CRYOMAGNETICS, INC.

Model 1200 S/H Digital Sample and Hold Liqid Helium Monitor

Operation and Instruction Manual

WARNING: Do not attempt to operate this equipment before you have thoroughly read this instruction manual.

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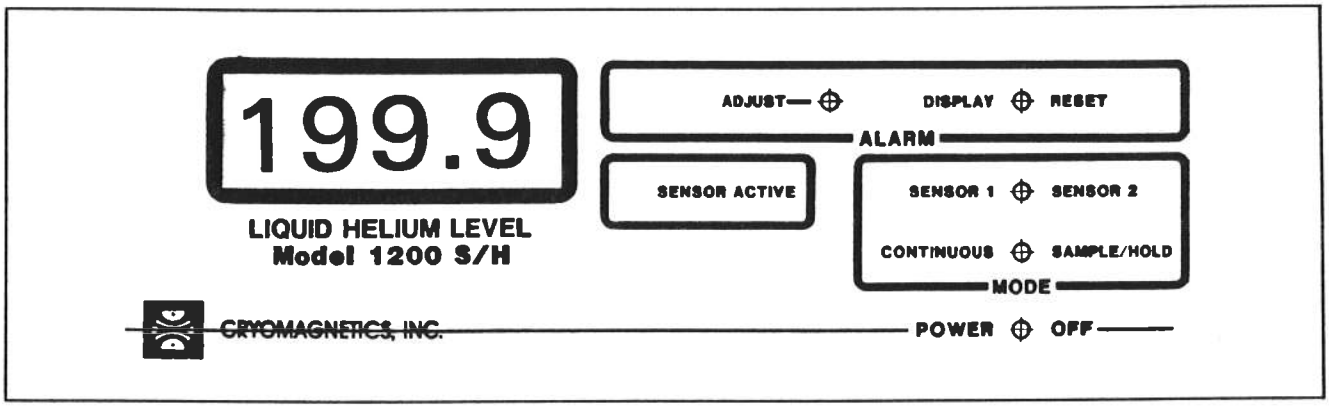
MODEL 1200 S/H
DIGITAL SAMPLE AND HOLD HELIUM LEVEL MONITOR

The Model 1200 S/H represents a major step forward in helium level monitoring technology. It provides all of the high performance features normally found in only the most advanced instruments while maintaining a surprisingly affordable price. In addition, the 1200 S/H offers a unique "deicing" cycle to insure accurate readings even under the most adverse cryogenic conditions. A variety of options are available to allow the instrument to be upgraded and tailored to your particular requirements.



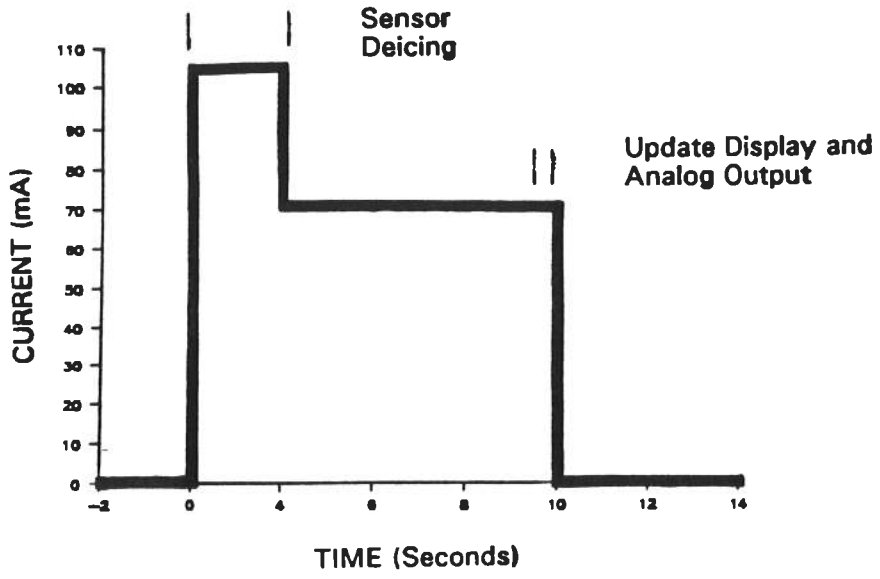
STANDARD FEATURES

* CONTINUOUS/SAMPLE AND HOLD/MANUAL UPDATE operational modes.
* Low noise, Adjustable, Linear current source.
* 0.4 inch high, 3.5 Digit LED readout.
* Plug-in Sensor Connections.
* Tilt Stand
* Compatible with 3 or 4 wire superconductive filament sensors (CI/ AMI/ Oxford) up to 200 cm active sensing length.
* Easy calibration in inches, cm or per cent.
* Remote control capabilities via TTL signals.
* Rugged, lightweight construction.
* Options available for analog output, alarm, two sensor operation, and rack mounting

