

# CS 100

## CONTROL SYSTEM

### K SERIES CRYOSTORAGE SYSTEMS

### TECHNICAL & MAINTENANCE MANUAL



### 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 IC BIOMEDICAL LABS OR K SERIES UNITS, YOU MUST READ THE SEPARATE OPERATING AND SAFETY MANUAL PROVIDED WITH THAT UNIT.

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This manual covers the use and maintenance for the CS100 installed on the K SERIES Cryogenic Storage Systems. Please read all documentation before using this equipment and all personnel who use this equipment should be trained. In addition, all service and maintenance on this equipment should be performed by an authorized distributor, service company or technician.

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. IC Biomedical LLC, makes no representations or warranties with respect to this manual. In no event shall IC Biomedical LLC, be held liable for any damages, direct or incidental arising out of or related to the use of this manual.

WARNING! Avoid injury



WARNING! Low temperature



Read owner's manual before use.



Waste electrical and electronic equipment directive





Please use proper handling procedures when working with Liquid Nitrogen (LN<sub>2</sub>). It is an extremely cold refrigerant and can cause serious injury if not handled properly. Also, the liquefied gas can cause asphyxiation in a confined area so be sure that all confined areas have adequate ventilation. 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 offices/clinics as well as hospitals.
- 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.
- This product is not a large permanently-installed product that is part of a system.

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 Model CS100.

The Model CS100 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 only. 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 Model CE

## **CONTROL SYSTEM unit or shielding the location.**

Portable and Mobile RF communications equipment can affect the performance of the Model CS100. Please use the guidelines and recommendations specified in Tables 4 and 6.

Other Medical Equipment or Systems can produce electromagnetic emissions and therefore can interfere with the functionality of the Model CS100. Care should not be used when operating the Model CS100 adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the Model CS100 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. Care should be taken to use only manufacturer-recommended cables, power supplies and electrical accessories with the Model CS100. If a third-party supplier offers cables, external power supplies and electrical accessories for use with the Model CS100 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 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 Model CS100 or decreased electromagnetic immunity of the Model CS100.

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 K SERIES Cryostorage system should be positioned such that the all sides of the unit are easily accessible and the user can easily connect/disconnect the power cord from the wall socket.

## CS100 Components

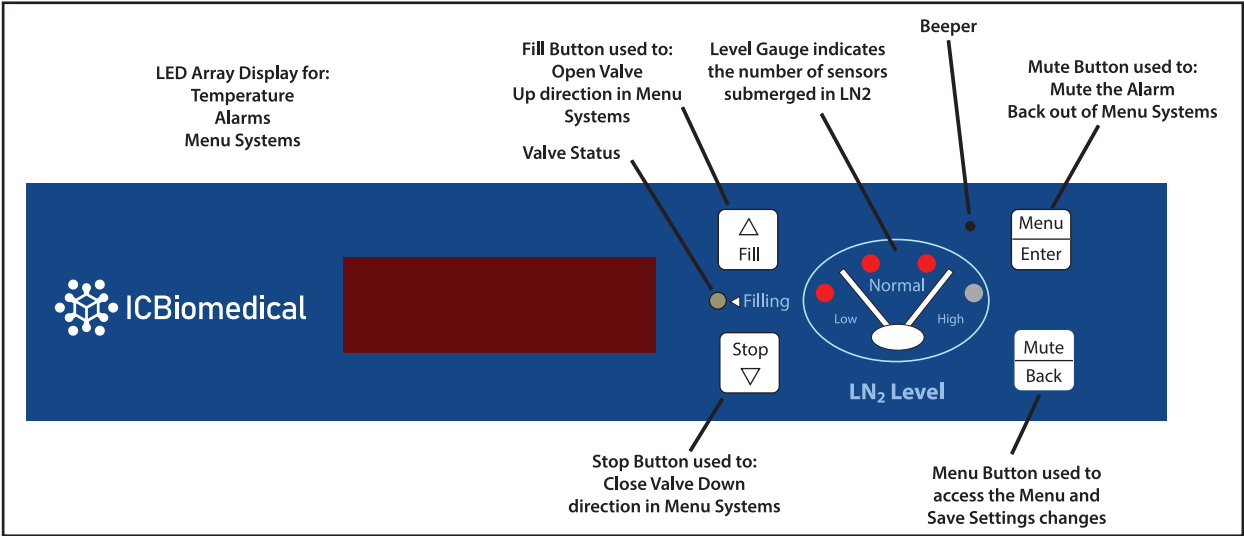
**The CS100 for the K SERIES Cryostorage system consists of the following components.**

