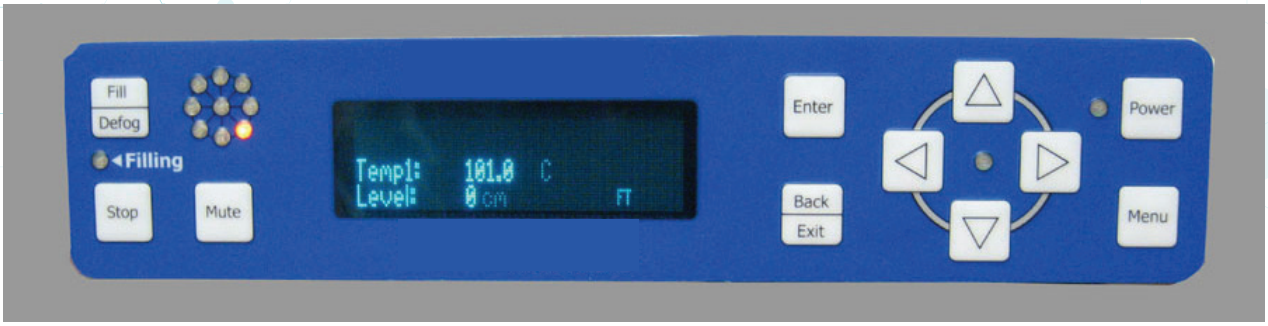
USER MANUAL

Control System

Liquid Nitrogen Storage System Operating Manual



phasetwo®

www.phasetwoCCS.com

Introduction

This manual covers the use and maintenance for the CS CONTROL SYSTEM installed on the phasetwo liquid nitrogen freezers. Please read all documentation before using this equipment and all personnel who use this equipment should be trained. In addition, an authorized distributor, service company, or technician should perform all service and maintenance on this equipment.

Failure to follow instructions in this manual may result in damage to equipment, poor or unexpected performance or injury to personnel operating the equipment.

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

Designed & Manufactured by:

Pacer Digital Systems, Inc.
8658 Castle Park Drive, Ste. 103
Indianapolis, IN 46256

Table of Contents

1. Symbols

WARNING! Avoid injury

WARNING! Low temperature

Read owners manual before use.

Waste electrical and electronic equipment directive

2. Safety

Please use proper handling procedures when working with Liquid Nitrogen (LN2). It is an extremely cold refrigerant and can cause serious injury if not handled properly. Also, the nitrogen gas can cause asphyxiation in a confined area, so be sure that all confined areas have adequate ventilation. In addition, for confined spaces, an Oxygen Monitoring System is recommended. For detailed information on the handling of cryogenic liquids, refer to the publication: P12 "Safe Handling of Cryogenic Liquids" available from the Compressed Gas Association Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

- This product is not intended for a life support function.
- This product is intended to be used in laboratories, repositories, hospitals and smaller offices / clinics.
- This product has no Radio Transmitter (Intentional Radiator) functions.
- This product is not intended for electromagnetic shielded rooms only.
- This product does not intentionally apply Radio Frequency (RF) energy for its function.
- This product does not intentionally receive RF energy for its function.
- This product is not a large permanently- installed product that is part of a system.
- To avoid the risk of electric shock, this equipment should only be connected to a supply main with protective earth.
- This product may be supplied with a SLA (Sealed Lead Acid) battery. Store the battery in a cool, dry area away from combustible material. Avoid overheating and overcharging. During normal battery installation, operation and maintenance, the user has no contact with the internal components of the battery or its internal hazardous chemicals.

3. Electromagnetic Compatibility (EMC)

Although this equipment conforms to the intent of the 2004/108/EC EMC Directive, all medical equipment may produce electromagnetic interference or be susceptible to electromagnetic interference. The following are guidance and manufacturer's declarations regarding electromagnetic compatibility (EMC) for the CS CONTROL SYSTEM.

The CS CONTROL SYSTEM needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in the following pages.

Warning: This equipment is intended for use by healthcare professionals.
As with all electrical medical equipment, this equipment may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the CS CONTROL SYSTEM unit or shielding the location.

Portable and Mobile RF communications equipment can affect the performance of the CS CONTROL SYSTEM. Please use the guidelines and recommendations specified in Tables 4 and 6.

Other Medical Equipment or Systems can produce electromagnetic emissions and can therefore interfere with the functionality of the CS CONTROL SYSTEM. Use care when operating the CS CONTROL SYSTEM THAT IS adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the CS CONTROL SYSTEM should initially be observed to verify normal operation in the configuration in which it will be used.

The electrical cables, external power supplies, and accessories listed or referenced in this manual have been shown to comply with the test requirements listed in the following tables. This guide only provides information for manufacturer-recommended cables, power supplies, and electrical accessories with the CS CONTROL SYSTEM. If a third-party supplier offers cables, external power supplies and electrical accessories for use with the CS CONTROL SYSTEM and they are not listed or referenced in this manual, then it is the responsibility of that third-party supplier to determine compliance with the standards and tests in the following tables.

The use of electrical cables and accessories other than those specified in this manual or referenced documents may result in increased electromagnetic emissions from the CS CONTROL SYSTEM or decreased electromagnetic immunity of the CS CONTROL SYSTEM.

4. Operating Environment

The CS CONTROL SYSTEM control system is designed to be operated at normal room temperatures (60o F to 80o F, 15o C to 27o C) at a relative humidity level of about 45%. The humidity level should be maintained so that the electronics are not exposed to condensation.

The phasetwo liquid nitrogen freezer should be positioned so that the all sides of the unit are easily accessible, and the user can easily connect/disconnect the power cord from the wall socket.

5. Operator Skills, Training, & Knowledge

The personnel using the CE CONTROL SYSTEM and the phasetwo liquid nitrogen freezer should have a basic understanding of the safety procedures involved when working with LN2. In addition, the operating personnel should understand the messages and error conditions associated with the control system and should request support if questions arise.

Training and support are available through the distributor who sold the equipment, as well as through the manufacturer of the equipment.

6. CS Control System Components

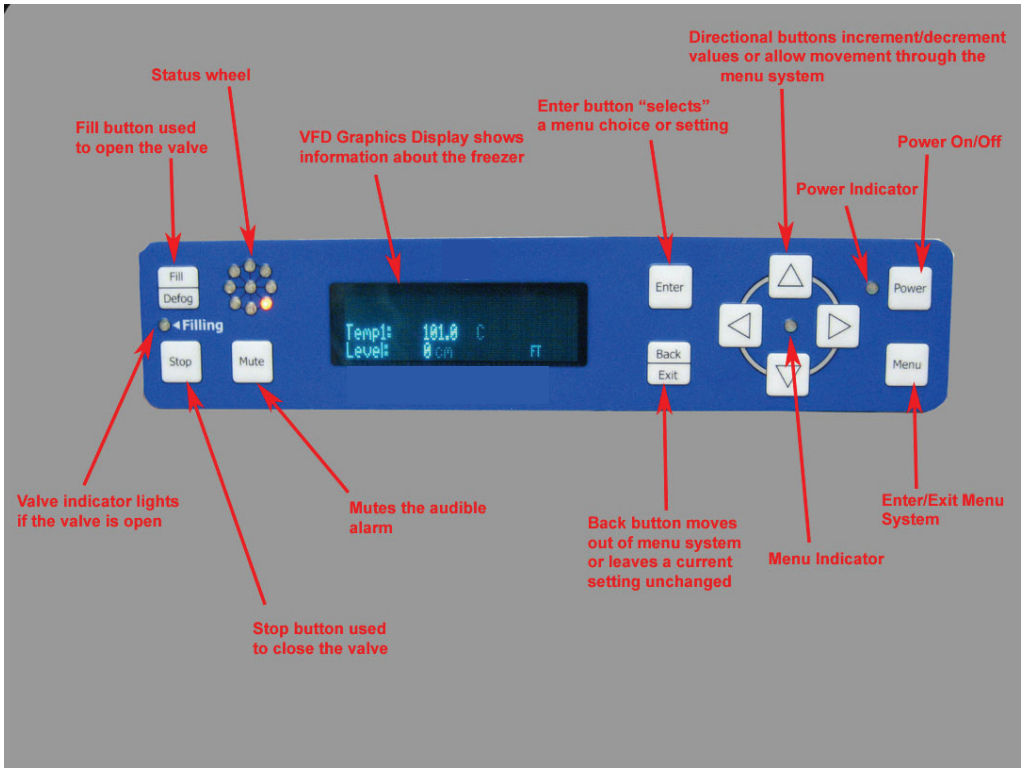
The CS CONTROL SYSTEM for the phasetwo liquid nitrogen freezer consists of the following components:.

- Main Control Module
- Display Module
- Shielded Display Cable
- Wiring Harness Assembly
- Power Supply
- Thermocouple Assembly (1 or 2)
- Sensor Assembly
- Valve Monitoring Sensor
- Cryogenic Solenoid Valve
- Remote Alarm Plug
- Lid Switch Assembly
- 12 Volt, 18aH battery

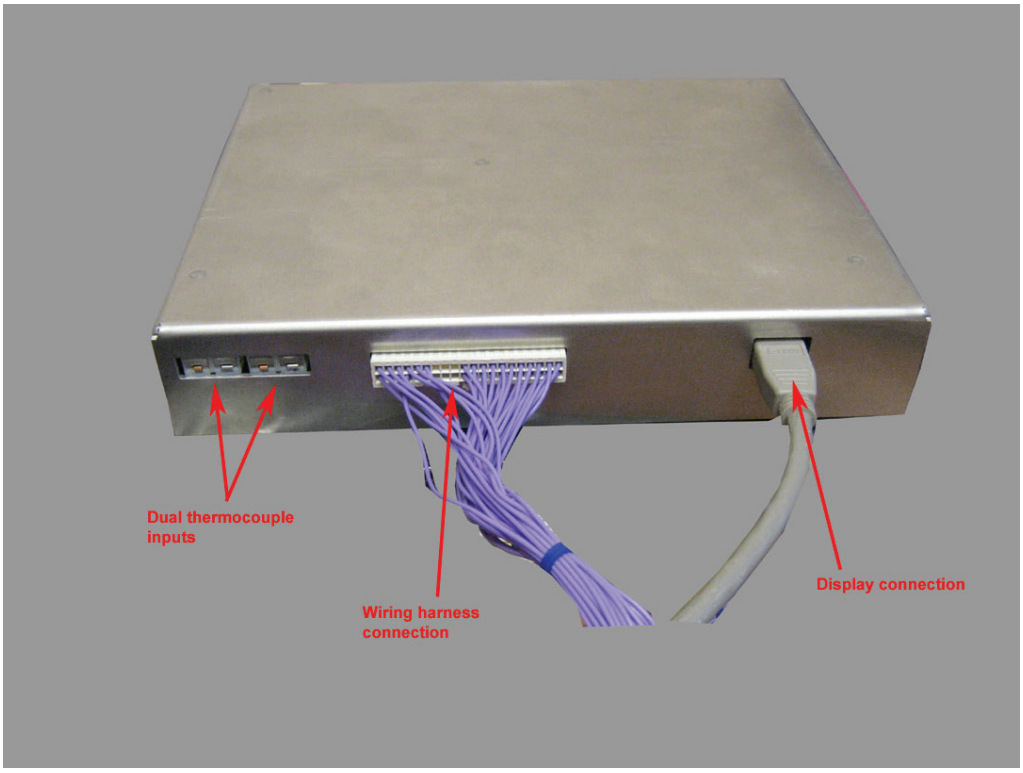
The CS CONTROL SYSTEM is assembled onto the freezer at the factory and completely tested. Start operation of the control system by plugging the power cord into the wall outlet. Press and hold the POWER button for 2 seconds. The CS CONTROL SYSTEM will go through a short startup routine and then start operation. For information relating to assembly of the control components and connection information refer to Appendix A.