THEORY OF OPERATION

The Model 1200 S/H is designed to be used with 3 or 4 wire superconductive filament level sensors (an industry standard). These sensors use a single filament of NbTi as the level sensing element. To activate the sensors a small constant current is applied to the filament forcing the portion of the filament which is in the helium gas to become resistive. The portion of the filament in the liquid remains superconducting. By reading the voltage across the filament the Model 1200 S/H determines the length of filament which is resistive (i.e. above the liquid helium surface.) This voltage is converted, according to the instrument's calibration, into a liquid level which is then displayed.

The Model 1200 S/H contains circuitry enabling it to perform a "Sensor Read" cycle during which the helium level sensor is activated only long enough to obtain a valid reading of the helium level. The sensor is then turned off to avoid unnecessary heat load on the cryostat - thus minimizing helium boil-off. The Model 1200 S/H also provides a unique "Sensor Deicing" cycle within the "Sensor Read" cycle. During deicing, the sensor's current is briefly pulsed to clear any ice blockages which may have formed on the sensing filament. This insures a highly accurate reading of the liquid level even when refilling the cryostat or when the cryogenic environment has been corrupted with frozen air or ice. The Sensor Deicing cycle can be disabled if desired.



SPECIFICATIONS

Accuracy:	1 mm resolution, 0.5% linearity
Probe:	Up to 200 cm active sensing length to 10 Tesla magnetic field, liquid helium temperature between 1.8 and 6.0 Kelvin.
Standard Sample and Hold Intervals	CONTINUOUS, 10 minute, 30 minute, 60 minute, 4 hour, 8 hour, 24 hour. Switch selectable on rear panel dipswitch.
Remote Control:	All I/O functions use standard TTL logic levels (0 to +5 V). CONTINUOUS/SAMPLE-HOLD selection.....Input Sensor Read Cycle in effect.....Output Sensor Selection (Option 003).....Input Alarm Status (Option 002).....Output Alarm Reset (Option 002).....Input Alarm Relay Contacts (Option 002). Common, Normally Open, Normally Closed.
Dimensions:	6.25" (159 mm) X 2.5" (63.5 mm) X 8.1" (205 mm) deep
Weight:	3.1 lbs (1.4 kg)
Power Requirements:	115/230 Vac +/- 10%, 50/60 Hz

OPTIONS

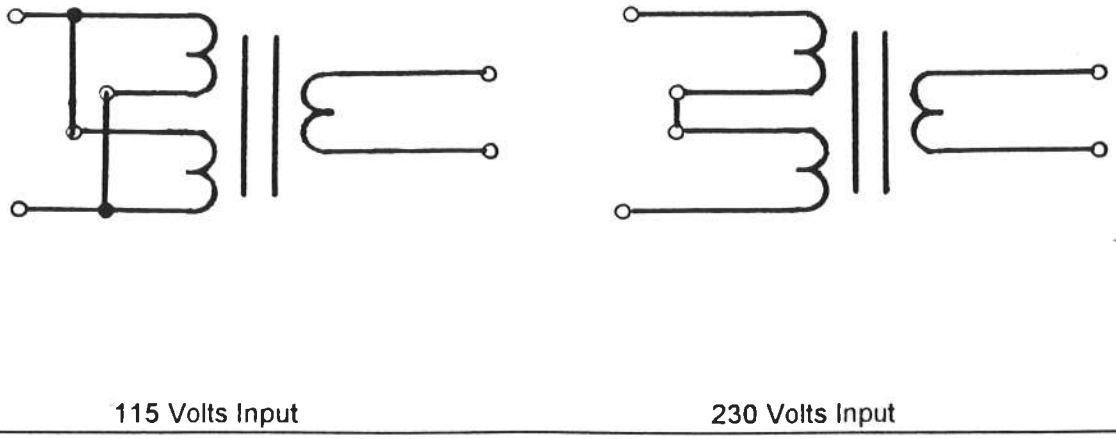
Option #	Option Name	Description
001	*Analog Output*	Provides analog voltage or 4-20 mA output for recorder or computer monitoring through rear panel BNC connector. Analog signal is maintained even when sensor has been deactivated. SPAN adjustment through rear panel.
002	*Alarm Option*	Adjustable set point on front panel. Alarm level display. Alarm reset via front panel or remote control. LED, audible (can be deactivated), and relay contact indications of alarm trip.
003	*Two Sensor Option*	Second sensor input, calibrations for sensor 1 and sensor 2 are completely independent. Front panel or remote control of active sensor.
004	*Rack Mount*	Standard 19 inch wide X 3.5 inch high