- 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

5.1. Main Control Front Panel



5.2. Main Control Back Panel



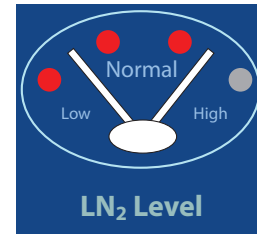
The LN2 level gauge on the face of the control indicates level by lighting the appropriate LED if a thermistor is submerged in LN2. In the picture, the Low Alarm thermistor, the Start Fill thermistor and the High Alarm thermistor are all submerged in LN2.

## 6.1. LN2 Level Measurement and Control

The CS100 uses thermistors to measure the LN2 level within the vessel. A thermistor is a thermal resistor and its resistance changes as the temperature changes. When a thermistor is submerged in LN2, 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 LN2 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 LN2 level drops below the Start Fill thermistor, the control opens a solenoid valve allowing LN2 to enter the vessel. This continues until the Stop Fill thermistor is submerged in LN2 at which point the solenoid valve is closed preventing the flow of additional LN2 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.



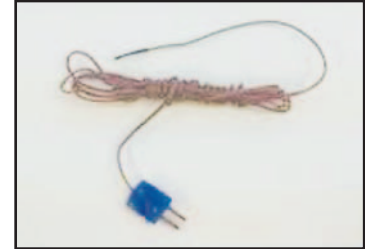
The LN<sub>2</sub> level gauge on the face of the control indicates level by lighting the appropriate LED if a thermistor is submerged in LN<sub>2</sub>. In the picture, the Low Alarm thermistor, the Start Fill thermistor and the High Alarm thermistor are all submerged in LN<sub>2</sub>.



## 6.2. 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 K SERIES freezer and the temperatures are measured at that point. Multiple temperature values are taken per second and then averaged.

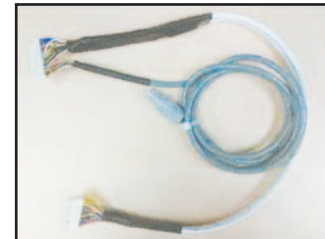
The control provides a High Temperature Alarm which can be adjusted by the user. If the temperature exceeds the temperature alarm set point, the display flashes and an audible alarm is triggered.



## 6.3 Harness Assembly

Provides a High Temperature Alarm 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.



## 6.4. 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**

LN2 level is too low. Thermistor #1 on the sensor assembly is not submerged in LN2.

### **High Level Alarm**

LN2 level is too high. Thermistor #4 on the sensor assembly is submerged in LN2.

### **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 head 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

## 6.5. Operation Data

The CS100 stores data related to the operation of the Cryostorage 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.

## 6.6. 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.


## 7.1. Level


The standard sensor assembly that is installed on a freezer consists of a circuit board with thermistors installed. The assembly has a fixed range of 2". 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.


## 7.2. 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 jump back to the main operational screen.


## 7.3. 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 high temperature alarm setting. If the temperature sensor is turned off, no temperature is displayed and no high temperature alarm can occur.

## 7.4. 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: 

## 7.5. 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 insure that the supply valve on turned on, a sufficient supply of LN2 is available in the supply cylinder and the head pressure is adequate.

## 7.6. High Temp Alarm

The High Temp Alarm setting determines the temperature that 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.

## 7.7. 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.

## 7.8. 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.

## 7.9. 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 minute increments.

## 7.10. Display Brightness

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

## 7.11. 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.

## 8. Menu System

1. Thermocouple Enable	On/Off
2. Set Date/Time	Hr – Min – Mon – Day – Yr
3. Low Supply Alarm	30-120
4. High Temp Alarm	0° to -196°
5. Temp Alarm Delay	0-60
6. Audible Alarm Retrigger	0 to 720
7. Remote Alarm Delay	0 to 720
8. Display Brightness	1 to 15
9. About	K SERIES V0.5 Firmware SER 12345 Serial Number

## 9. 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 minute
• Remote Alarm Delay	30 minutes
• Display Brightness	7

## 10. 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.

To ensure proper operation and maintain excellent performance of the K SERIES, a regular maintenance schedule should be followed for the CS100. This would include the following:

## CS100 Control System

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.