7. General Equipment Description

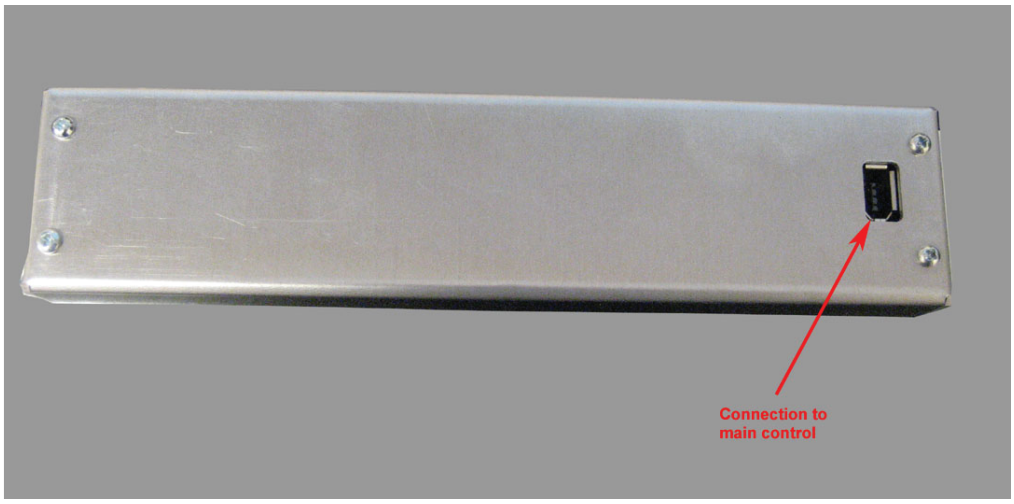
7.1 Main Control Front Panel



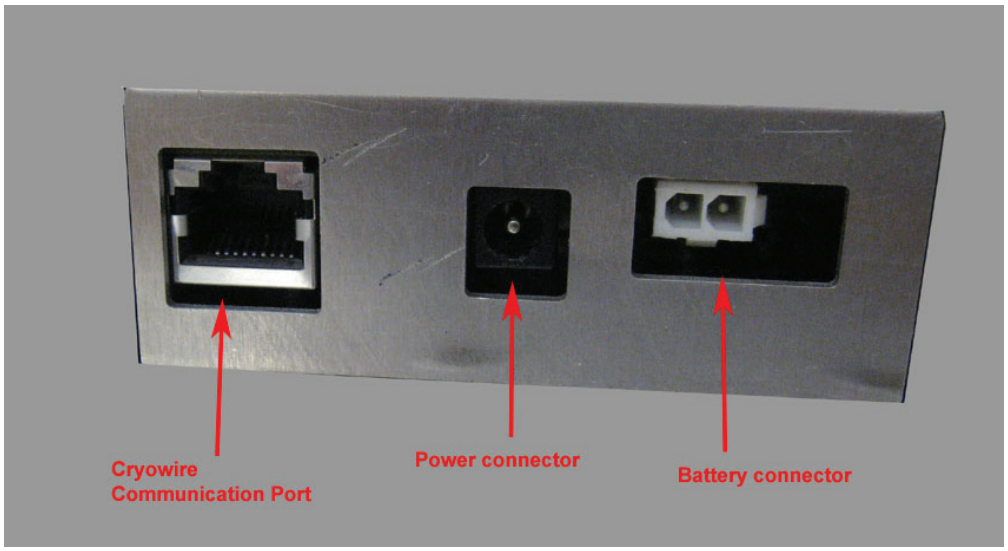
7.2 Main Control Back Panel

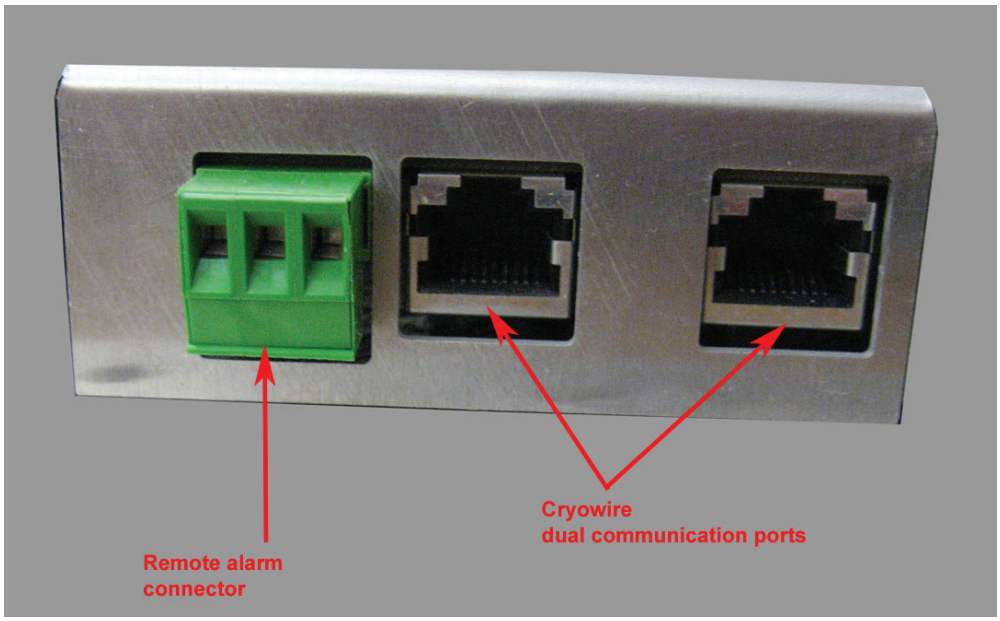


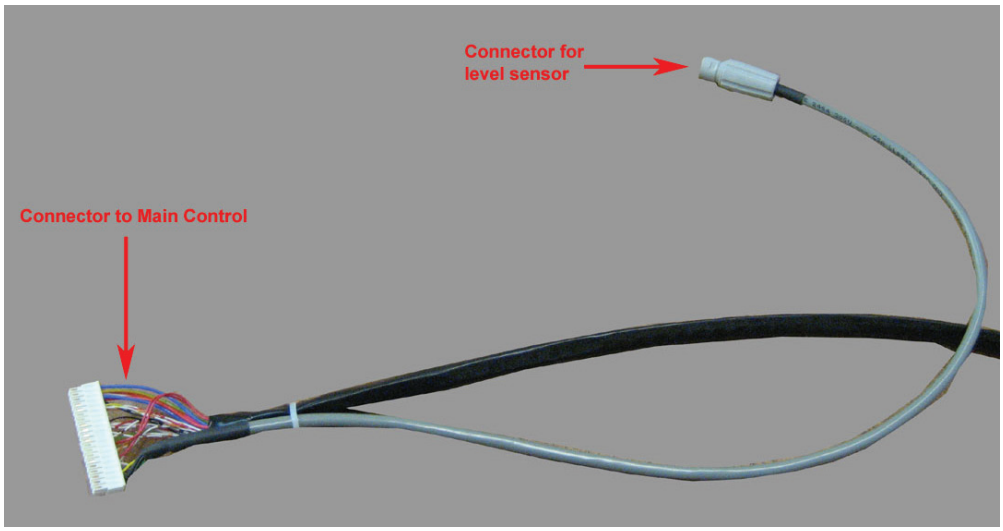
7.3 Main Control Front Panel

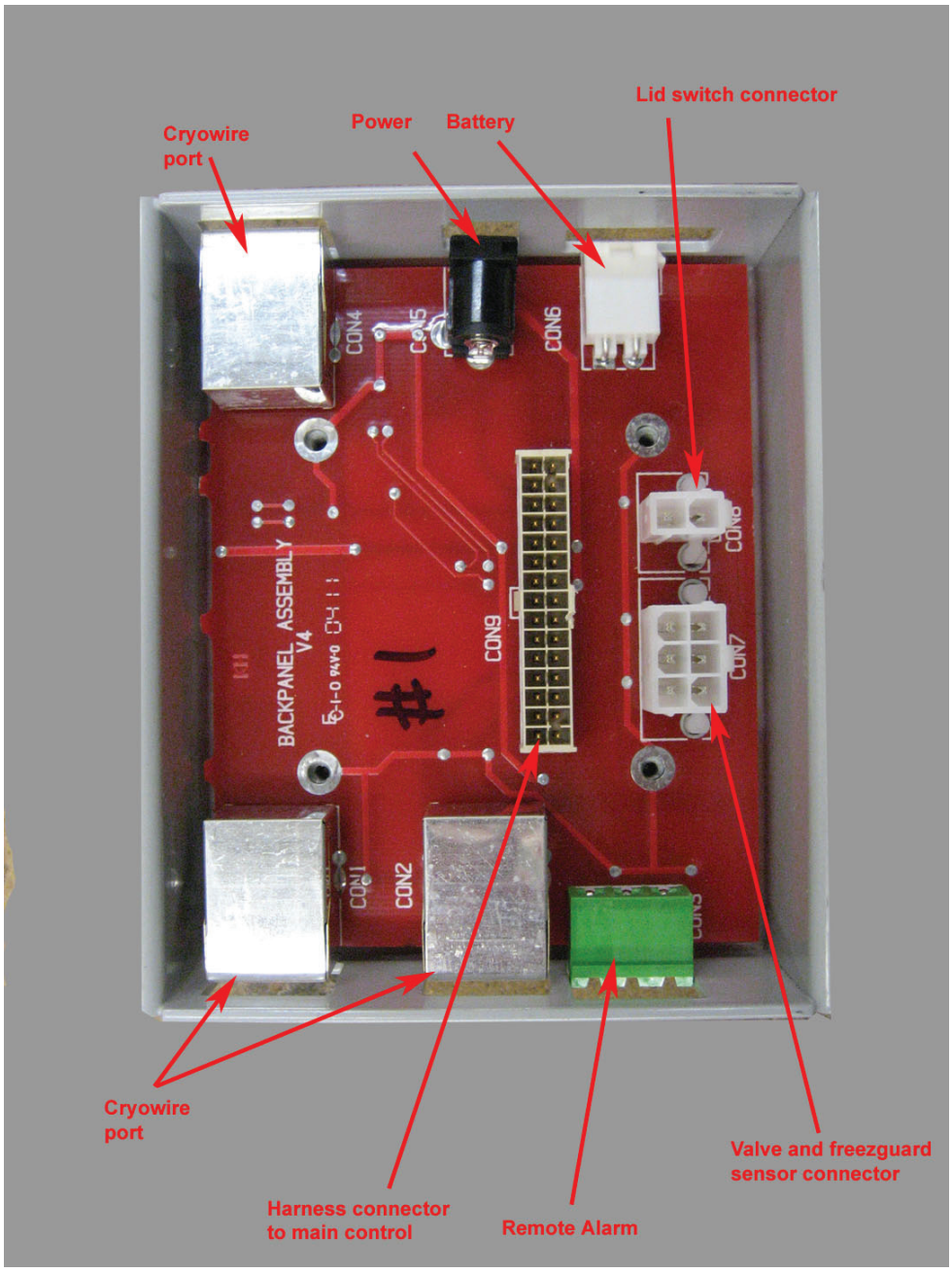


7.4 Harness Assembly & Back Panel








Cryowire port
Power
Battery
Lid switch connector
CON4
CON5
CON6
CON8
CON7
CON9
CON1
CON2
CON3
BACKPANEL ASSEMBLY V4
Cryowire port
Harness connector to main control
Remote Alarm
Valve and freezguard sensor connector

8. Features

The CS CONTROL SYSTEM automatically maintains LN2 level and monitors temperature in the Cryogenic freezer. In addition, operational conditions are monitored, and an alarm is triggered if necessary. Audit and operations data is stored in memory on the control board.

