low Alarm”. Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.

Alarm masks added for Low and High Temperature alarms for both sensors A and B. This allows these alarms to be enabled or disabled by the user. Note these are called alarm masks because the alarms are not actually disabled. They are simply no longer indicated via audio / visual means. The text in the menu screens uses enable and disable since that is the more conventionally understood terminology. Feature is available with Firmware Version 2.03.

Temp A Low Alarm -
200.0°C
Use ▲/▼ to adjust
Press ENTER to save

7. Press “SETUP”

The display will read “Temp A High Alarm”. Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.

Temp A High Alarm
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

8. Press “SETUP”

The display will read “Temp A Low Alarm”. Use the “▲/▼” keys to adjust setting and press “ENTER” to save the change.

Temp A Low Alarm
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

Liquid Nitrogen Saturation Temperature

This section shows how to adjust the LN₂ saturation temperature. This temperature is altitude dependent. The default LN₂ saturation temperature is -195.8°C (-320.4°F, 77.4 K). This value is accurate for altitudes ranging from sea level to 500 feet (152 m). For the appropriate saturation temperature, refer to table “LN₂ Saturation Temp vs. Altitude”.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “ENTER”

The display will read “Temp A Menu”.

Press ENTER for
Temp A Menu or press
SETUP for next menu

4. Press “SETUP”

Until the display reads “LN₂ Temperature”. Use the “▲/▼” keys to adjust setting per Table 5 and press “ENTER” to save the change.

LN₂ Temperature
Use ▲/▼ to adjust
Press ENTER to save
-195.8°C

Table 5. LN₂ Saturation Temp vs. Altitude

Altitude		LN ₂ Saturation Temperature		
Feet	Meters	°C	°F	K
Sea Level – 500	Sea Level – 152	-195.8	-320.4	77.4
501 -1000	152 -305	-196.0	-320.7	77.2
1000 – 1500	305 – 457	-196.2	-321.1	77.0
1501 – 2000	457 – 610	-196.4	-321.5	76.8
2001 – 3000	610 – 915	-196.6	-321.9	76.6
3001 – 4000	915 – 1220	-196.9	-322.4	76.3
4001 – 5000	1220 – 1524	-197.2	-322.9	76.0
5001 – 6000	1524 – 1829	-197.5	-323.5	75.7
6001 – 7000	1829 – 2134	-197.8	-324.0	75.4
7001 – 8000	2134 – 2439	-198.1	-324.6	75.1
8001 – 9000	2439 – 2744	-198.4	-325.1	74.8
9001 – 10000	2744 – 3049	-198.7	-325.7	74.4

Liquid Level Settings

This section demonstrates how to adjust the LN₂ level settings.

Level Setpoints and Alarms

The auto fill settings can be adjusted in the Liquid Level Menus. With auto fill enabled, the Controller will initiate an auto fill when the level is at or below the Low Level Setpoint and terminate a fill when the level reaches the High Level Setpoint. If the level is at or below the Low Level Alarm or at or above the High Level Alarm, the Controller will initiate that respective alarm.

Note: There must be a minimum of 0.5 inches between each of setpoint and alarm. For example, if the Low Level Alarm is set to be 4.0 inches, then the Low Level Setpoint would have to be set at least 4.5 inches. The Low Level Alarm can be set to a minimum value of 3.0 inches and the High Level Alarm can be set to a maximum value of 48.0 inches.

Note: Security Level 2 or higher is required to adjust the Liquid Level Settings.

1. Press "SETUP"

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the appropriate number. Press "ENTER" to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press "ENTER"

The display will read "Temperature Menu".

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press "SETUP"

Until the display reads "Liquid Level Menu".

Press ENTER for
Liquid Level Menu or
press SETUP for next
menu

4. Press "ENTER"

The display will read "High Level Alarm". Use the "▲/▼" keys to adjust the High Level Alarm value and press "ENTER" to save the change.

High Level Alarm
8.0 in Use ▲/▼ to
adjust
Press ENTER to save

5. Press "SETUP"

The display will read "High Level Setpoint". Use the "▲/▼" keys to adjust the High Level Setpoint value and press "ENTER" to save the change.

High Level Setpoint
7.0 in Use ▲/▼ to
adjust
Press ENTER to save

6. Press "SETUP"

The display will read "Low Level Setpoint". Use the "▲/▼" keys to adjust the Low Level Setpoint value and press "ENTER" to save the change.

Low Level Setpoint
5.0 in
Use ▲/▼ to adjust
Press ENTER to save

7. Press "SETUP"

The display will read "Low Level Alarm". Use the "▲/▼" keys to adjust the Low Level Alarm value and press "ENTER" to save the change.

Low Level Alarm 4.0 in
Use ▲/▼ to adjust
Press ENTER to save

Enable / Disable Auto Fill Control

Auto Fill Control can be enabled or disabled in the Advanced Level Menu.

Note: Security Level 3 or higher is required to enable / disable Auto Fill.

1. Press "SETUP"

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the appropriate number. Press "ENTER" to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press "ENTER"

The display will read "Temperature Menu".

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press "SETUP"

Until the display reads "Liquid Level Menu".

Press ENTER for
Liquid Level Menu or
press SETUP for next
menu

4. Press "ENTER"

The display will read "High Level Alarm".

High Level Alarm
8.0 in
Use ▲/▼ to adjust
Press ENTER to save

5. Press "SETUP"

Until the display reads "Advanced Level Menu".

Press ENTER for
Advanced Level Menu
or press SETUP for next
menu

6. Press "ENTER"

The display will read Auto Fill Control". Use the "▲/▼" keys to adjust and press "ENTER" to save the change.

Auto Fill Control
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

Level Offset

Since the annular line that carries the pressure level signal to the Controller is not located at the very bottom of the LN₂ column, a Level Offset is needed. This value is determined and set at the factory and should not be adjusted to fix an inaccurate level reading unless setting up a freezer (see the "First Fill Startup procedure") or if instructed to do so by an authorized CryoExtra Distributor or Technical Service. For liquid level calibration see section "Liquid Nitrogen Level Calibration".

Note: Security Level 3 or higher is required to adjust the Level Offset.

1. Press "SETUP"

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the

Higher User Level
Required
use ▲/▼ to ENTER
Password 0000

appropriate number. Press “ENTER” to advance the cursor to the next position.

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for Temperature Menus or press SETUP for next menu

3. Press “SETUP”

Until the display reads “Liquid Level Menus”.

Press ENTER for Liquid Level Menus or press SETUP for next menu

4. Press “ENTER”

The display will read “High Level Alarm”.

High Level Alarm 8.0 in
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

Until the display reads “Advanced Level Menus”.

Press ENTER for Advanced Level Menus or press SETUP for next menu

6. Press “ENTER”

The display will read Auto Fill Control”.

Auto Fill Control
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

7. Press “SETUP”

The display will read “Level Offset”. Use the “▲/▼” keys to adjust value and press “ENTER” to save the change.

Level Offset 1.3 inches
Use ▲/▼ to adjust
Press ENTER to save

Additional Feature Settings

This section details how to view and adjust the settings for the Battery Backup, Power Failure Alarm and Hot Gas Bypass.

Note: Security Level 2 or higher is required to adjust the Hot Gas Bypass settings.

Battery Backup Status

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for Temperature Menus or press SETUP for next

3. Press “SETUP”

The display will read “Add-on Menus”.

Press ENTER for Add-on menus or press SETUP for next menu

4. Press “ENTER”

The current battery status will be displayed. The display will read On AC Power if battery is connected or not connected and Controller running on AC.

Battery Status
On AC Power

-OR-

The display will read On Battery Backup 26 VDC or 80% or 100% if Controller is running on battery backup (AC disconnected).

Battery Status On
Battery Backup 26 VDC
80% or 100%

5. Press “SETUP”

The Power Failure Alarm status will display. Use the “▲/▼” keys to ENABLE or DISABLE and press “ENTER” to save the change.

Power Failure Alarm
Enabled
Use ▲/▼ to adjust
Press ENTER to save

Hot Gas Bypass Settings

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for Temperature Menus or press SETUP for next menu

3. Press “SETUP”

The display will read “Add-on Menus”.

Press ENTER for Add-on menus or press SETUP for next menu

4. Press “ENTER”

The current battery status will be displayed.

Battery Status on AC
Power

5. Press “SETUP”

Until the display reads “Hot Gas Bypass Menus”.

Press ENTER for Hot Gas Bypass menus or press SETUP for next menu

6. Press “ENTER”

The display will read “Hot Gas Bypass”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Hot Gas Bypass DISABLED
Use ▲/▼ to adjust
Press ENTER to save

7. Press “SETUP”

The current Bypass Temperature Sensor reading will be displayed.

Bypass Temperature 20.0°C

8. Press “SETUP”

The display will read “Bypass Temp Setpoint”. Use the “▲/▼” keys to adjust the value and press “ENTER” to save.

Bypass Temp Setpoint - 70.0°C
Use ▲/▼ to adjust
Press ENTER to save

9. Press “SETUP”

The display will read “Bypass Alarm Time Delay”. Use the “▲/▼” keys to adjust the value and press “ENTER” to save.

Bypass Alarm Time Delay 5 min
Use ▲/▼ to adjust
Press ENTER to save

10. Press “SETUP”

The display will read “Stuck Valve Alarms”. Use the “▲/▼” keys to adjust the value and press “ENTER” to save.

Stuck Valve Alarms DISABLED
Use ▲/▼ to adjust
Press ENTER to save

11. Press “SETUP”

The display will read “Stuck Open Delay”. Use the “▲/▼” keys to adjust the value, 1 min to 90min and press “ENTER” to save.

Stuck Open Delay 1 min
Use ▲/▼ to adjust
Press ENTER to save

12. Press “SETUP”

The display will read “Stuck Closed Delay”. Use the “▲/▼” keys to adjust the value, 1 min to 90 min and press “ENTER” to save.

Stuck Closed Delay 1 min
Use ▲/▼ to adjust
Press ENTER to save

Display and Output Settings

This section demonstrates how to adjust the Display and Output Settings.

Temp and Level Display Units

Note: Security Level 1 or higher is required to change the display units.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level Required use ▲/▼ to ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for Temperature Menus or press SETUP for next menu

3. Press “SETUP”

Until the display reads “Display and Output”.

Press ENTER for Display and Output or press SETUP for next menu

4. Press “ENTER”

The display will read “Temperature Units”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Temperature Units °C
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

The display will read “Level Display Menus”.

Press ENTER for Level Display Menus or press SETUP for next menu

6. Press “ENTER”

The display will read “Level Units”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Level Units in
Use ▲/▼ to adjust
Press ENTER to save

7. Press “SETUP”

The display will read “Define 100%”. If using the percentage level units, then use the “▲/▼” keys to adjust and press “ENTER” to save.

Define 100% 8.0 in
Use ▲/▼ to adjust
Press ENTER to save

8. Press “SETUP”

The display will read “Define 0%”. If using the percentage level units, then use the “▲/▼” keys to adjust and press “ENTER” to save.

Define 0% 0.0 in
Use ▲/▼ to adjust
Press ENTER to save

Percentage Level Units Explanation

The defined 0% and 100% values are independent of the automatic level control parameters. The percentage level units are just an alternative to displaying the measured level in inches or millimeters. The percentage parameters can be set to match the high and low fill setpoints or they can be set to any other value that makes interpreting the liquid level easier for the user.

Liquid Usage Display

Note: Security Level 1 or higher is required to enable / disable the liquid usage display.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Display and Output”.

Press ENTER for
Display and Output or
press SETUP for next
menu

4. Press “ENTER”

The display will read “Temperature Units”.

Temperature Units °C
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

Until the display reads “Display Liquid Usage”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Display Liquid Usage
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

6. Press “SETUP”

Until the display reads “Liquid Usage Alarm”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Liquid Usage Alarm
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

DISPLAY AND OUTPUT:

Liquid Usage Alarm can now be “Enabled or Disabled” on software versions starting with 2.03. When this alarm is disabled, there will be no visual or audible indication at the Controller, but the event code for the alarm will continue to be recorded in the internal data log. Since this alarm is the early warning to potential vacuum failure, it is recommended that it not be disabled.

With software version 2.03 the liquid usage warning will no longer be indicated on the unit either audibly or visually. It will only be recorded in the internal data log. This is to minimize self-correcting nuisance warnings. A New menu page was added in the Display and Output menu, after the Enable Liquid Usage Display page, to allow enabling / disabling the liquid usage alarm.

Alarm Buzzer

The audible alarm buzzer can be disabled. This will not disable the alarms, only the audible buzzer. Alarms will still be displayed visually on the screen if the alarm buzzer is inactive.

Note: Security Level 2 or higher is required to enable / disable the alarm buzzer.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Display and Output”.

Press ENTER for
Display and Output or
press SETUP for next
menu

4. Press “ENTER”

The display will read “Temperature Units”.

Temperature Units °C
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

Until the display reads “Advanced Display and Output”.

Press ENTER for
Advanced Display and
output or press SETUP
for next menu

6. Press “ENTER”

The display will read “Alarm Buzzer”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Alarm Buzzer
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

Languages

The Controller has five language options to choose from: English, Spanish, German, Italian and French.

Note: Security Level 2 or higher is required to change the language setting.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. **Press “ENTER”**

The display will read “Temperature Menus”.

Press ENTER for Temperature Menus or press SETUP for next menu

3. **Press “SETUP”**

Until the display reads “Display and Output”.

Press ENTER for Display and Output or press SETUP for next menu

4. **Press “ENTER”**

The display will read “Temperature Units”.

Temperature Units °C Use ▲/▼ to adjust Press ENTER to save

5. **Press “SETUP”**

Until the display reads “Advanced Display and Output”.

Press ENTER for Advanced Display and Output or press SETUP for next menu

6. **Press “ENTER”**

The display will read “Alarm Buzzer”.

Alarm Buzzer ENABLED Use ▲/▼ to adjust Press ENTER to save

7. **Press “SETUP”**

The display will read “Language”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Language ENGLISH Use ▲/▼ to adjust Press ENTER to save

Printer

This section describes how to adjust the Printer settings. For instructions on how to connect a printer, see the “**Communication / Networking**” section.

Note: Security Level 2 or higher is required to adjust the Printer settings.

1. **Press “SETUP”**

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level Required use ▲/▼ to ENTER Password 0000

2. **Press “ENTER”**

The display will read “Temperature Menus”.

Press ENTER for Temperature Menus or press SETUP for next menu

3. **Press “SETUP”**

Until the display reads “Display and Output”.

Press ENTER for Display and Output or press SETUP for next menu

4. **Press “ENTER”**

The display will read “Temperature Units”.

Temperature Units °C Use ▲/▼ to adjust Press ENTER to save

5. **Press “SETUP”**

Until the display reads “Advanced Display and Output”.

Press ENTER for Advanced Display and Output or press SETUP for next menu

6. **Press “ENTER”**

The display will read “Alarm Buzzer”.

Alarm Buzzer ENABLED Use ▲/▼ to adjust Press ENTER to save

7. **Press “SETUP”**

Until the display reads “Printer Menu”.

Press ENTER for Printer Menus or press SETUP for next menu

8. **Press “ENTER”**

The display will read “Print Interval”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Print Interval 30 min Use ▲/▼ to adjust Press ENTER to save

9. **Press “SETUP”**

The display will read “Print Header”. Press “ENTER” to print a new header.

Press ENTER to Print Header or press SETUP for next menu

10. **Press “SETUP”**

The display will read “Print Event”. Press “ENTER” to print a new event.

Press ENTER to Print Event or press SETUP for next menu

Advanced Settings

This section describes how to change the various Advanced Settings.

Timed Filling

The Controller has several advanced filling options including Timed Filling. Timed Filling allows the user to set a regular filling schedule based on a fill start time and a fill frequency. If a facility staff would like the peace of mind of knowing that all the freezers are full of LN₂ before leaving for the weekend, then they could set up a timed fill for every Friday afternoon.

Even if the LN₂ level in a freezer is above Low Level Setpoint, the Controller will initiate a fill and top off the freezer to its High Level Setpoint. If the liquid level is at or above the High Level Setpoint, then the Controller will skip that timed fill event and not initiate a fill.

A Controller with a Timed Filling schedule will still maintain Auto Fill Control. If Timed Filling and Auto Fill Control are enabled, then the Controller will still initiate a fill anytime the

liquid level reaches the Low Level Setpoint. Firmware Ver. 2.03 or higher will allow the Timed Fill Start to be set to any hour and minutes except midnight.

Timed Filling Setup

Enable Timed Filling and then select the number of days to elapse between timed fillings. Select a Timed Fill Start time that is later that same day. If Timed Filling is being enabled at 9:30 AM, then the Timed Fill Start should be set to 9:31 AM or later. This is recommended for simplicity. The Controller will initiate a fill when the Timed Fill Start is reached later that day. From then on, each time the Timed Fill Frequency elapses, the Controller will fill the freezer to its High Level Setpoint. The Timed Fill Frequency has a range of 1 to 28 days and the Timed Fill Start can be set to any hour and minutes except midnight. If midnight is selected controller with Ver. 2.03 or higher will automatically change the hour and minutes to 01:00 hours.

Note: Security Level 3 or higher is required to setup or change Timed Filling.

1. Press "SETUP"

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the appropriate number. Press "ENTER" to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press "ENTER"

The display will read "Temperature Menu".

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press "SETUP"

Until the display reads "Advanced Settings".

Press ENTER for
Advanced Settings
or press SETUP for next
menu

4. Press "ENTER"

The display will read "Advanced Fill Menu".

Press ENTER for
Advanced Fill Menu
or press SETUP for next
menu

5. Press "ENTER"

The display will read "Timed Fill". Use the "▲/▼" keys to adjust and press "ENTER" to save.

Time Fill DISABLED
Use ▲/▼ to adjust
Press ENTER to save

6. Press "SETUP"

The display will read "Timed Fill Frequency". Use the "▲/▼" keys to adjust and press "ENTER" to save. It can be set from 1 to 28 days.

Timed Fill Frequency
5 Days
Use ▲/▼ to adjust
Press ENTER to save

7. Press "SETUP"

The display will read "Timed Fill Start Hour". Use the "▲/▼" keys to adjust and press "ENTER" to save.