SECTION 1.0
SETUP AND CALIBRATION

The Model 1200 S/H is delivered to you fully tested and ready to operate. If the active sensing length of the sensor(s) has been specified at the time of order, the unit will be fully calibrated. Unless otherwise specified, the Model 1200 S/H will be supplied for operation with 115 VAC +/- 10%, 60 Hz input power. In the following sections there is a detailed description on how to recalibrate for different sensor lengths, change line voltage and line frequency requirements. Also there are instructions on how to calibrate the optional analog output and set the optional alarm.

Section 1.1 Procedure for Change of Input Voltage

Before beginning this procedure make sure the power cord is disconnected. Place the instrument on its top. Locate the two screws on either side of the bottom panel. Remove these screws and remove the bottom panel to reveal the power transformer. Change the two wire connections on the primary side of the transformer as shown below. In order for the timing of the Model 1200 S/H to be correct see Section 1.2 to make sure the instrument is correctly set for 50 or 60 Hz.

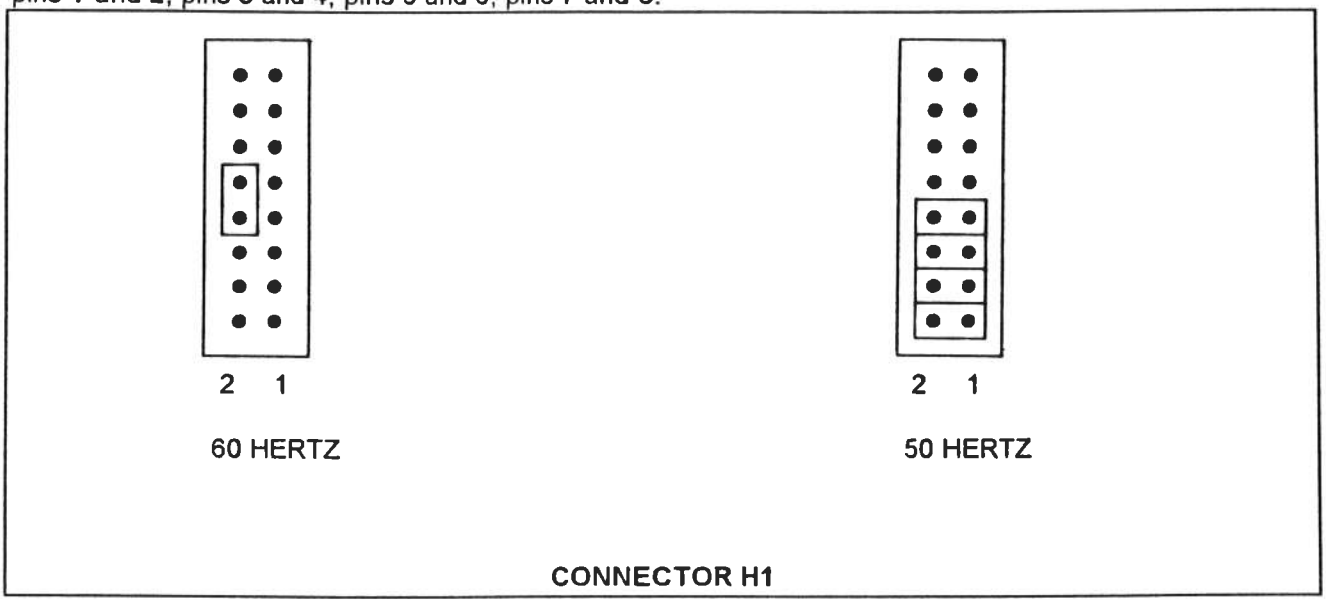


115 Volts Input

230 Volts Input

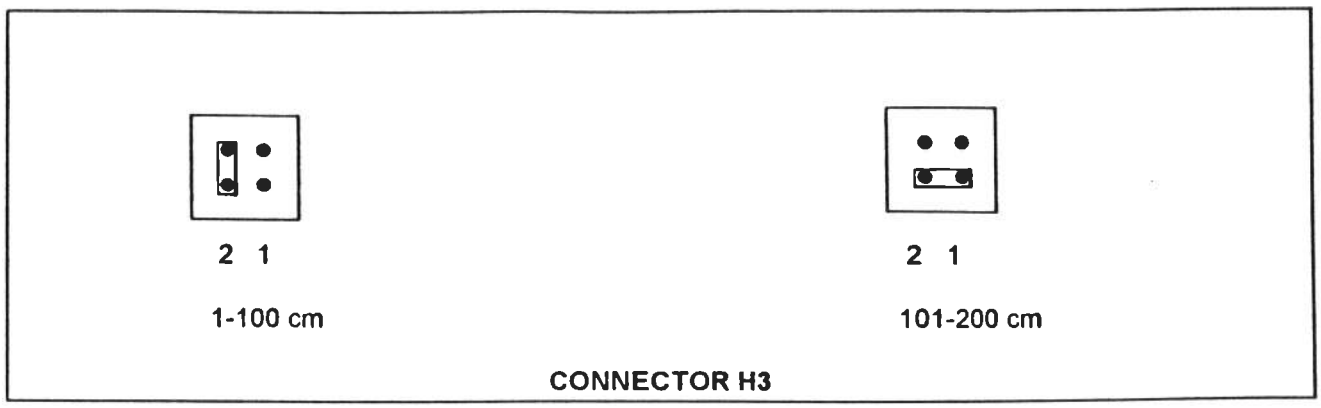
Section 1.2 Procedure to Select Line Frequency

The Model 1200 S/H uses line frequency to determine all timing sequences within the instrument. If the instrument will be used in an area where the line frequency differs from the factory setting, the timing between samples will not be accurate. Setting the correct line frequency is a simple procedure. Using the method described in Section 1.1 to remove the case, locate on the circuit board a 16 pin header labeled H1. For 60 Hz, only one jumper is required between pins 8 and 10. For 50 Hz, four jumpers are required: pins 1 and 2, pins 3 and 4, pins 5 and 6, pins 7 and 8.



Section 1.3 Procedure for Sensors Longer than 100 cm