8.1 Dual Level Sensing Technology

The DLSI control system utilizes a new dual level detection technology. This technology provides full range operation without the need to move a sensor assembly, finer resolution for level control and additional redundancy which enhances sample safety. This system combines the use of thermistors (thermal resistors) and differential pressure detection, utilizing the advantages of both technologies to provide the very best in LN2 level control.

Differential Pressure (DP): Used as the primary level detection system. Allows four settings to be set as determined by the user.

- Low Level Alarm: The level which triggers an alarm if the LN2 level gets too low in the freezer.
- Start Fill: The level at which the freezer will start a refill action.
- Stop Fill: The level at which the freezer will stop the automatic filling action.
- High Level Alarm: The level which triggers an alarm if the LN2 level gets too high in the freezer.

Connects to the main control system with two tubes that originate at the DP sensor. The tubes run to the main control box and are connected to barbed fittings on the control box.

- High Pressure: Located by the thermocouple connectors. (Red tube)
- Low Pressure: Located by the display cable connector. (Blue tube)

Thermistors: Used as the secondary level detection system. The thermistors are fixed and located at specific heights within the freezer. These cannot be changed through the menu system. When the control system is operating in normal mode, the thermistors simply act as redundant detection points in the system. They can confirm the level as determined by the DP system. If a problem develops with the DP system, the thermistor system can become the primary level control system. If this occurs the levels are defined as follows:

- 5 cm (2") Low Level Alarm
- 7.5cm (3") Start Fill
- 15.2cm (6") Stop Fill
- 17.8cm (7") High Level Alarm
- 30.5cm (12") LN2 level locator
- 43.2cm (17") LN2 level locator
- 55.9cm (22") LN2 level locator
- 68.6cm (27") LN2 level locator

8.2 Temperature Monitoring

The CS CONTROL SYSTEM uses a type T thermocouple to determine the temperature in the vessel. The thermocouple is installed near the top of the freezer and the temperatures are measured at that point.

The CS CONTROL SYSTEM accommodates a second thermocouple for temperature measurement at a secondary location, which is a Type T thermocouple.

The control provides a High Temperature Alarm for each thermocouple, which can be adjusted by the user. If the temperature exceeds the temperature alarm set point, the display flashes and an audible alarm is triggered.

Please see Appendix B for instructions on calibrating the temperature.

8.3 Alarm Conditions

The CS CONTROL SYSTEM monitors a number of conditions and provides an alarm if a problem is detected. The alarms are listed below:

Low Level Alarm	LN_2 level is too low.
High Level Alarm	LN_2 level is too high.
Sensor Error Alarm	A problem exists with the level sensor assembly. The control detects an open sensor circuit, meaning that the sensor is unplugged, or the sensor assembly has been damaged.
High Temperature Alarm	The temperature detected is warmer than the high temperature alarm setting.
Low Temperature Alarm	The temperature detected is colder than the low temperature alarm setting.
Thermocouple Calibration Alarm	The calibration data is incorrect.
Thermocouple Open Alarm	A problem exists with the temperature sensor (thermocouple). The control detects an open circuit, meaning that the sensor is unplugged or the sensor assembly has been damaged.
Power Failure	No Power.
Low LN_2 Supply Alarm	A problem may exist with the LN_2 supply connected to the freezer. This alarm occurs if the freezer does not fill within the designated amount of time determined by the setting on the control. This may occur for a number of reasons, including an empty supply cylinder, low head pressure in the supply cylinder, or a closed shut off valve.
Operating in battery mode alarm warning	The power from the power supply has been disrupted and the control system is operating on battery power.
Lid Open Too Long Alarm	The lid has been opened for a period which is longer than the designated alarm setting.
Valve Stuck Open Alarm	The valve is stuck open
Unauthorized Access Warning	The lid has been opened and an incorrect identification has been entered.
LN_2 Use Warning	The consumption of LN_2 has increased and should be checked.

Low Battery Voltage	The voltage on the battery is low.
Temp Alarm Delay	This is the amount of time after a warm temperature is detected before the control goes into alarm.
Audible Alarm Retrigger	The audible alarm is retriggered if the error condition that caused it is not corrected. The retrigger time can be adjusted by the user.
Remote Alarm Relay	The control provides a relay to provide an external signal that an alarm condition has occurred. The user can set the remote alarm timer that determines the amount of time an error must be active before the relay is triggered.

All alarms include the following:

- The status wheel flashes to signal an error condition (see appendix E for description of the flashing patterns)
- An audible tone sounds.
- The error detected is displayed and scrolled on the screen.
- The remote alarm relay changes state to provide a dry contact output signal.

8.4 Operation Data

The CS CONTROL SYSTEM stores data related to the operation of the freezer. This data includes: date, time, LN2 level, temperature, system events, and error conditions. This data can be useful for audit purposes, operation analysis, and preventive maintenance.

8.5 Communications

The CS CONTROL SYSTEM has been designed with advanced communications capabilities. This allows for the transfer of data out of the control where the data can more easily be used. Please check with your supplier for available protocols and compatible products.

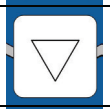
9. Control Setting Adjustments

9.1 Level

The standard sensor assembly that is installed on a freezer consists of a differential pressure level sensing system.

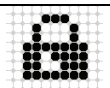
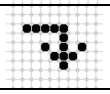
9.2 Features & Settings

Some control settings can be changed through the menu system.

Enter and Exit the menu system by pressing:	
Move down through the menu system by pressing:	
Move up through the menu system by pressing:	
Select a menu choice or lock in a setting by pressing:	
Back out of the menu system by pressing:	

When changing settings, single button presses will increment/decrement a value one step at a time. Pressing and holding a button will allow for rapid change of a setting.

The menu system incorporates icons to show the user which settings can be changed and which are locked.

Locked menu choice	
Accessible menu choice	

Also, the menu system includes a scroll bar on the right side of the display. The scroll bar will indicate the current location in the menu system and will indicate if additional menu choices are available with the display of up and down arrows on the scroll bar.

The control will continue to monitor all sensors and conditions while the user accesses the menu system. If no activity is detected for 3 minutes, then the control will automatically jump back to the main operational screen.

View Only

The View Only menu selection allows the user to view settings, but will not allow changes to any settings. This restriction is designated with a lock symbol.

Change Settings

The Change Settings menu selection allows the user to change operational settings for the control system.

Temperature

Thermocouple Select: Allows the user to turn on/off thermocouples for temperature measurement.

Calibrate

Calibrate Thermocouple 1: Allows the user to calibrate the control for use with thermocouple #1.

Calibrate Thermocouple 2: Allows the user to calibrate the control for use with thermocouple #2.

Restore Calibration: Resets the calibration to the data stored during factory calibration.

Test Temperature System

Check Thermocouples: Gives status of temperature sensors.

Test Temp Alarms: Allows the user to manually test temperature alarms for the thermocouples.

Control by Temperature

Temp Control On/Off: Enables/Disables temperature control.

Temp Control Range: Allows the user to set the range for temperature control.

Temperature Alarms

High Temperature Alarm: Allows the user to set the high temperature alarm for both thermocouples. Settings [0 to -190]

Thermocouple 1

Thermocouple 2

Low Temperature Alarm: : Allows the user to set the low temperature alarm for both thermocouples. Settings [0 to -190]

Thermocouple 1

Thermocouple 2

Time with no Temp alarm: Displays the time since the last high or low temperature alarm

Temperature Units: Allows the user to choose the units of measure for temperature.

Level

Thermistor Status: Gives the user the status for the 8 thermistors on the level sensor assembly, for the freezeguard sensor installed at the valve, and for the lid switch.

Sensor Positions: Allows the user to set the positions for low level alarm, start fill, stop fill, high level alarm, and the sensor offset.

Valve Open Duration: Allows the user to set the fixed times for valve open and valve closed durations.

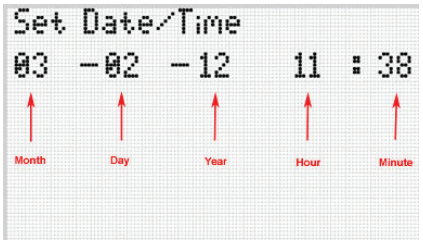
Sensor Error Mute: Allows the user to mute the audible alarm for a sensor error.

Inch/Metric: Allows the user to switch between English and Metric measurement systems.

System

Date/Time:

Set Date/Time: Allows the user to set the date and the time. Use the up/down arrows to change settings. Use the left/right arrows to move between the date and time fields.



Date Format: Allows the user to change between U.S. and International format.

Date & Time Sync

Lid Functions

Lid Switch: Allows the user to enable/disable the lid switch feature.

Quickchill Timer: Allows the user to set the amount of time that the valve will stay open after the lid is closed.

Manual Defog Timer: Allows the user to set the amount of time that the valve stays open when the Fill/Defog button is pressed, and the LN2 level is within normal range.

User Access

User Access On/Off: Allows the user to enable/disable this feature.

User ID's: Allows the user to set user identification for freezer access.

User ID On/Off: Allows the user to turn off user identification.

Lid Safety Interlock

System Alarms

Test Alarm: Allows the user to manually check the audible, visual, and remote alarm.

Audible

Visual

Remote

LN2 Supply Alarm Delay: Allows the user to set the time to wait before setting an alarm off if an error condition occurs, in the case that if the freezer does not fill in a timely manner. If this alarm occurs, the supply should be checked to that the supply valve on turned on, a sufficient supply of LN2 is available in the supply cylinder, and the head pressure is adequate. Settings: [30, 45, 60, 75, 90 min] or [2, 3, 4 hours].

Remote Alarm Delay: Allows the user to set the time before the remote alarm relay is triggered after an error condition occurs. Settings [Immediate, 30, 60, 90 min] or [2,3, 4, 6 hours]

Lid Open Alarm Delay: Allow the user to set the time before an alarm is triggered if the lid is opened too long.

Valve Stuck Alarm: Allow the user to enable/disable this feature.

Audible Repeat Delay: Allows the user to set the time before the audible alarm is re-triggered after an alarm has been acknowledged. Settings: [15, 30, 60, 120, 240, 480 min] or [1 day].