## Solenoid Valve

Examine wires and connector for damage. Replace every 2 years.

## Level Sensor Assembly

Examine for damage to wires and connector. Replace every 2 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.

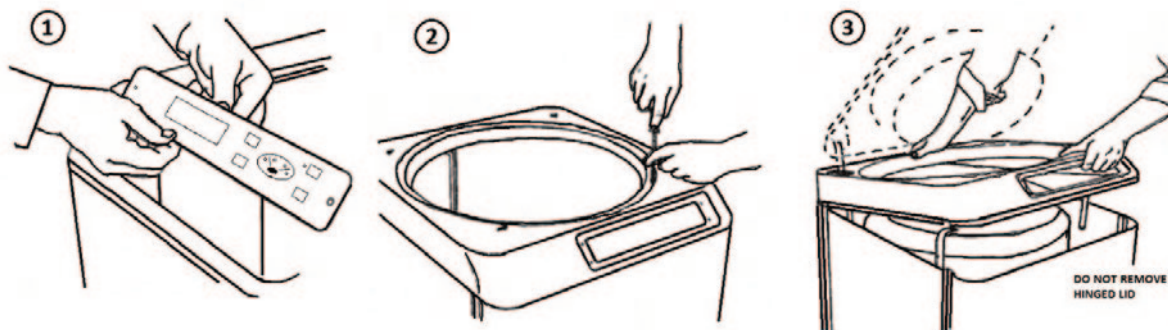
If any intermittent operation with the Cryostorage System is observed or suspected, it should be investigated and remedied immediately even if this falls outside of the normal maintenance schedule.

## Removing/Installing the Controller 10K/24K Units

Remove the cabinet top, follow the steps illustrated on page 18. 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.



## Removing/Installing the Thermocouple

Remove the controller using the procedures outlined for your particular refrigerator model in Removing the Controller section. Disconnect only the thermocouple lead connection from the controller board. Gently pull the thermocouple from the sensor tube.

To install a thermocouple, feed the thermocouple lead into the sensor tube to an elevation in the storage chamber you want to monitor. Connect the thermocouple to the controller board. At the completion of maintenance or repairs, install the controller using the procedure outlined for your refrigerator model in the Removing/Installing the Controller section.

## 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 factory settings for the CS100 control system are as follows:

- Low Level Alarm = 1 (Always 1" below the start fill)
- Start Fill Sensor = 2
- Stop Fill Sensor = 4
- High Level Alarm = 5 (Always 1" above the stop fill)

The sensor assembly is located at the bottom of the refrigerator as delivered from the factory. If adjustments need to be made, the following procedure will simplify the process.

- Determine the range of LN level in the refrigerator (i.e. Start Fill = 9; Stop Fill = 12) 2
- Determine the appropriate offset by subtracting 2 from the Start Fill. (i.e. Offset =  $9 - 2 = 7$ )
- Set the sensor assembly so that the very bottom of the assembly matches the desired offset. 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.

To make adjustments to a sensor assembly in a refrigerator filled with LN, the following procedure can be used:

Measure the LN liquid level in the refrigerator.

Take this measured level and subtract the offset to determine how many sensors should be in liquid.

Select **MENU**, Change Settings, Level, Thermistor Status. “L” means a sensor is in liquid while “G” means a sensor is in gas.

Move the sensor up or down so that the appropriate numbers of sensors are in liquid “L”.

Go back to the Thermistor status screen and the level indicated should match the physically measured reading. The Sensor Offset, the Start Fill and the Stop Fill can all be set through the MENU, Change Settings, Level, Sensor Position.

## Removing/Installing the Solenoid Valve

Remove the controller using the procedures outlined for your particular refrigerator model in the Removing/Installing the Controller section. Disconnect only the solenoid valve lead connection from the controller board. 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.

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 lead connection to the controller board. At the completion of maintenance or repairs, install the controller using the procedure outlined for your refrigerator model in the Removing/Installing the Controller section.

## Troubleshooting

If the K SERIES 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.