To reduce unnecessary heat buildup in the power supply section of the Model 1200 S/H, a provision has been made to select between sensors of active length between 1 and 100 centimeters and between sensors of active length between 101 and 200 centimeters. The Model 1200 S/H is factory set for use on sensors between 1 and 100 centimeters active length (Unless otherwise specified at the time of order). For sensors between 101 and 200 centimeters active length a jumper change must be made on the circuit board. Using the method described in Section 1.1 to remove the case, locate on the circuit board a 4 pin header labeled H3. For sensors between 1 and 100 centimeters active length jumper pins 2 and 4 together. For sensors between 101 and 200 centimeters active length jumper pins 1 and 2 together. Refer to the diagram on the following page.



CONNECTOR H3

Section 1.4 Calibration

Unless otherwise specified at the time of order, the Model 1200 S/H will be calibrated for 100 centimeter active length sensor(s), output read current of 70 milliamps, output boost current of 105 milliamps. The boost current provides a 4 second high current to the sensor to help "deice" the sensor before the 8 second low current read cycle. This method gives the most accurate helium level readings in the most adverse conditions. The boost and read currents can be readjusted if so desired.

*****THE FOLLOWING SHOULD ONLY BE ATTEMPTED BY PERSONS QUALIFIED TO WORK ON ELECTRONIC EQUIPMENT DUE TO THE FACT THAT HIGH VOLTAGES ARE DEVELOPED IN THE POWER SUPPLY SECTION OF THE MODEL 1200 S/H, SEVERE INJURY CAN OCCUR*****

Section 1.41 Set Boost Cycle Current

Following the method described in Section 1.1 remove the case. Locate on the circuit board a potentiometer labeled P6. This potentiometer is the boost current adjustment. Connect an ammeter between pins A and B of the Sensor Connector at the rear panel (If your Model 1200 S/H has the 2 Sensor Option be sure the ammeter is connected to the active sensor). Make sure the instrument is set to CONTINUOUS read operation. Power ON the instrument and adjust P6 during the boost cycle to the desired current. By switching the mode switch between SAMPLE/HOLD and CONTINUOUS a new boost cycle will be entered.