Display

Display Brightness: Allows the user to adjust brightness for the display. Settings [1 to 15]

Freezer ID: Allows the user the capability to adjust the freezer identification.

Fill Sequence Number

Scheduled Events

Scheduled Fills

Set Time: Allows the user to set the day and time for the next filling operation.

Next Fill: Displays the next scheduled fill.

Maintenance Reminder

Acknowledge Reminder

Next Reminder

LN2 Supply Reminder

Set Reminder: Allows the user to set the day which the control will display a reminder to check the supply of LN2.

Acknowledge Reminder: Allows the user to acknowledge that the LN2 supply has been checked.

Next Reminder: Displays the next scheduled reminder.

Check level Reminder

Set Reminder

Acknowledge Reminder

Next Reminder

Security

Settings Password: Allows the user to set a password to allow setting changes.

Power Password: Allows the user to set the password, which secures power button operation.

Change Remote Password (Add Here)

Contact Support

LN2 Supplier

Distributor: Contact information for the distributor.

phasetwo: Contact information for phasetwo.

Pacer Digital: Contact information for Pacer Digital.

Select Language

System Information: Displays the control serial number, the firmware version, and the freezer identification.

Usage

9.3 Temperature

The temperature in the freezer is measured at the location of the thermocouple. The installation location is different depending on the model of the freezer, but usually the thermocouple is positioned near the top of the freezer. This may mean that temperatures displayed may be slightly warmer that the temperature experienced by the samples or product stored in the freezer.

Temperature Control

The CS CONTROL SYSTEM has the capability to control the temperature inside the freezer. The temperature is controlled at the location of thermocouple 1.

To maintain temperature, the CS CONTROL SYSTEM bubbles N2 gas through the pool of LN2 in the bottom of the freezer. The warm gas evaporates some of the LN2 , causing a cooling effect, which reduces the temperature in the freezer. Since a pool of LN2 is important in the process of temperature control, an adequate level is always maintained by the control systems, and the level control always takes precedence over temperature control.

The temperature control feature will increase the use of LN2. The increased consumption will depend on a number of factors, including: the temperature to be maintained, the range of the controlled temperature, the ambient temperature, and the length of supply hose connected to the freezer.

9.4 Battery Operation (NOT INCLUDED)

The CS CONTROL SYSTEM is designed to operate with an optional battery backup system if required. A kit can be obtained which provides the appropriate parts. Simply plug the battery into the appropriate connector on the connector box. The control will recognize that the battery has been connected, which will activate the battery backup mode.

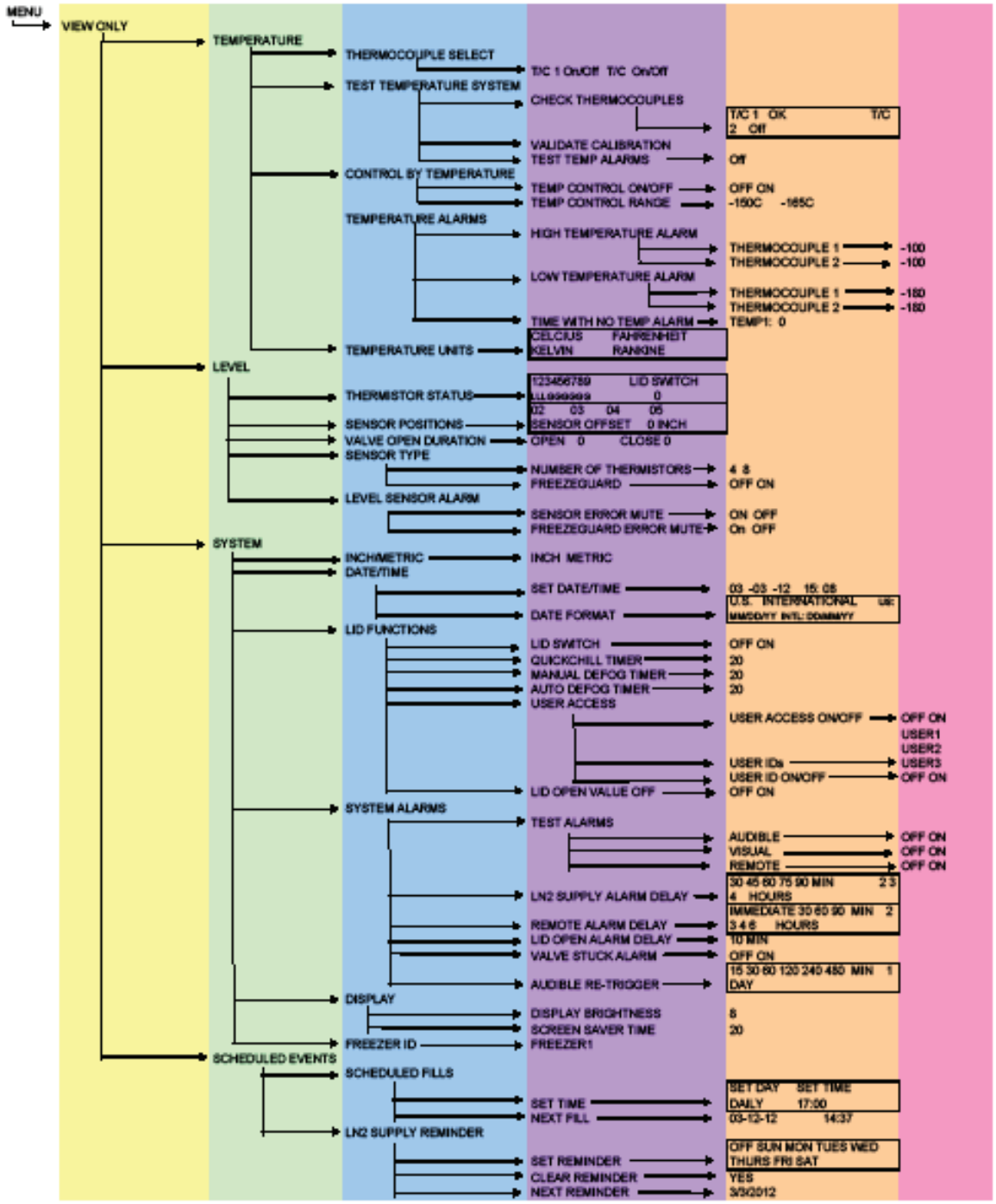
9.5 Status Wheel

The CS CONTROL SYSTEM offers an innovative concept called a status wheel. In normal operation, the LED's on the status wheel light to show a slow clockwise rotation of the wheel, then lights up forming a box every fourth rotation. If an error condition occurs, the control will alert the user with an additional visual alarm from the status wheel. The rotation can be accelerated, flashed, or even illuminated in the opposite direction. Please see Appendix E.

9.6 Lid Switch

The lid switch consists of a magnet and a pickup installed on the lid. The control can determine when the lid is opened, because the magnet moves out of range of the pickup and the circuit opens. A number of features are associated with the lid switch such as Auto Defog, Quickchill, and the Lid Open Too Long Alarm. If the lid switch is deactivated, these features are also disabled.

10. Menu System




CHANGE SETTINGS
TEMPERATURE
THERMOCOUPLE SELECT
T/C 1 On/Off T/C On/Off
CALIBRATE
PUT T/C 1 IN ICE WATER (0C)
PUT T/C 1 IN LN2 (-196C)
CALIBRATE THERMOCOUPLE 1
DONE!
PUT T/C 2 IN ICE WATER (0C)
PUT T/C 2 IN LN2 (-196C)
CALIBRATE THERMOCOUPLE 2
DONE!
RESTORE CALIBRATION
ABORT LOAD
SET AMBIENT
25.3
TEST TEMPERATURE SYSTEM
T/C 1 OK T/C 2
CHECK THERMOCOUPLES
Off
VALIDATE CALIBRATION
TEST TEMP ALARMS
Off
CONTROL BY TEMPERATURE
TEMP CONTROL ON/OFF
OFF ON
TEMP CONTROL RANGE
-1500 -1650
TEMPERATURE ALARMS
HIGH TEMPERATURE ALARM
THERMOCOUPLE 1
-100
THERMOCOUPLE 2
-100
LOW TEMPERATURE ALARM
THERMOCOUPLE 1
-180
THERMOCOUPLE 2
-180
TIME WITH NO TEMP ALARM
TEMP1: 0
CELCIUS FAHRENHEIT
KELVIN RANKINE
TEMPERATURE UNITS
LEVEL
123456789 LID SWITCH
LLLOOOOOO 0
THERMISTOR STATUS
02 03 04 05
SENSOR POSITIONS
SENSOR OFFSET 0 INCH
VALVE OPEN DURATION
OPEN 0 CLOSE 0
SENSOR TYPE
NUMBER OF THERMISTORS
4 8
FREEZEGUARD
OFF ON
LEVEL SENSOR ALARM
SENSOR ERROR MUTE
ON OFF
FREEZEGUARD ERROR MUTE
On OFF
SYSTEM
INCH/METRIC
INCH METRIC
DATE/TIME
SET DATE/TIME
03 -03 -12 15:00
U.S. INTERNATIONAL
DATE FORMAT
LID FUNCTIONS
LID SWITCH
OFF ON
QUICKCHILL TIMER
20
MANUAL DEFOG TIMER
20
AUTO DEFOG TIMER
20
USER ACCESS
USER ACCESS ON/OFF
OFF ON
USER1
USER2
USER3
USER IDs
USER ID ON/OFF
OFF ON
LID OPEN VALUE OFF
OFF ON
SYSTEM ALARMS
TEST ALARMS
AUDIBLE
OFF ON
VISUAL
OFF ON
REMOTE
OFF ON
LN2 SUPPLY ALARM DELAY
3-4 HOURS
REMOTE ALARM DELAY
IMMEDIATE 30 60 90 MIN
3-4-6 HOURS
LID OPEN ALARM DELAY
10 MIN
VALVE STUCK ALARM
OFF ON
AUDIBLE RE-TRIGGER
15 30 60 120 240 480 MIN
1 DAY
DISPLAY
DISPLAY BRIGHTNESS
8
SCREEN SAVER TIME
20
FREEZER ID
FREEZERID#1
SCHEDULED EVENTS
SCHEDULED FILLS
SET DAY SET TIME
DAILY 17:00
SET TIME
NEXT FILL
03-13-12 14:37
LN2 SUPPLY REMINDER
OFF SUN MON TUES WED
THURS FRI SAT
SET REMINDER
CLEAR REMINDER
YES
NEXT REMINDER
3/3/2012
SECURITY
SETTINGS PASSWORD
0 0 0 0
POWER PASSWORD
0 0 0 0
CONTACT SUPPORT
DISTRIBUTOR
CONTACT INFO
PACER DIGITAL
CONTACT INFO
TAYLOR-WHARTON
CONTACT INFO
SERIAL # 12345
VERSION 1. 03
SYSTEM INFORMATION
FREEZER ID FRZ01

11. Factory Defaults

Thermocouple #1	On
Thermocouple #2	Off
Control by Temperature	Off
High Temperature Alarm #1	-100C
High Temperature Alarm #2	-100C
Low Temperature Alarm #1	Off
Low Temperature Alarm #2	Off
Temperature Units	Celsius
Sensor Position	Freezer dependant
Valve Open Duration	Off
Sensor Type	8 thermistor sensor
Freezeguard feature	On
Sensor Error Mute	Off
Freezeguard Error Mute	Off
Level Units of Measure	inch
Date/Time	Factory Set for Eastern Standard Time
Lid Switch	On
Quickchill Timer	30 seconds
Manual Defog Timer	30 seconds
Auto Defog Timer	30 seconds
User Access	Off
Lid Open-Valve Off	Off
LN_2 Supply Alarm Delay	30 minutes
Remote Alarm Delay	30 minutes
Lid Open Alarm Delay	10 minutes
Valve Stuck Alarm	On
Audible Retrigger	30 minutes
Display Brightness	10
Screen Saver Time	30 minutes
Freezer ID	Not set
Scheduled Fills	Off
LN_2 Supply Reminder	Off
Settings Password	Off
Power Password	Off

12. Validation

Some organizations require that equipment be validated periodically. If information is needed on the proper techniques to validate this equipment, please contact your supplier.

