Cryovita
FROILABO

OPERATING AND MAINTENANCE INSTRUCTIONS

CS100 Controller for use with Voyager

Series Vessels

CAUTION - SAFETY FIRST!

- DO NOT ATTEMPT TO USE OR MAINTAIN ANY LIQUID NITROGEN FREEZER UNTIL YOU READ AND UNDERSTAND THESE INSTRUCTIONS. DO NOT PERMIT UNTRAINED PERSONS TO USE OR MAINTAIN THIS UNIT.
- IF YOU DO NOT FULLY UNDERSTAND THESE INSTRUCTIONS, CONTACT YOUR SUPPLIER FOR FURTHER INFORMATION.
- BEFORE ATTEMPTING TO OPERATE THIS CONTROLLER WITH ANY FROILABO VOYAGER SERIES UNITS, YOU MUST READ THE SEPARATE OPERATING AND SAFETY MANUAL PROVIDED WITH THAT UNIT.

TABLE of Contents

TABLE of Contents

Liquid Nitrogen
Nitrogen is an inert, colorless, odorless, and tasteless gas making up four-fifths of the air you breathe – and can be very dangerous. Air is roughly one-fifth oxygen.

Liquid nitrogen is at a temperature of -196°C (-320°F) under normal atmospheric pressure. Cryogenic freezers are used in LN2 service only.

Extreme Cold - Cautionary Statement
Accidental contact of liquid nitrogen or cold issuing gas with the skin or eyes may cause a freezing injury similar to frostbite. Handle the liquid so it won't splash or spill. Protect your eyes and cover the skin where the possibility of contact with the liquid, cold pipes and equipment, or cold gas exists.
Safety goggles or a face shield should be worn when operating this equipment. Insulated gloves that can be easily removed and long sleeves are recommended for arm protection. Trousers without cuffs should be worn outside boots or over the shoes to shed spilled liquid.

Keep Equipment Area Well Ventilated
Although nitrogen is non-toxic and non-flammable, it can cause asphyxiation in a confined area without adequate ventilation. Any atmosphere not containing enough oxygen for breathing can cause dizziness, unconsciousness, or even death. Nitrogen, a colorless, odorless, and tasteless gas that cannot be detected by the human senses, will be inhaled normally as if it were air. One (1) liter of liquid nitrogen is equivalent to 24.6 scf of nitrogen gas. Without adequate ventilation, the expanding nitrogen will displace the normal air resulting in death.

Liquid Nitrogen System
The liquid nitrogen supply pressure at the inlet to the freezer should be in the range of 10 psig (0.7 bar/69 kPa) to 20 psig (1.4 bar/138 kPa) for optimum performance.

Higher operating pressures will increase transfer losses and create excessive turbulence of the liquid in the freezer, which can generate false signals to the liquid level controller causing the freezer to under-fill. In "liquid phase" storage applications, excessive turbulence can cause splashing, which could result in personal injury and/or damage to the freezer.

When installing piping or fill hose assemblies, make certain a suitable safety relief valve is installed in each section of plumbing between any two isolation points. Trapped liquefied gas will expand greatly as it warms and may burst hoses or piping, causing damage or personal injury. A relief valve is installed in the freezer plumbing to protect the line between the customer-supplied shut-off valve and the freezer solenoid valve. Relief valves can be piped to the outside of the building.

WARNING:
The following safety precautions are for your protection.
Before installing, operating, or maintaining this unit, read and follow all safety precautions in this section and in reference publications. Failure to observe all safety precautions can result in property damage, personal injury, or possibly death.

WARNING:
Maintain adequate ventilation to prevent asphyxiation hazard (see Safety Precautions).

Caution:
When installing field fabricated piping, make certain a suitable safety relief valve is installed in each section of piping between any two isolation points.

WARNING:
Inlet pressure should not exceed 22 psig (1.5 bar/152 kPa). Higher pressures could result in damage to equipment.

Electrical

This product is not intended for a life support function.
This product is intended to be used in hospitals and 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 RF energy for its function.
This product does not intentionally receive RF energy for its function.

The liquid level controllers used with these freezers operate from 12 VDC. Disconnect the electrical power cord from the outlet before attempting any service.

WARNING:

Electrical shock can kill. Do not attempt any service on these units without first disconnecting the electrical power cord.

General Information

The CS100 SERIES Control System can monitor and control the liquid nitrogen level range in the cryostorage unit you have selected. CS100 SERIES Control Systems are designed to work with Froilabo Voyager systems. The features are designed to provide a safe environment for samples while at the same time tracking all relevant information associated with the freezer.

This control provides a complete historical record of the environment in your unit and therefore, the environment in which your samples have been stored in this system. This controller features a vacuum fluorescent display. The addition of a liquid nitrogen supply and inventory control racks for systematic retrieval of stored product completes the total cryostorage system.

Froilabo cryostorage systems are designed for applications where extremely low temperature storage of biological products is required. They are also appropriate for industrial or other applications where liquid nitrogen temperatures and high capacity are needed.

Before beginning installation or operation of this CS100 SERIES Control System, make sure that you read and understand this manual as well as the operating and safety instructions for the cryostorage unit you will be using with this controller.

Unpacking and Inspection
Inspect shipping containers for external damage. All claims for damage (apparent or concealed) or partial loss of shipment must be made in writing within five (5) days from receipt of goods. If damage or loss is apparent, please notify the shipping agent immediately. In all cases, Froilabo should be notified so we can assist if needed in filing damage claims. Open the shipping containers; a packing list is included with the system to simplify checking that all components, cables, accessories, and manuals were received. Please use the packing list to check off each item as the system is unpacked. Inspect for damage. Be sure to inventory all components supplied before discarding any shipping materials. If there is damage to the system during transit, be sure to file proper claims promptly. Please advise Froilabo of such filings. In case of parts or accessory shortages, advise Froilabo immediately. Froilabo cannot be responsible for any missing parts unless notified within 10 days of shipment.

Freight Damage Procedures
Any freight damage claims are your responsibility. Cryostorage systems are delivered to your carrier from Froilabo's dock in new condition; when you receive the product, you may expect it to be in that same condition. For your own protection, take time to visually inspect each shipment in the presence of the carrier's agent before you accept delivery. If any damage is observed, make an appropriate notation on the freight bill. Then, ask the driver to sign the notation before you receive the equipment. You should decline to accept containers that show damage which might affect serviceability.

Repackaging for Shipment
If it is necessary to return any part of the system for repair or replacement, a Returned Material Authorization (RMA) number must be obtained from an authorized factory representative before returning the equipment to our service department. Contact your distributor for return authorization. When returning equipment for service, the following information must be provided before obtaining an RMA: System model and serial number, and controller model and serial number. User's name, company, address, and phone number Malfunction symptoms. possible, the original packing material should be retained for reshipment. If not available, consult Froilabo for shipping and packing instructions. It is your responsibility to assure that the goods are adequately packaged for return to the factory. All freezers returned to Froilabo must be clean and decontaminated before return.

Delivery & Returns

Getting Unit into Service
Your cryostorage system comes with complete instructions for how you should remove the unit from the crate and put it into service. Read both this manual and your cryostorage system's manual before beginning any installation. Make sure to follow any required procedures and safety guidelines when you are connecting your Liquid Nitrogen source.

The CS100 SERIES Control System is designed to be operated at normal room temperatures 15° C to 27° C (60° F to 80° F) at a relative humidity level below 50%. The humidity level should be maintained such that the electronics are not exposed to condensation.

The Froilabo cryostorage freezer should be positioned such that all sides of the unit are easily accessible and the user can easily connect/ disconnect the power cord from the wall socket.
Proper ventilation MUST BE adequate to sustain life for those working with or maintaining this equipment.