Section 1.42 Set Read Cycle Current

Using the method described in Section 1.1 remove the case. Locate on the circuit board a potentiometer labeled P7. This potentiometer is the read current adjustment. Connect an ammeter between pins A and B of the Sensor Connector at the rear panel (If your Model 1200 S/H has the TWO SENSOR Option be sure the ammeter is connected to the active sensor). Make sure the instrument is set to CONTINUOUS Read operation. Power ON the instrument. After the boost cycle ends the current should settle to approximately 70 milliamps. Now adjust P7 to the desired output current.

Section 1.43 SPAN Adjustment

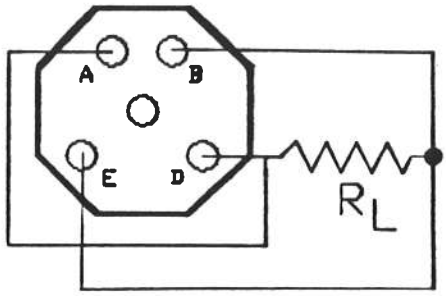
Remove the male sensor connector from the rear panel of the Model 1200 S/H. Power ON and make sure the instrument is in CONTINUOUS read mode, adjust the SPAN potentiometer on the rear panel with a small screwdriver until the readout indicates the active length of the sensor. This readout can be in inches, centimeters or expressed as a percentage. If you have the TWO SENSOR Option, follow the above procedure to adjust SPAN for the second sensor. Be sure to adjust the correct potentiometer that corresponds to the sensor selected on the front panel. The two sensors can be set independently of each other.

NOTE: WHEN OPERATING THE SENSOR OUTSIDE THE DEWAR AND/OR AT ROOM TEMPERATURE, THE READOUT WILL INDICATE A NEGATIVE NUMBER, THE VALUE OF WHICH DEPENDS ON THE SENSOR ACTIVE LENGTH.

Section 1.44 ZERO Adjustment

When setting the ZERO calibration of the Model 1200 S/H, a load resistor is required to simulate the resistance of the helium level sensor in the system. The value of this resistor should be (4.55 X L) ohms, where L is the active length of the sensor. It is also important that the power rating for this resistor be adequate. The resistor should have a power rating of at least (0.0455 X L) watts.

Power off. Remove the male sensor connector from the rear panel of the Model 1200 S/H. Make sure the instrument is in the CONTINUOUS read mode. Insert the load resistor between V+ (pin D) and I- (pin B), short together I+ (pin A) and V+ (pin D). Also short pin B (I-) to pin E (V-).



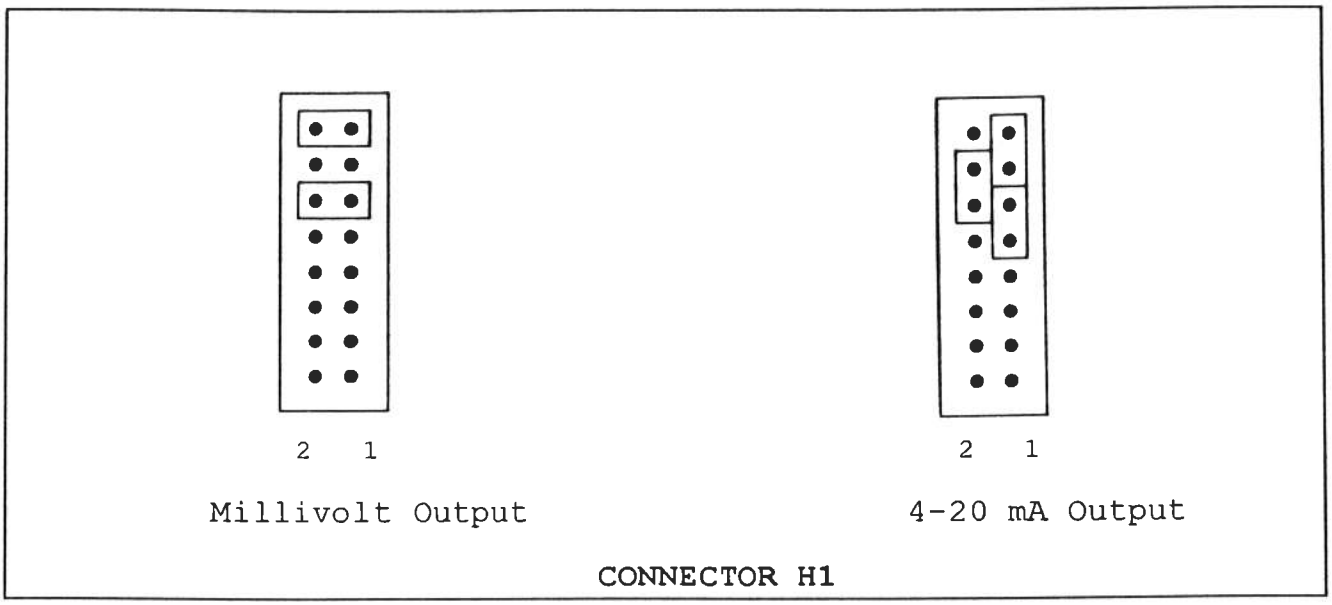
Rear Panel Sensor Connector Pinout for Zero Calibration