13. Maintenance

To insure proper operation and maintain excellent performance of the phasetwo freezer, a regular maintenance schedule should be followed for the CS CONTROL SYSTEM. This would include the following:

CS SERIES Control	Examine for exposure to moisture, wear and tear, connector problems, and damage to the faceplate or buttons. In addition, periodic firmware updates may be important
Harness Assembly	Examine for damage to the cable and damage to connectors,
Battery	Examine connection cable and connector for damage. Examine vinyl cover for damage. Replace every 3 years
Solenoid Valve	Examine wires and connector for damage. Replace every 2 years.
Lid Switch	Examine lid switch pickup and wires for damage. Replace if necessary
Level Sensor Assembly	Examine for damage to wires and connector. Replace every 3 years
Thermocouple Assembly	Examine for damage to wires and connector.
Power Supply	Examine for damage to power supply and power cords.

In addition, inspection and preventive maintenance should also be performed on the freezer and its mechanical parts. Refer to owner's manual for details.

If any intermittent operation with the Cryo-Storage System is observed or suspected, it should be investigated and remedied immediately, even if this falls outside of the normal maintenance schedule.

Cleaning: If the control system needs to be cleaned, follow the procedure outlined below.

1. Remove all power from the control (check both AC power and battery power)
2. Using a vacuum or a compressed air jet (max 3kg/cm2) remove all deposits of dust and dirt.
3. To clean external parts, use a cloth moistened with:
    a. Ethyl Alchohol or
    b. Isopropil Alcohol or
    c. Water with 10% bleach mixture
4. Before re-assembling, be sure all components are 100% dry.

14. Troubleshooting

If the phasetwo freezer with the CS Control System installed experiences problems or appears that it is not operating at optimum efficiency, please contact your supplier for assistance. The CS CONTROL SYSTEM has incorporated state of the art diagnostic tools to assist in the identification and correction of any issues that may arise.

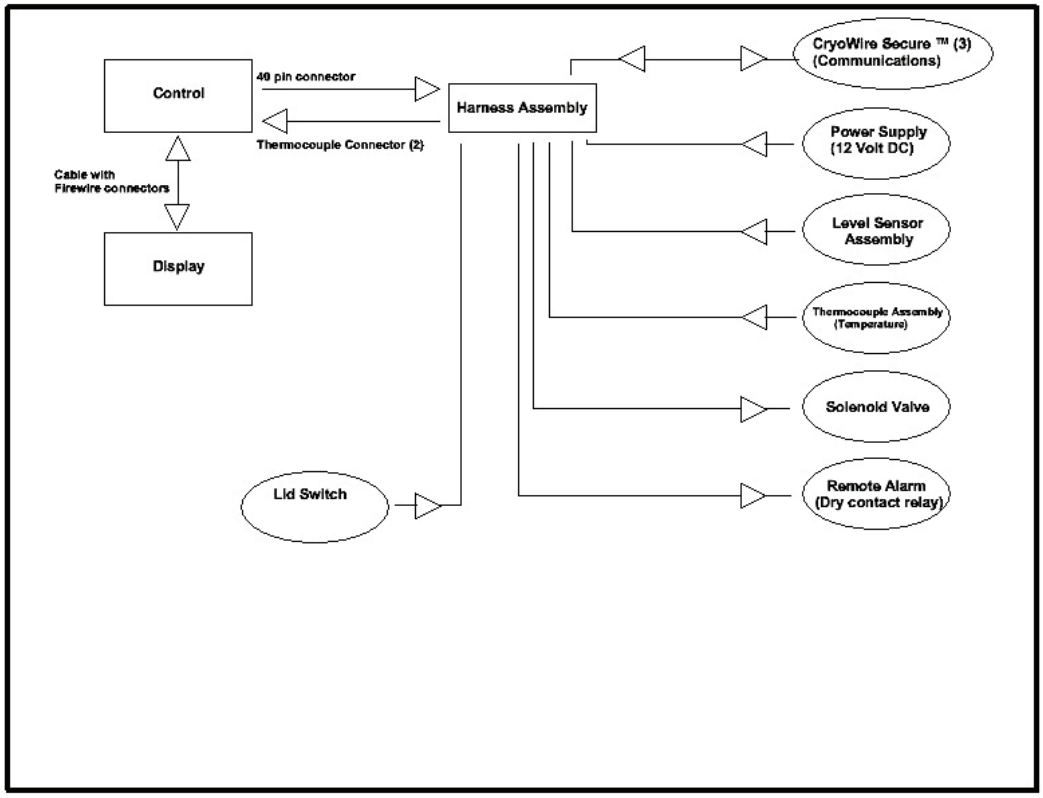
15. Product Information

15.1 Specifications

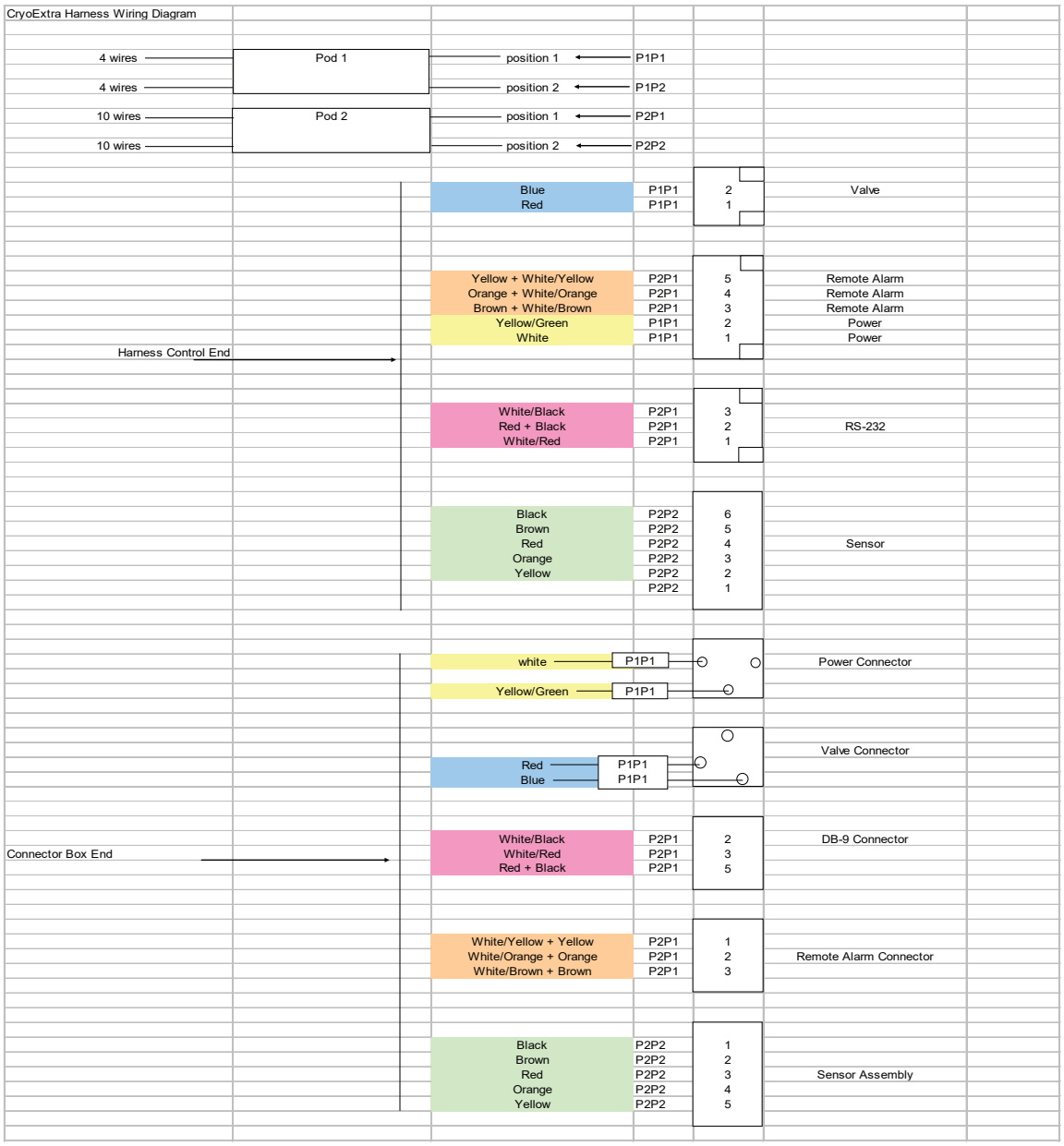
Control Type	LN_2 Level Control & Temperature Control
Level Measurement Sensor Type	Differential Pressure
	4-Thermistor Redundant
Range	Throughout Storage Chamber
Redundancy	Multiple discrete points
Temperature Measurement Sensor Type	Type T Thermocouples
Accuracy	1° or 1.5% of reading
Resolution	.1°C
Number of channels	2
Temperature Display Units	°C, F, K, R
Electrical	
Input Voltage	100-240 VAC
Input Current (max)	1.75 A
Input Current (continuous)	.5 A
Power Consumption (max)	21 W
Power Consumption (continuous)	6 W
Input Frequency	50/60 Hz
Output	12 VDC
Control Input Voltage	12 VDC
Power cord	Available for all countries
Battery	
Rating	12 Volt, 18Ah
Type	AGM Sealed Non-Spillable
Short Protection	Installed PCB with thermal fuse
Battery Cover	Vinyl
Solenoid Valve	
Input Voltage	12 VDC
Input Current	.96 amps
Communications	
Protocol	CryoWire Secure ™
Number of Communication Ports	3
User Interface	
Display Type	Vacuum Fluorescent Display (VFD)
Buttons	11
Level, Temperature and Alarm Information	VFD
“At a Glance” status	LED status wheel
Filling	1 LED
Menu Access	1 LED
Control Tests	
Power Up Self Test	Control system check
Thermistor Status	Yes
Battery voltage	Yes
Control voltages	Yes
Temperature circuit	Yes