Electrical
The liquid level controllers used with these freezers operate at 12 VDC. The external power supply has a 120 VAC (50/60 Hz) primary. Disconnect the electrical power cord from the wall outlet before attempting any service.

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 EMC for the CS100 SERIES Control System.

The CS100 SERIES 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.

Portable and Mobile RF communicati ons equipment can affect the performance of the CS100 SERIES Control System. Please use the guidelines and recommendations specified in the EN Compliance tables found on pages 30–33.

Other equipment or systems can produce electromagnetic emissions and therefore can interfere with the functionality of the CS100 SERIES Control System. Care should be used when operating the CS100 SERIES Control System adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the CS100 SERIES 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 EN Compliance tables found on pages 30–33. Care should be taken to use only manufacturer-recommended cables, power supplies and electrical accessories with the CS100 SERIES Control System. If a third-party supplier offers cables, external power supplies and electrical accessories for use with the CS100 SERIES Control System and they are not listed or referenced in this manual, it is the responsibility of that third-party supplier to determine compliance with the standards and tests in the EN Compliance tables found on pages 30–33.

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 CS100 SERIES Control System or decreased electromagnetic immunity of the CS100 SERIES Control System.

Power Supply Connection
Connect the power supply to your cryostorage system and then plug the power supply into a surge-protected wall outlet.

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.

These instructions are for operators experienced with cryogenic equipment. Before operating the system, become familiar with the safety precautions in this manual and in reference publications. Make certain all applicable provisions set forth in the Installation Section have been followed before placing a system in operation. Study this manual thoroughly. Know the location and function of all system components.

Initial Fill
The Cryostorage System, using the CS100 SERIES Controller, comes preset from the factory. The liquid nitrogen supply pressure at the inlet to the freezer should be in the range of 10 psig (0.7 bar/69 kPa) to 22 psig (1.5 bar/152 kPa) for optimum performance.

Higher operating pressures will increase transfer losses and create excessive turbulence of the liquid in the freezer, which can generate false signals to the liquid level controller causing the freezer to under fill. In “liquid phase” storage applications, excessive turbulence can cause splashing which could result in personal injury.

Operation

Operating Environment
The CS100 is designed to be operated at normal room temperatures (60°F to 80°F, 15°C to 27°C) and a relative humidity level below 50%. The humidity level should be maintained such that the electronics are not exposed to condensation.

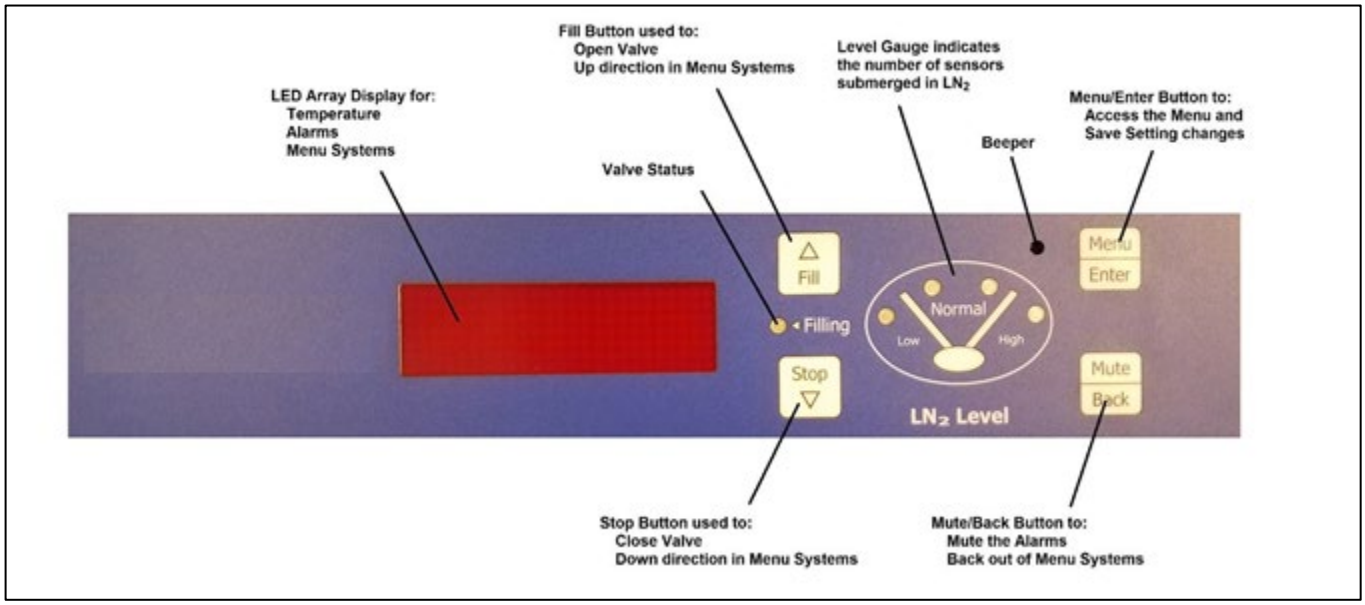
The Voyager Series cryostorage system should be positioned such that all sides of the unit are easily accessible, and the user can easily connect/disconnect the power cord from the wall socket.

CS100 Components
The CS100 for the Voyager Series cryostorage system consists of the following components:
Main Control and Display
Harness Assembly
Power Supply
Thermocouple Assembly
Sensor Assembly
Cryogenic Solenoid Valve
Remote Alarm Plug

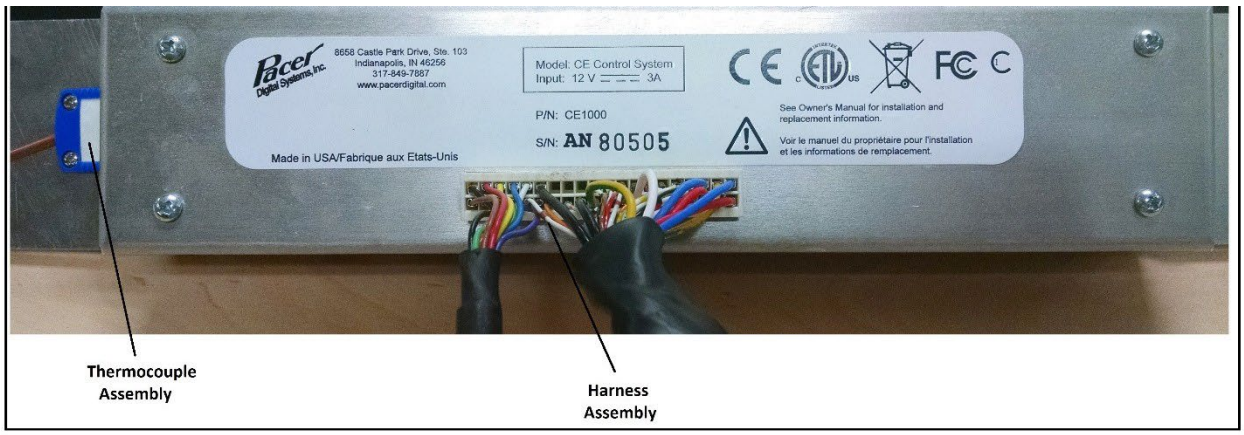
The CS100 is assembled onto the freezer at the factory and completely tested. Start operation of the control system by plugging the power cord into the wall outlet. The CS100 will go through a short startup routine and then start operation. For information relating to assembly of the control components and connection information, refer to Appendix A.