## Specifications

<b>Control Type</b>	LN2 Level Control
<b>Level Measurement Sensor Type</b>	4-Thermistor Fixed
<b>Range</b>	Low, Normal, High
<b>Redundancy</b>	Multiple discrete points
<b>Temperature Measurement Sensor Type</b>	Type T Thermocouple
Accuracy	1° or 1.5% of reading
Resolution	.1° C
Number of channels	1
Temperature Display Units	° C
<b>Electrical</b>	
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
<b>Solenoid Valve</b>	
Input Voltage	12 VDC
Input Current	.96 amps
<b>Communications</b>	
Protocol	CAN
Number of Communication Ports	1

## Specifications

<b>Control Type</b>	LN2 Level Control
<b>Level Measurement Sensor Type</b>	4-Thermistor Fixed
<b>Range</b>	Low, Normal, High
<b>Redundancy</b>	Multiple discrete points
<b>Temperature Measurement Sensor Type</b>	Type T Thermocouple
Accuracy	1° or 1.5% of reading
Resolution	.1° C
Number of channels	1
Temperature Display Units	° C
<b>Electrical</b>	
Input Voltage	100-240 VAC
Input Current (max)	1.75 A <sub>Input</sub>
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
<b>Solenoid Valve</b>	
Input Voltage	12 VDC
Input Current	.96 amps
<b>Communications</b>	
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)