Alarms	
Low Level Alarm	Always enabled
High Level Alarm	Always enabled
Sensor Error Alarm	Always enabled
High Temperature Alarm (T/C #1, T/C #2)	Programmable
Low Temperature Alarm (T/C#1, T/C#2)	Programmable
Thermocouple Calibration Alarm	Always enabled
Thermocouple Open Alarm	Always enabled
Power Failure (Remote only)	Always enabled
Low LN_2 Supply Alarm	Programmable
Battery Mode Warning	Always enabled
Lid Open Too Long Alarm	Programmable
Valve Stuck Open Alarm	Programmable
Unauthorized Access Warning	Programmable
LN_2 Use Warning	Programmable
Low Battery Voltage	Always enabled
Temperature Alarm Delay	Programmable
Audible Alarm	Always enabled
Audible Alarm Re-trigger	Programmable
Visual Alarm Indicator	Always enabled
Remote Alarm Delay	Programmable
Buttons	
Power	Turns power on/off
Fill/Defog	Open Valve
Stop	Close Valve
Menu	Access Menu
Mute	Silence audible
Enter	Save a setting or select a menu choice
Back/Exit	Leave a setting unchanged or back out of menu.
Up arrow	Scroll the menu system or increase a value
Down arrow	Scroll the menu system or decrease a value
Left arrow	Scroll horizontal menu
Right arrow	Scroll horizontal menu
Data Collection	
Temperature	Yes
Dimensions	
Display Width	9.5” (241 mm)
Display Height	2.0” (50.8 mm)
Display Depth	1.31” (33.3 mm)
Display Weight	.625 lbs (.28 kg)
Main Control Width	8.875” (225.4 mm)
Main Control Height	6.688” (169.9 mm)
Main Control Depth	1” (25.4 mm)
Main Control Weight	1.0 lbs (.45 kg)
Battery Width	7.25” (184.2 mm)
Battery Height	6.375” (161.9 mm)
Battery Depth	3.25” (82.6 mm)
Battery Weight	12.4 lbs (5.6 kg)

15.2 Interconnection Block Diagram



15.3 Wiring Diagram



15.4 Parts List

These are not user serviceable parts and only original or authorized parts should be used in the system. Original replacement parts should be obtained from your distributor or supplier.

* CAUTION: There is a risk of explosion or fire if the battery is replaced with the incorrect type. Non-rechargeable batteries should never be used. Also, batteries should be recycled. Please call 1-877-BATTERIES for proper disposal instructions.

16. Certifications & Listings

This product complies with the following standards and directives:

- CB Scheme Report and Certificate
- EN 60101-1
- IEC 61010-1
- UL 61010-1
- CAN/CSAC22.2#61010-1
- 93/42/EEC Medical Device Directive for the European Union
- IEC 60601-1-2, 2007 Edition 3.0 (EMC Directive)
- RoHS Directive
- WEEE Directive
- Packaging Directive
- ETL/cETL Listing for North America
- CE marked to the Low Voltage Directive

17. Classification of Control System for ME Equipment

- Protection against electrical shock – Class I
- Protection against harmful ingress of water or particulate matter – IP22
- Mode of Operation – Continuous

18. EN Compliance Tables

Table 1

Guidance and Manufacturer's Declaration – Electromagnetic Emissions		
The CS CONTROL SYSTEM is intended for use in the electromagnetic environment specified below. The customer or the end user of the CE1000 should assure that it is used in such an environment.		
Emissions test	Compliance	Electromagnetic environment - guidance
RF Emissions - CISPR 11 (Radiated & Conducted)	Group 1	The CS CONTROL SYSTEM uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emissions - CISPR 11 (Radiated & Conducted)	Class B	The CS CONTROL SYSTEM is suitable for use in all establishments, including domestic establishments, and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions EN/IEC 61000-3-2	Class A	
Voltage fluctuations/ Flicker Emissions EN/IEC 61000-3-3	Complies	

Table 2

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The CS CONTROL SYSTEM is intended for use in the electromagnetic environment specified below. The customer or the end user of the CS CONTROL SYSTEM unit should assure it is used only in such an environment.			
Immunity Test	EN/IEC 60601 Test Level	Compliance Level	Intended Electromagnetic Environment
Electromagnetic Discharge (ESD) EN/IEC 61000-4-2	± 6kV contact ± 8kV air	± 6kV contact ± 8kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst EN/IEC 61000-4-4	± 2kV for power supply lines ± 1kV for input/output lines	± 2kV for power supply lines ± 1kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge EN/IEC 61000-4-5	± 1kV differential mode (line-line) ± 2kV common mode (line-earth)	± 1kV differential mode (line-line) ± 2kV common mode (line-earth)	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines EN/IEC 61000-4-11	<5% UT (>95% dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5 seconds	<5% UT (>95% dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5 seconds	Mains power quality should be that of a typical commercial or hospital environment. If the user of the CS CONTROL SYSTEM requires continued operation during power mains interruptions, it is recommended that the CS CONTROL SYSTEM be powered from an uninterruptible power supply or a battery.
Power frequency (50/60Hz) magnetic field EN/IEC 61000-4-8	3A/m	3A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note UT is the a.c. mains voltage prior to application of the test level.			

Table 3

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The CS CONTROL SYSTEM is intended for use in the electromagnetic environment specified below. The customer or the end user of the CS CONTROL SYSTEM should assure it is used in such an environment.			
Immunity Test	EN/IEC 60601 Test Level	Compliance Level	Intended Electromagnetic Environment
Conducted RF EN/IEC 61000-4-6	3Vrms 150kHz to 80MHz	3Vrms 150kHz to 80MHz	Portable and mobile RF communications equipment should be used no closer to any part of the CS CONTROL SYSTEM, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ 80MHz to 800 MHz $d = 2.3\sqrt{P}$ 800MHz to 2.5GHz ,where P is the maximum output power rating of the transmitter in watts (W), according to the transmitter manufacturer, and d is the recommended minimum separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 
Radiated RF EN/IEC 61000-4-3	3V/m 80MHz to 2.5GHz	3V/m 80MHz to 2.5GHz	
NOTE 1: At 80MHz and 800MHz, the higher frequency range applies NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from objects, structures, and people.			
[a] Field strengths from fixed transmitters, such as base stations for radios, (cellular/cordless) telephones, and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the CS CONTROL SYSTEM is used exceeds the applicable RF compliance level above, the CS CONTROL SYSTEM should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the CS CONTROL SYSTEM. [b] Over the frequency range 150kHz to 80MHz, field strengths should be less than 3V/m.			

Table 4

Recommended separation distances between portable and mobile RF communications equipment and the CS CONTROL SYSTEM.			
The CS CONTROL SYSTEM is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the CS CONTROL SYSTEM can help prevent electromagnetic interference by maintaining a minimum distance between the portable and mobile RF communications equipment (transmitters) and the CS CONTROL SYSTEM as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter in watts (W)	Separation distance according to frequency of transmitter in meters (m)		
	150kHz to 80MHz $d = 1.2\sqrt{P}$	80MHz to 800MHz $d = 1.2\sqrt{P}$	800MHz to 2.5GHz $d = 2.3\sqrt{P}$
0.01	.12	.12	.23
0.1	.38	.38	.73
1.0	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W), according to the transmitter manufacturer. NOTE 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies. NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

19. Declaration of Conformity

EC DECLARATION OF CONFORMITY

The undersigned representing the manufacturer
Pacer Digital Systems, Inc.
Attn: Kevin Oeff
8658 Castle Park Drive
Suite 103
Indianapolis, IN 46256
USA

Herewith declared that the Product: LN2 Level Control for Cryostorage System

Model/Type ref.: CS CONTROL SYSTEM

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is in conformity with the Essential requirements of the following EC Directives when subject to correct installation, maintenance, and use conforming to its (their) intended purpose, to the applicable regulations and standards, to our operation and maintenance manual.

93/42/EEC Medical Device Directive
2004/108/EC EMC Directive
2006/95/EC Low Voltage Directive

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and that the Standards and/or technical specifications referenced below have been applied:

- EN 60601-1:2006+A11:2001 Medical Electrical Equipment – General Requirements for basic safety and essential performance.
- IEC 61010-1:2001 (Second Edition)- Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1: General requirements
- IEC 60601-1-2: 2007 Edition 3 Medical Electrical Equipment – General Requirements for basic safety and essential performance – Collateral standard : Electromagnetic Compatibility
- IEC/CISPR 11:2009+A1:2010 Radiated & Conducted Emissions.
- IEC61000-3-2:2005+A1:2008+A2:2009. Harmonics
- IEC 61000-3-3:2008. Flicker

Year of CE Marking: 2012

Manufacturer: Pacer Digital Systems, Inc.
Signature: Kevin Oeff
Position: President
Date: 24 May 2012
Place: Indianapolis, IN USA

20. Warranty

Pacer Digital Systems, Inc. warrants that each of its electronic control products will be free from defects in material and workmanship in the normal service for which the product was manufactured, for a period of two years from the date of purchase. Pacer Digital Systems, Inc. at its option will either repair or replace any item covered under this warranty.

This warranty is void if the product is used for any other purpose than that for which it was designed, including but not limited to connection with third party systems. This warranty is also void if the product is in any way altered or repaired by others. Pacer Digital Systems, Inc. shall not be liable under this warranty, or otherwise, for defects caused by negligence, abuse, or misuse of this product, corrosion, fire, or the effects of normal wear.

The remedies set forth herein are exclusive. Pacer Digital Systems, Inc. shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits, or loss of products, resulting from the delivery, use or failure of the product, or for any other cause. By accepting delivery of the product, the purchaser acknowledges that this limitation of remedies is reasonable and enforceable. In no case shall Pacer Digital Systems, Inc's liability exceeds the purchase price for the product.

21. Essential Performance and Risk Analysis

Equipment Under Test: Model CS Control System to maintain LN2 Level in freezer and monitor temperature and alarms.
Product Used for Life Support: No Product use in Shielded Enclosure: No

The following information on Test Mode and Essential Performance was determined by:
Pacer Digital Systems, Inc.

Mode of Operation	Essential Performance / Degradation of Performance
For all emissions testing: The Model CS was operated in its normal mode as used by the customer (normal use). The unit has only one mode (operating mode). The unit was powered using the 12 VDC power supply and a partially charged 12 Volt battery. The unit operated continuously, displaying level and temperature. The battery charger was tested while charging the partially charged battery. **For all immunity testing:** The Model CS was operated in its normal mode as used by the customer (normal use). The unit has only one mode (operating mode). The unit was powered using the 12 VDC power supply and a partially charged 12 Volt battery. The unit operated continuously, displaying level and temperature for the duration of each test. The unit was monitored for proper functioning (no false alarms.) The battery charger was tested while charging the partially charged battery.	**Unallowable Actions during system operation:** • There should be no shutdown of the Model CS. For the immunity test program, there should be no interference with the Level LED indicators, or the temperature displayed. • There should be no permanent damage to the unit due to the immunity test. **Essential Performance:** • The essential performance for the Model CS should keep the control running and monitor LN2 level, temperature, and alarms. If the control fails, it should provide a remote alarm signal through the dry contact relay and close the solenoid valve. **Degradation of Performance Not Allowed:** • There should be no loss of stored programming or calibration. The control performs internal range checking and CRC checks and will reset if these tests fail. **Allowable Degradation of Performance:** • None.