Timed Fill Start Hour
20.00
Use ▲/▼ to adjust
Press ENTER to save

8. Press "SETUP"

The display will read "Timed Fill Start Minute". Use the "▲/▼" keys to adjust and press "ENTER" to save.

Timed Fill Start Minute
20.00
Use ▲/▼ to adjust
Press ENTER to save

Maximum Fill Time

The maximum fill time can be adjusted in the Advanced Fill Menus. If a freezer begins filling but does not reach its High Level Setpoint within the maximum fill time, then the Controller will terminate the fill and trigger a Fill Time Alarm. Auto Fill Control will then be disabled until the Fill Time Alarm is cleared. The maximum fill time has a range of 30 to 240 minutes.

Note: Security Level 3 or higher is required to adjust the maximum fill time.

1. Press "SETUP"

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the "▲/▼" keys to scroll to the appropriate number. Press "ENTER" to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press "ENTER"

The display will read "Temperature Menu".

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press "SETUP"

Until the display reads "Advanced Settings".

Press ENTER for
Advanced Settings
or press SETUP for next
menu

4. Press "ENTER"

The display will read "Advanced Fill Menu".

Press ENTER for
Advanced Fill Menu
or press SETUP for next
menu

5. Press "ENTER"

The display will read "Timed Fill".

Timed Fill DISABLED
Use ▲/▼ to adjust
Press ENTER to save

6. Press "SETUP"

Until the display reads "Maximum Fill Time". Use the "▲/▼" keys to adjust and press "ENTER" to save.

Maximum Fill Time 60
min
Use ▲/▼ to adjust
Press ENTER to save

Time and Date

The time and date can be set in the Advanced Settings Menus. The user has the option of a 12 or 24 hour clock and a MM/DD/YY or DD/MM/YY date format.

Note: Security Level 2 or higher is required to change the time and date.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Advanced Settings”.

Press ENTER for
Advanced Settings
or press SETUP for next
menu

4. Press “ENTER”

The display will read “Advanced Fill Menu”.

Press ENTER for
Advanced Fill Menus
or press SETUP for next
menu

5. Press “SETUP”

The display will read “Set Time and Date”.

Press ENTER for Set
Time and Date or press
SETUP for next menu

6. Press “ENTER”

The display will read “Hour”. Use the “▲/▼” keys to adjust the hour and press “ENTER” to save.

Hour 12.00
Use ▲/▼ to adjust
Press ENTER to save

7. Press “SETUP”

The display will read “Minute”. Use the “▲/▼” keys to adjust the minute and press “ENTER” to save.

Minute 12.31
Use ▲/▼ to adjust
Press ENTER to save

8. Press “SETUP”

The display will read “Year”. Use the “▲/▼” keys to adjust the year and press “ENTER” to save.

Year 2009
Use ▲/▼ to adjust
Press ENTER to save

9. Press “SETUP”

The display will read “Month”. Use the “▲/▼” keys to adjust the month and press “ENTER” to save.

Month 10
Use ▲/▼ to adjust
Press ENTER to save

10. Press “SETUP”

The display will read “Day”. Use the “▲/▼” keys to adjust the day and press “ENTER” to save.

Day 22
Use ▲/▼ to adjust
Press ENTER to save

11. Press “SETUP”

The display will read “Time Format”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Time Format 12.31 PM
Use ▲/▼ to adjust
Press ENTER to save

12. Press “SETUP”

The display will read “Date Format”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

Date Format MM/DD/
YY
Use ▲/▼ to adjust
Press ENTER to save

Communication Settings

COM Setup / Type

The settings for the two serial ports can be adjusted in the COM 1 and COM 2 Setup Menus. Since they are independent serial ports, only one serial port can be set to a given COM Type. If COM 1 is set to ASCII, then COM 2 cannot also be set to ASCII. Networked controller must be daisy chained together with RJ-45 splitters in order to communicate using the same COM Type.

Note: Security Level 3 or higher is required to change the Communication Settings.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Advanced Settings”.

Press ENTER for
Advanced Settings
or press SETUP for next
menu

4. Press “ENTER”

The display will read “Advanced Fill Menu”.

Press ENTER for
Advanced Fill Menus
or press SETUP for next
menu

5. Press “SETUP”

Until the display reads “COM 1 Menu”. For COM 2 Menu, press “SETUP”.

Press ENTER for
COM 1 Menus or press
SETUP for next menu

6. Press “ENTER”

The display will read “COM 1 Setup”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

COM 1 Setup 9600 N81
Use ▲/▼ to adjust
Press ENTER to save

7. Press “SETUP”

The display will read “COM 1 Type”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

COM 1 Type ASCII
Use ▲/▼ to adjust
Press ENTER to save

MODBUS ID

The Controller MODBUS ID also serves as the ASCII Unit ID. This address can be adjusted in the MODBUS Menu and has a range of 1 to 200.

Note: Security Level 2 or higher is required to change the MODBUS ID.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Advanced Settings”.

Press ENTER for
Advanced Settings or
press SETUP for next
menu

4. Press “ENTER”

The display will read “Advanced Fill Menu”.

Press ENTER for
Advanced Fill Menus or
press SETUP for next
menu

5. Press “SETUP”

Until the display reads “MODBUS Menu”.

Press ENTER for
MODBUS menu or
press SETUP for next
menu

6. Press “ENTER”

The display will read “MODBUS ID”. Use the “▲/▼” keys to adjust and press “ENTER” to save.

MODBUS ID 200
Use ▲/▼ to adjust
Press ENTER to save

One Fill All Fill (OFAF)

This section describes how to adjust the various OFAF settings. For more information and instructions on how to setup an OFAF network, refer to the “**OFAF Network Setup**” section of this manual.

Note: Security Level 3 or higher is required to adjust the OFAF settings.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Advanced Settings”.

Press ENTER for
Advanced Settings or
press SETUP for next
menu

4. Press “ENTER”

The display will read “Advanced Fill Menu”.

Press ENTER for
Advanced Fill Menus
or press SETUP for next
menu

5. Press “SETUP”

Until the display reads “OFAF Menu”.

Press ENTER for OFAF
menus or press SETUP
for next menu

6. Press “ENTER”

The display will read “OFAF ID”. Use the “▲/▼” keys to adjust the OFAF ID and press “ENTER” to save.

OFAF ID 1
Use ▲/▼ to adjust
Press ENTER to save

7. Press “SETUP”

The display will read “OFAF Units”. Use the “▲/▼” keys to adjust the number of units and press “ENTER” to save.

OFAF Units 3
Use ▲/▼ to adjust
Press ENTER to save

8. Press “SETUP”

The display will read “One Fill All Fill”. Use the “▲/▼” keys to adjust the type and press “ENTER” to save.

One Fill All Fill
SEQUENTIAL
Use ▲/▼ to adjust
Press ENTER to save

Restore Default Settings (Global Password)

The Controller can be reset to the factory defaults in the Advanced Settings Menu. This will also reset post-factory calibrations and **global password to 3 4 5 6**. The accuracy of the level and temperature measurements should be confirmed after resetting.

Note: It is recommended to download complete data from the Controller prior to performing a restore to defaults. Restoring to defaults will erase previous stored data and it cannot be retrieved once the restore function is performed.

Note: Security Level 3 or higher is required to reset to factory default settings.

1. **Press “SETUP”**

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. **Press “ENTER”**

The display will read “Temperature Menus”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. **Press “SETUP”**

Until the display reads “Advanced Settings”.

Press ENTER for
Advanced Settings or
press SETUP for next
menu

4. **Press “ENTER”**

The display will read “Advanced Fill Menus”.

Press ENTER for
Advanced Fill Menus
or press SETUP for next
menu

5. **Press “SETUP”**

Until the display reads “Restore All Defaults”.

Press ENTER to Restore
All Defaults or press
SETUP for next menu

6. **Press “ENTER”**

The display will read “Confirm Restore”. Use the “▲/▼” keys to change to “YES” and press “ENTER” to save.

Confirm Restore NO
Use ▲/▼ to adjust
Press ENTER to save

Controller Default Settings

Parameter	Default Setting
High Temp Alarm	-110.0°C / -166.0°F / 163.2 K
Low Temp Alarm	-200.0°C / -327.6°F / 73.4 K
High Level Alarm	8.0 in / 205 mm
High Level Setpoint	7.0 in / 180 mm
Low Level Setpoint	5.0 in / 125 mm
Low Level Alarm	4.0 in / 100 mm
Defined 100%	8.0 in / 205 mm
Defined 0%	4.0 in / 100 mm
Level Offset	+1.3 in / +35 mm
Auto Fill	Enabled
Maximum Fill Time	60 minutes
Temperature Display Units	°C
Liquid Level Display Units	Inches
Hot Gas Bypass MENU	DISABLED
Hot Gas Bypass Temp Setpoint	-70°C
Hot Gas Bypass Alarm Time Delay	5 minutes
COM 1 Type	ASCII
COM 2 Type	Disabled
Event Log Interval	240 minutes
Global Password	3 4 5 6

Restart Controller

The Controller can be restarted in the Advanced Settings Menu. Restarting the Controller and cycling the power are both safe ways to reboot the Controller.

Note: Security Level 3 or higher is required to restart the Controller from the Advanced Settings Menu.

1. **Press “SETUP”**

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

2. **Press “ENTER”**

The display will read “Temperature Menu”.

Press ENTER for Temperature Menu or press SETUP for next

3. **Press “SETUP”**

Until the display reads “Advanced Settings”.

Press ENTER for Advanced Settings or press SETUP for next menu

4. **Press “ENTER”**

The display will read “Advanced Fill Menu”.

Press ENTER for Advanced Fill Menu or press SETUP for next menu

5. **Press “SETUP”**

Until the display reads “Restart Controller”.

Press ENTER to Restart Controller or press SETUP for next menu

6. **Press “ENTER”**

The display will read “Confirm Restart”. Use the “▲/▼” keys to change to “YES”.

Confirm Restart NO Use ▲/▼ to adjust Press ENTER to save

7. **Press “ENTER”**

The Controller will restart and the display will read “Starting Please Wait”. Following the startup sequence, the display will return to the main monitoring screen.

Starting Please Wait Version: 2.03

Firmware Update

Note: Controller firmware should only be updated by authorized CryoExtra Distributors or under the direction of Technical Service. Improper firmware updates can render the Controller inoperable.

The firmware or Controller software, can be updated in the event that a new revision is released. A personal computer, COM USB communications kit (PN CE8100COM) and the current firmware updater program are required to perform an upgrade. Contact your authorized CryoExtra Distributor or Technical Service for more information.

1. Connect the Controller COM USB kit to serial port 1 on the Controller and a USB port on a computer.
2. Start the current firmware updater program.
3. When prompted, select “Update Firmware” in the Controller Advanced Settings Menu and cycle power to the Controller.
4. The updater program should begin loading the new firmware.

5. Once complete, the Controller may take several minutes to reboot. It is normal for an occasional beep to sound during this rebooting period.

Note: Security Level 3 or higher is required to update the firmware.

1. **Press “SETUP”**

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level Required use ▲/▼ to ENTER Password 0000

2. **Press “ENTER”**

The display will read “Temperature Menu”.

Press ENTER for Temperature Menu or press SETUP for next

3. **Press “SETUP”**

Until the display reads “Advanced Settings”.

Press ENTER for Advanced Settings or press SETUP for next menu

4. **Press “ENTER”**

The display will read “Advanced Fill Menu”.

Please ENTER for Advanced Fill menu or press SETUP for next menu

5. **Press “SETUP”**

Until the display reads “Update Firmware”.

Press ENTER to Update Firmware or press SETUP for next menu

6. **Press “ENTER”**

The display will read “Confirm Update”. Use the “▲/▼” keys to change to “YES”.

Confirm Update NO Use ▲/▼ to adjust Press ENTER to save

7. **Press “ENTER”**

The display will read “Connect COM 1 to a PC and cycle Controller power”. After cycling Controller power, the updater program should begin loading the new firmware.

Connect COM 1 to a PC and Cycle Controller power.

8. During the firmware update, the display will read “Communications Loss Check Controller”. This is normal. Upon completion, the startup sequence should begin within several minutes.

Communications Loss Check Controller

Password / Security Setup

This section details how to enable / disable password entry mode as well as how to change and setup multilevel security passwords.

Note: Security Level 4 is required to setup or change passwords.

Password Entry Mode

This section details how to enable / disable password entry mode. Disabling the password entry mode will remove all Controller password protection.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menu or
press SETUP for next

3. Press “SETUP”

Until the display reads “Password Menu”.

Press ENTER for
Password menu or
press SETUP for next

4. Press “ENTER”

The display will read “Password Entry Mode”. Use the “▲/▼” keys to change and press “ENTER” to save.

Password Entry Mode
ENABLED
Use ▲/▼ to adjust

Global Password Change

This section describes how to change the **Global Password 3 4 5 6**. The Global Password has Security Level 4 clearance.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Password Menu”.

Press ENTER for
Password menu or
press SETUP for next
menu

4. Press “ENTER”

The display will read “Password Entry Mode”.

Password Entry Mode
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

The display will read “Change Global Password”. The Global Password has Security Level 4 clearance.

Press ENTER to Change
Global Password or
press SETUP for next

6. Press “ENTER”

The display will read “Global Password”. Use the “▲/▼” keys to input new Global Password and press “ENTER” to advance the cursor.

Global Password
Use ▲/▼ to adjust
Press ENTER for next

7. Press “ENTER”

The display will read “Confirm new Password?”. To confirm new password, use the “▲/▼” keys to change from “NO” to “YES” and press “ENTER” to save.

Confirm new
Password?
NO

Multilevel Passwords

This section describes how to setup and change the 9 multilevel passwords.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor on the entry screen will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Password Menu”.

Press ENTER for
Password menu or
press SETUP for next
menu

4. Press “ENTER”

The display will read “Password Entry Mode”.

Password Entry Mode
ENABLED
Use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

Until the display reads “Change Password 1”. Continue to press “SETUP” to access passwords 2-9.

Press ENTER to Change
Password 1
or press SETUP for next

6. Press “ENTER”

The display will read “Password 1”. Use the “▲/▼” keys to input Password 1 and press “ENTER” to advance the cursor.

Password 1
Use ▲/▼ to adjust
Press ENTER for next
XXXX

7. Press “ENTER”

The display will read “Password 1 Level” Use the “▲/▼” keys to select the appropriate Security Level.

Password 1
Use ▲/▼ to adjust
Press ENTER for next
Level 1

8. Press “ENTER”

The display will read “Confirm new Password?” Use the “▲/▼” keys to change “NO” to “YES” and press “ENTER” to save.

Confirm new Password?
No Use ▲/▼ to adjust
Press ENTER to save

Calibration Procedures

Temperature Sensor Calibration

This section describes how to calibrate the Controller temperature sensors. There are two calibration procedures: single point and two point calibration. For single point calibration, the reference point is LN₂. For two point calibration, the reference points are LN₂ and ice water. Unless regulations require a two point calibration, the single point calibration procedure is recommended. The benefit of two point calibration is more accurate temperature measurement in near room temperature environments. The drawback is a longer, more complex calibration procedure. The benefit of a single point calibration is a simple calibration procedure. The drawback of single point calibration is less accurate temperature measurement in near room temperature environments.

All new freezers equipped with controller have been calibrated at the factory. The temperature sensors should only be calibrated if faulty readings are suspected; a sensor or the Controller itself has been replaced, following a firmware update or as a part of a preventative maintenance schedule. For an accurate calibration, the LN₂ Saturation Temperature (Section “**Liquid Nitrogen Saturation Temperature**”) needs to be correctly set based on the altitude of the freezer location.

Note: Security Level 2 or higher is required to calibrate temperature sensors.



CAUTION : Always wear protective gloves and face shield when handling LN₂. Refer to the “**Safety and First Aid**” section of this manual.

Single Point Calibration

The single point calibration procedure requires a small volume of LN₂; enough to completely submerge the end of the temperature sensor. It may be possible to use the LN₂ in the freezer space if the probe length permits.

1. Press “SETUP”

Controller will prompt for a password. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menus”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “ENTER”

The display will read “Temp A Menu”. Press “SETUP” for Temp B.

Press ENTER for
Temp A menu or press
SETUP for next menu

4. Press “ENTER”

The display will read “Temp A”.

Temp A ENABLED Use
▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

Until the display reads “Temp A Calibration”.

Press ENTER to
Temp A Calibration or
press SETUP for next
menu

6. **Press “ENTER”**

The display will read “Calibration Type”. Use the “▲/▼” keys to adjust to “SINGLE POINT”.

Calibration Type
SINGLE POINT
Use ▲/▼ to adjust
Press ENTER for next

7. **Press “ENTER”**

The display will read “Temp A Calibration”. Completely submerge the sensing end of Temp probe A in LN₂.

Temp A Calibration.
Place Probe A in LN₂
and press ENTER

8. **Press “ENTER”**

The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in LN₂ before pressing “ENTER”.

Wait for Temp A to
stabilize then press
ENTER
Temp A -195.8°C

9. **Press “ENTER”**

The display will read “Probe A single point calibration complete”.

Probe A single point
calibration complete

5. **Press “SETUP”**

Until the display reads “Temp A Calibration”.

Press ENTER to
Temp A Calibration or
press SETUP for next
menu

6. **Press “ENTER”**

The display will read “Calibration Type”. Use the “▲/▼” keys to adjust to “Two Point”.

Calibration Type TWO
POINT
Use ▲/▼ to adjust
Press ENTER for next

7. **Press “ENTER”**

The display will read “Temp A Calibration”. Completely submerge the sensing end of Temp probe A in LN₂.

Temp A Calibration
Place Probe A in LN₂
and press ENTER

8. **Press “ENTER”**

The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in LN₂.

Wait for Temp A to
stabilize then press
ENTER Temp A -
195.8°C

9. **Press “ENTER”**

The display will read “Remove Probe A from LN₂”. Remove the temperature sensor from the LN₂.

Remove Probe A from
LN₂ and press ENTER

10. **Press “ENTER”**

The display will read “Wait while probe warms to room temperature”. Wait while the temperature sensor warms to room temperature and the Controller counts down.

Wait while probe warms
to room temperature
180 seconds

11. **Wait 180 seconds**

After the Controller counts down, the display will read “Place Probe A in ice water”. Completely submerge the sensing end of the probe in the ice water bath.

Place Probe A in ice
water and press ENTER

12. **Press “ENTER”**

The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in the ice bath.