Reconnect the male sensor plug with the load resistor. Power ON. Adjust the ZERO potentiometer located on the rear panel until the digital display reads zero. If you have the TWO SENSOR Option follow the above procedure to adjust ZERO for the second sensor. Be sure to adjust the correct potentiometer that corresponds to the sensor selected on the front panel. The two sensors can be set independently of each other.

Section 1.45 Analog Output (Option 001)

Millivolt Output Locate on the board a 16 pin header labeled H1. For millivolt output, pins 11-12 and pins 15-16 must be jumpered together. Refer to the diagram on the following page. Disconnect level sensor(s) at the rear panel. Make sure the Model 1200 S/H has been calibrated by the procedures detailed in Sections 1.41 to Section 1.44. Connect a voltmeter to the Analog Output BNC connector on the rear panel. Power ON, verify the instrument is set for CONTINUOUS read and the display indicates full sensor active length or 100 per cent. Adjust the Analog Output calibration potentiometer on the rear panel until the Analog Output voltage reaches a voltage equivalent to 10 millivolts per centimeter or inch, or 1.000 volts for 100 per cent. No calibration is necessary for readings at zero centimeters, inches, or per cent. Since the Analog Output voltage tracks only the display, there is no separate adjustment if this instrument has the TWO SENSOR Option.

4-20 mA Output Locate on the board a 16 pin header labeled H1. For a 4-20 mA output, jumper together pins 9 and 11, 12 and 14, 13 and 15. To calibrate the analog output, power ON, verify the instrument is set for CONTINUOUS read and the display indicates full sensor active length or 100 per cent. Connect an ammeter between BNC ground (-) and the BNC center connector (+) located on the rear of the instrument. Adjust the rear panel Analog Output potentiometer until the ammeter reads 20 mA. Make the Model 1200 S/H indicate a zero level by inserting the proper load resistor (See Section 1.44 Zero Adjustment). Locate on the board a potentiometer labeled P9. Adjust this potentiometer until ammeter connected to the analog output reads 4 mA. To verify the Analog Output is correctly set, repeat the above procedure to calibrate both the 4 and 20 mA settings.



CONNECTOR H1

SECTION 2.0
ALARM OPERATION (OPTION 002)

With this feature a liquid helium level alarm point can be set. When the liquid level goes below this point, a relay internal to the Model 1200 S/H will trip, a front panel LED will flash on and off, and an audible alarm (which can be disabled) will sound. The Alarm will latch and hold when the instrument is in SAMPLE/HOLD MODE. The alarm relay contacts are accessible through the 9 pin D-sub connector found on the rear panel. These contacts are rated for a maximum of one amp at 24 VDC. The common terminal is located on pin 6, the normally open terminal on pin 7, the normally closed terminal on pin 8. The Alarm status can be monitored by pin 4 of the D-sub connector found on the rear panel. A TTL logic one indicates the alarm is tripped, a TTL logic zero indicates the alarm is reset.

Section 2.1 Set the Alarm Point

Power ON the instrument making sure it is in the CONTINUOUS read mode. Locate the front panel switch labeled "Display-Reset". Move the switch left to display the alarm set point (Note the switch is a momentary type and must be held left to display the alarm setting). Locate front panel potentiometer labeled "Adjust". Using a small screwdriver, adjust the potentiometer until the desired setpoint is reached. Allow the "Display-Reset" switch to return to its normal position. Note the display returns to the liquid helium level reading. When in SAMPLE/HOLD mode the display does not update the current liquid helium level automatically. It is necessary to switch the mode select switch to CONTINUOUS until a valid reading is taken, then switch back to SAMPLE/HOLD.