Contact Us

United States : + 1 770-985-1313

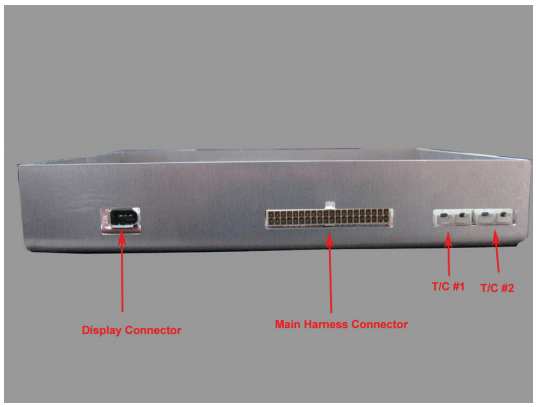
Sales support/order placement : customerservice@phasetwoCCS.com
Technical Services : techservices@phasetwoCCS.com

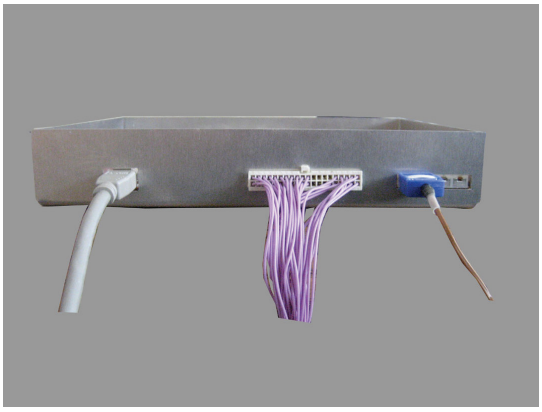
22. Appendix A - Installation & Setup

The CS CONTROL SYSTEM consists of the following components.

- Main Control
- VFD Display Module
- Wiring Harness Assembly
- Power Supply
- Thermocouple Assembly
- Lid Switch Assembly
- Sensor Assembly
- Cryogenic Solenoid Valve
- Remote Alarm Plug

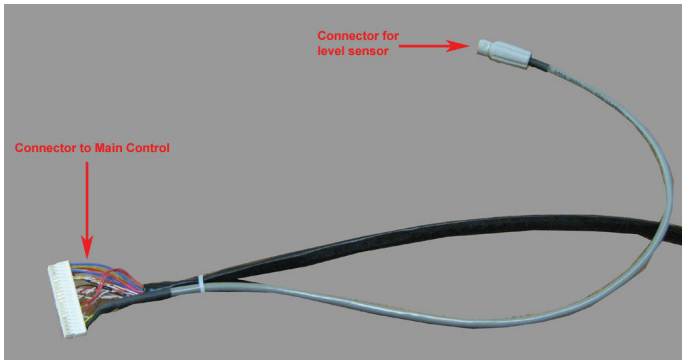
Connect the wiring harness assembly to the main control. The connector is keyed and can only be plugged in one way.



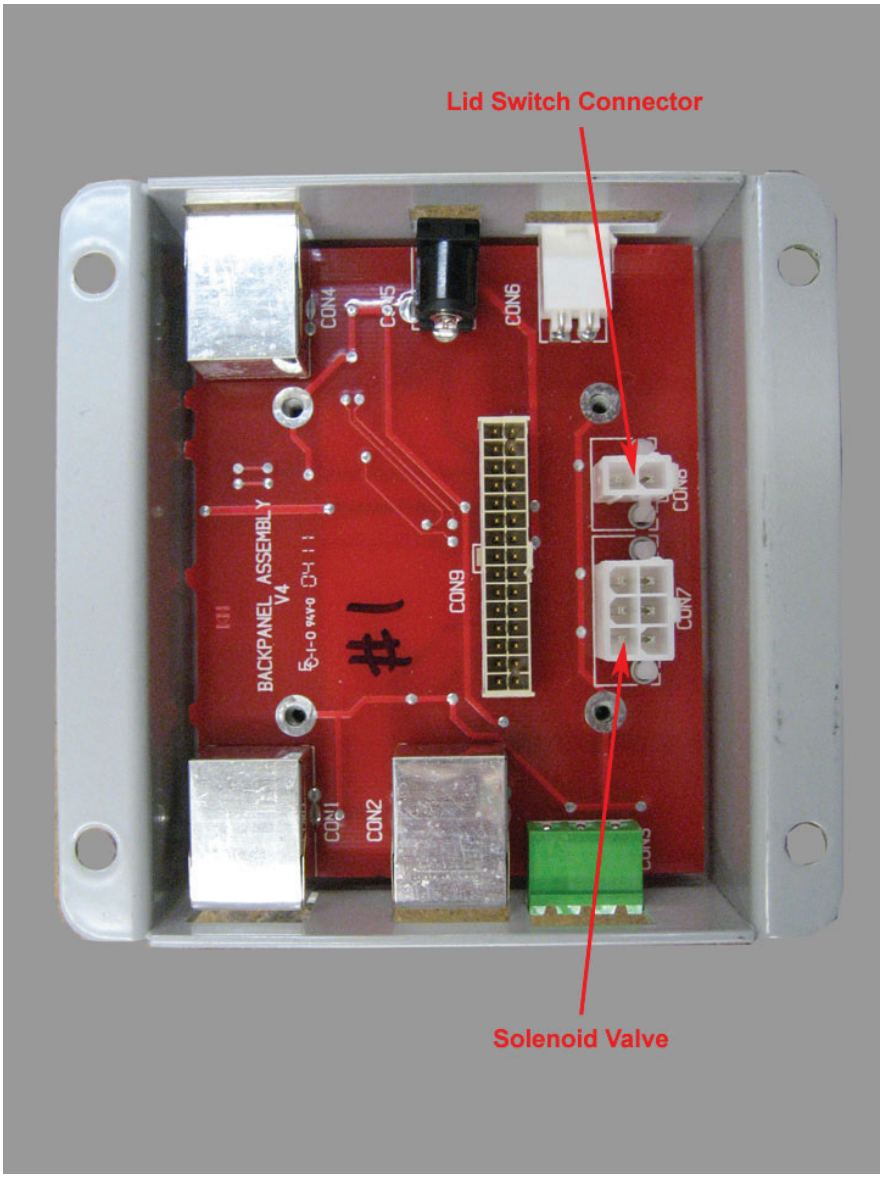


Connect the thermocouple plug of the harness assembly into the control at the thermocouple plug labeled T/C #1. One of the blades on the plug is slightly wider insuring that it is plugged in correctly. The copper blade should plug into copper colored plug. Finally, connect the display cable into the main control and the display.

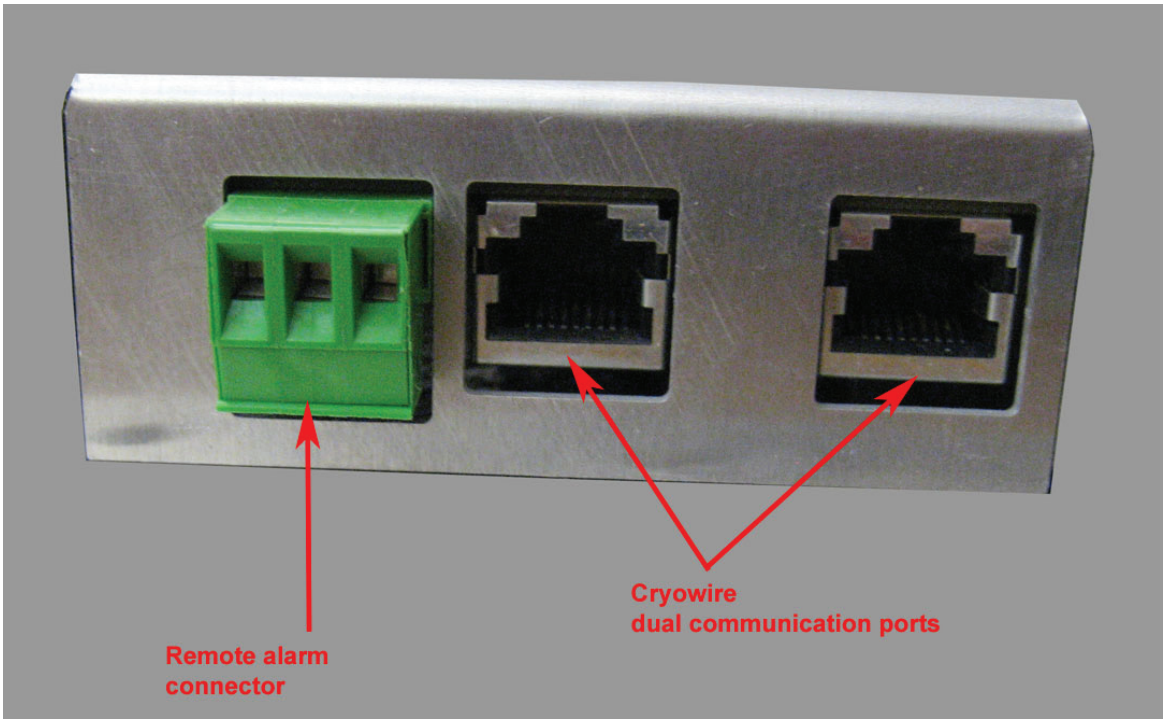
Connect the level sensor assembly into the pigtail with the round connector terminating at the control end of the harness assembly. The connector is a round locking connector that is keyed so it can only be plugged in one way.



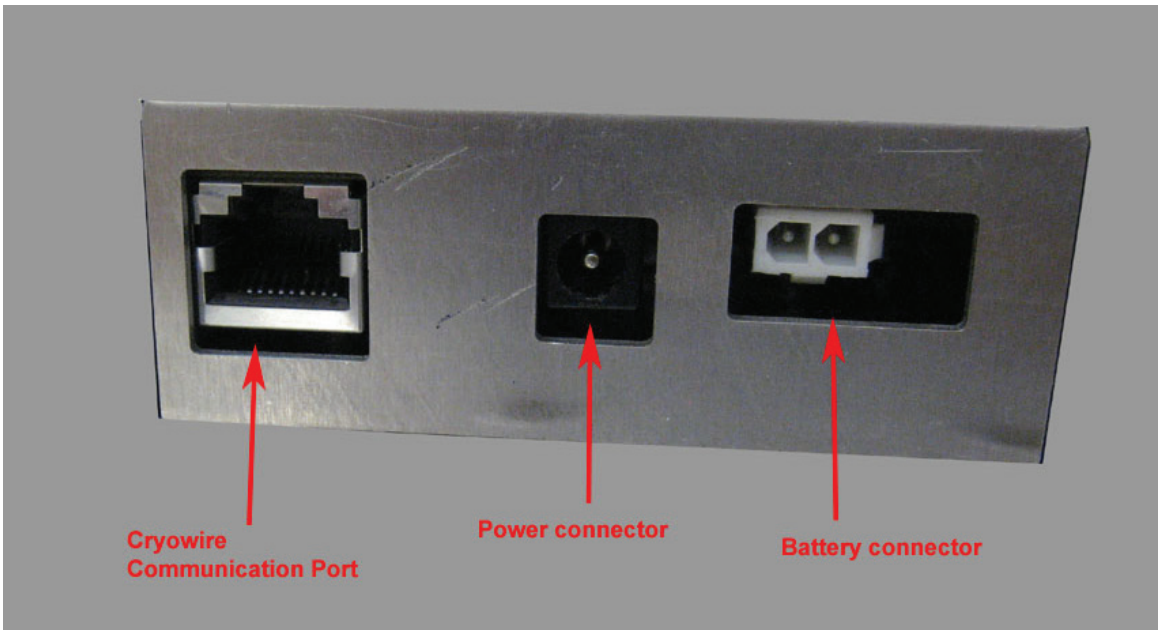
Connect the solenoid valve and the lid switch into the appropriate connectors on the connector box. These are located on the circuit board inside the box and are labelled. The solenoid connector is a 6-pin locking connector and the lid switch is a 2 pin locking connector. Each is keyed so they can only be plugged in one way.