Wait for Temp A to
stabilize then press
ENTER Temp A 0°C

13. **Press “ENTER”**

The display will read “Probe A two point calibration complete”.

Probe A two point
calibration complete

Two Point Calibration

The two point calibration procedure requires a small volume of LN₂ and an ice water bath; enough to completely submerge the end of the sensor. Proper ice water bath preparation is imperative to ensure accuracy. It is best to add filtered water to a Styrofoam cup containing crushed ice. Allow the solution to stand at room temperature for five minutes prior to beginning procedure.

1. **Press “SETUP”**

Controller will prompt for a password. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. **Press “ENTER”**

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. **Press “ENTER”**

The display will read “Temp A Menu”. Press “SETUP” for Temp B.

Press ENTER for Temp
A Menu or press SETUP
for next menu

4. **Press “ENTER”**

The display will read “Temp A”.

Temp A ENABLED
Use ▲/▼ to adjust
Press ENTER to save

Liquid Nitrogen Level Calibration

This section describes the procedure to calibrate the LN₂ level. This procedure requires the cryogenic meter dip stick supplied with each CryoExtra freezer. This calibration method provides level measurements with a ± 0.5 inch (± 13 mm) accuracy.

All new freezers equipped with controller have been calibrated at the factory. The liquid level should only be calibrated if faulty readings are suspected, the Controller itself has been replaced, following a firmware update or as a part of a preventative maintenance schedule.



CAUTION : Always wear protective gloves and face shield when handling LN₂. Refer to the “**Safety and First Aid**” section of this manual.

Dip Stick Procedure

1. Open or remove the freezer lid to access the interior storage space.
2. Hold the meter dip stick vertically with the 0.0 inch end pointed down.
3. Lower the meter dip stick into the LN₂ at the bottom of the freezer. Ensure the meter dip stick is vertical and touching the bottom of the inner Dewar. Some LN₂ boiling will occur around the meter dip stick.
 - a. CryoExtra Freezers:
Insert meter dip stick into the rectangular channel on the turn tray in order to access the liquid below the tray.
4. Leave the meter dip stick in the LN₂ for approximately 5 seconds.
5. Remove the meter dip stick from the liquid and immediately wave it back and forth in the air. A distinct frost line will begin to develop as moisture in the air condenses on the meter dip stick predominately where it was submerged.
6. Subtract 0.5 inches (13 mm) from the observed frost line to account for the LN₂ boiling up around the meter dip stick while it was submerged. This resultant level measurement represents the actual liquid level inside the freezer. Once you have obtained the measured level, proceed to the liquid level calibration.

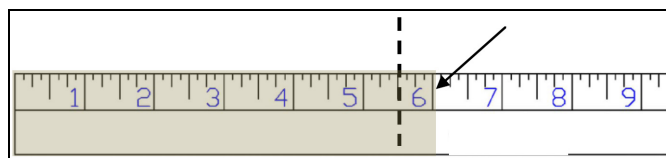


Figure 10. Meter dip stick showing example level frost line. The resultant measured level would be 5.5 inches after subtracting 0.5 inches from the frost line to account for the LN₂ boiling.

Note: LN₂ liquid at or above turn tray height will rise higher in the dip stick channel.



Level dip stick inserted to measure the physical liquid nitrogen level.



CAUTION : Picture is for demonstration only (on an empty tank), Please use protective gear while working with liquid nitrogen. Please refer section “**Safety and First Aid**” for Safety while working with Liquid nitrogen.

Liquid Level Calibration

Note: Liquid level calibration cannot be performed while the Controller is filling. If Controller is filling, press “Stop Fill” and perform the calibration. Allow freezer plumbing to thaw 10 to 15 minutes before calibrating.

Note: Liquid level calibration is most accurate when calibrated at 10.0 inches (254 mm). Calibration must be performed above 3.0 inches (75 mm).

Note: Security Level 3 or higher is required to calibrate the liquid level.

Hot Gas Bypass Sensor Calibration

This section describes how to calibrate the Controller hot gas bypass sensor. There are two calibration procedures: single point and two point calibration.

For single point calibration, the reference point is LN₂. For two point calibration, the reference points are LN₂ and ice water. Unless regulations require a two point calibration, the single point calibration procedure is recommended.

All new freezers have been calibrated at the factory. The hot gas bypass sensor should only be calibrated if faulty readings are suspected, bypass sensor has been replaced or as a part of a preventative maintenance schedule.

For an accurate calibration, the LN₂ Saturation Temperature (Section **“Liquid Nitrogen Saturation Temperature”**) needs to be correctly set based on the altitude of the freezer location.

Both the single and two point calibration procedures require a small volume of LN₂; enough to completely submerge the bypass sensor. The two point calibration also requires an ice water bath. Proper ice water bath preparation is imperative to ensure accuracy. It is best to add filtered water to a Styrofoam cup containing crushed ice. Allow the solution to stand at room temperature for five minutes prior to beginning the calibration procedure.

Note: Security Level 2 or higher is required to calibrate the bypass sensor.

Hot Gas Bypass Sensor Removal



CAUTION : Removing the hot gas bypass sensor while a LN₂ supply is connected to the freezer will cause the user to be exposed to LN₂. Before beginning procedure, shut off and disconnect all LN₂ supply sources. Always wear protective gloves and face shield when handling LN₂. Refer to the **“Safety and First Aid”** section of this manual.

1. Ensure all LN₂ supply sources are shut off and disconnected.
2. Remove plumbing shroud or rear panel to access the plumbing assembly.
3. Locate the hot gas bypass sensor on the plumbing assembly.
4. Using a 9/16" or small adjustable wrench, remove the sensor from the plumbing assembly. It may be necessary to temporarily disconnect the sensor from the wire harness to avoid over twisting of the wires. Following removal of the sensor, reconnect the sensor wires.

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menus or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Liquid Level Menu”.

Press ENTER for
Liquid Level Menus or
press SETUP
for next menu

4. Press “ENTER”

The display will read “High Level Alarm”.

High Level Alarm 8.0 in
use ▲/▼ to adjust
Press ENTER to save

5. Press “SETUP”

Until the display reads “Advanced Level Menu”.

Press ENTER to
Advanced Level Menus
or press SETUP
for next menu

6. Press “ENTER”

The display will read “Auto Fill Control”.

Auto Fill Control
ENABLED Use ▲/▼ to
adjust Press ENTER to
save

7. Press “SETUP”

Until the display reads “Level Calibration”.

Level Calibration
Press ENTER to Start
Calibration or SETUP
for next

8. Press “ENTER”

The display will read “Please wait while the sensor zeros”. Wait for the Controller to count down from 60 seconds.

Please wait while the
sensor zeros 60 seconds

9. Wait 60 seconds

After the Controller counts down, the display will read “Actual Level”. Use the “▲/▼” keys to input the meter dip stick measured level.

Actual Level 10.0 in
Use ▲/▼ to adjust
Press ENTER to save

10. Press “ENTER”

The display will read “Level Calibration Complete”.

Level Calibration
Complete

11. Verify that the home screen reads the liquid level value that was just entered. In some cases the Controller should be restarted. Contact Technical Support with any questions.

- Perform the hot gas bypass sensor calibration procedure.
- Following calibration, reinstall the bypass sensor using new PTFE thread tape, ensure sensor wires are connected, reinstall plumbing shroud or rear panel and reconnect the LN₂ supply source.

Hot Gas Sensor Single Point Calibration

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Add-on Menu”.

Press ENTER for Add-
on menu or press
SETUP for next menu

4. Press “ENTER”

The display will read “Battery Status”.

Battery Status
On AC Power

5. Press “SETUP”

Until the display reads “Hot Gas Bypass Menu”.

Press ENTER to Hot
Gas Bypass menu or
press SETUP for next
menu

6. Press “ENTER”

The display will read “Hot Gas Bypass”.

Hot Gas Bypass
ENABLED
use ▲/▼ to adjust

7. Press “SETUP”

Until the display reads “Bypass Probe Calibration”.

Press ENTER for
Bypass Probe
Calibration or press
SETUP for next menu

8. Press “ENTER”

The display will read “Calibration Type”. Use the “▲/▼” keys to set as “SINGLE POINT”.

Calibration Type
SINGLE- POINT
Use ▲/▼ to adjust
Press ENTER for next
menu

9. Press “ENTER”

The display will read “Bypass Calibration”. Submerge the sensing end of the bypass probe in LN₂.

Bypass Calibration
Place Bypass Probe in
LN₂ and press ENTER

10. Press “ENTER”

The display will read “Wait for Bypass Temp to stabilize”. Wait for the displayed temp reading to stabilize while the probe is submerged in liquid.

Wait for Bypass Temp to
stabilize then press
ENTER Bypass Temp -
195.8°C

11. Press “ENTER”

The display will read “Bypass Probe single point calibration complete”.

Bypass Probe Single
Point Calibration
complete

Hot Gas Sensor Two Point Calibration

1. Press “SETUP”

Controller will prompt for a password. A flashing cursor will make it clear which digit is being changed. Use the “▲/▼” keys to scroll to the appropriate number. Press “ENTER” to advance the cursor to the next position.

Higher User Level
Required use ▲/▼ to
ENTER Password 0000

2. Press “ENTER”

The display will read “Temperature Menu”.

Press ENTER for
Temperature Menu or
press SETUP for next
menu

3. Press “SETUP”

Until the display reads “Add-on Menu”.

Press ENTER for Add-
on menu or press
SETUP for next menu

4. Press “ENTER”

The display will read “Battery Status”.

Battery Status
On AC Power

5. Press “SETUP”

Until the display reads “Hot Gas Bypass Menu”.

Press ENTER to Hot
Gas Bypass menu or
press SETUP for next
menu

6. Press “ENTER”

The display will read “Hot Gas Bypass”.

Hot Gas Bypass
ENABLED Use ▲/▼ to
adjust Press ENTER to
save

7. Press “SETUP”

Until the display reads “Bypass Probe Calibration”.

Press ENTER for
Bypass Probe
Calibration or press
SETUP for next menu

Communication / Networking

The Controller is equipped with two independent RJ-45 serial ports. These ports are intended for connection to another Controller, PC, serial printer or other RS-485 device. Up to 100 controller can be successfully networked.



Note: The Controller should never be connected directly to a LAN or public telecommunications network.

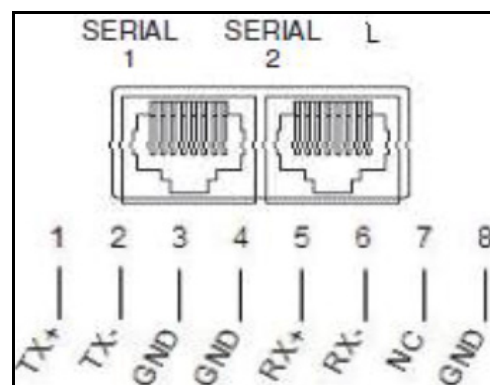
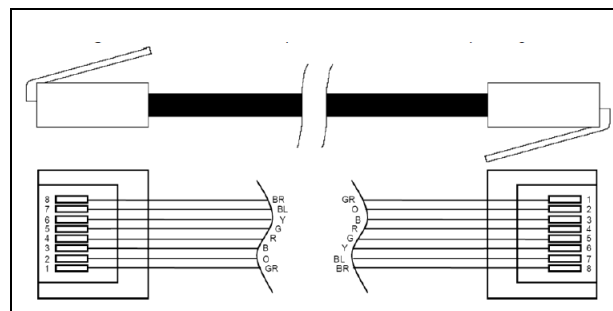


Figure 11. Controller serial ports and RS-485 4-wire pin diagram



8. Press “ENTER”

The display will read “Calibration Type”. Use the “▲/▼” keys to set as “TWO POINT”.

Calibration Type TWO
POINT Use ▲/▼ to
adjust Press ENTER to
next menu

9. Press “ENTER”

The display will read “Bypass Calibration”. Submerge the sensing end of the bypass probe in LN₂.

Bypass Calibration
Place Bypass Probe in
LN₂ and press ENTER

10. Press “ENTER”

The display will read “Wait for Bypass Temp to stabilize”. Wait for the temp reading to stabilize while the probe is submerged in LN₂.

Wait for Bypass Temp to
stabilize then press
ENTER Bypass
Temp - 195.8°C

11. Press “ENTER”

The display will read “Remove Probe A from LN₂”. Remove the bypass sensor from the LN₂.

Remove Bypass Probe
from LN₂ and press

12. Press “ENTER”

The display will read “Wait while probe warms to room temperature”. Wait while the bypass sensor warms to room temperature and the Controller counts down.

Wait while Probe Warms
to room
temperature 180
seconds

13. Wait 180 seconds

After the Controller counts down, the display will read “Place Probe A in ice water”. Completely submerge the sensing end of the probe in the ice water bath.

Place Bypass Probe in
ice water and press
ENTER

14. Press “ENTER”

The display will read “Wait for Temp A to stabilize”. Wait for the displayed Temp A reading to stabilize while the probe is submerged in the ice bath.

Wait for Bypass Temp to
stabilize then press
ENTER
Bypass Temp 0.0°C

15. Press “ENTER”

The display will read “Bypass Probe two Point calibration complete”.

Bypass Probe two Point
calibration complete

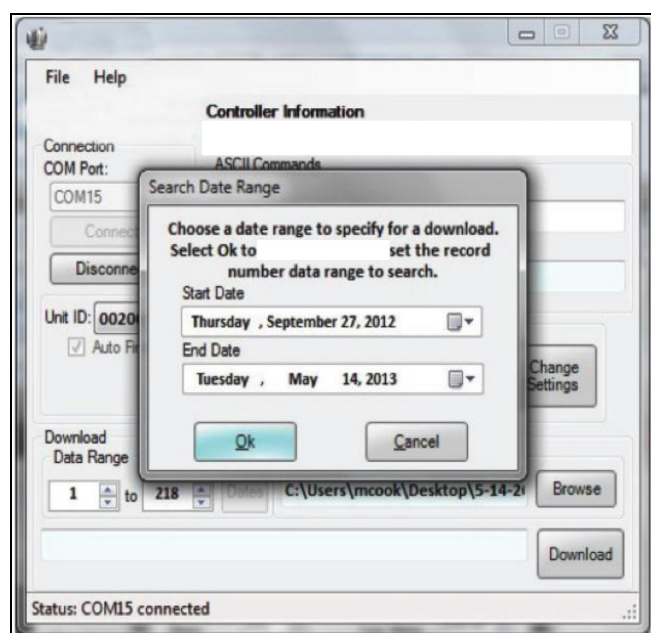
Table 6. RS-485 Interface Specifications

COM Setup	bits / sec	Parity	Data bits	Stop bits
9600 N81	9600	None	8	1
9600 N82	9600	None	8	2
19200 N81	19200	None	8	1
19200 N82	19200	None	8	2

COM Type				
ASCII	Printer	OFAF	MODBUS	Disabled
Transmission		Mode	Terminator	
4-wire		Asynchronous	CR, LF	

Controller Connect (Computer Interface)

Controller Connect is a free, downloadable software program that enables a user to download the event log and query and adjust Controller parameters. Features include a user-friendly ASCII command window, automatic COM Port selection, real-time temperature, level monitoring and the event log download button that allows a date range selection. It will include the fill control buttons and a quick parameter setup table. For additional information refer to the Controller Connect user manual.



Required Items

- Microsoft Windows (Vista, XP, WIN7).
- Controller COM USB Kit (P/N CE8100COM)
- USB Port.

Installing Controller COM USB Kit

1. Insert the included USB to Serial Driver Disc into the PC CD-ROM.
2. Plug the Controller COM USB Kit COM USB Kit into an open USB port.
3. Follow the automatic installation prompts.

Downloading Controller Connect

1. Download latest version online.
2. Click the link and open the compressed folder.
3. Extract all files from the compressed folder to a location on your hard drive.
4. Open the extracted SETUP file.
5. Follow the prompts to complete installation.
6. A Controller Connect icon should appear on your programs list when complete.

Connecting to Controller

Controller Settings

1. COM Setup: "9600 N81".
2. COM Type: "ASCII".
3. Select a unique MODBUS ID (Unit ID) for each Controller involved.

Controller Connect Settings

1. Connect Controller serial port to PC with Controller COM USB Kit.
2. Open Controller Connect.
3. Determine the Windows COM Port by clicking "Find COM Port" on the Controller Connect main page.
4. Note the COM number listed beside "RS-485 Isolated Port" in the Device Manager window.
5. Close Device Manager and click "OK".
6. Select the appropriate Windows COM Port from the drop down menu.
7. Connect to Controller.
 - For a single Controller: Select "Single Controller" and click "Connect". The Unit ID is automatically detected.
 - For networked controller: Select "Networked Controller", enter the Unit ID of the desired Controller and click "Connect". In order to connect to another

Controller on the network, click “Disconnect”, change the Unit ID and then click “Connect”.

- If the Controller is successfully connected, “COM Port Connected” and “Controller Detected” will be displayed in the status box.

Note: Contact your CryoExtra Distributor or Technical Service if you experience problems connecting to a Controller.

Downloading the Event Log

- Connect to Controller using Controller Connect.
- Select Event Download Range with Event 1 being the most recent logged event. The default download range includes all events.
- Designate a filename and save location. The default file name is the current date and time while the save location is the c:\ drive.
- Click “Download Event Log”.
- Once the event log has finished downloading, select “Click to Open Downloaded Data File” or open the file from its saved location.

Plotting the Event Log

- Open downloaded event log with EXCEL.
- Before plotting be sure to delete any rows containing text; such as, “Parameter number...” refer to **Figure 12** for clean data.
- Insert new column between the Time and Temp A columns.
- Label this new column heading Date / Time.
- In cell E4, enter the formula “= C4+D4”.
- Fill down the rest of column E with this formula.
- Format the cells in column E so that the Number Category is Date and the Type is a date / time combination.
- Sort all the data by Descending Date, then by Descending Time and then by Ascending Record #.
- Select the desired data to plot (Date / Time through LN₂ Usage columns) and insert a scatter chart.
- Once the chart has been created, select a secondary axis for the LN₂ Level and LN₂ Usage data sets.
- Format the chart and adjust the axis scales so that the data is easy to view and analyze.