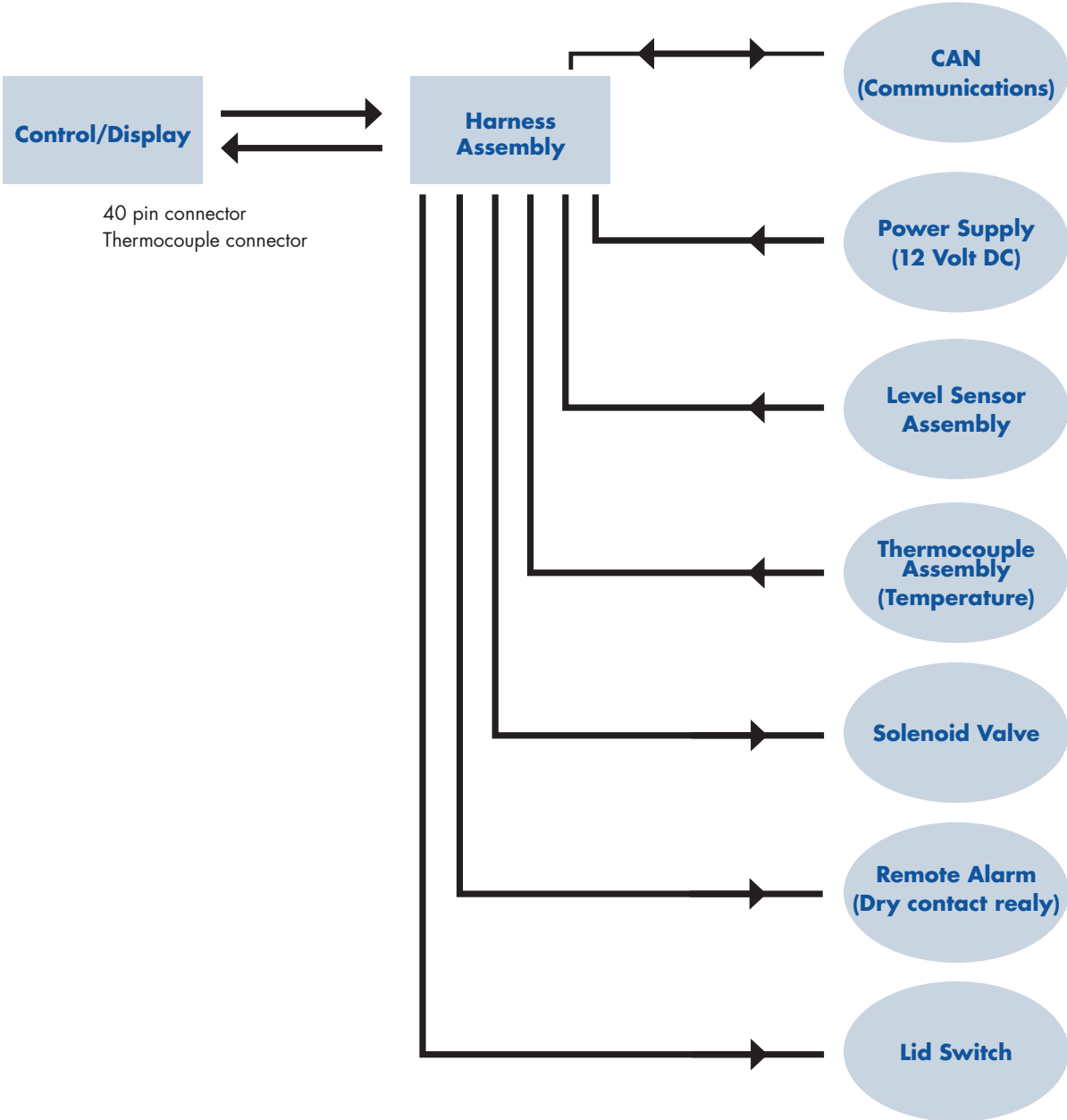
## Data Collection

Temperature	Yes
Level	Yes
Alarms	Yes
Memory	4 Mb

Dimensions

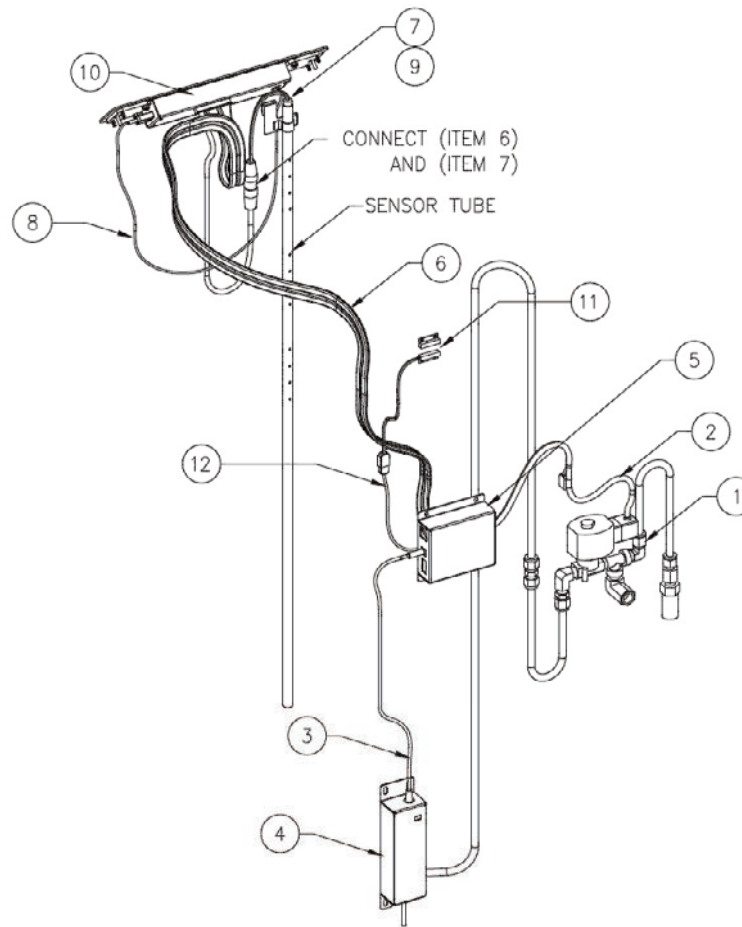
Width	9.5" (241 mm)
Height	2.0" (5.1 mm)
Depth	1.31" (3.3 mm)
Weight	.625 lbs (.28 kg)