General Equipment Description

Main Control Front Panel



Main Control Back Panel

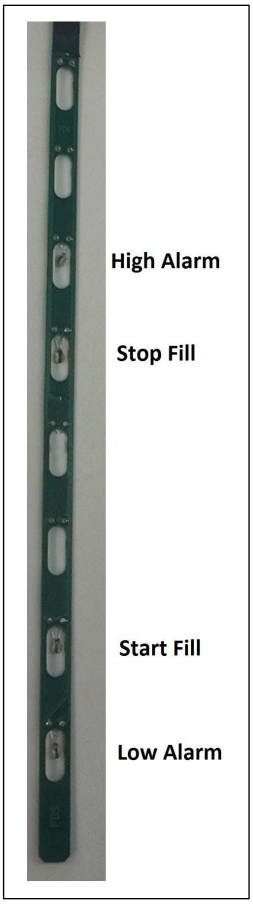


Features

The CS100 automatically maintains the Liquid Nitrogen (LN_2) 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.

LN_2 Level Measurement and Control

The LN_2 level gauge on the face of the control indicates level by lighting the appropriate LED if a thermistor is submerged in LN_2. In the picture, the Low Alarm thermistor, the Start Fill thermistor and the High Alarm thermistor are all submerged in LN_2.

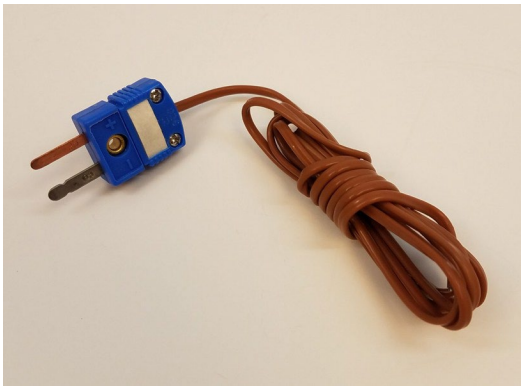


The CS100 uses thermistors to measure the LN_2 level within the vessel. A thermistor is a thermal resistor and its resistance changes as the temperature changes. When a thermistor is submerged in LN_2, its resistance will be significantly greater than its resistance at room temperature. The control can detect this resistance change and determine the level of the LN_2 within the freezer. The CS100 uses 4 thermistors to maintain the level. These thermistors correspond to Low (Low Alarm), Normal (Start Fill), Normal (Stop Fill) and High (High Alarm). When the LN_2 level drops below the Start Fill thermistor, the control opens a solenoid valve allowing LN_2 to enter the vessel. This continues until the Stop Fill thermistor is submerged in LN_2 at which point the solenoid valve is closed preventing the flow of additional LN_2 into the vessel. The High Alarm thermistor is located 1” above the Stop Fill thermistor and provides a safety. Likewise, the Low Alarm thermistor is located 1” below the Start Fill thermistor and provides a safety. Factory settings provide a 2” range between the start fill and stop fill thermistors.

The LN_2 level gauge on the face of the control indicates level by lighting the appropriate LED if a thermistor is submerged in LN_2. In the picture, the Low Alarm thermistor, the Start Fill thermistor and the Stop Fill Thermistor are all submerged in LN_2.

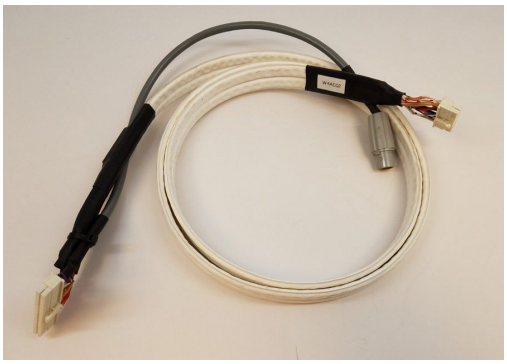
Operation

Temperature Monitoring
The CS100 uses a Type T Thermocouple to determine the temperature in the vessel. The thermocouple is installed near the top of the Voyager Series freezer and the temperatures are measured at that point. Multiple temperature values are taken per second and then averaged.



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

Harness Assembly



Please see Appendix B for instructions on calibrating the temperature.

Alarm Conditions
The CS100 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. Thermistor #1 on the sensor assembly is not submerged in LN_2.

High Level Alarm
LN_2 level is too high. Thermistor #4 on the sensor assembly is submerged in LN_2.

Sensor Fault Alarm
A problem exists with the level sensor. The control detects an open sensor circuit, meaning that the sensor is unplugged or the sensor assembly has been damaged.

High Temp Alarm
The temperature detected exceeds the high temperature alarm setting.

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 LN2 Supply Alarm
A problem may exist with the LN2 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 pressure in the supply cylinder or a closed shut off valve.

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 Delay
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.

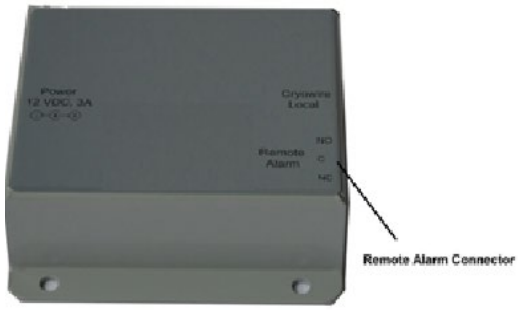
All alarms include the following:
The LED array screen flashes to signal an error condition
An audible tone sounds
The error detected is displayed and scrolled on the screen
The remote alarm relay changes state to provide a dry contact output signal

Solenoid Valve
These units are designed to work with 12 VDC solenoid valve.

Thermocouples
Type T thermocouples monitor the temperature in the freezer. The user may choose to use NONE, 1 thermocouples with this control at any time. (The unit comes complete with one Thermocouple.)

Operation

Power Supply
A 12 VDC power supply is supplied for the CS100 SERIES Control System. This system is supplied with a universal power supply that accepts 100/240 VAC (50/60 Hz). UL approval for the system as a whole is not required since the control operates on low voltage. If your power source differs, or is subject to disruption or line surges due to other equipment on line, consult your Froilabo representative.



Remote Alarm
If an error condition occurs after a user defined period of time, a remote alarm can be initiated. This is accomplished by connecting a remote device to the remote alarm jack on the rear electrical panel. The 3-pin jack on the back of the unit provides continuity between pin #2 (common) and pin #3 in the normal condition. Continuity between pin #1 and pin #2 is provided in an error condition.

Operating Parameters
When materials are immersed in LN_2, they will assume the temperature of the liquid (-196°C/-320°F). When material is stored in the vapour phase over the liquid, the liquid nitrogen vapour is still a very cold refrigerant, but the freezer's interior temperature increases as product is stored higher above the liquid. This temperature differential is not significant for many biological storage applications, and is affected by the amount of product stored in the freezer, the type, size and material of the inventory control system, and the liquid level in the unit. The liquid level in the freezer is determined by the position of the Thermistor Assembly in the sensor tube. These sensors are set at installation to maintain a specific liquid level. A filling cycle is initiated when the level falls below the Start Fill sensor and is completed when the Stop Fill sensor is reached. This filling cycle repeats when the level fall below the Start Fill sensor.

Temperature Monitoring
The CS100 SERIES Control System uses a Type T thermocouple to monitor the temperature in the vessel. The thermocouple is factory-installed near the top of the Froilabo freezer vapour chamber and the temperature is measured at that point.

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

Liquid Phase Storage
Liquid phase storage is normally utilized when (-196°C/-320°F) is required to maintain stored product viability and the storage medium is adequate for storage in LN_2. In a typical liquid phase storage system, the liquid level sensors are positioned to maintain the liquid level at or below the top level of the inventory control system. During operation, the upper levels of the inventory control system will at times become exposed as the liquid level fluctuates.

Care must be taken to ensure that the liquid level remains below the bottom of the freezer lid. Exposure to LN_2 may result in physical damage to the lid. Additionally, operating the freezer with high liquid levels characteristic of liquid phase storage may result in turbulence during fill cycles. Caution must be exercised if the freezer lid is opened during a fill, and appropriate safety equipment should always be worn.
The Froilabo cryostorage systems are factory set for vapour phase storage.