	A	B	C	D	E	F	G	H	I	J
1										
2	00200									
3	Record #	Unit ID	Date	Time	Date/Time	TempA	TempB	LN2 Level	LN2 Usage	Event Codes
4	1	200	2/4/2008	9:00 AM	2/4/08 9:00	-195.9	-190	6.5	0.3	
5	2	200	2/4/2008	5:00 AM	2/4/08 5:00	-195.9	-190	6.5	0.3	
6	3	200	2/4/2008	1:00 AM	2/4/08 1:00	-195.9	-190	6.6	0.3	
7	4	200	2/4/2008	12:00 AM	2/4/08 0:00	-195.9	-190.3	6.6	0.3	
8	5	200	2/4/2008	12:00 AM	2/4/08 0:00	-195.9	-190.3	6.6	0.3	ZO
9	6	200	2/3/2008	9:00 PM	2/3/08 21:00	-195.9	-190.3	6.6	0.3	
10	7	200	2/3/2008	5:00 PM	2/3/08 17:00	-195.9	-190.6	6.7	0.3	
11	8	200	2/3/2008	1:00 PM	2/3/08 13:00	-195.9	-190.9	6.7	0.3	
12	9	200	2/3/2008	9:00 AM	2/3/08 9:00	-195.9	-191.5	6.7	0.3	
13	10	200	2/3/2008	5:00 AM	2/3/08 5:00	-195.9	-192.8	6.8	0.3	
14	11	200	2/3/2008	4:19 AM	2/3/08 4:19	-195.9	-190.9	7	0.3	

Figure 12. Properly formatted event log for plotting

ASCII Command Interface

American Standard Code for Information Interchange (ASCII) commands can be used to query and adjust all Controller settings and parameters. Commands must be entered in all capital letters just as they appear in the below tables. For a complete list of proper syntax and responses, refer to the “Appendix”.

CONTROL COMMANDS

*IDN?	ID Query	CODE?	Global Password Query
ALMS	Set Alarm Status	HITSTA	Initiate Temp A High Alarm Test
ALMS?	Alarm Status Query	HITSTB	Initiate Temp B High Alarm Test
CALTA	Calibrate Temp A in LN ₂	INITEE	Restore All Defaults
CALTB	Calibrate Temp B in LN ₂	LNSATP	Set LN ₂ Saturation Temp
CALVL	Set Level Offset	LNSATP?	LN ₂ Saturation Temp Query
CALVL?	Level Offset Query		

TEMPERATURE COMMANDS

BPTMP?	Bypass Temp Query	LOTAS?	Temp A Low Alarm Status Query
HITA	Set Temp A High Alarm	LOTAM	Set Temp A Low Alarm Mask
HITA?	Temp A High Alarm Query	LOTAM?	Temp A Low Alarm Mask Query
HITAS?	Temp A High Alarm Status Query	LOTB	Set Temp B Low Alarm
HITAM	Set Temp A High Alarm Mask	LOTB?	Temp B Low Alarm Query
HITAM?	Temp A High Alarm Mask Query	LOTBS?	Temp B Low Alarm Status Query
HITB	Set Temp B High Alarm	LOTBM	Set Temp B Low Alarm Mask
HITB?	Temp B High Alarm Query	LOTBM?	Temp B Low Alarm Mask Query
HITBS?	Temp B High Alarm Status Query	TEMPA?	Current Temp A Query
HITBM	Set Temp B High Alarm Mask	TEMPB?	Current Temp B Query
HITBM?	Temp B High Alarm Mask Query	TUNI	Set Temp Units
LOTA	Set Temp A Low Alarm	TUNI?	Temp Units Query
LOTA?	Temp A Low Alarm Query		

LEVEL COMMANDS

BPFIL?	Bypass Status Query	HILM	Set High Level Alarm Mask
FILAS?	Fill Time Alarm Status Query	HILM?	High Level Alarm Mask Query
FILL	Set Fill Status	LEVL?	Current LN ₂ Level Query
FILL?	Fill Status Query	LFIL	Set Low Level Setpoint
FILLM?	Auto Fill Status Query	LFIL?	Low Level Setpoint Query
FILT	Set Max Fill Time	LOLA	Set Low Level Alarm
FILT?	Max Fill Time Query	LOLA?	Low Level Alarm Query
FILTIM?	Current Fill Duration Query	LOLS?	Low Level Alarm Status Query
HFIL	Set High Level Setpoint	LOLM	Set Low Level Alarm Mask
HFIL?	High Level Setpoint Query	LOLM?	Low Level Alarm Mask Query
HILA	Set High Level Alarm	LUNI	Set Level Units
HILA?	High Level Alarm Query	LUNI?	Level Units Query
HILS?	High Level Alarm Status Query	RATE?	Current Liquid Usage Query

LEVEL PERCENT COMMANDS

DSPN	Define 100% Point	DZER	Define 0% Point
DSPN?	100% Point Query	DZER?	0% Point Query
PCNT?	Current Percent Query		

EVENT LOG COMMANDS

CLEVLG	Clear Event Log	LOGPER	Set Event Log Interval
DATE	Set Date	LOGPER?	Event Log Interval Query
DATE?	Date Query	TIME	Set Time
EVENT?	Last Event Query	TIME?	Time Query
EVNCT?	Number of Events Query	UNID	Set Unit ID
EVNLOG? n	Event Log [n] Query	UNID?	Unit ID Query

OFAF Network Setup

OFAF networking allows multiple controller to be linked together such that all of the freezers will fill whenever any networked Controller calls for a fill. When multiple freezers are connected to a common supply source, it is advantageous to fill all freezers at the same time. LN₂ transfer losses are significantly reduced by filling all networked freezers while the supply system is primed and cold. Using an OFAF network is more efficient than cooling the supply system every time an individual freezer fills. This approach is also more efficient than employing a keep full / keep cold system. Up to 100 controller can be connected to an OFAF network.

An OFAF network can be configured in two modes: “Sequential” or “Simultaneous.” For both modes, when any Controller in the network initiates a fill, the Master Controller (OFAF ID 1) recognizes this and triggers all other Controller to initiate fills as well.

In Sequential OFAF mode, once the Controller that initiated the first fill has reached its High Level Setpoint, the Master will trigger the freezer with the next sequential OFAF ID to fill until it reaches its High Level Setpoint. The Master will then trigger the freezer with the next sequential OFAF ID to fill and this process will continue until all freezers in the network including the Master have reached their High Level Setpoints.

In Simultaneous OFAF mode, when any Controller initiates a fill and fills for at least 60 seconds, the Master will then broadcast a signal for all freezers, including itself, to begin filling. Each freezer will continue to fill until its High Level Setpoint is reached.

A user would select sequential OFAF over simultaneous if their supply system is not able to maintain the proper filling pressure while multiple freezers filling at the same time. Sequential OFAF allows freezers to fill one at a time with a primed and cold supply system so that it is easier for the system to maintain the proper filling pressure.

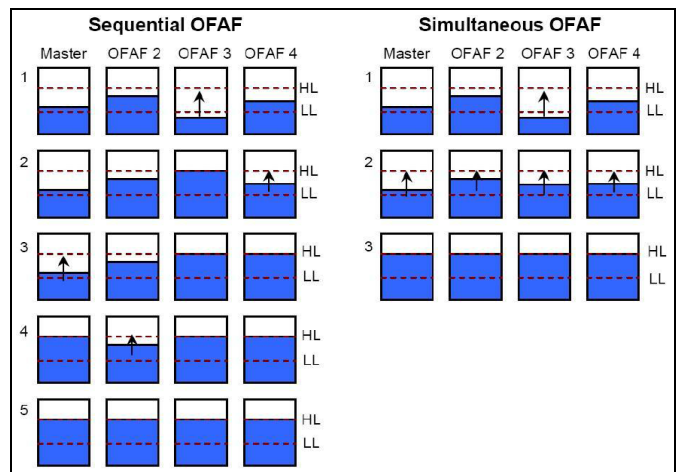


Figure 13. Diagram showing difference between Sequential and Simultaneous OFAF

Network Setup

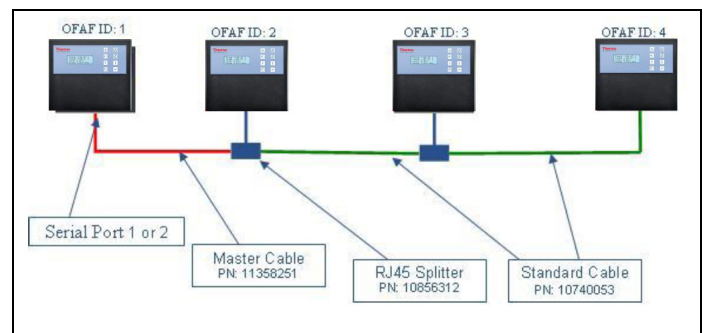


Figure 14. Diagram showing a typical OFAF network setup

Table 7. Required items for OFAF network

P/N	Description	Quantity needed
11358251	OFAF Master Cable	1
10740053	Standard CAT 5e Cable	# of controller - 2
10856312	RJ-45 Splitter	# of controller - 2

12. Designate the Master Controller by setting its OFAF ID to “1”. Generally, this is the Controller on the far end of the network from the LN₂ supply.

13. Connect one end of the OFAF Master Cable to either Serial Port 1 or 2 of the Master Controller.

Note: Either Serial Port 1 or 2 can be used for OFAF as long as the COM Types are in agreement.

14. Connect an RJ-45 splitter to the next Controller in the network. Connect the free end of the OFAF Master Cable to this splitter.

15. Set the OFAF ID of this second Controller to “2”.

16. Connect an RJ-45 splitter to the third Controller in the network. Connect the splitters on the second and third controller with a standard CAT 5e cable.

17. Set the OFAF ID of the third Controller to “3”.

18. Continue this pattern until all controller in the network are daisy chained and assigned sequential OFAF IDs.

19. Each Controller in the network should also have the following settings:

- a. Auto Fill Control “Enabled”
- b. COM Setup “9600 N81”
- c. COM Type “OFAF”
- d. OFAF Type “Sequential” or “Simultaneous”. All controller in a network must have the same OFAF Type.
- e. OFAF Units “# of controller - 1”. The Master Controller is not counted in the number of OFAF Units. All controller in a network must have the same number of OFAF Units.

Cable Wiring

OFAF Master Cable

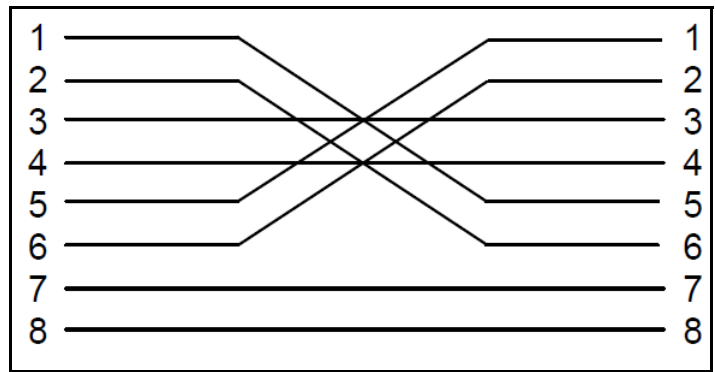


Figure 15. OFAF Master Cable wiring configuration. Numbering as viewed from side of RJ-45 connector opposite latch.

Standard Cable

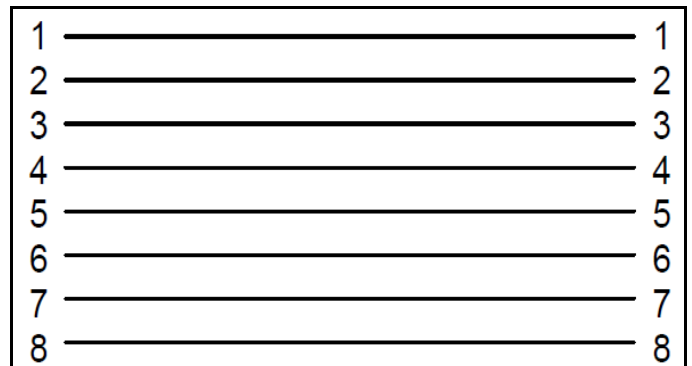


Figure 16. Standard reverse RJ-45 network cable configuration. Numbering as viewed from side of the connector opposite latch.

Note: Pressing STOP FILL will delay the automatic fill circuit for 30 minutes. To initiate the Automatic Fill Circuit restart Controller.

Printer Setup

The Controller compatible printer kit allows users to print a hard copy of the freezer’s status at a set interval and as events occur. The Controller will print the current status of the freezer in the event log format. The default print interval is 30 minutes.

Note: Adjusting the print interval will not affect the event log interval. These two parameters are independent. The event log interval can be adjusted using ASCII commands. All printed events are not necessarily logged in the event log; however, all the events in the event log are printed.

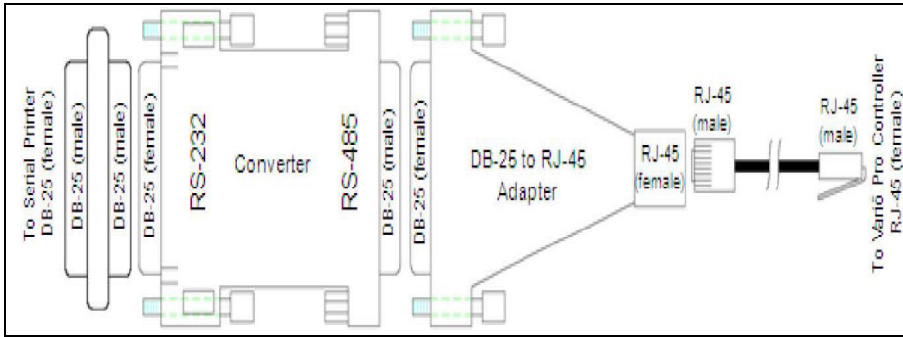
Controller Printer Kit (P/N CE8100PRINT)

- Epson LX-300+II Serial Dot Matrix Printer
- RS-485 Converter and Adapters
- User’s Guide

Installation

1. Setup printer as described in the included user’s guide. Assemble and connect RS-485 converter and adapters as shown below.

2. Connect the printer to Controller serial port 1 or 2 via the RS-485 converter assembly.
3. Set the corresponding COM Setup to “9600 N81”.
4. Set the corresponding COM Type to “Printer”.
5. Adjust the Print Interval to the desired value.
6. Test setup by forcing an event or printing a new header or event.



Remote Alarm Tests

Global Remote

The Global Remote contacts can be checked for continuity using a digital multimeter or ohm meter.

- Normal State (No Alarms)

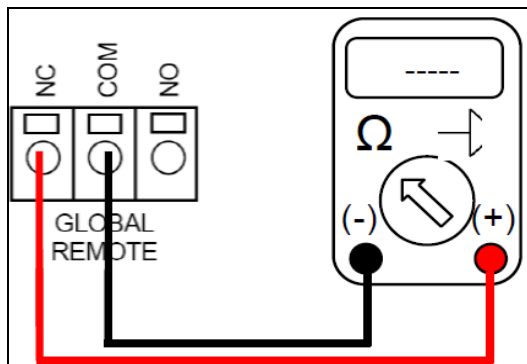
There should be continuity between the COM and NC terminals.

The COM – NO circuit should be open.

- Alarm State

There should be continuity between the COM and NO terminals.

The COM – NC circuit should be open.



Discrete Contacts

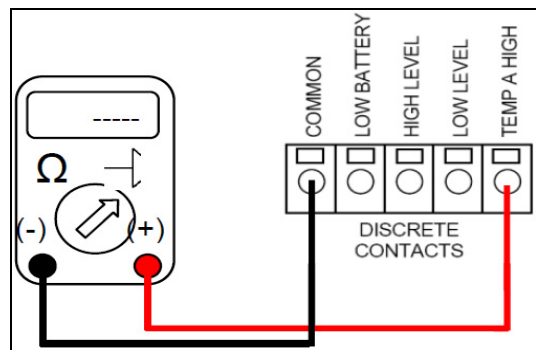
The Discrete Contacts can be tested for continuity using a digital multimeter with diode check. Since the Discrete Contacts are open collectors, the diode check function () should be used.

- Normal State (No Alarms)

All Discrete Contact terminals should be open with respect to COMMON.

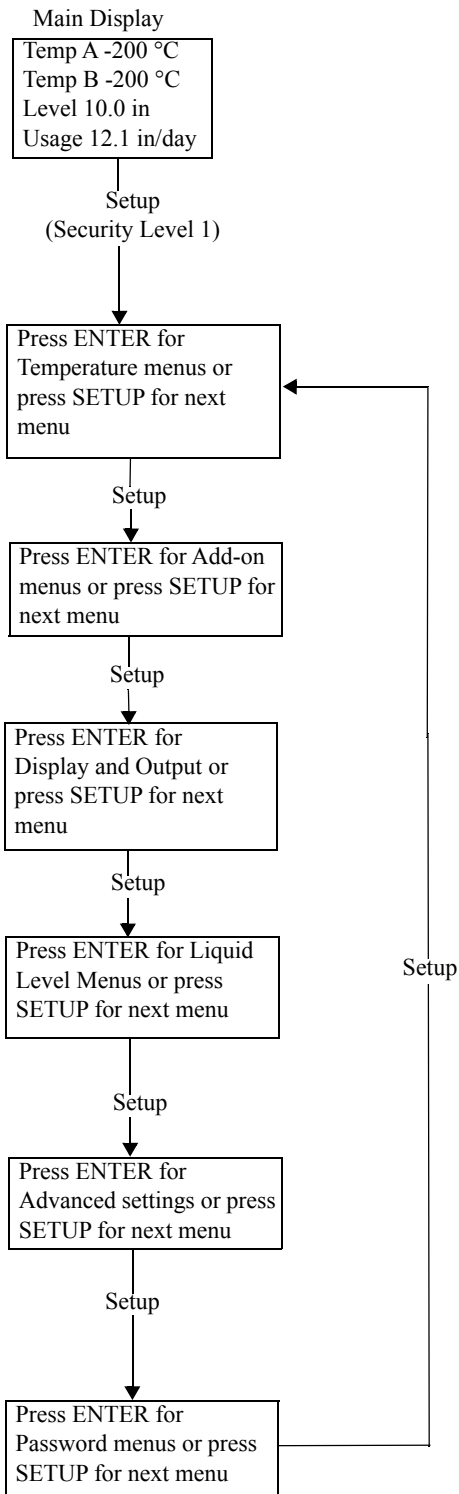
- Alarm State

There should be continuity between the specific active alarm terminal and COMMON. Inactive alarms should remain open with respect to COMMON.