13.2. Interconnection Block Diagram



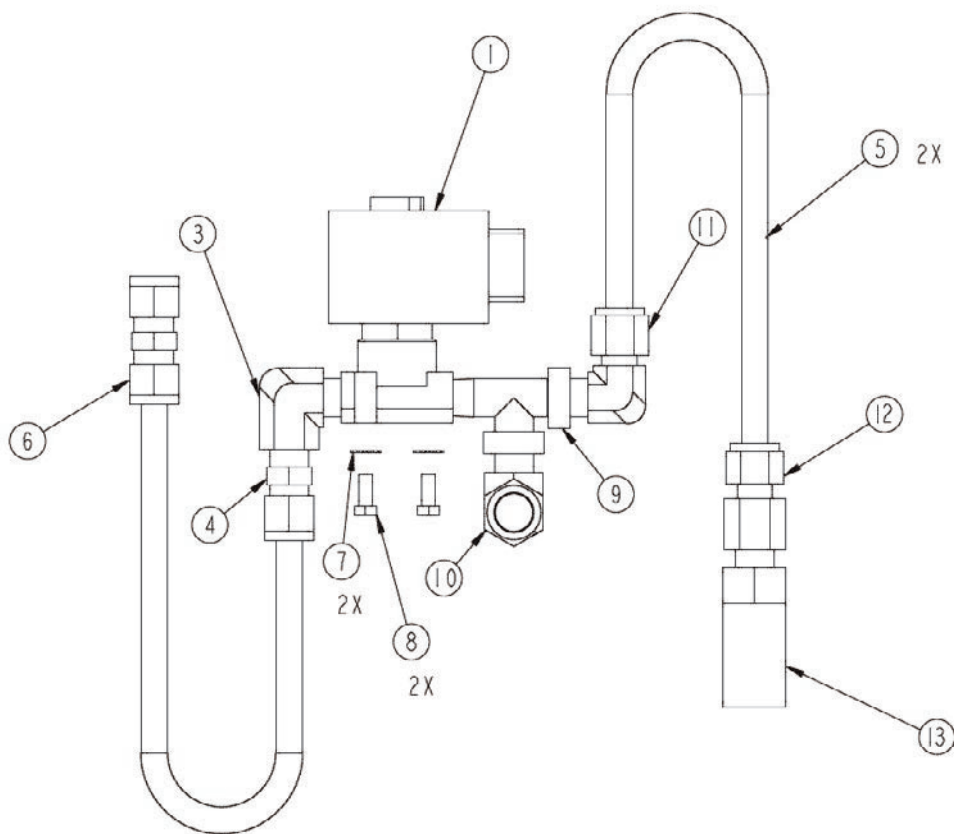
## 13.3. Parts List

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.



BILL OF MATERIAL			
ITEM NO.	PART OR CODE NO.	NO. REQ'D	DESCRIPTION
1	R10K-8C69	1	PLUMBING ASSEMBLY, CS100 CONTROLLER
2	5140-1279	1	SOLENOID VALVE HARNESS, K-CS-SERIES, 36"
3	5140-1229	1	12 VDC TRANSFORMER NO PLUG
4	LA80-9C51	1	TRANSFORMER COVER, LABS CS
5	5140-1285	1	JUNCTION BOX, WITH NO "T" PLATE, CS200
6	5140-1283	1	HARNESS ASSEMBLY 10K-CS, 74" CABLE
7	5140-1281	1	LEVEL SENSOR-4 THERMISTERS, CS100 CONTROL
8	RO8K-9C51	1	THERMOCOUPLE ASSEMBLY
9	R10K-9C63	1	PLUG, SENSOR TUBE
10	5140-1276	1	CS100 DISPLAY/ CONTROL WITH MOUNTING WINGS
11	5140-1247	1	LID SWITCH ASSEMBLY
12	5140-1248	1	LID SWITCH EXTENSION WIRE

## 13.3a Part List



BILL OF MATERIALS			
ITEM NO.	PART OR CODE NO.	NO. REQ'D	DESCRIPTION
1	6999-9041	1	12 VDC CRYOGENIC SOLENOID VALVE CS200
2	99400975	A/R	TAPE, TEFLON, 1/2" WIDE
3	6814-3998	1	ELBOW, 90 DEG., STREET, 1/4 NPT, BRASS
4	45701960	1	CONNECTOR, MALE, 3/8" ODT X 1/4" MNPT, BRASS
5	R08K-9C42	2	TUBE, FILL KIT
6	45554690	1	UNION 3/8" ODT X 3/8" ODT, STN STL
7	6460-7090	2	WASHER, EXTERNAL TOOTH, #10
8	6160-4905	2	SCREW, MACHINE, HEX HEAD, 10-32 UNC x 0.44 LG
9	6816-0025	1	STREET TEE, 1/4", BRASS
10	6814-4178	1	ELBOW, 90 DEG, STREET, 3/8 FNPT X 1/4 MNPT, BRASS
11	6814-9973	1	ELBOW, 90 DEG., 1/4" MNPT X 3/8" ODT, BRASS.
12	45701970	1	FEMALE CONNECTOR, .38 ODT COMPRESSION x .25 FPT, BRASS
13	6913-9077	1	RELIEF VALVE, 1/4" MNPT, 100 PSIG, BRASS

## 14. EN Compliance Tables


14.1- 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 may 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:  <b>Warning:</b> 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 measures, 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	

## 14.2 - 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 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 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.			