Introduction
The CS100 Control System, temperature and LN_2 level controller is designed for easy operation and reliable uninterrupted service. This controller will maintain the selected liquid level range of LN_2 in your freezer as well as providing audible and visual alarms for any non-conforming conditions that may occur. An alarm is any condition outside the activated preset limits on the control, such as an open sensor circuit or temperature alarm. “System Events” are solenoid valve openings and closings, and operation of the controller’s relay for remote alarm indication. System Events, Alarms and Temperature “Data” can be downloaded.

The System should require no additional attention to maintain liquid level if an adequate supply source of liquid nitrogen is available. If your protocol calls for you to “top-off” the Cryostorage System at the end of a workday or workweek, press the FILL button. The unit will fill to the upper allowable liquid level and stop automatically. You may choose to manually stop the fill by pressing the STOP button at anytime during the fill.

Operation Data
The CS100 stores data related to the operation of the cryostorage freezer. This data includes date, time, LN_2 level, temperature, system events and error conditions. This data can be useful for audit purposes, operation analysis and preventive maintenance.

Communications
The CS100 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.

Normal Fill Cycle
When the freezer is filled and the controller is operating, the START FILL and LOW ALARM sensors are immersed in LN_2. Their resistance values are interpreted by the controller as “in liquid”. At the same time, the STOP FILL and the HIGH ALARM sensors are above the liquid pool, informing the control that these sensors are in vapor. As LN_2 evaporates, the liquid level in the freezer drops slowly until the START FILL sensor is above the liquid and sends a different signal to the controller. After a delay sufficient to ensure the signal, the controller interprets this condition as low liquid level and opens the solenoid valve, admitting more liquid nitrogen from the supply source.

The freezer will fill slowly. The fill continues until the STOP FILL sensor sends the controller a signal that it is now in liquid. The controller will close the solenoid valve to stop the fill. As liquid evaporates, the display will indicate the liquid is at a normal level as the cycle begins again.

Control Setting Adjustments
The standard sensor assembly that is installed on a freezer consists of a circuit board with thermistors installed. The assembly has a fixed fill range of 3”. The level can be changed by either raising or lowering the circuit board within the freezer.

If a wider range is needed between the start fill and stop fill thermistor, please contact your supplier.

Menu System
Some control settings can be changed through the menu system.

Enter 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 control will continue to monitor all sensors and conditions while the user accesses the menu system. If no activity is detected for 30 seconds, the control will automatically revert back to the main operational screen.

Thermocouple Enable
The temperature sensor (thermocouple) can be turned on / off through the menu system. If the thermocouple is turned on, the temperature is displayed on the LED display and a high temperature alarm will occur if temperature exceeds the user-defined high temperature alarm setting. If the temperature sensor is turned off, no temperature is displayed and no high temperature alarm can occur.

Set Date/Time
The date and time can be set through the menu system. The date and time is used to provide a date stamp for data that is collected within the control. Use the appropriate buttons to adjust the settings and lock in the values.

Select Date/Time and lock in values:	
Decrement values:	
Increment values:	

Low Supply Alarm
The Low Supply Alarm timer can be changed through the menu system and can range from 30 to 120 minutes. This alarm occurs if the filling operation takes too long to complete. If this alarm occurs the supply should be checked to ensure that the supply valve is turned on, a sufficient supply of LN_2 is available in the supply and the supply pressure is adequate.

High Temp Alarm
The High Temp Alarm setting determines the temperature at which the control will indicate a high temperature alarm. This is accessed through the menu system and values can range from 0°C to -196°C.

Temp Alarm Delay
The Temp Alarm Delay setting determines the length of time after the control detects a warm temperature before it goes into alarm. This is accessed through the menu system and values can range from 0 to 60 minutes.

Audible Alarm Retrigger
The Audible Alarm Retrigger setting determines the length of time before the audible alarm reoccurs after it has been muted. This only occurs if the error condition has not been corrected. This is accessed through the menu system and values range from 0 to 720 minutes in 10 minutes increments.

Remote Alarm Delay
The Remote Alarm Delay setting determines the length of time before the remote alarm relay is triggered after an error condition occurs. This is accessed through the menu system and values range from 0 to 720 minutes in 10 minutes increments.

Display Brightness
The Display Brightness is the setting that determines the lamination intensity of the display. This is accessed through the menu system and values range from 1 to 15.

Operation

About
This provides information about the control including the firmware version, the control serial number and contact information. This is accessed through the menu system.

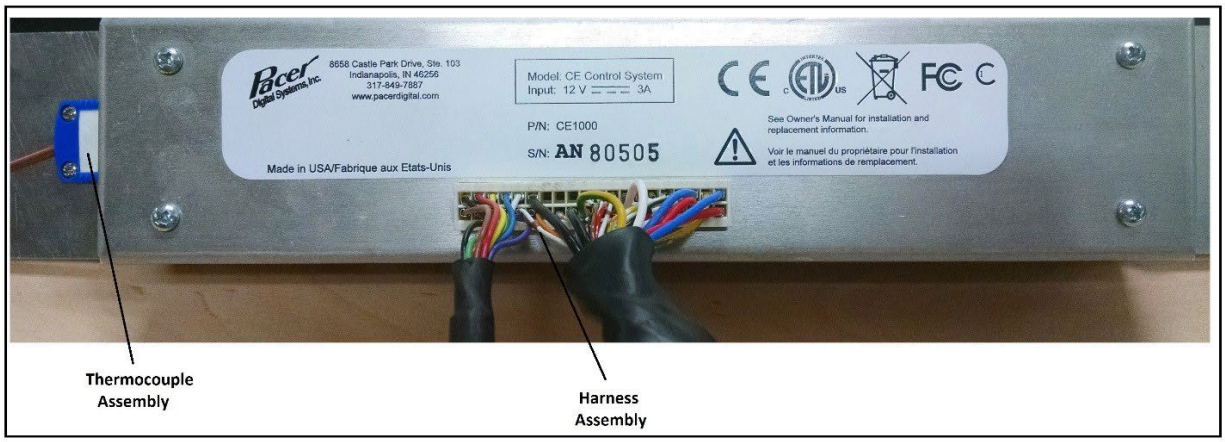
Temperature
The temperature in the cryostorage freezer is measured at the location of the thermocouple. The installation location is different depending on the model of the freezer but usually the thermocouple is positioned level with the top storage box. This may mean that temperatures displayed may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

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.

Menu System
MENU
Thermocouple Enable. On/Off
Set Date/Time. Hr – Min – Mon – Day - Yr
Low Supply Alarm. 30-120
High Temp Alarm. 0° to -196°
Temp Alarm Delay 0-60
Audible Alarm Retrigger 0 to 720
Remote Alarm Delay 0 to 720
Display Brightness. 1 to 15
About. Voyager SERIES V1.1 Firmware
SER 12345 Serial Number
Factory Defaults
Thermocouple. On
Date/Time. Factory Set for Eastern Standard Time
Low Supply Alarm. 30 minutes
High Temp Alarm..... -100° C
Temp Alarm Delay 0 minutes
Audible Retrigger 10 minutes
Remote Alarm Delay 30 minutes
Display Brightness. 7

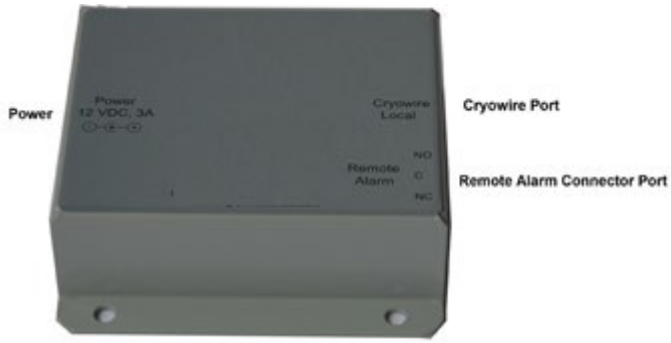
Installation & Setup
The CS100 consists of the following components:
Main Control / Display
Power Supply
Harness Assembly
Thermocouple Assembly
Sensor Assembly
Cryogenic Solenoid Valve
Remote Alarm Plug

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



Operation

Connect the thermocouple plug of the harness assembly into the control at the thermocouple plug. This is located on the right edge of the control if looking at it from the front. One of the blades on the plug is slightly wider insuring that it is plugged in correctly. Copper blade should plug into copper colored plug. On the other end of the harness, connect the Thermocouple assembly into the plug insuring that copper-coloured blade is plugged into copper colored contact on receptacle.
Connect the level sensor assembly into the panel at the end of the level sensor 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 into the panel at the end of the wiring harness assembly. The connector is a 4 pin locking connector that is keyed so it 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 into the receptacle on the back of the controller panel.