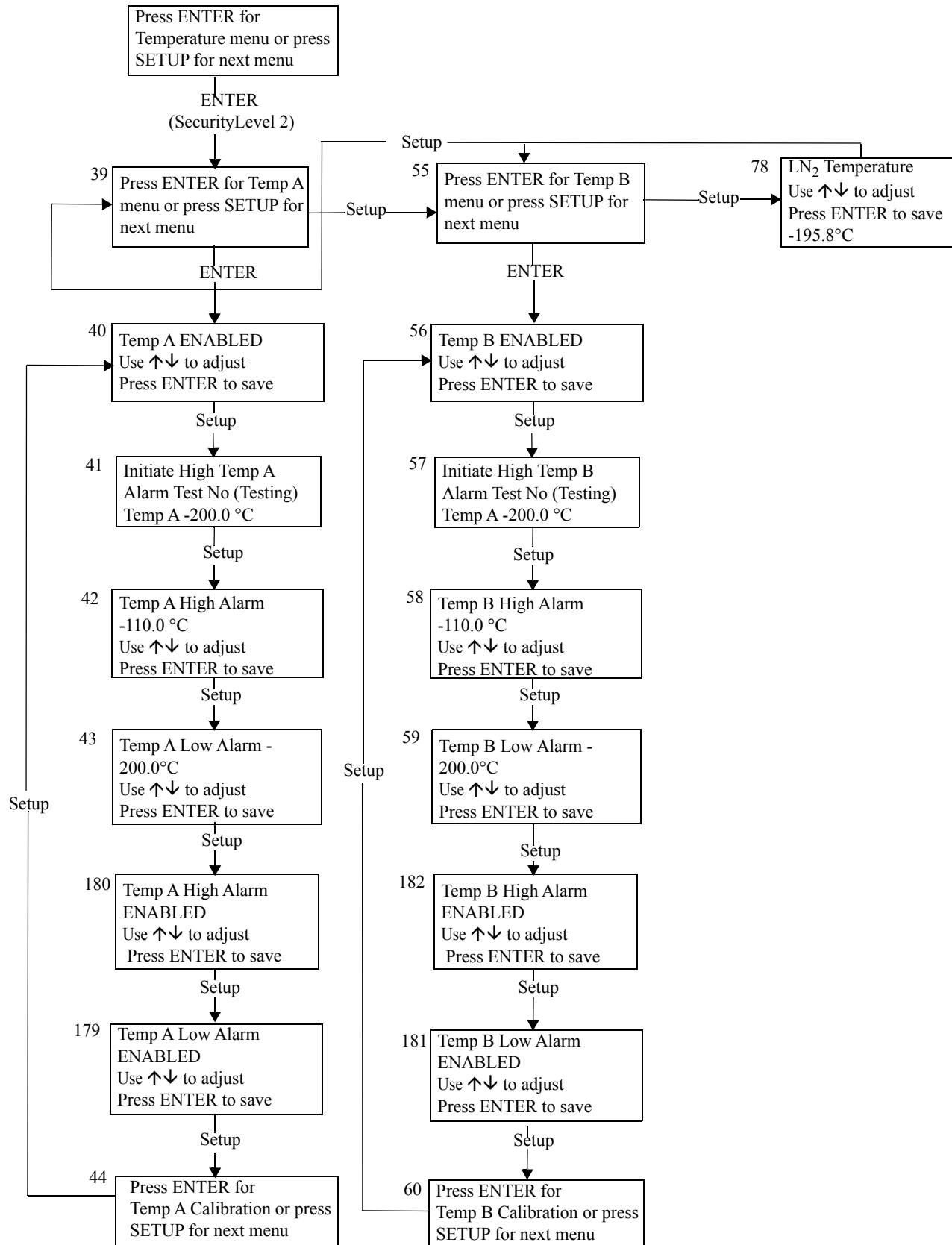


Controller Menu Maps

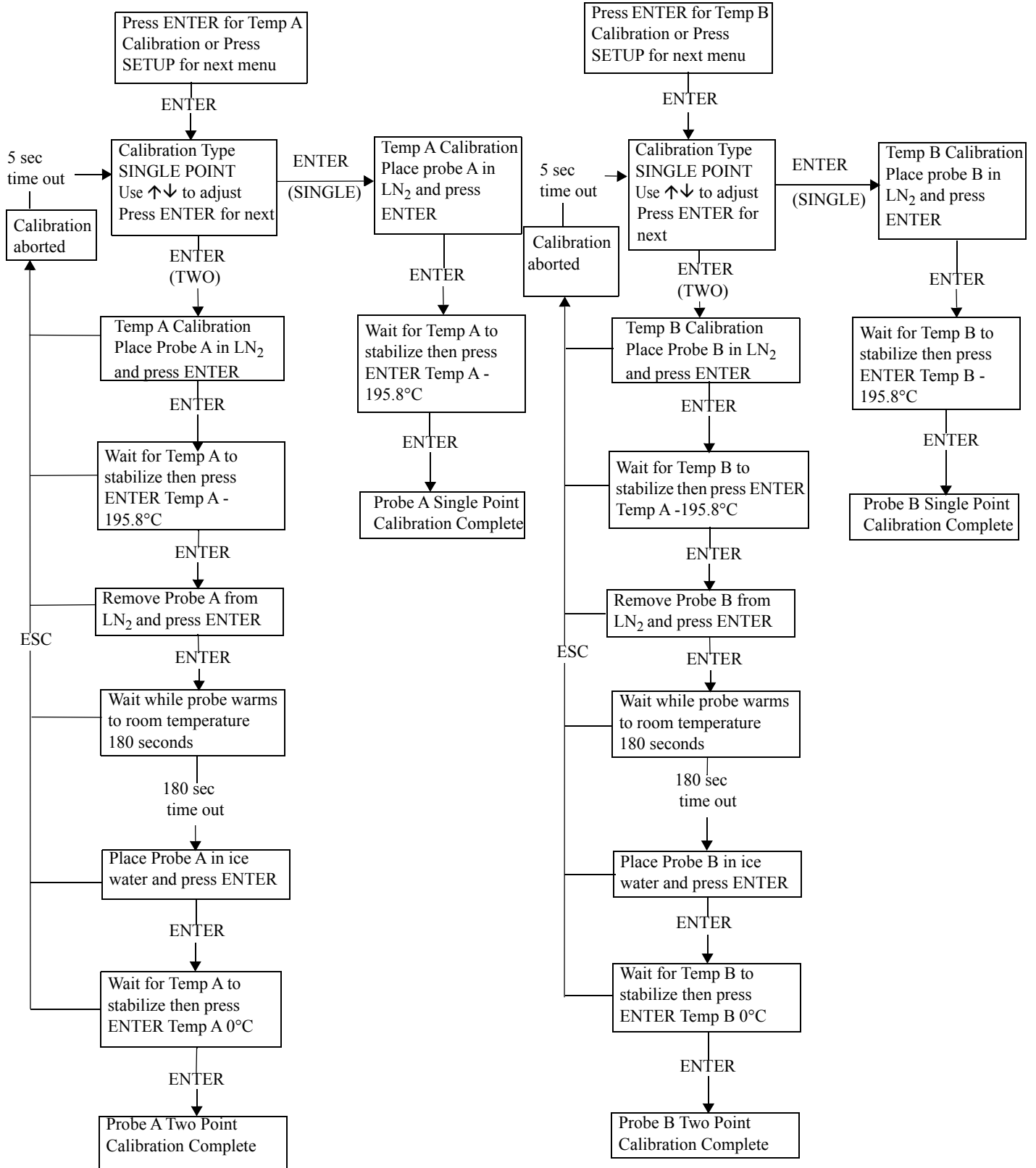
Main Setup Menus



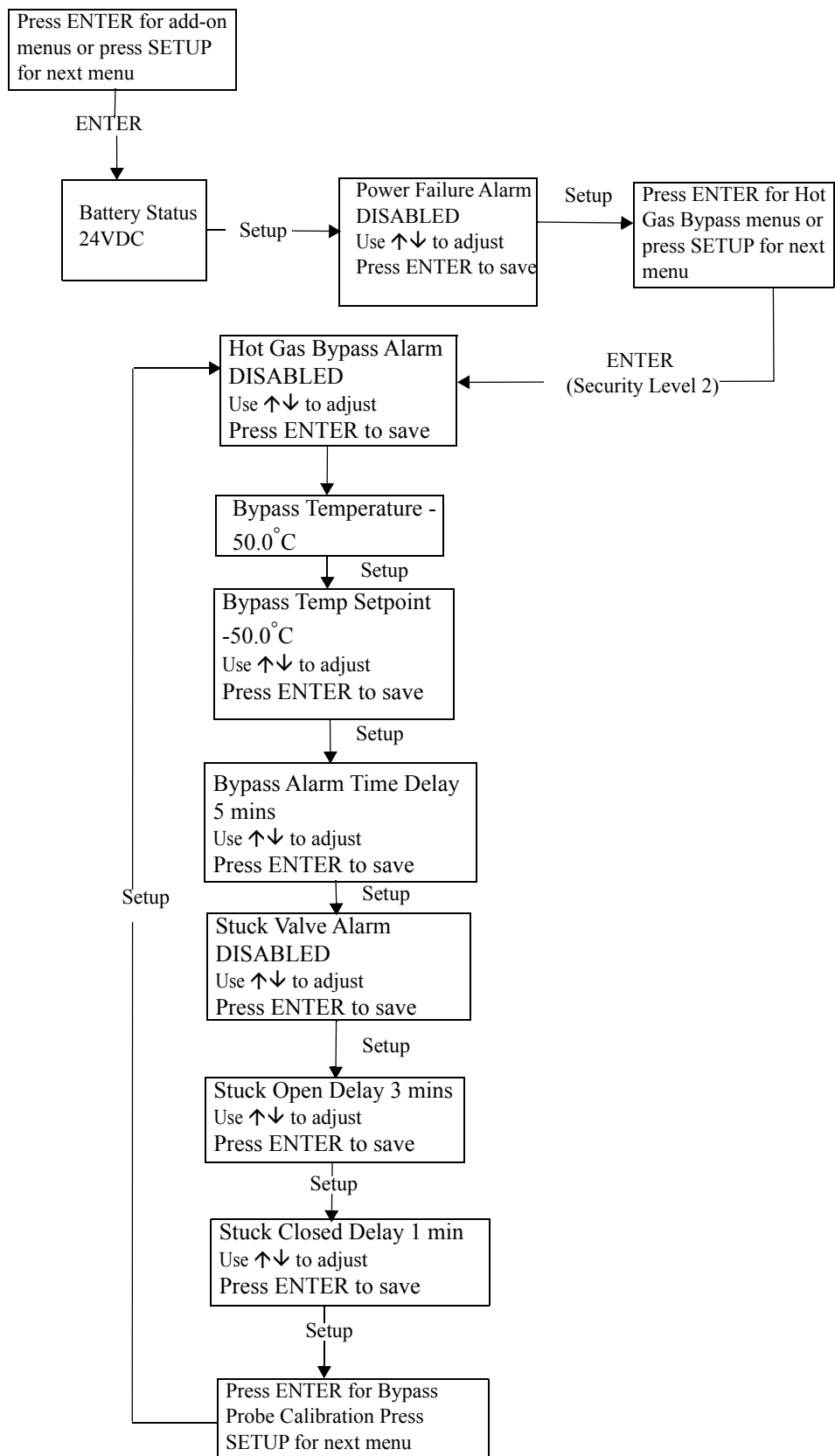
Temperature Setting Menus



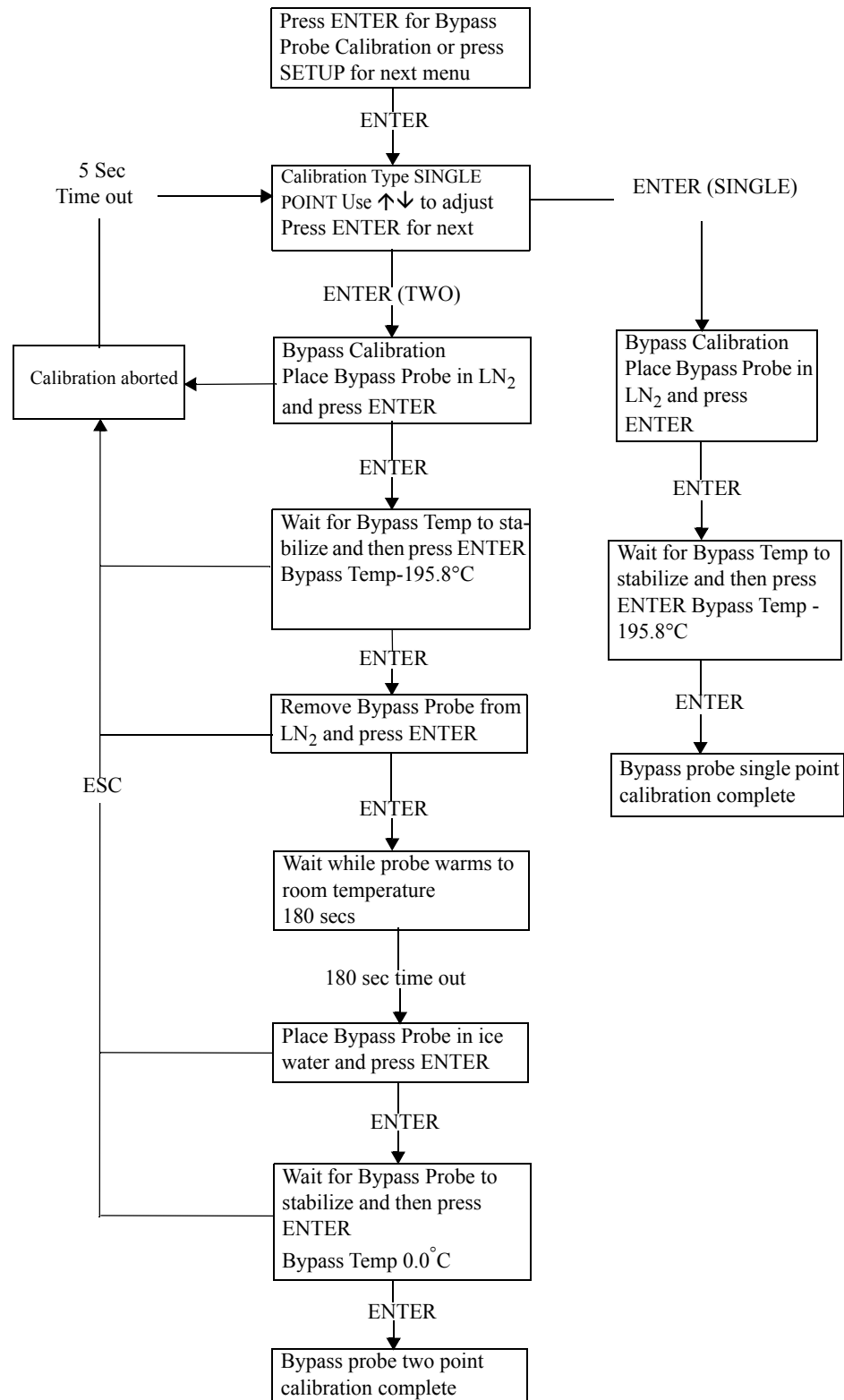
Temperature Calibration Menus



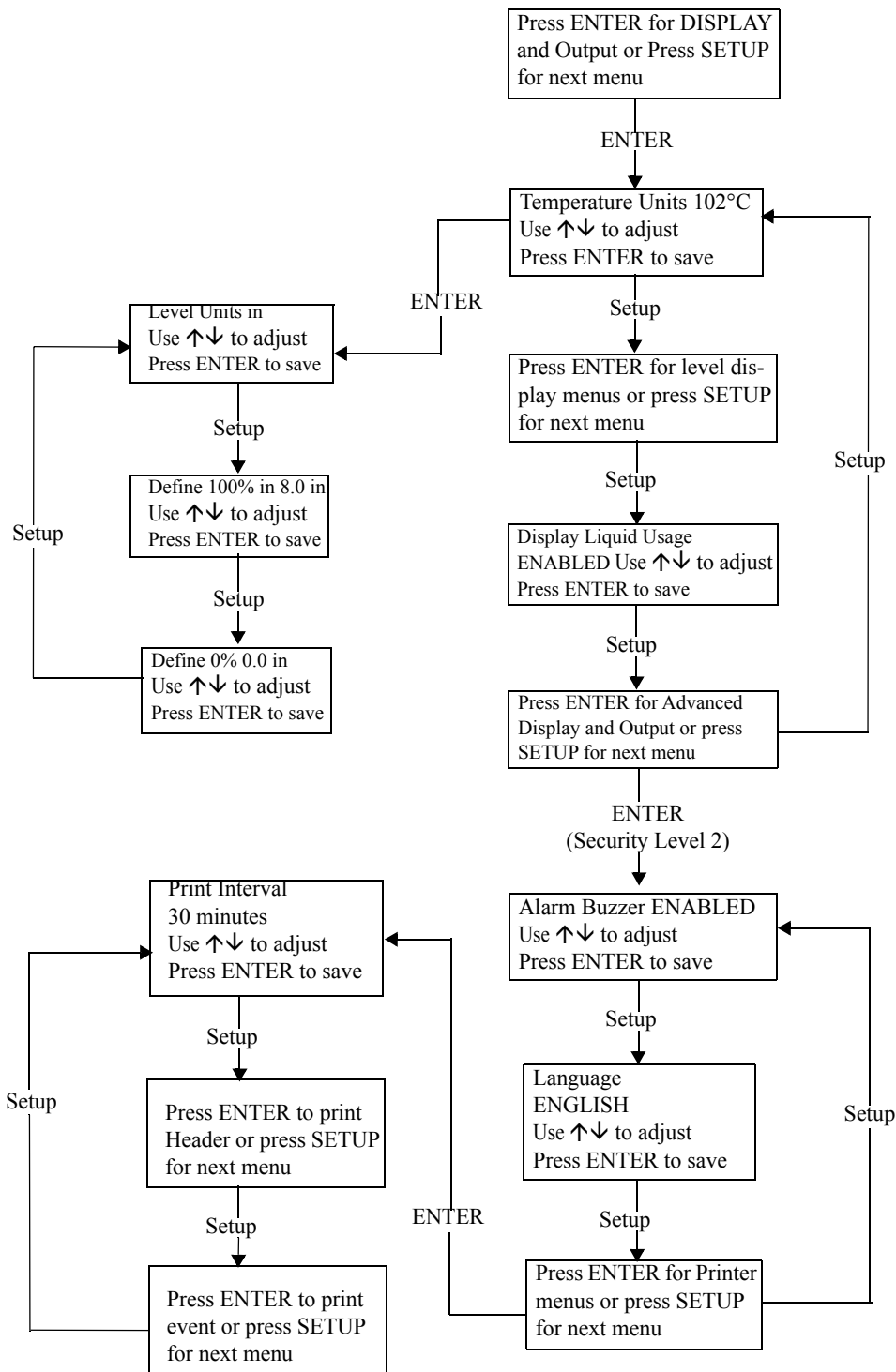
Add On Menus



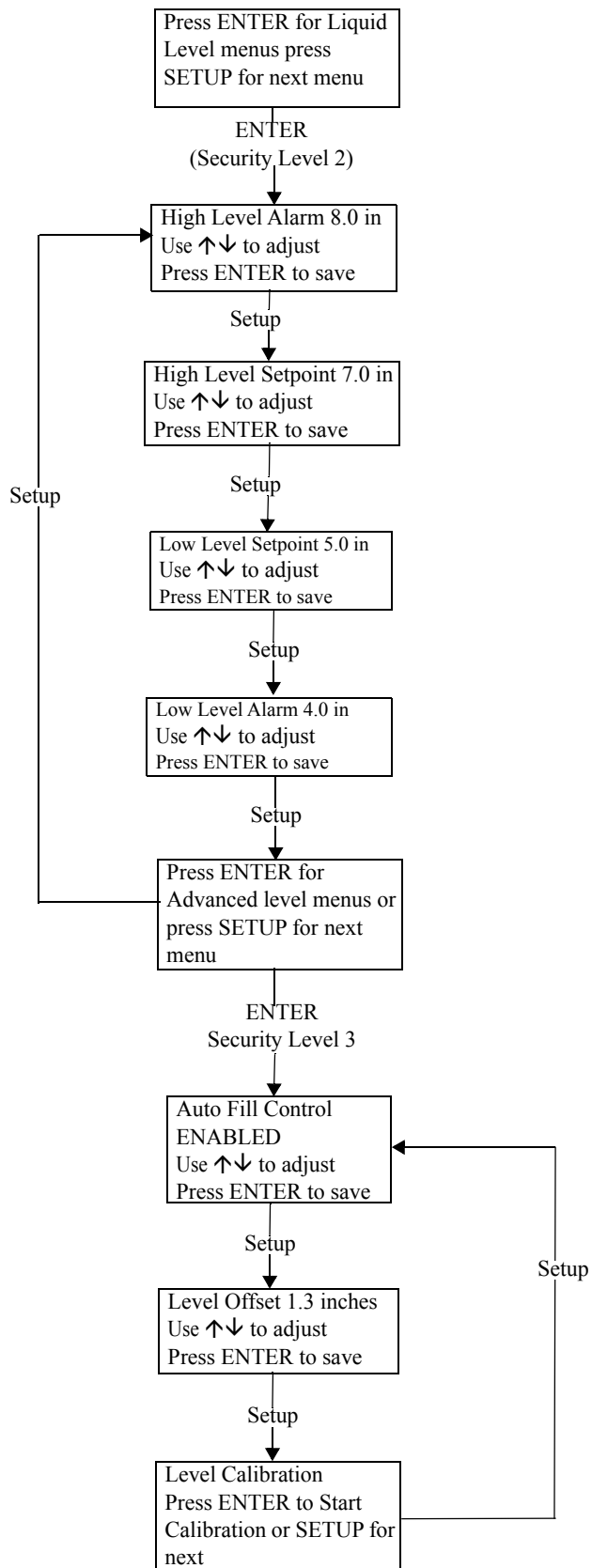
Hot Gas Bypass Sensor Calibration Menus



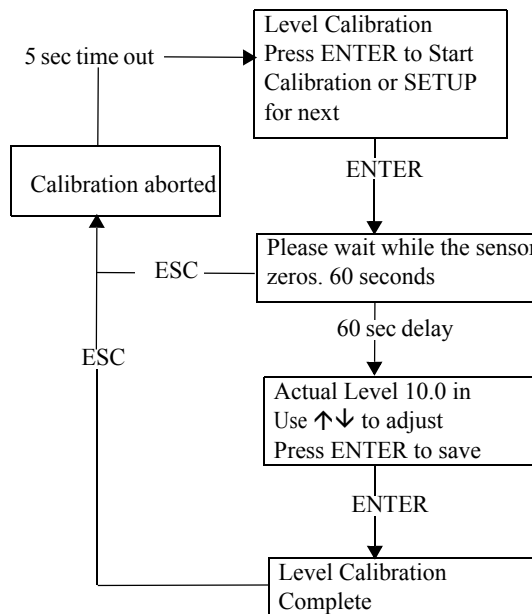
Display and Output Menus



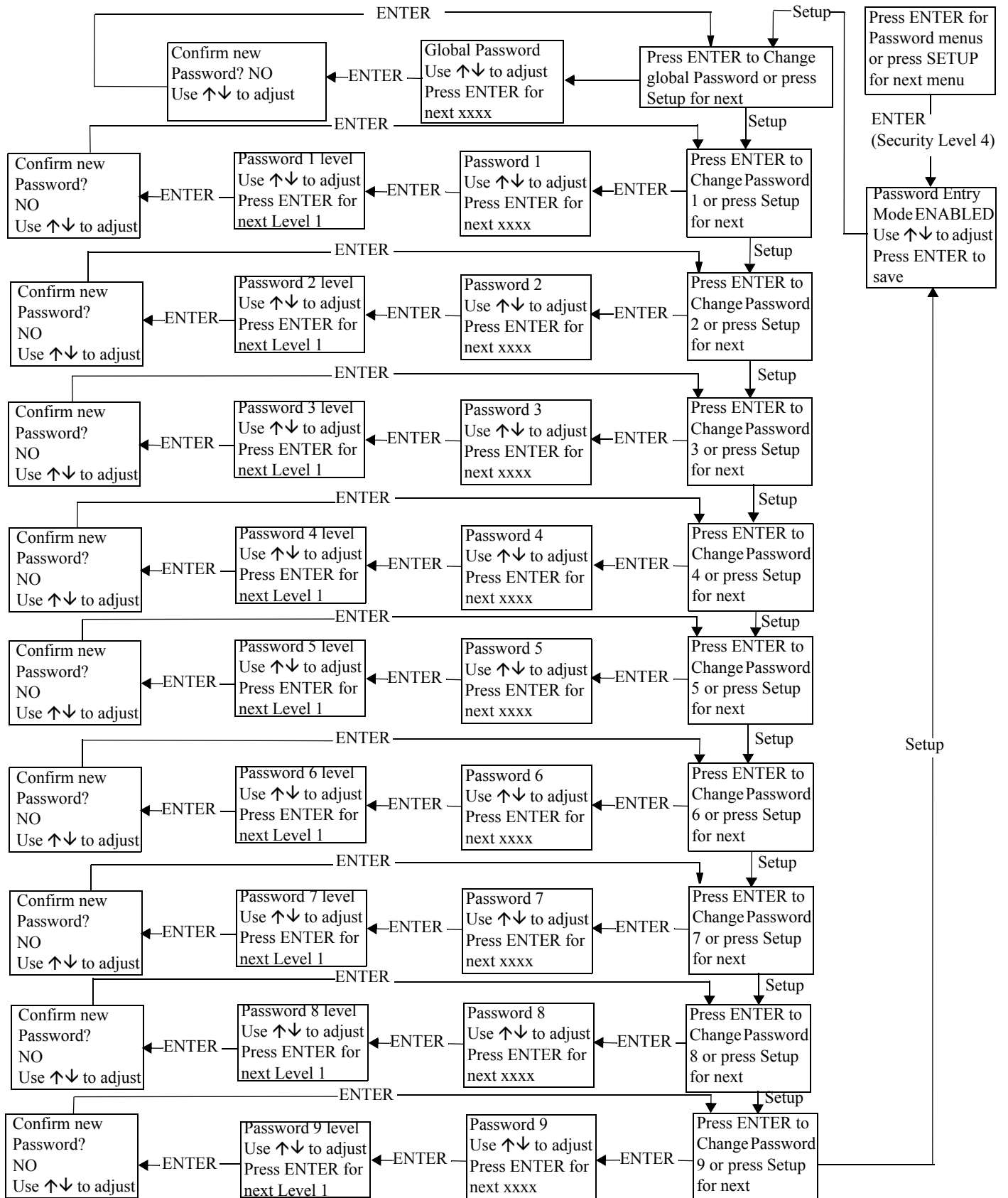
Liquid Level Menus



Liquid Level Calibration Menu



Password Menu



Controller Display Screens

Main Display	Filling Display	Bypass Display	Alternate Display Test	Power Up Display	Confirmation Display	Loss of communication from the control board to the display (English Only)
Temp A -200.0°C Temp B -200.0°C Level 10.0 in Usage 12.1 in/day	Temp A -200.0°C Temp B -200.0°C Level 10.0 in Filling MM:SS	Bypass Temp -200.00°C Bypass Time 00:00	Temp A Open Temp B Disabled Level 10.0 in Usage 12.1 in/day	Starting Please Wait Version 2.02	NEW SETTING ACCEPTED	Communications Loss Check Controller

Alarm Display (flashing from the main display)

ALARM High Temp A Ended at: 11/25/05 15:30	ALARM High Temp A Started at: 11/25/05 15:30	ALARM High Temp B Ended at: 11/25/05 15:30	ALARM High Temp B Started at: 11/25/05 15:30	Higher User Level Required use ↑↓ to ENTER Password 0000
ALARM Low Temp A Ended at: 11/25/05 15:30	ALARM Low Temp A Started at: 11/25/05 15:30	ALARM Low Temp B Ended at: 11/25/05 15:30	ALARM Low Temp B Started at: 11/25/05 15:30	
ALARM Low Level Ended at: 11/25/05 15:30	ALARM Low Level Started at: 11/25/05 15:30	ALARM High Level Ended at: 11/25/05 15:30	ALARM High Level Started at: 11/25/05 15:30	
ALARM Fill time 60 min Ended at: 11/25/05 15:30	ALARM Fill time 60 min Started at: 11/25/05 15:30	ALARM Bypass Time 5 min Ended at: 11/25/05 15:30	ALARM Bypass Time 5 min Started at: 11/25/05 15:30	
ALARM Lid open 30 min Ended at: 11/25/05 15:30	ALARM Lid open 30 min Started at: 11/25/05 15:30	Communications Loss Unit 2 Ended at: 11/25/05 15:30	Communications Loss Unit 2 Started at: 11/25/05 15:30	
ALARM Temp A Calibration Ended at: 11/25/05 15:30	ALARM Temp A Calibration Started at: 11/25/05 15:30	ALARM Temp B Calibration Ended at: 11/25/05 15:30	ALARM Temp B Calibration Started at: 11/25/05 15:30	
ALARM Bypass Calibration Ended at: 11/25/05 15:30	ALARM Bypass Calibration Started at: 11/25/05 15:30	ALARM Usage Ended at: 11/25/05 15:30	ALARM Usage Started at: 11/25/05 15:30	
Usage Warning Ended at: 11/25/05 15:30	Usage Warning Started at: 11/25/05 15:30	ALARM Power Failure Ended at: 11/25/05 15:30	ALARM Power Failure Started at: 11/25/05 15:30	
ALARM Low Battery Started at: 11/25/05 15:30	ALARM Low Battery Started at: 11/25/05 15:30	ALARM Valve Stuck Open Started at: 11/25/05 15:30	ALARM Valve Stuck Open Started at: 11/25/05 15:30	
ALARM Valve Stuck Closed Started at: 11/25/05 15:30	ALARM Valve Stuck Open Started at: 11/25/05 15:30			

Preventative Maintenance

Preventative Maintenance Schedule

Note: This is the CryoExtra recommended preventative maintenance. CryoExtra Distributors may have a more comprehensive maintenance/service plan. At the minimum, the below schedule should be followed.

This section describes the preventative maintenance that should be performed on CryoExtra freezers to ensure optimum operation and performance, as well as maximum service life. As with any technical piece of laboratory equipment, preventative maintenance is key to equipment success.

Table 8. Periodic Preventative Maintenance Schedule

	Weekly	Monthly	6 Months	12 Months	24 Months	60 Months
Level Verification	X					
Verify Adequate Supply	X					
Plumbing Leak Check		X				
High Temp Alarm Test			X			
Level Alarm Test			X			
Thaw Freezer Lid			X			
Folding Step Inspection			X			
Lid Hinge Inspection			X			
Inline Filter Replacement				X		
Complete Function Test				X		
Solenoid Valve Replacement					X	
Relief Valve Replacement					X	
Lid Gasket Replacement					X	
Complete Freezer Thaw and Moisture Removal						X

Preventative Maintenance Procedures

Level Verification

The differential pressure measurement system used on CryoExtra freezers is nearly maintenance free. It provides a high level of accuracy and resolution to give the operator a precise indication of the exact amount of LN₂ present in the freezer at all times. Despite its reliability, it is important that the accuracy of the level measurement system is verified on a weekly basis. This will prevent a control system malfunction from adversely affecting the temperature in the freezer storage space. Use the meter dipstick provided with every CryoExtra freezer to manually measure the amount of LN₂ in the freezer. Follow the “Dip Stick Procedure” listed in section “**Liquid Nitrogen Level Calibration**” to properly measure the level. If the level is off by 1.0 inch (25 mm) or more, follow the calibration procedure listed in the aforementioned section.

Verify Adequate Supply