## 14.3 - 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 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 CE CONTROL SYSTEM including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.  <b>Recommended separation distance</b> $d = 1.2\sqrt{P}$  $d = 1.2\sqrt{P}$ 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 <sup>a</sup> , should be less than the compliance level in each frequency range. <sup>b</sup>  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.			
<sup>a</sup> 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.			
<sup>b</sup> Over the frequency range 150kHz to 80MHz, field strengths should be less than 3V/m.			

## 14.4 - Table 4

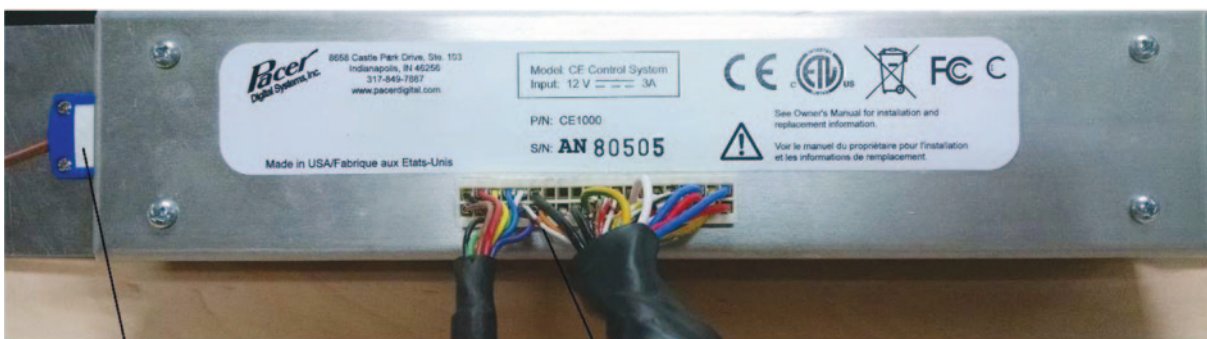
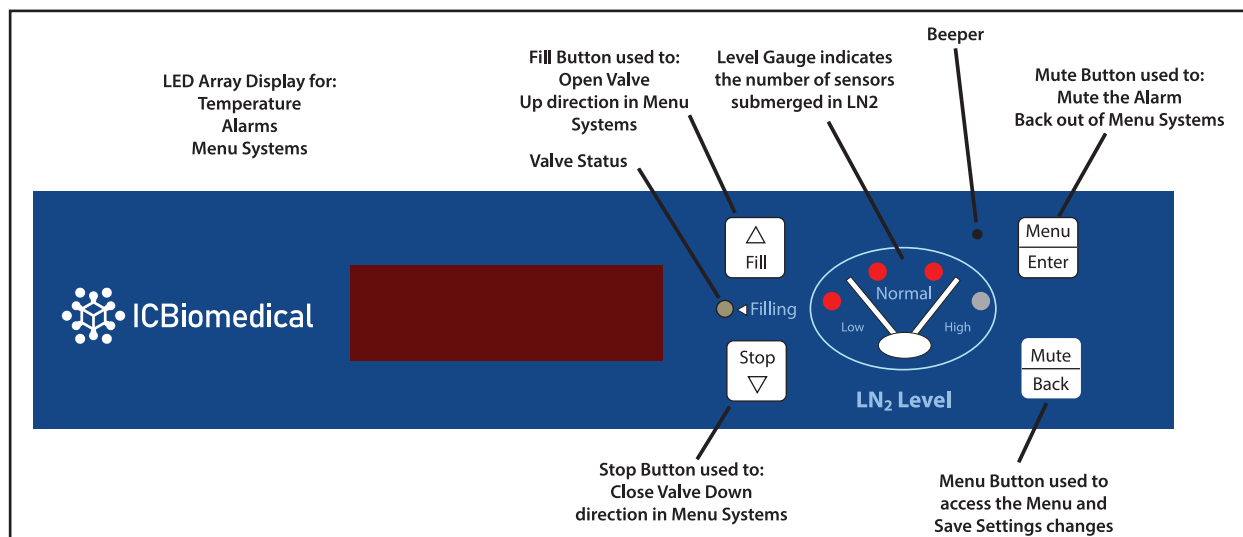
Recommended separation distances between portable and mobile RF communications equipment and the CE CONTROL SYSTEM.			
The CE CONTROL SYSTEM is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the CE CONTROL SYSTEM can help 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.			