Alarms and Error Conditions
The CS100 SERIES Control System control monitors many different conditions in the freezer and has a full complement of alarms associated with these different conditions. As alarms occur, they trigger an audible tone. A remote alarm relay is also triggered following a user-designated period of time, after the error condition occurs, if it is not corrected. In addition, the error condition is displayed on the top line of display until the error condition is corrected.

When an error occurs, the audible alarm may be muted by pressing the designated button. The audible alarm will then be silent until activated by a new error condition or the alarm is not corrected by the time the retrigger timer expires. A red light will continue to flash until all errors are corrected. The remote alarm will be activated if the power is interrupted.

The High Temperature Alarm for the Thermocouple can be set through the menu system. This alarm is activated if the temperature rises above the designated temperature. The alarm temperature can range from 0°C (32°F) to -196°C (-320°F). It can also be disabled**.**

System Alarms
A Low LN_2 Supply Alarm can be set through the menu system. This alarm is activated if the solenoid valve is not closed within a designated time period after a fill starts. The solenoid valve can be closed either automatically (the LN_2 level reaches the STOP FILL sensor) or manually (the Stop Fill button is pressed). To change the timer which activates this alarm, the menu options for this alarm are None, 15, 30, 45, 60 minutes, 2 or 3 hours. This alarm does not correct itself until the fill is stopped (the solenoid closes).

A Remote Alarm Timer can be set through the menu system. This is the amount of time before the remote alarm relay is triggered if an error condition is not corrected. The possible choices are None, Immediate, 30 minutes, 60 minutes or 2 hours.

Thermocouple Alarm can be set through the menu system. This alarm is activated if either thermocouple experiences an open circuit. Your choices are ENABLE or DISABLE.

Logging
On-board memory logging is one of the most powerful and useful features of the CS100 SERIES Control System. It provides a historical record for the freezer and a complete record of the environment in which specimens are stored.
System Log: System logs are events that occur in the system including LN_2 filling.
Error Log: Error logs are outside the activated preset limits detected by the system.
Temperature Log: This temperature log are simply records of the temperatures recorded by the thermocouples in the system.

All logs are kept in a non-volatile memory, meaning that the information is saved regardless of whether the controller has power.

Display Brightness
DISPLAY BRIGHTNESS changes the intensity of the display. The default setting is 7.

Making Adjustments to the CS100 SERIES Control System Sensor Assembly

SYSTEM	LOW LEVEL ALARM	START FILL	STOP FILL	HIGH LEVEL ALARM
Voyager Series 10K,24K, 38K	2 in. (50 mm)	3 in. (76 mm)	6 in. (152 mm)	7 in. (178 mm)

Operation

The sensor assembly is preset at the factory for vapour phase storage. If adjustments need to be made, the following procedure will simplify the process.

The CS100 SERIES Control System control installed on the Froilabo Cryostorage units operates with specially designed software to match the design characteristics of your freezer. Refer to the chart below to see the versions and their difference.

Maintenance
To insure proper operation and maintain excellent performance of the Froilabo cryostorage freezer, an annual maintenance schedule should be followed for the CS100 SERIES Control System. This would include the following:
In addition, inspection and preventive maintenance should also be performed on the freezer and its mechanical parts. Refer to owner's manual for details.

CS100 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.
Solenoid Valve	Examine wires and connector for damage. Replace every 2 years.
Level Sensor Assembly	Examine for damage to wires and connector. Replace every 3 years
Thermocouple Assembly	Examine for damage to wires and connector.

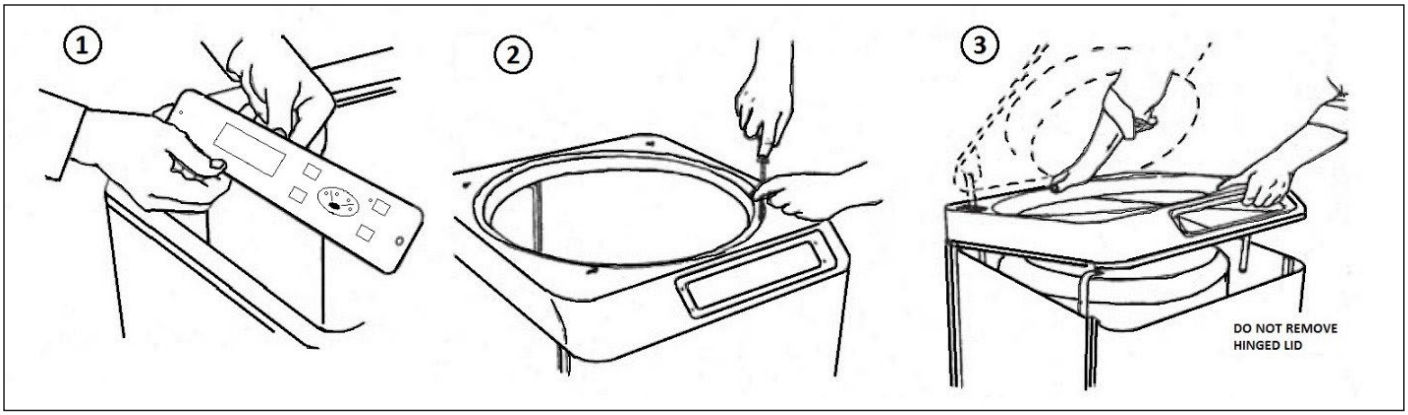
If any intermittent alarm or defect with the cryostorage system is observed or suspected, it should be investigated and remedied immediately even if this falls outside of the normal maintenance schedule.

Removing/Installing the Controller on 10K/24K Units
Remove the cabinet top, follow the steps illustrated on page 23. Remove two (2) screws from the controller and lift it from the refrigerator far enough to detach its electrical connection wiring. Remove four (4) screws from the top of the refrigerator and lift the cabinet top to gain access to the area between the cabinet and the insulated inner vessel. On the 10K and 24K, the cabinet top may only be raised as shown because of the lid hinges. Do not remove the hinged lid. After the cabinet top is loosened and propped up, the electrical connection wiring may be detached to allow access to its back panel connection. At the completion of maintenance or repairs, reattach the electrical connection wiring to the controller.

Ice or frost in the sensor tube may restrict the movement of sensor probes in the tube. Do not pull excessively on the sensor wiring while attempting to remove sensors. It may be necessary to remove the sensor tube from the container and allowed it to thaw before the sensors can be removed.

To install the controller, install the electrical supply connections panel to the back of the refrigerator. Feed the wiring harness from the electrical supply connections panel to the front of the refrigerator and through the opening to where the controller will be mounted. Attach the electrical supply connections to the controller board. Be sure to follow all of the installation procedures for the thermocouple, sensor probes and solenoid valve before you reattach the cabinet top. Reattach the cabinet top with the (4) four screws that were taken

out to remove the cabinet top. Carefully lower the controller into the cabinet. Attach the controller to the cabinet top with the (2) two supplied screws. Be sure that all of the necessary installation procedures have been completed before you start to fill the refrigerator. To start filling, refer to Filling the Refrigerator (Initial Fill) section of this manual.