Adequate LN₂ supply pressure and flow is imperative to the proper operation of CryoExtra freezers. Any LN₂ supply whether from bulk tank or liquid cylinder must be able to maintain a pressure of 22-35 psi (1.52 – 2.41 bar) during a filling cycle and must have enough liquid to ensure the completion of a fill cycle. The majority of nuisance alarms reported from CryoExtra freezers are due to inadequate supply.

1. Observe the pressure of the supply source. Ideally, pressure should be 22 – 35 psi (1.52 – 2.41 bars).

Note: It is very common for the pressure gauge on an industrial liquid cylinder to be inoperative. If you suspect this to be the case, install a pressure gauge inline between the liquid cylinder and the freezer for verification.

2. Verify the amount of liquid in the supply source. Most bulk tanks have some method of digital or analog volume measurement. Liquid cylinders typically use a sight gauge. As with the pressure gauge on liquid cylinders, it is common for the sight gauge to be inoperative.
3. The minimum amount of liquid necessary in the supply should be enough to completely fill the number of freezers it is supplying. This amount can be determined from the LN₂ inch to volume table in the Appendix.
4. Initiate a fill start on at least one freezer on the network. The supply system should be able to maintain appropriate pressure throughout the duration of the fill cycle.
5. If the supply is determined to be inadequate, have your gas supplier replenish / replace the supply.

Plumbing Leak Check

Leaky plumbing connections can create a host of problems including but not limited to:

- Slow fill times
- Nuisance Alarms
- High LN₂ Consumption
- Inaccurate level readings
- Inaccurate liquid usage readings

Leaky plumbing connections are especially common on liquid cylinder supply systems, since the fittings are regularly loosened and tightened during liquid cylinder swap out.

1. With the supply system at operating pressure, thoroughly spray all transfer hose connections and freezer plumbing connections with leak detect solution.
2. Allow leak detect solution to penetrate fittings for at least 30 seconds.
3. Large leaks will be immediately apparent with large bubble formations.
4. Small leaks will take longer to detect, with small bubble formation in the appearance of “foam”.
5. Most leaks can be repaired by tightening the suspect fitting with a crescent or appropriate sized wrench.
6. If tightening the fitting does not fix the leak, check the fitting for cracks and or galling. If the fitting is damaged, replace.
7. Recheck any replaced fittings for leaks.

High Temp Alarm Test

Please refer to “High Temperature Alarm Test” for details and instructions on the High Temp Alarm Test.

Level Alarm Test

The Controller can trigger a high level or low level alarm if the LN₂ level in the freezer exceeds the user defined parameters.

High Level Alarm Test

1. Observe and record the current LN₂ level.
2. Record the current level settings. They may be accessed by pressing the “▲” and “▼” simultaneously to access the quick reference menu or through the “Liquid Level Menu”. The current LN₂ level should be between the High Level Alarm setting and Low Level Alarm setting. If not, allow the freezer to fill until it reaches the High Level Fill setting.
3. Adjust the level offset so that the current level is a value that is greater than the High Level Alarm setting. For example, if the High Level Alarm setting is currently 10.0 inches, increase the offset value by at least 1.0 inch. This will “fool” the Controller into thinking that the level

inside the freezer is higher than actual. Refer Section **“Level Offset”** for offset adjustment procedure.

4. Observe the audible / visual alarm. Be aware that the level alarms have a one minute. This delay is intentional and is to prevent nuisance alarms.
5. If the alarm does not occur after one minute, verify that the audible alarm is turned on.
6. Decrease the offset value to the original observed setting.

Low Level Alarm Test (Stand Alone Controller Configuration):

1. Observe and record the current LN₂ level.
2. Remove the vinyl tube from the hose barb on the bottom of the Controller. Be careful not to damage the tube.
3. The displayed level should drop to 0.0 inches.
4. After one minute, the audible alarm should sound.
5. If the alarm does not sound, verify that the audible alarm is turned on.
6. Reconnect the vinyl tube. If the tube is deformed at the end, it may be necessary to trim off ¼" of the tube to ensure a good connection.
7. Press “Fill Start” to purge the level sensing line. After 30 seconds, the level should gradually increase to actual.
8. After the fill cycle is complete, manually measure the level using the dipstick.

Lid Thaw Procedure

1. Open or remove lid from freezer.
2. It is recommended that the freezer opening be covered with a spare lid or in another non-airtight manner to prevent moisture from entering the storage space and to minimize the top box temperature change while the lid is open.
3. Allow lid to sit at room temperature for approximately 30 minutes.
4. Once thawed, thoroughly dry lid, cork and liner.
5. Inspect lid for damage and replace parts if necessary.