## 15. Appendix A - 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.

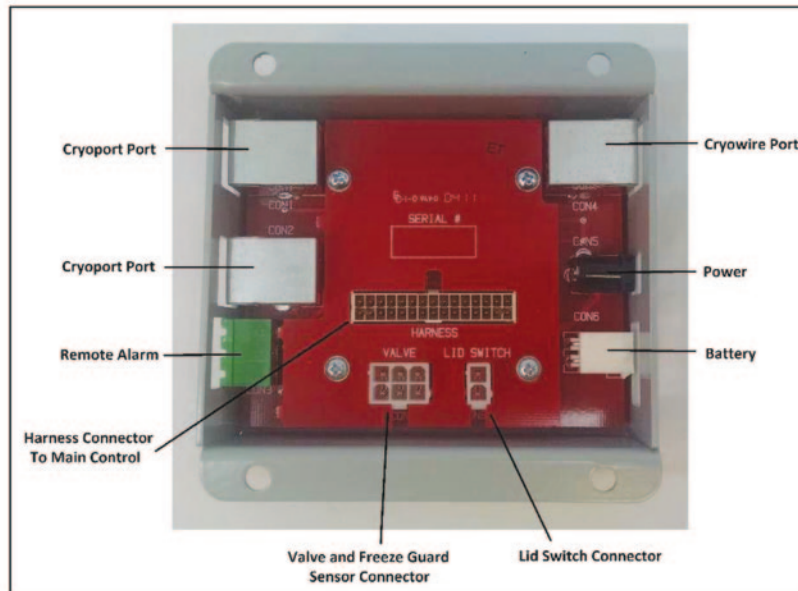


Thermocouple Assembly

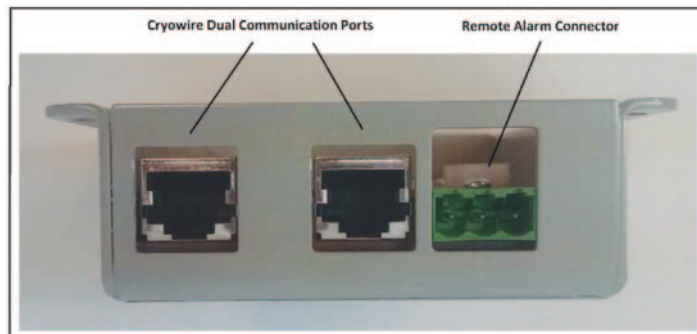
Harness Assembly

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 colored blade is plugged into copper colored contact on receptacle.

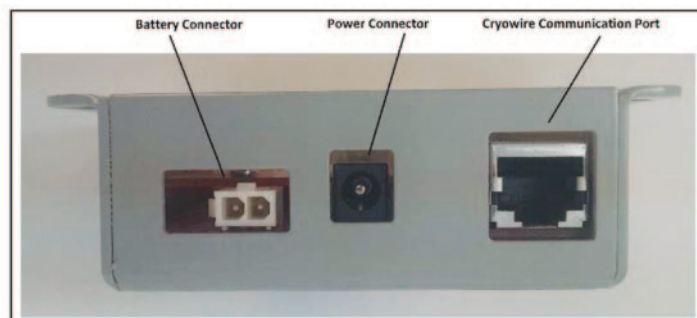
Connect the level sensor assembly into the panel at the end of the level sensor harness assembly. The connector is a round locking connector that is keyed so it can only be plugged in one way.



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.

## 16. Appendix B – Temperature Calibration

The CS100 control system uses a type T thermocouple to measure temperature within the Cryostorage vessel. The temperature curve for a thermocouple is nonlinear so it is important that the CS100 have 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 the 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 LN<sub>2</sub>. 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  

Press 5 times until the display reads  



Press to enter the calibration mode  the display will read 

Submerge the thermocouple into an ice water bath. The number of dots will decrease as the control approaches a good calibration point.

When the display shows  , press  (0, 1 or 2 dots will provide a good calibration)

The display will now read 

Submerge the thermocouple into LN<sub>2</sub>. The number of dots will decrease as the control approaches a good calibration point.

When the display shows  , press  (0, 1, or 2 dots will provide a good calibration)

If the calibration values fall within the expected range, a message will be displayed 

## 17. Appendix C – 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



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