Removing/Installing the Sensor Probes
Remove the controller using the procedures outlined for your particular refrigerator model in Removing/ Installing the Controller section. Disconnect the sensor probe lead connection from the controller board. Carefully remove the sensor tube plug from the sensor tube and remove the sensor leads from the plug.

Making Adjustments to the Sensor Assembly
The sensor assembly is pushed to the bottom of the refrigerator as delivered from the factory. If adjustments need to be made, the following procedure will simplify the process.

This can be done as follows:
Push the sensor down the sensor tube until it touches the bottom of the refrigerator.
Mark the sensor wire where it emerges from the top of the sensor tube.
Using the marked wire as a reference, pull the sensor up the same distance as the offset setting. The sensor assembly is now in the correct location.

Removing/Installing the Solenoid Valve
Remove the back plumbing cover of the refrigerator to gain access to the plumbing and solenoid valve. Disconnect only the solenoid valve wiring harness lead connection from the valve. Remove the back plumbing cover of the refrigerator to gain access to the plumbing and solenoid valve.

To remove the solenoid valve loosen the compression fitting that connects the plumbing tubing to fill tube. Unscrew the two (2) mounting screws that hold the solenoid valve to the solenoid bracket. Then remove the solenoid valve and its associated plumbing. Disconnect the plumbing from the inlet and outlet side of the solenoid valve.

Operation

To install a new solenoid valve, attach the connecting plumbing to the inlet and outlet connections of the valve using Teflon tape. Attach the compression fitting to the fill tube first and then connect the compression fitting to the elbow that is connected to the outlet side of the solenoid valve. Position the solenoid valve onto the solenoid valve bracket and tighten the two (2) mounting screws. Attach the solenoid valve wiring harness lead connection to the valve.

Troubleshooting

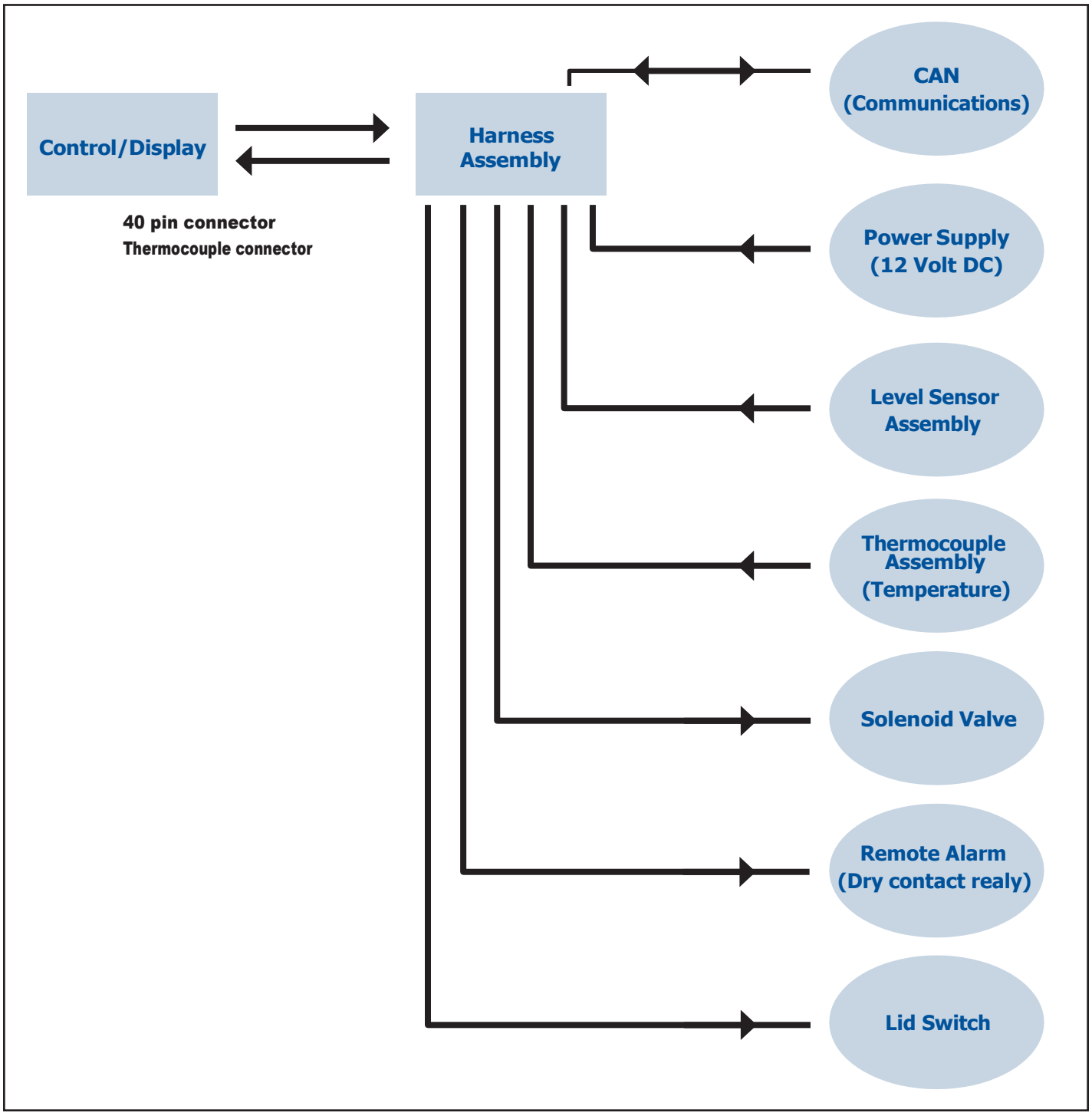
If the Voyager freezer experiences problems or appears that it is not operating at optimum efficiency, please contact your supplier for assistance. The CS100 has incorporated state of the art diagnostic tools to assist in the identification and correction of any issues that may arise.

Product Information

Specifications	
Control Type	**LN_2 Level Control**
Level Measurement	
Sensor Type	**4-Thermistor Fixed**
Range	**Low, Normal, High**
Redundancy	**Multiple discrete points**
Temperature Measurement Sensor Type	**Type T Thermocouple**
Accuracy	**1° or 1.5% of reading, whichever is greater**
Resolution	**.1°C**
Number of channels	**1**
Temperature Display Units	**°C**
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**
Frequency	**50/60 Hz**
Output	**12 VDC**
Control Input Voltage	**12 VDC**
Power cord	**Available for all countries**
Solenoid Valve	
Input Voltage	**12 VDC**
Input Current	**.96 amps**
Communications	
Protocol	**CAN**
Number of Communication Ports	**1**