Folding Step Inspection

CryoExtra freezers equipped with folding steps assemblies should be inspected for integrity at least every 6 months. Verify that hinges are free of cracks and all connections are secure. Check that the anti-slip strips on the steps are in good condition and replace if necessary (PN 4810179). Ensure the step locking strap is able to securely hold the steps in their folded position. If the pivot bolts continuously loosen, apply thread locker (PN 11087674) and re-tighten.

Inline Filter Replacement



CAUTION : Ensure that the LN₂ supply valve is closed and the plumbing assembly is vented before removing the inline filter.

1. Close the LN₂ supply valve and disconnect the LN₂ transfer hose from the plumbing assembly fill tee.
2. Loosen and remove the fill tee and inline filter from the plumbing assembly.
3. Replace the inline filter (PN 11648945) and reassemble the fill tee and filter to the plumbing assembly using new Teflon tape if needed. Ensure the filter is oriented correctly so that the affixed arrow indicates the direction of LN₂ flow.
4. Reconnect the LN₂ transfer hose, open the LN₂ supply valve and check fittings for any leaks.

Complete Function Test

Thermo Fisher Scientific recommends that freezers undergo a complete function test every 12 months to ensure correct functionality and identify potential problems before symptoms develop. Function test documents can be written based on this manual or this manual itself can be used to verify the function of CryoExtra freezers.

Solenoid Valve Replacement

All CryoExtra freezers are equipped with electromechanical solenoid valves that have been tested and approved by CryoExtra for cryogenic use. These valves utilize a PTFE seal for optimal sealing in cryogenic environments. Over time, the normal thermal cycling that this seal is subject to will cause it to harden and lose its ability to seal completely. This will result in seepage past the sealing surface which can increase the LN₂ consumption of the system and in extreme cases result in an overfill situation. Thermal cycling through normal operation can also cause moisture ingress into the coil of the solenoid valve. Over time this may cause the connections and wiring in the coil to corrode and eventually fail. This will result in an inoperative solenoid valve.

Note: Always use replacement solenoid valves from Thermo Fisher Scientific. Substituting non CryoExtra components may result in inoperable valves and even damage to the Controller system. Damage to the control system due to use of non CryoExtra parts will not be covered by warranty.

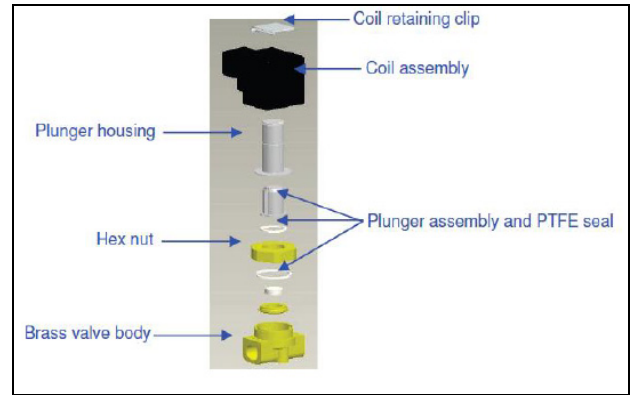
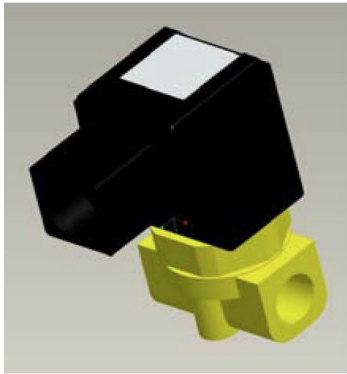


Figure 17. SMC Solenoid Valve (Current Production)

SMC (black) Solenoid Valve Replacement



CAUTION : Ensure that the LN₂ supply valve is closed and the plumbing assembly is vented before removing the solenoid valves.

1. Remove plumbing shroud to gain access to plumbing system.
2. Remove coil retaining clip by inserting a flathead screwdriver between the clip and the edge of the coil body. Twist the screwdriver and the clip should slide off.
3. Remove and discard the coil assembly.
4. Using a crescent wrench loosen hex nut and remove the plunger housing. Remove plunger housing and plunger assembly. Discard these parts.
5. Remove any debris that may have collected in brass valve body.
6. Inspect the brass valve body of the solenoid valve for nicks or damage. If the sealing surface appears to be in good condition, the valve body may be reused. If the sealing surface is damaged, the plumbing will need to be disassembled and the entire body will need to be replaced (this is not common).
7. Disassemble a new SMC valve (PN 14224611S) using the above procedure.
8. Install the new plunger, plunger housing and coil assembly onto the old valve body.
9. Assemble valve with new components in the reverse order.
10. Verify that no leaks are present using leak detect solution.
11. Open the LN₂ supply valve and initiate a fill cycle by pressing “Fill Start”. Allow the fill cycle to complete and verify that flow stops at the termination of the fill cycle.

Note: If the brass valve body requires replacing, the freezer plumbing will need to be disassembled and the entire valve replaced (PN 14224611S). It is typically easier to start disassembling the plumbing assembly beginning at the fill tee for fill valve replacement or the gas bypass muffler for gas bypass valve replacement.

Note: When installing a complete new valve, ensure it is oriented correctly. An “N” is engraved on the side of the SMC brass valve body. The valve should be installed so that this “N” is on the inlet side of the valve.

Relief Valve Replacement



CAUTION : Ensure that the LN₂ supply valve is closed and the plumbing assembly is vented before removing the relief valve.

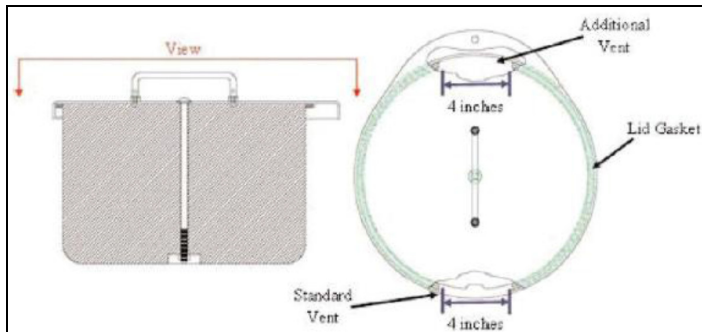
1. Remove plumbing shroud to gain access to plumbing system.
2. If equipped with a relief valve deflector, loosen the deflector clamp and slide off the deflector.
3. Loosen the relief valve and remove it from the plumbing assembly. Be sure to support the attachment tube with wrench to prevent damage from twisting.
4. Install new relief valve (PN 1810032) applying new Teflon tape if needed. Ensure relief valve is rated to 50 PSI (3.4 bar).



CAUTION : Installing a relief valve with a different pressure rating could prevent proper operation and lead to a dangerous over pressurized condition.

Gasket Removal or Replacement

1. Depending on the condition of the current gasket, the gasket material can be removed and replaced or more material can simply be added to the existing gasket.
2. The replacement gasket material will be a neoprene tape.
3. Simply clean the surfaces, remove the tape back to expose the adhesive and install gasket material.
4. Trim to size as needed.
5. Cut a 4 inch gap in the gasket material on either side of the lid as shown below to allow sufficient venting of the freezer space.



Complete Freezer Thaw and Moisture Removal

1. Remove freezer LN₂ supply.
2. Unplug Controller main power and battery backup if equipped.
3. Open or remove lid from freezer.
4. Allow LN₂ to completely evaporate and the freezer space to warm to room temperature. Placing a fan blowing into the freezer will accelerate this process.
5. After it has reached ambient temperature, thoroughly remove any moisture from the freezer space. This can be done with a wet / dry vacuum and towels. Open the hinged hatch on the bottom of the turn-tray to access the bottom of the freezer.
6. Once moisture has been removed from the freezer space, purge the plumbing assembly and annular lines with nitrogen gas. Compressed nitrogen or the gas use valve on a LN₂ cylinder work best. The LN₂ cylinder vent valve can also work, but will deplete the cylinder head pressure quickly. Ensure the nitrogen gas pressure does not exceed 50 PSI (3.4 bar).
7. Plug in the Controller main power and connect the freezer plumbing via transfer hose to a compressed nitrogen supply or the gas use valve on a LN₂ cylinder. Ensure gas bypass is disabled if equipped.
8. Press “Start Fill” and allow the freezer to fill for 30 seconds.
9. Press “Stop Fill”.

10. Press “Start Fill” and allow the freezer to fill for 30 seconds.
11. Continue cycling fills for 30 seconds until the plumbing assembly and annular lines are clear and completely dry.

In some cases, it may be necessary to purge the level sensing annular line separately. This can be done by connecting pressurized nitrogen gas directly to the freezer annular line fitting.



CAUTION : Ensure that the LN₂ supply valve is closed and the plumbing assembly is vented before loosening the compression fittings and removing the annular line tube.

1. Loosen and remove the 1/4 inch compression fittings from the purge valve and the freezer annular line fitting.
2. Remove 1/4 inch copper tube and purge to clear any moisture.
3. Connect nitrogen gas source directly to the freezer’s 3/8 inch FPT annular line connection.
4. Purge annular line with nitrogen gas, maintaining a pressure below 50 PSI (3.4 bar), until the line is clear and completely free of any moisture.

Note: If moisture is not completely removed for the freezer space and annular lines, ice will form when LN₂ is reintroduced into the freezer. Ice blockage in the freezer space or annular lines will interfere with proper function of the freezer and level sensing system.

ENSURE ALL MOISTURE IS COMPLETELY REMOVED PRIOR TO INTRODUCING LN₂ .

Replacement Parts and Accessories

Replacement Parts	
Part Number	Description
11648945	Inline Filter – 40 micron mesh
1810032	Relief Valve – 50 PSI (3.4 bar)
14224611 S	SMC Solenoid Valve – Fill and Gas Bypass
13284954 S	Purge/3-way Solenoid Valve
10713400	Gas Bypass Temperature Sensor – Pt-1000 RTD
11499812	Gas Bypass Muffler
11885449	Gas Bypass Muffler Deflector
20570663	Temperature Probe – All CryoExtra Series (65")
14248816	HE Series 3-Tube Temperature Sensor Assembly – 39 inch (990 mm) CE8120 & CE8140
14248752	HE Series 3-Tube Temperature Sensor Assembly – 44 inch (1118 mm) CE8180 & CE8194
20965617	Jerome Power Supply – Input: 110-230 VAC; Output: 30 VDC (AC cord not included)
14010103	Power Outlet Cord – 110 VAC (The Americas)
10995363	Power Outlet Cord – 230 VAC (Europe)
21081273S	Battery Backup Replacement Battery – 12 VDC
CE8100BB	Cryo Extra Battery Back-up 8100
20781848	Controller - Stand-alone with Text Display
20781849	Controller - Stand-alone with Symbolic Display
12885791	Battery Backup Assembly
14122236	Mounting Bracket for Battery Backup
11858467	Fuse for Battery Backup
10539413	Nut to Secure Sensor Tube
20782210	Lid Assembly (for Cryoextra 40F)
10640087	Lid Gasket (for Cryoextra 40F)
20782213	Lid Assembly (for Cryoextra 80F and Cryoextra 94F)
10728791	Lid Gasket (for Cryoextra 80F and Cryoextra 94F)

Accessories

Part Number	Description
CE8100COM	8100 COM Port Kit
CE8100CHAIN	8100 Daisy Chain Kit
CE8100STEP	Two-tiered step for the CE8120
10740053	RJ-45 Network Cable
10856312	RJ-45 Jack Splitter
11358251	OFAF Master Cable
4000290	Fill Valve Tee Assembly – Tee two freezer to one LN ₂ supply connection
1611592	Relief Valve Pipe Away Adapter – 3/8 inch NPT Outlet
1810092	Relief Valve Pipe Away Adapter – 1/2 inch NPT Outlet
9713159	LN ₂ Transfer Hose – 4 ft (1220 mm), 1/2 inch (12.7 mm) ODT
9713109	LN ₂ Transfer Hose – 6 ft (1829 mm), 1/2 inch (12.7 mm) ODT
1110862	LN ₂ Transfer Hose Coupler – Daisy chain two transfer hoses
CE8100PRINT	8100 Printer Kit
CE8100TS	CryoExtra8100 Tank Switcher - Used exclusively with the Thermo Scientific CryoExtra 8100 Series of products. (NOTE: For use only with CE8120, CE8140, CE8180 and CE8194. Field Installed.)

Troubleshooting Quick Reference

Symptom	Possible Causes	Fixes	Instructions
Freezer not filling	Improperly connected LN ₂ supply	Verify LN ₂ connections	Equipment Usage page 2
	Inadequate LN ₂ supply volume or pressure	Verify adequate supply	Verify Adequate LN ₂ Supply page 61
	Fill solenoid valves not opening	Verify fill solenoid resistance	Solenoid Valve Replacement page 62
		Check fill solenoid valves for debris	
	Current LN ₂ level at or above the high level setpoint	Verify current LN ₂ level and level control settings	Liquid Level Settings page 26
	Auto Fill disabled	Press Start Fill to verify manual operation. Confirm auto fill settings	Auto Fill Control page 27
Slow fills or Long fill times	Inadequate LN ₂ supply	Verify adequate supply	Verify Adequate LN ₂ Supply page 61
	Clogged inline filter	Clean/replace inline filter	Inline Filter Replacement page 62
	Fill solenoid valves not opening all the way	Verify fill solenoid resistance	Solenoid Valve Replacement page 62
		Check fill solenoid valves for debris	
	Leak in plumbing or LN ₂ supply connection	Check for leaks	Plumbing Leak Check page 61
Incorrect temperature readings	Restore to defaults, improperly calibrated or requires recalibration	Recalibrate temperature sensor	Temperature Sensor Calibration page 38
	Incorrect LN ₂ saturation temperature for altitude	Verify and adjust LN ₂ saturation temperature	LN ₂ Saturation Temperature page 26
	Faulty temperature probe	Confirm resistance values and replace if necessary	Resistance Table Page 119

Symptom	Possible Causes	Fixes	Instructions
Incorrect LN ₂ level readings	Requires calibration	Perform LN ₂ level calibration	LN ₂ Level Calibration page 40
	Disconnected clear vinyl tube	Check clear vinyl tube connections and integrity	
	Leak in level sensing line	Perform leak test on purge valve, vinyl tube and fittings	Plumbing Leak Check page 61
	Purge valve defective	Check resistance of purge valve (140 ohms)	Purge valve replacement
	Insufficient freezer venting	Increase lid gasket vent. Replace gasket/lid if necessary	Lid Gasket Replacement page 60
	Obstruction in level sensing line	Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary	Complete Freezer Thaw and Moisture Removal page 60
Consistent power failure alarms	Non-uniform AC voltage (dirty power)	Install uninterruptible power supply (UPS), Battery Backup or quality surge protector	
	Transition to generator power		
Short cycle fills	Inaccurate level readings	See "Incorrect LN ₂ level readings" above.	
	Insufficient freezer venting	Increase lid gasket vent. Replace gasket / lid if necessary	Lid Gasket Replacement page 60
	Obstruction in level sensing line	Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary	Complete Freezer Thaw and Moisture Removal page 64
High liquid usage	Inaccurate level readings	See "Incorrect LN ₂ level readings" above.	
	Insufficient venting	Increase lid gasket vent. Replace gasket/lid if necessary	Lid Gasket Replacement page 60
	Introduction/retrieval of racks or samples	Liquid usage value should return to normal as more data is acquired	
	Lid open for extended period of time		
	Inadequate LN ₂ supply	Verify adequate LN ₂ supply	Verify Adequate LN ₂ Supply page 61
	Obstruction in level sensing line	Purge level sensing annular line and clear any debris in the bottom of freezer. Complete freezer thaw and moisture removal may be necessary	Complete Freezer Thaw and Moisture Removal page 64
Consistently high and increasing liquid usage	Potential vacuum failure	Contact your authorized CryoExtra Distributor or Technical Service	

Disposal Of Product

Stainless Steel Freezer:

Freezers used to store biological materials require decontamination prior to disposal. Contact Thermo Scientific for decontamination information or refer Section **“Decontaminating and Sanitizing”** of the manual.

Controller:

Local or national environmental laws and regulations may prohibit disposal of electrical and / or electronic equipment such as the Controller. Contact the local city or town offices for instructions on proper disposal of electrical or electronic equipment. Alternately, Thermo Scientific may be contacted for disposal information.

Appendix

LN₂ Volume per Inch of Liquid in CryoExtra Freezers

The below values are accurate for the cylindrical portion of the freezer and do not take into account inventory components that will displace LN₂.

Freezer Model	Inches	Liters
CE 8120 / CE8120M	1	10.1
CE 8140 / CE8140M	1	19.3
CE 8180 / CE8180M	1	38.9
CE 8194 / CE8194M	1	38.9

The following table shows the conversion of inches to various pressure units.

Note: Conversion values do not take into account the Controller Level Offset.