Section 2.2 Reset the Alarm

When in the SAMPLE/HOLD mode it may be desirable to reset the alarm after it trips. On the front panel locate the "Display-Reset" switch. Move the switch right momentarily and the alarm will reset. The alarm can also be reset remotely by a logic 1 TTL signal placed on pin 5 of the D-sub connector found on the rear panel. A logic 0 provides normal operation.

Section 2.3 Enable/Disable the Audible Alarm

At times it may be desirable to disable the audible alarm. This can be done easily by locating the 7 position dipswitch on the rear panel. Locate position number 7 switch. Open switch 7 (up position) to disable the audible, switch down (close) to enable the audible.

SECTION 3 OPERATION

After completion of setup and calibration the Model 1200 S/H will now be ready for operation. In the following sections operating modes for the Model 1200 S/H will be detailed. Necessary connections and how to operate the instrument via remote control will also be covered.

Section 3.1 Sensor Connection

Cryomagnetics, Inc. liquid helium level sensors have only three (3) #30 AWG lead wires for sensor hookup. The wiring code for the supplied 5 pin male connector is as follows:

LEVEL SENSOR WIRE COLOR CODE		
RED	I+	PIN A
BLACK	I-, V-	PINS B & E
BLUE	V+	PIN D

For liquid helium level sensors that have four (4) wires the following code will be used:

4-WIRE LEVEL SENSOR WIRE CODE	
I+	PIN A
I-	PIN B
V+	PIN D
V-	PIN E

The sensor supplied by Cryomagnetics, Inc. will have pigtail leads. The interconnecting cable between the supplied 5 pin male connector and the level sensor is not provided. Cable wire sizes for various distances between the Model 1200 S/H and the level sensor are tabulated on the following page.

DISTANCE BETWEEN MODEL 1200 S/H AND DEWAR	RECOMMENDED CABLE WIRE SIZE
Up to 12 feet	#18 AWG
12 to 50 feet	#16 AWG
50 to 100 feet	#14 AWG

Unshielded cable may be used where no significant use of SCR-controlled equipment or intense electrostatic field sources are present. Otherwise, it is recommended that shielded cable be used.

Section 3.2 CONTINUOUS Operation

In the CONTINUOUS read mode the Model 1200 S/H will begin one Boost current cycle at the time of power up. After the Boost current cycle is complete, a continuous Read cycle current will be applied to the sensor. Make sure the sensor is plugged into the Model 1200 S/H. Power ON the instrument and locate the front panel mode selector switch. Move the switch to the left for CONTINUOUS mode operation. Note the front panel LED labeled "Sensor Active". If the sensor is properly wired, this LED will illuminate indicating current is flowing through the sensor. If the LED does not illuminate, check the sensor wiring.

Section 3.3 SAMPLE/HOLD Operation

To minimize heat load on the cryostat choose the SAMPLE/HOLD mode of operation. At the beginning of a sample the Model 1200 S/H will begin a Boost cycle and then take a reading at the lower Read cycle current. The time between samples can be set at the rear panel. Locate the rear panel seven (7) position dipswitch. Note that positions one (1) through six (6) are reserved for timing. To set the time between samples, refer to the table on the following page.

Desired Time Between Samples	Dipswitch Pin Number Setting
10 Minutes	1 CLOSED
30 Minutes	2 CLOSED
60 Minutes	3 CLOSED
4 Hours	4 CLOSED
8 Hours	5 CLOSED
24 Hours	6 CLOSED

*** CAUTION: Only one dipswitch setting between positions one (1) through six (6) can be closed at one time. The Model 1200 S/H cannot give accurate sample times if more than one dipswitch setting is closed. ***

After setting the desired time between samples locate the mode selector switch and move it to SAMPLE/HOLD. Power ON the instrument. Note the "Sensor Active" LED will illuminate for approximately twelve (12) seconds and then turn off. If the LED does not illuminate, check sensor wiring. The Model 1200 S/H will now hold the reading on its display until the preset time interval between samples is reached. If at any time between samples the operator desires to update the reading, simply move the mode selector switch to CONTINUOUS. When the switch is first moved over to CONTINUOUS the display will read a certain value for the first four (4) seconds and then the display will settle to a different value. The value first read is made during the Boost current cycle and should be disregarded. The value continuously displayed is the accurate liquid helium level. After the display settles to the correct value, the operator may switch the mode selector back to SAMPLE/HOLD. The manual update procedure has no effect on the timing between samples.