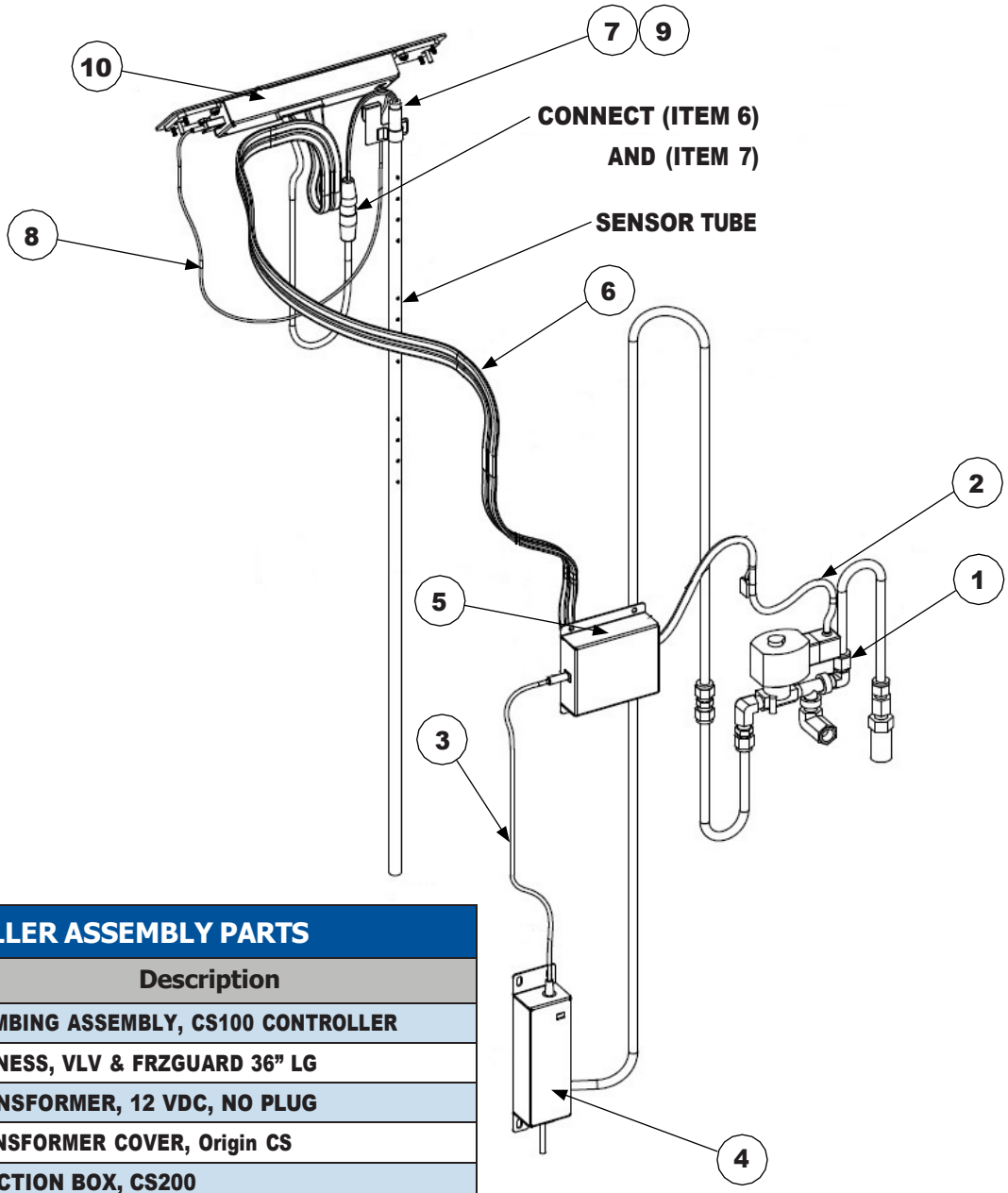
User Interface	
Display Type	LED Array
Buttons	4
Level Display	4 LED's
Filling	1 LED
Control Tests	
Power Up Self-Test	Control system check
Thermistor Status	Yes
Alarms	
Low Level Alarm	Always enabled
High Level Alarm	Always enabled
Sensor Error Alarm	Always enabled
High Temperature	Alarm Programmable
Thermocouple Open Alarm	Always enabled
Remote Alarm	Always enabled
Power Failure (Remote only)	Always enabled
Low Supply	Alarm Programmable
Audible Alarm	Always enabled
Audible Alarm	Re-trigger Programmable
Visual Alarm Indicator	Always enabled
Buttons	
Fill (up arrow)	Open Valve (Menu up)
Stop Fill (down arrow)	Close Valve (Menu down)
Menu (Enter)	Access Menu (Save setting)
Mute (Back)	Silence audible (Exit menu level)
Data Collection	
Temperature	Yes
Level	Yes
Alarms	Yes
Memory	4 Mb

Interconnection Block Diagram



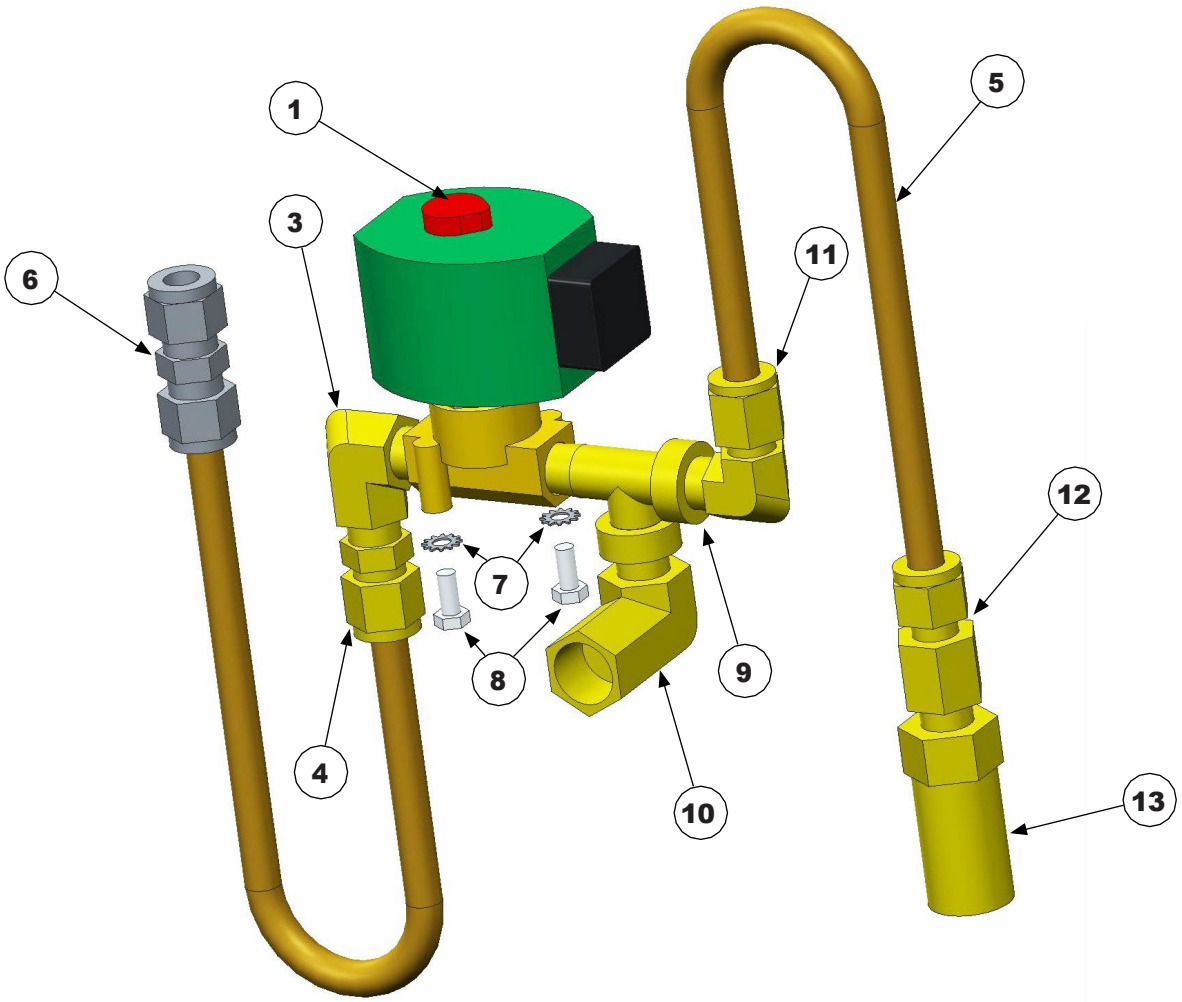
Parts List

The parts and components listed below have been specified and tested for use with the CS100. These are not user serviceable parts. Replacement parts should be obtained from your distributor or supplier.