In. LN ₂	In. H ₂ O	KPa	PSI	In. LN ₂	In. H ₂ O	KPa	PSI	In. LN ₂	In. H ₂ O	KPa	PSI
0.0	0.0	0.000	0.000	16.5	13.4	3.327	0.483	33.0	26.7	6.655	0.965
0.5	0.4	0.101	0.015	17.0	13.8	3.428	0.497	33.5	27.1	6.755	0.980
1.0	0.8	0.202	0.029	17.5	14.2	3.529	0.512	34.0	27.6	6.856	0.994
1.5	1.2	0.302	0.044	18.0	14.6	3.630	0.526	34.5	28.0	6.957	1.009
2.0	1.6	0.403	0.058	18.5	15.0	3.731	0.541	35.0	28.4	7.058	1.024
2.5	2.0	0.504	0.073	19.0	15.4	3.831	0.556	35.5	28.8	7.159	1.038
3.0	2.4	0.605	0.088	19.5	15.8	3.932	0.570	36.0	29.2	7.260	1.053
3.5	2.8	0.706	0.102	20.0	16.2	4.033	0.585	36.5	29.6	7.360	1.068
4.0	3.2	0.807	0.117	20.5	16.6	4.134	0.600	37.0	30.0	7.461	1.082
4.5	3.6	0.907	0.132	21.0	17.0	4.235	0.614	37.5	30.4	7.562	1.097
5.0	4.1	1.008	0.146	21.5	17.4	4.336	0.629	38.0	30.8	7.663	1.111
5.5	4.5	1.109	0.161	22.0	17.8	4.436	0.643	38.5	31.2	7.764	1.126
6.0	4.9	1.210	0.175	22.5	18.2	4.537	0.658	39.0	31.6	7.864	1.141
6.5	5.3	1.311	0.190	23.0	18.6	4.638	0.673	39.5	32.0	7.965	1.155
7.0	5.7	1.412	0.205	23.5	19.0	4.739	0.687	40.0	32.4	8.066	1.170
7.5	6.1	1.512	0.219	24.0	19.4	4.840	0.702	40.5	32.8	8.167	1.185
8.0	6.5	1.613	0.234	24.5	19.9	4.941	0.717	41.0	33.2	8.268	1.199
8.5	6.9	1.714	0.249	25.0	20.3	5.041	0.731	41.5	33.6	8.369	1.214
9.0	7.3	1.815	0.263	25.5	20.7	5.142	0.746	42.0	34.0	8.469	1.228
9.5	7.7	1.916	0.278	26.0	21.1	5.243	0.760	42.5	34.4	8.570	1.243
10.0	8.1	2.017	0.292	26.5	21.5	5.344	0.775	43.0	34.8	8.671	1.258
10.5	8.5	2.117	0.317	27.0	21.9	5.445	0.790	43.5	35.3	8.772	1.272
11.0	8.9	2.218	0.322	27.5	22.3	5.545	0.804	44.0	35.7	8.873	1.287
11.5	9.3	2.319	0.336	28.0	22.7	5.646	0.819	44.5	36.1	8.974	1.302
12.0	9.7	2.420	0.351	28.5	23.1	5.747	0.834	45.0	36.5	9.074	1.316
12.5	10.1	2.521	0.366	29.0	23.5	5.848	0.848	45.5	36.9	9.175	1.331
13.0	10.5	2.621	0.380	29.5	23.9	5.949	0.863	46.0	37.3	9.276	1.345
13.5	10.9	2.722	0.395	30.0	24.3	6.050	0.877	46.5	37.7	9.377	1.360
14.0	11.3	2.823	0.409	30.5	24.7	6.150	0.892	47.0	38.1	9.478	1.375
14.5	11.8	2.924	0.424	31.0	25.1	6.251	0.907	47.5	38.5	9.579	1.389
15.0	12.2	3.025	0.439	31.5	25.5	6.352	0.921	48.0	38.9	9.679	1.404
15.5	12.6	3.126	0.453	32.0	25.9	6.453	0.936				
16.0	13.0	3.226	0.468	32.5	26.3	6.554	0.951				

Controller ASCII Interface

American Standard Code for Information Interchange (ASCII) is a standard code used in data transmission, in which 128 numerals, letters, symbols and special control codes are represented by a 7-bit binary number. Below is a chart for these binary codes.

Controller ASCII Command List

Control Commands

*IDN?

Identification Query

Input: *IDN?

Returned: Controller, Software ver. X.XX

Comments: Used to query the Controller ID. Command must include "*"preface. Returns Controller model and firmware version.

ALMS

Set Alarm Status

Input: ALMS 0 or ALMS 1

Returned: No response

Comments: Used to set the audible alarm status where 0 = Off and 1 = On. Has same function as the Alarm Mute key.

ALMS?

Alarm Status Query

Input: ALMS?

Returned: 0 or 1

Comments: Used to query the current audible alarm status where 0 = Off and 1.

CALTA

Calibrate Temp A in LN₂ (Single Point)

Input: CALTA

Returned: No response

Comments: Used to perform a single point calibration of Temp A. Temp A sensor must be submerged in LN₂. See the "Temperature Calibration Menus" section of this manual.

CALTB

Calibrate Temp B in LN₂ (Single Point)

Input: CALTB

Returned: No response

Comments: Used to perform a single point calibration of Temp B. Temp B sensor must be submerged in LN₂. See the "Temperature Calibration Menus" Section of this manual.

CALVL

Set Level Offset

Input: CALVL ±XXX.X

Returned: No response

Comments: Used to set the liquid level offset.

CALVL?

Level Offset Query

Input: CALVL?

Returned: ±XXX.X

Comments: Used to query the current level offset value.

CODE?

Global Password Query

Input: CODE?

Returned: XXXX

Comments: Used to query the current global password.

HITSTA

Temp A High Alarm Test

Input: HITSTA

Returned: No response

Comments: Used to initiate the High Temp A Alarm Test. See the "High Temperature Alarm Test" section for more information.

HITSTB

Temp B High Alarm Test

Input: HITSTB

Returned: No response

Comments: Used to initiate the High Temp B Alarm Test. See the "High Temperature Alarm Test" section for more information.

INITEE

Restore All Defaults

Input: INITEE

Returned: No response

Comments: Used to restore all factory default settings.

LNSATP

Set LN₂ Saturation Temperature

Input: LNSATP ±XXX.X

Returned: No response

Comments: Used to set the LN₂ saturation temperature for single point calibration reference point.

Temperature Commands

BPTMP?

Bypass Temp Query

Input: BPTMP?

Returned: ±XXX.X

Comments: Used to query the current bypass temp sensor reading.

HITA

Set Temp A High Alarm

Input: HITA ±XXX.X

Returned: No response

Comments: Used to set the Temp A High Alarm value.

HITA?

Temp A High Alarm Query

Input: HITA?

Returned: ±XXX.X

Comments: Used to query the current Temp A High Alarm value.

HITAS?

Temp A High Alarm Status Query

Input: HITAS?

Returned: 0 or 1

Comments: Used to query the Temp A High Alarm status where 0 = Off and 1 = On.

HITAM

Set Temp A High Alarm Mask

Input: HITAM 0 or HITAM 1

Returned: No response

Comments: Used to enable or disable the Temp A High Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HITAM?

Temp A High Alarm Mask Query

Input: HITAM?

Returned: 0 or 1

Comments: Used to query the Temp A High Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HITB

Set Temp B High Alarm

Input: HITB ±XXX.X

Returned: No response

Comments: Used to set the Temp B High Alarm value.

HITB?

Temp B High Alarm Query

Input: HITB?

Returned: ±XXX.X

Comments: Used to query the current Temp B High Alarm value.

HITBS?

Temp B High Alarm Status Query

Input: HITBS?

Returned: 0 or 1

Comments: Used to query the Temp B High Alarm status where 0 = Off and 1 = On.

HITBM

Set Temp B High Alarm Mask

Input: HITBM 0 or HITBM 1

Returned: No response

Comments: Used to enable or disable the Temp B High Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HITBM?

Temp B High Alarm Mask Query

Input: HITBM?

Returned: 0 or 1

Comments: Used to query the Temp B High Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTA

Set Temp A Low Alarm

Input: LOTA ±XXX.X

Returned: No response

Comments: Used to set the Temp A Low Alarm value.

LOTA?

Temp A Low Alarm Query

Input: LOTA?

Returned: ±XXX.X

Comments: Used to query the Temp A Low Alarm value.

LOTAS?

Temp A Low Alarm Status Query

Input: LOTAS?

Returned: 0 or 1

Comments: Used to query the Temp A Low Alarm status where 0 = off and 1 = on.

LOTAM

Set Temp A Low Alarm Mask

Input: LOTAM 0 or LOTAM 1

Returned: No response

Comments: Used to enable or disable the Temp A Low Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTAM?

Temp A Low Alarm Mask Query

Input: LOTAM?

Returned: 0 or 1

Comments: Used to query the Temp A Low Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOTB

Set Temp B Low Alarm

Input: LOTB ±XXX.X

Returned: No response

Comments: Used to set the Temp B Low Alarm value.

LOTB?

Temp B Low Alarm Query

Input: LOTB?

Returned: ±XXX.X

Comments: Used to query the Temp B Low Alarm value.

LOTBS?

Temp B Low Alarm Status Query

Input: LOTBS?

Returned: 0 or 1

Comments: Used to query the Temp B Low Alarm status where 0 = off and 1 = on.

LOTBM?

Temp B Low Alarm Mask Query

Input: LOTBM?

Returned: 0 or 1

Comments: Used to query the Temp B Low Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

TEMPA?

Temp A Current Data Query

Input: TEMPA?

Returned: ±XXX.X

Comments: Used to query the current Temp A sensor reading.

TEMPB?

Temp B Current Data Query

Input: TEMPB?

Returned: ±XXX.X

Comments: Used to query the current Temp B sensor reading.

TUNI

Set Temp Units

Input: TUNI C, TUNI F or TUNI K

Returned: No response

Comments: Used to set the Temp units where C = Celsius, F = Fahrenheit and K = Kelvin. Default setting is degrees Celsius.

TUNI?

Temp Units Query

Input: TUNI?

Returned: C, F or K

Comments: Used to query the Temp units where C = Celsius, F = Fahrenheit and K = Kelvin. Default setting is degrees Celsius.

Level Commands

BPFIL?

Bypass Status Query

Input: BPFIL?

Returned: 0 or 1

Comments: Used to query the current hot gas bypass status where 0 = not bypassing and 1 = bypassing.

FILAS?

Fill Time Alarm Status Query

Input: FILAS?

Returned: 0 or 1

Comments: Used to query the Fill Time Alarm Status where 0 = off and 1 = on.

FILL

Set Fill Status

Input: FILL 0 or FILL 1

Returned: No response

Comments: Used to set the current Fill Status where 0 = Stop Fill and 1 = Start Fill.

FILL?

Fill Status Query

Input: FILL?

Returned: 0 or 1

Comments: Used to query the current Fill Status where 0 = not filling and 1 = filling.

FILLM?

Auto Fill Status Query

Input: FILLM?

Returned: 0 or 1

Comments: Used to query the Auto Fill Status where 0 = disabled and 1 = enabled.

FILT

Set Max Fill Time

Input: FILT XXX

Returned: No response

Comments: Used to set the maximum fill time in minutes from 30 to 240 minutes.

FILT?

Max Fill Time Query

Input: FILT?

Returned: XXX

Comments: Used to query the maximum fill time. Value returned in minutes.

FILTIM?

Fill Duration Query

Input: FILTIM?

Returned: XXX

Comments: Used to query the duration of the current fill. Value returned in seconds.

HFIL

Set High Level Setpoint

Input: HFIL XXX.X

Returned: No response

Comments: Used to set the High Level Setpoint. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

HFIL?

High Level Setpoint Query

Input: HFIL?

Returned: XXX.X

Comments: Used to query the High Level Setpoint. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

HILA

Set High Level Alarm

Input: HILA XXX.X

Returned: No response

Comments: Used to set the High Level Alarm value. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

HILA?

High Level Alarm Query

Input: HILA?

Returned: XXX.X

Comments: Used to query the High Level Alarm value. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

HILS?

High Level Alarm Status Query

Input: HILS?

Returned: 0 or 1

Comments: Used to query the High Level Alarm Status where 0 = off and 1 = on.

HILM

Set High Level Alarm Mask

Input: HILM 0 or HILM 1

Returned: No response

Comments: Used to enable or disable the High Level Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

HILM?

High Level Alarm Mask Query

Input: HILM?

Returned: 0 or 1

Comments: Used to query the High Level Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LEVEL?

Current LN₂ Level Query

Input: LEVEL?

Returned: XXX.X

Comments: Used to query the current LN₂ Level reading.

LFIL

Set Low Level Setpoint

Input: LFIL XXX.X

Returned: No response

Comments: Used to set the Low Level Setpoint. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LFIL?

Low Level Setpoint Query

Input: LFIL?

Returned: XXX.X

Comments: Used to query the Low Level Setpoint. Value returned in either inches or millimeters depending on the current level units. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLA

Set Low Level Alarm

Input: LOLA XXX.X

Returned: No response

Comments: Used to set the Low Level Alarm value. Input value uses the current level units, either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLA?

Low Level Alarm Query

Input: LOLA?

Returned: XXX.X

Comments: Used to query the Low Level Alarm value. Value returned in either inches or millimeters. There must be at least a 0.5 inch interval between each level setting and alarm.

LOLS?

Low Level Alarm Status Query

Input: LOLS?

Returned: 0 or 1

Comments: Used to query the Low Level Alarm Status where 0 = off and 1 = on.

LOLM

Set Low Level Alarm Mask

Input: LOLM 0 or LOLM 1

Returned: No response

Comments: Used to enable or disable the Low Level Alarm where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LOLM?

Low Level Alarm Mask Query

Input: LOLM?

Returned: 0 or 1

Comments: Used to query the Low Level Alarm Mask status where 0 = disabled and 1 = enabled. Default setting is 1 = enabled.

LUNI

Set Level Units

Input: LUNI E, LUNI M or LUNI %

Returned: No response

Comments: Used to set the LN₂ level units where E = English (inches), M = Metric (millimeters) and % = Percent.

LUNI?

Level Units Query

Input: LUNI?

Returned: E, M or %

Comments: Used to query the current LN₂ level units E = English (inches), M = Metric (millimeters) and % = Percent.

RATE?

Current Liquid Usage Query

Input: RATE?

Returned: XXX.X

Comments: Used to query the current LN₂ liquid usage rate.

Level Percent Commands

DSPN

Define 100% Point

Input: DSPN XXX.X

Returned: No response

Comments: Used to set the 100% level setting in inches or millimeters.

DSPN?

100% Point Query

Input: DSPN?

Returned: XXX.X

Comments: Used to query the 100% level setting.

PCNT?

Current Percent Query

Input: PCNT?

Returned: XXX.X

Comments: Used to query the current percent level reading.

DZER

Define 0% Point

Input: DZER XXX.X

Returned: No response

Comments: Used to set the 0% level setting in inches or millimeters.

DZER?

0% Point Query

Input: DZER?

Returned: XXX.X

Comments: Used to query the 0% level setting.

Event Log Commands

CLEVLG

Clear the Event Log

Input: CLEVLG

Returned: No response

Comments: Used to clear all data from the event log. Data will be permanently lost when the event log is cleared.

DATE

Set the Date

Input: mm/dd/yy

Returned: No response

Comments: Used to set the current date in the format: mm/dd/yy (month/day/year).

DATE?

Date Query

Input: DATE?

Returned: mm/dd/yy

Comments: Used to query the current date.

EVENT?

Last Event Query

Input: EVENT?

Returned: XXXXX, MM/DD/YY, HH:MM, XXX.X, XXX.X, XXX.X, XXX.X

Comments: String returned: Date, Time, Temp A, Temp B, LN₂ Level, Liquid Usage, Event Codes.

EVNCT?

Event Log Count Query

Input: EVNCT?

Returned: XXXXX

Comments: Used to query the number of event log records.

EVNLOG?

Event Log Record Query

Input: EVNLOG? N

Returned: XXXXX, MM/DD/YY, HH:MM, XXX.X, XXX.X, XXX.X, XXX.X

Comments: Used to query Event Record [n] where n = record number. String returned: Date, Time, Temp A, Temp B, LN₂ Level, Liquid Usage, Event Codes.

LOGPER

Set Event Log Interval

Input: LOGPER XXX

Returned: No response

Comments: Used to set the event log interval between 1 and 240 minutes. Default setting is 240 minutes.

LOGPER?

Event Log Interval Query

Input: LOGPER?

Returned: XXX

Comments: Used to query the current event log interval.

TIME

Set the Time

Input: hh:mm:ss

Returned: No response

Comments: Used to set the Controller Time in the format hh:mm:ss (hour:minute:second).

TIME?

Time Query

Input: TIME?

Returned: hh:mm:ss

Comments: Used to query the current time.

UNID

Set Unit ID

Input: UNID XXXXX

Returned: No response

Comments: Used to set the Controller 5-digit Unit ID. Controller Unit ID should be between 1 and 200.

UNID?

Unit ID Query

Input: UNID?

Returned: XXXXX

Comments: Used to query the Controller Unit ID.

Decontaminating and Sanitizing

CryoExtra Freezers are constructed from Stainless Steel sheets. Any cleaning solution which does not react with Aluminum and Stainless Steel can be used in these freezers. Any cleaning solution that does not react with aluminum or stainless steel can be used in the sanitation process of these dewars. In most cases, any household detergent or mild soap solution is suitable. The U.S. Custom Service uses a solution called EXPOR for incoming shipments from abroad. This is mixed 9 parts water mixed with sodium chloride & lactic acid. As mentioned above, however, any household cleaning solution can be used. These include bleach, detergents and mild soaps. Other cleaners and disinfectants that can be safely used include hydrogen peroxide, chlorine / water and denatured alcohol. NOTE: DO NOT USE ANY PETROLEUM BASED CLEANING SOLUTION. It is important that the inner vessel is thoroughly rinsed with water and all cleaner residues have been removed. Spraying the solution into the inner vessel is preferred, although agitation of the solution inside the inner will suffice.

The generally accepted practice of using 10% chlorine bleach with 90% water solution still holds as the best method for decontamination. However, with some of the bovine and swine virus strains showing up today, it is the conclusion of the agricultural professors at the University of Minnesota and Texas A & M that an increased mixture of chlorine bleach to 30% and 70% water will kill all known viruses except BSE. This is still unknown to them and are not willing to offer a solution.

To perform this sanitizing procedure, cover all inner surfaces with the solution, let stand for 30 minutes and remove. Rinse the decontaminated surfaces with clean water and remove rinse water. Allow to dry before putting into service.

Note: Units can be used immediately after rinsing but may take longer to recharge to 100% capacity.

Important

For your future reference and when contacting the factory, please have the following information readily available:

Model Number: _____

Serial Number: _____

Date Purchased: _____

The above information can be found on the dataplate attached to the equipment. If available, please provide the date purchased, the source of purchase (manufacturer or specific agent/rep organization) and purchase order number.

If you need Assistance:

Thermo Fisher Scientific products are backed by a global technical support team ready to support your applications. We offer cold storage accessories, including remote alarms, temperature recorders and validation services.

Visit www.thermofisher.com or call:

Countries	Sales	Countries	Sales
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India	+91 22 6716 2200	Austria	+43 1 801 40 0
Italy	+39 02 02 95059 432-254-375	Spain / Portugal	+34 93 223 09 18
China	+8621 68654588	Belgium	+32 2 482 30 30
Netherlands	+31 76 571 4440	Switzerland	+34 93 223 09 18
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Find out more at thermofisher.com