Connect the Remote Alarm plug into the panel at the end of the wiring harness assembly. This is keyed so that it can only be plugged in one way.



Finally, connect the barrel plug of the power supply and the battery into the appropriate receptacles in the connector box.



23. Appendix B - Temperature Calibration

The CS CONTROL SYSTEM uses a type T thermocouple to measure temperature within the CryoStorage freezer. The temperature curve for a thermocouple is nonlinear, so it is important that the CS CONTROL SYSTEM has a good calibration to provide accurate temperature readings. The temperature is traceable to the National Institute of Standards and Technology (NIST) ITS-90 Thermocouple Database.

There are three important reference points needed for calibration:

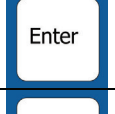
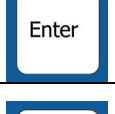
Ambient Temperature:
Ice Water: 0°C
Liquid Nitrogen (LN2): -196°C

The ambient temperature is the temperature measured inside the control box and is used to provide temperature compensation adjustment. This is calibrated at the factory and should not be adjusted in the field.

Ice water and LN2 provide reference points on the temperature curve. If these two points are calibrated correctly then all other points (temperatures) on the curve are correct.

The accuracy of a thermocouple is +/- 1°C or +/- 1.5% of the reading, whichever is greater.

To check a calibration, dip the thermocouple in ice water and then LN2. If readings are within accuracy specifications noted above, then the temperature circuit on the control is properly calibrated. If not, follow the steps below to calibrate the temperature.

Access the menu by pressing	
Highlight CHANGE SETTINGS and press	
Highlight TEMPERATURE and press	
Highlight CALIBRATE and press	
Highlight CALIBRATE THERMOCOUPLE 1. The display will read Dip the thermocouple into ice water.	
Submerge the thermocouple into an ice water bath. The bar graph will fluctuate. When a good stable reading in obtained, the bar graph will decrease to 1 or 2 bars. At this point, press to lock in the value	

The display will read Dip the thermocouple into LN_2.	
Submerge the thermocouple into LN_2. The bar graph will fluctuate. When a good stable reading in obtained, the bar graph will decrease to 1 or 2 bars. At this point, press to lock in the value	
If the calibration values fall within the expected range, DONE! Will be displayed on the screen.	

24. Appendix C - Diagnostic Menu

25. Appendix D - External Connector Ratings

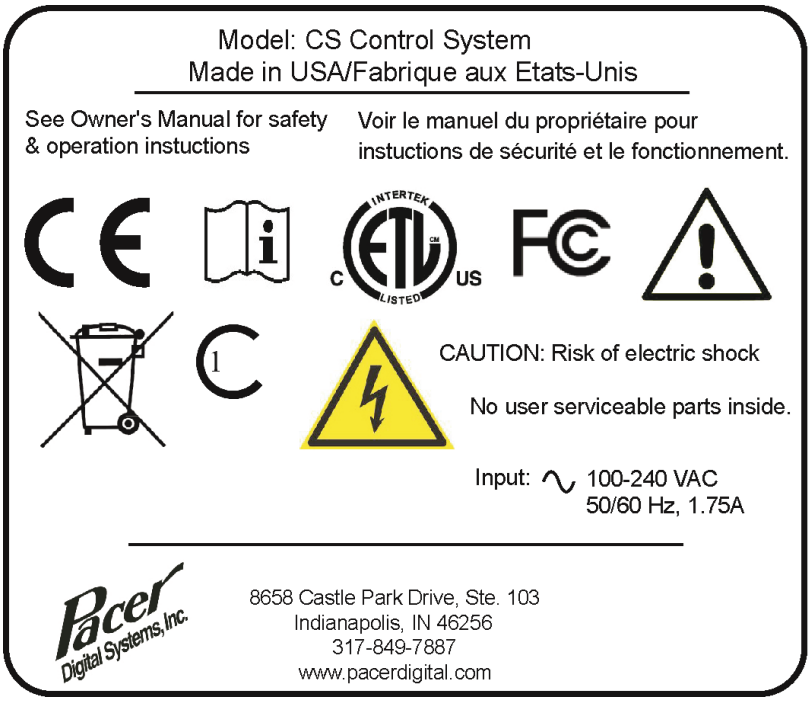
Designated Use	Max rated voltage/current ratings	Connector type
Power	36 VDC	2.5mm barrel connector
CryoWire Secure ™	N/A	Modular shielded jack
Remote Alarm	300 volts	5mm terminal block
Solenoid Valve	600 volts	4.2mm header
Thermocouple	N/A	2 pin thermocouple
Level Sensor	5 amps / contact	Sealed circular connector

26. Appendix E - LED Status Wheel Flash Patterns

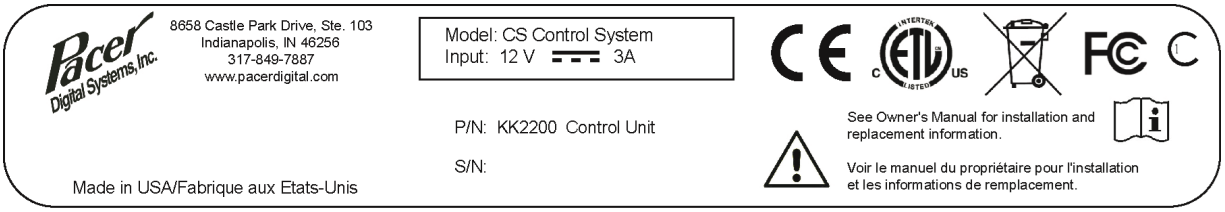
Condition	LED Flash Pattern	Message
Normal	Clockwise pattern, LED's illuminate once per second alternating between blue and orange	The system is operating normally, no errors, warnings, or reminders.
Information	Alternating Flash pattern, 4 blue, 4 orange, repeat.	Information is available for the user. Immediate attention is not required; however, user should investigate at earliest convenience.
High Priority Alarm	Red LED in center is lit, orange LED's illuminate in fast clockwise pattern - 4 rotations) followed by 4x4 flashing orange LED's , repeat	Error conditions exist. Immediate attention is required.

27. Appendix F - Labels

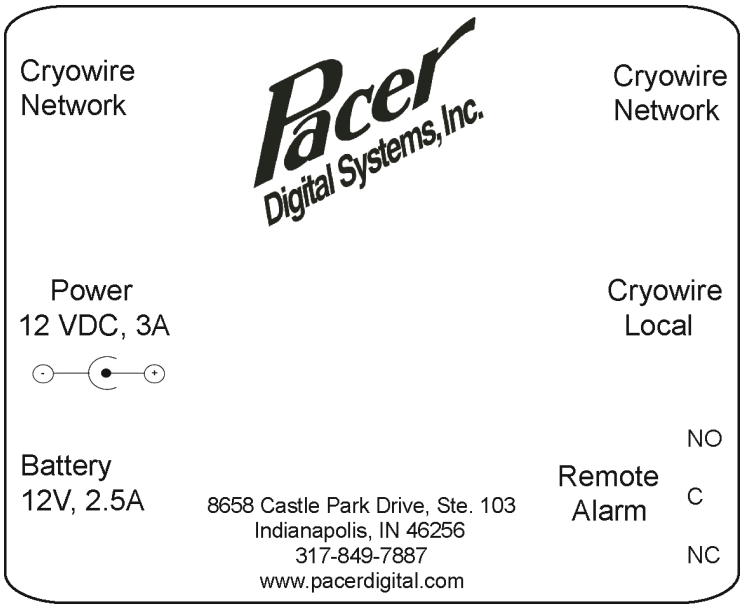
27.1 Main Rating Label



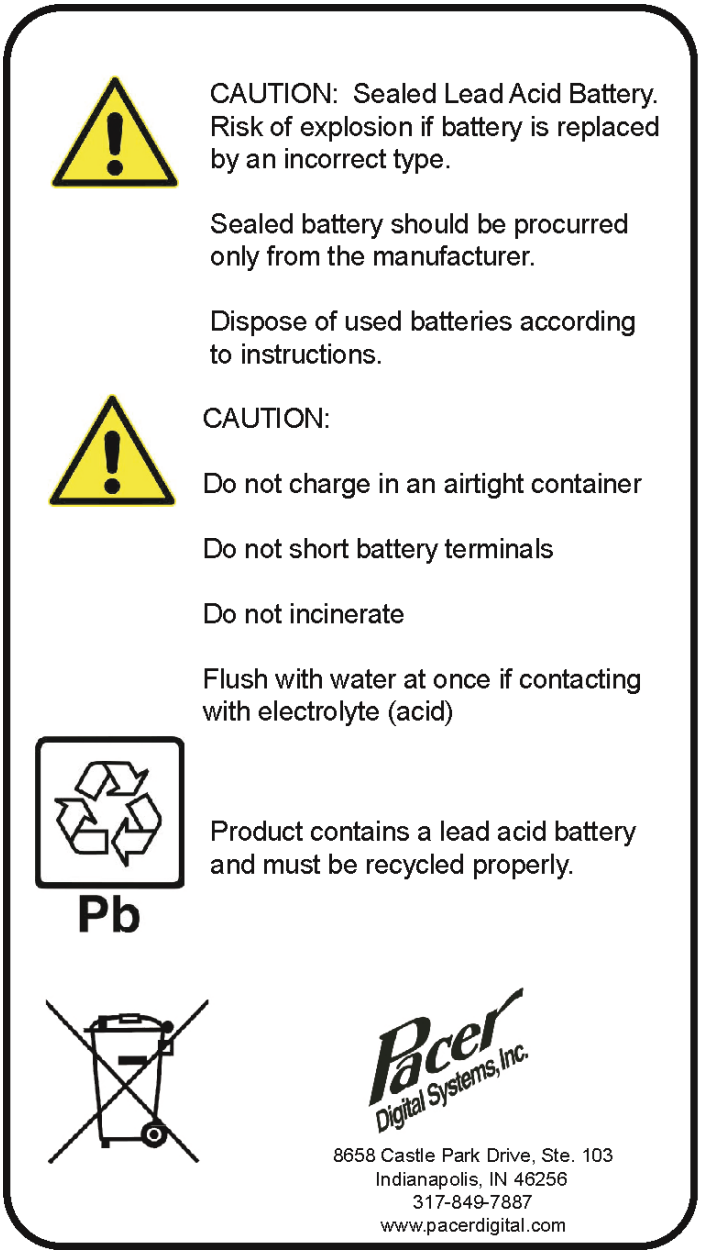
27.2 Control & Display Label



27.3 Connector Box Label



27.4 Battery Label



phasetwo®

1110 Ridgeland Pkwy Suite 110 Alpharetta, GA 30004
770.985.1313
www.phasetwoccs.com