CONTROLLER ASSEMBLY PARTS		
Item	Part No.	Description
1	R10K-8C69	PLUMBING ASSEMBLY, CS100 CONTROLLER
2	367909	HARNESS, VLV & FRZGUARD 36" LG
3	367823	TRANSFORMER, 12 VDC, NO PLUG
4	367824	TRANSFORMER COVER, Origin CS
5	376044	JUNCTION BOX, CS200
6	367911	HARNESS ASSY, 10K-CS 74" CABLE
7	375892	4-THERMISTOR SENSOR ASSY
8	366891	THERMOCOUPLE ASSY
9	367859	PLUG FOR SENSOR TUBE
10	372606	CONTROLLER, CS100
11	367795	LID SWITCH ASSY, CS200 CTRL
12	367796	LID SWITCH EXT WIRE, Origin CS200

Replacement Parts



PLUMBING CONTROLLER ASSEMBLY PARTS		
Item	Part No.	Description
1	367778	VALVE, SOLENOID, 2-WAY, 1/4"FPT
2	367409	TEFLON TAPE 1/2" A/R
3	372607	ELL, 1/4" STREET, BRS
4	367174	CONN, MALE, 3/8"ODTX1/4"NPTM
5	366889	TUBE, U-SHAPED FILL CONN
6	367170	UNION, 3/8"ODT X 3/8"ODT, SS
7	367246	LOCKWASHER #10 18-8 SS
8	367723	SCREW, HEX HEAD, 10-32 X.50" LG
9	367265	TEE, STREET 1/4" NPT BRS
10	367259	ELL, 1/4"MNPTX 3/8"FNPT RED ST
11	367264	ELL, 3/8"ODT X 1/4" NPT-EXT
12	367176	CONN, FEM, 3/8" ODTX 1/4"FPT
13	367276	VALVE,RELIEF,100PSIG,1/4"MNPT

A complete list of Replacement Parts and Accessories for the CS100 Series Controllers is available from the following Froilabo:

Phone: +33 (0) 4 78 04 75 75

Email: commercial@froilabo.com

FREEZER SERVICE AND MAINTENANCE HISTORY LOG

Fill in top section at installation. Copy this form each time service is required.

Fill bottom section with service notes to keep a complete log of each freezer service and maintenance history. End User Company Name_____ LOG NO _____

Service Contract/Company Name_____

Service Contract Phone Number/Fax _____

Model/Serial Number _____

Controller Serial Number _____

Controller Version Number _____

In-service Date _____

Describe Conditions – Actual

Liquid Level – via Dipstick _____

Level Sensor Type _____FG_____ 4T_____

Lid _____ Open_____ Closed

Filling _____ Yes _____ No

Temperature_____

LN_2 Supply _____ltr_____ psi

Note: Ice Build-up __ a little __a lot

Gasket condition ____ Seals____ Leaks

Describe Conditions – Controller Reading

Liquid Level – Per Controller _____

Liquid Level Setting_____ HIGH _____ LOW

Lid_____Open _____ Closed

Filling _____ Yes_____ No

Temperature _____

Supply Alarm _____On_____ Off

Remote Alarm ____ On ____Off Note:

Audible Alarm ____ On _____Off Display Lights_____On Off

Service History Log (note date and log number on each service entry)

Date: _____

Date: _____

Date: _____

Date: _____

Date: _____

Date: _____

Date: _____

NOTE: All cryostorage systems must be cleaned and decontaminated prior to return to Froilabo for repair or maintenance and must be accompanied by a written statement to this effect. Any cryostorage system received without this statement will be returned to the sender, freight collect. Contact Customer Service by telephone:

+33 (0) 4 78 04 75 75 or email: commercial@froilabo.com

Appendix

Certifications & Listings

This product complies with the following standards and directives:

- CB Scheme Report and Certificate
- 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

TABLE 1 - Guidance and Manufacturer's Declaration – Electromagnetic Emissions

The CE CONTROL SYSTEM is intended for use in the electromagnetic environment specified below.
The customer or the end user of the CE CONTROL SYSTEM 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 CE 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 A**	**The CE CONTROL SYSTEM is suitable for use in all commercial establishments other than domestic, and many be used in domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes, provided the following warning is heeded.** **Warning: This equipment/system is intended for use by healthcare professionals only. This equipment/system may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation mesures, such as re-orienting or relocating the CE CONTROL SYSTEM or shielding the location.**
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 CE CONTROL SYSTEM is intended for use in the electromagnetic environment specified below. The customer or the end user of the CE CONTROL SYSTEM should assure that it is used 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 CE CONTROL SYSTEM requires continued operation during power mains interruptions, it is recommended that the CE 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.			

Appendix

TABLE 3 - Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The CE CONTROL SYSTEM is intended for use in the electromagnetic environment specified below.
The customer or the end user of the CE CONTROL SYSTEM should assure that it is used in such an environment.

Immunity Test	EN/IEC 60601 Test Level	Compliance Level	Intended Electromagnetic Environment
			Portable and mobile RF communications equipment should be used no closer to any part of the CE CONTROL SYSTEM, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Conducted RF EN/IEC 61000-4-6	3Vrms 150kHz to 80MHz	3Vrms 150kHz to 80MHz	Recommended separation distance $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ 80MHz to 800 MHz
Radiated RF EN/IEC 61000-4-3	3V/m 80MHz to 2.5GHz	3V/m 80MHz to 2.5GHz	$d = 2.3\sqrt{P}$ 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: 

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 radio (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 CE CONTROL SYSTEM is used exceeds the applicable RF compliance level above, the CE 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 CE 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 CE CONTROL SYSTEM.

The CE CONTROL SYSTEM is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the CE CONTROL SYSTEM can help prevent electromagnetic interference by maintaining a minimum distance between the portable and mobile RF communications equipment (transmitters) and the CE 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.

Appendix

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: **LN_2 Level Control for Cryostorage System**
Model/Type ref.: **CS CONTROL SYSTEM**

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

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

- **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 (Digitally signed by Kevin Oeff)**

Position: **President**
Date: **24 May 2012**
Place: **Indianapolis, IN USA**

Warranty

Froilabo 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. Froilabo at its option will either repair or replace any item covered under this warranty.

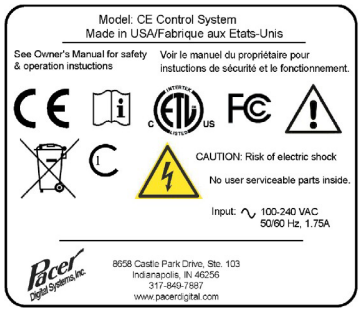
This warranty is void if the product is used for any other purpose than that for which it was designed, including but not limited to connection with third party systems. This warranty is also void if the product is in any way altered or repaired by others. Froilabo shall not be liable under this warranty, 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. Froilabo 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 Froilabo liability exceed the purchase price for the product.

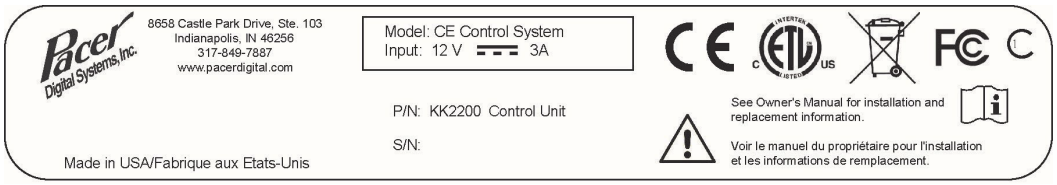
External Connector Ratings

Designated Use	Max rated voltage/current ratings	Connector type
Power	**36 VDC**	**2.5mm barrel connector**
CAN	**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**

Labels



Main Rating Label



Control & Display Label

[END]