Section 3.4 TWO SENSOR Operation (Option 003)

To select the active sensor, locate the front panel switch labeled "Sensor 1-Sensor 2". The active sensor can also be selected remotely as described in Section 3.5 "Remote Control". Note the Alarm Option operates only on the active sensor. There is not a separate alarm setpoint for Sensor 1 and Sensor 2. The same is true for the Analog Output Option. The Analog Output voltage tracks the display sensor only. The Analog Output does not track the Alarm Display.

Section 3.5 Remote Control

By using remote TTL signals, the operator has access to many functions within the unit. The available capabilities of this interface are outlined on the next page along with the proper pin designations for the 9 pin D-Sub connector. All signals are standard TTL.

REMOTE CONTROL PINOUT DESIGNATIONS

PIN	INPUT/OUTPUT	FUNCTION	DETAIL
1	INPUT	Sensor Select	Selects between Sensors if instrument has TWO SENSOR Option. For remote operation the mode switch must be set to Sensor 1. Logic 1 selects Sensor 2, Logic 0 selects Sensor 1.
2	INPUT	Mode Select	Select between CONTINUOUS and SAMPLE/HOLD Operation. For remote operation the mode selection switch must be in the SAMPLE/HOLD position. Logic 1 selects CONTINUOUS, Logic 0 selects SAMPLE/HOLD.
3	OUTPUT	Read Signal	Logic 1 indicates an active sensor. Logic 0 indicates an inactive sensor.
4	OUTPUT	Alarm Status	Logic 1 indicates the Alarm has tripped. Logic 0 indicates the Alarm is reset.
5	INPUT	Alarm Reset	Logic 1 resets the optional alarm. Logic 0 provides normal operation.
6	INPUT/OUTPUT	Alarm Relay	Common terminal of the optional Alarm. Maximum current is one (1) amp at 24 VDC.
7	INPUT/OUTPUT	Alarm Relay	Normally open terminal of the optional Alarm. Maximum current is one (1) amp at 24 VDC.
8	INPUT/OUTPUT	Alarm Relay	Normally closed terminal of the optional Alarm. Maximum current is one (1) amp at 24 VDC.
9		GROUND	

SECTION 4

TROUBLESHOOTING

Due to the high voltages present in the power supply section of the Model 1200 S/H, user attempts at repair are highly discouraged. However, steps may be taken in the event of a problem that may prevent return of the instrument to the factory.

Symptom	Possible Cause
No Display	* Correct Input Voltage not Selected - Section 1.1 * Fuse Blown - Replace with .25 Amp Slow-Blow
Sensor Active LED Not Illuminating	* Check Sensor wiring - Section 3.0 * Is correct sensor selected on models with TWO SENSOR option? * Is the Model 1200 S/H in SAMPLE/HOLD mode? * Check current output between pins A & B on an active sensor - Section 1.4
Time between Samples not Correct	* Correct Line Frequency not selected - Section 1.2 * More than one timing dipswitch is closed - Section 3.3
Cannot Calibrate Sensor	* Sensor length selection for current source is incorrect - Section 1.3 * Check sensor wiring - Section 3.1 * Current output incorrectly set - Sections 1.41 and 1.42
Cannot Switch Between CONTINUOUS and SAMPLE/HOLD by Remote Control	* Front panel mode selector must be set to SAMPLE/HOLD - Section 3.5
Cannot Switch Between Sensor 1 and Sensor 2 by Remote Control	* Front panel mode selector must be set to Sensor 1 - Section 3.5

LIMITED WARRANTY POLICY

Cryomagnetics, Inc. warrants its products to be free from defects in materials and workmanship. This warranty shall be effective for one (1) year after the date of shipment from Cryomagnetics. Cryomagnetics reserves the right to elect to repair, replace, or give credit for the purchase price of any product subject to warranty adjustment. Return of all products for warranty adjustment shall be FOB Oak Ridge, TN, and must have prior authorization for such return from an authorized Cryomagnetics, Inc. representative.

This warranty shall not apply to any product which has been determined by Cryomagnetics, Inc. inspection to have become defective due to abuse, mishandling, accident, alteration, improper installation or other causes. Cryomagnetics, Inc. products are designed for use by knowledgeable, competent technical personnel.

In any event, the liability of Cryomagnetics, Inc. is strictly limited to the purchase price of the equipment supplied by Cryomagnetics, Inc. Cryomagnetics, Inc. shall not assume liability for any consequential damages associated with use or misuse of its equipment.